



THE CORPORATION OF THE CITY OF PORT COQUITLAM

BYLAW NO. 2241

A Bylaw to Regulate the Servicing of Subdivisions for the City of Port Coquitlam

WHEREAS it is desired to guide City growth for the ultimate benefit of the community as a whole by ensuring that land is subdivided in an orderly and economical way to produce a safe, efficient, convenient and healthful environment and to preserve and enhance its natural amenities;

AND WHEREAS it is desired to ensure that the subdivision of land does not create a cost to the City of providing public utilities or other works or services which would be an excessive burden on the existing taxpayers;

NOW THEREFORE the Municipal Council of The Corporation of the City of Port Coquitlam, in open meeting assembled, enacts as follows:

1. This Bylaw is divided into six parts and five schedules dealing with the following subjects:

Part I	- Interpretation
Part II	- General Provisions
Part III	- Subdivision Design and Layout
Part IV	- Servicing Requirements
Part V	- Subdivision Procedure
Part VI	- Penalties and Procedural Provisions

Schedule A	- Ultimate Road Network
Schedule B	- Minimum Standards
Schedule C	- Design Criteria
Schedule D	- Construction Specifications
Schedule E	- Waiver Agreement

2. The provisions of this Bylaw apply to the whole of the territorial area of the City.

PART I – INTERPRETATION

101. In this Bylaw or in any resolution of Council passed relating to this Bylaw,

“Applicant” means a person applying for the approval of a subdivision, whether as the owner of the property proposed to be subdivided or as the agent for the owner;

“Approving Officer” means the officer so appointed by Council resolution according to the provisions of the “Land Title Act”;

“Arterial Street” means a street which is so designated on City drawing number 211-152 dated April 8, 1997 which is attached as schedule A; being a street whose primary function is to carry through traffic from one area to another with as little interference as possible from adjacent land uses;

“City” means the Corporation of The City of Port Coquitlam or the municipal area comprised within the boundaries of The Corporation of the City of Port Coquitlam, as the context may require;

“Collector Street” means a street which is so designated on City drawing number 211-152 dated April 8, 1997 which is attached as Schedule A; being a street whose primary function is to distribute traffic between arterial streets and local streets but which also usually provides direct access to properties;

“Cul-de-sac” means a local street which has only one connection to the City street system and which terminates in an area for the turning of motor vehicles;

“Engineer” means the City Engineer of The Corporation of the City of Port Coquitlam or his lawful deputy and persons authorized to act on his behalf;

“Frontage” means the length of the front lot line;

“Front Lot Line” means the lot line common to the lot and an abutting street, or where there is more than one lot line common to abutting streets, the shortest of these lines;

“Highway” includes a public street, road, lane, bridge, walkway, path, trail, thoroughfare and any other public way, whether or not improved for the passage of vehicles or pedestrians;

“Lane” means a highway more than 3m but less than 10m in width intended to provide a secondary access to parcels of land;

“Local Street” means a street which is used or intended or likely to be used primarily for travel to and from and providing access to parcels abutting thereon, and which usually connects to other local streets or to collectors;

“Lot” means a parcel of land registered in the Land Title Office and includes parcels created by bare land strata subdivision;

“Owner” means the registered owner of land;

“Street” includes all roads, squares, thoroughfares and any other public way, but not lanes, walkways, trails, and bridges;

“Subdivision” means the division of land into two or more parcels, whether or not involving the creation of a greater number of parcels than existing;

“Walkway” means a public way for pedestrian traffic and to accommodate necessary utility and drainage services which is not less than 2m nor more than 6m wide;

“Zoning Bylaw” means the Zoning Bylaw of the City.

102. Unless otherwise defined herein, any word or expression in this Bylaw shall have the same meaning as any identical word or expression contained in the “Land Title Act” R.S.B.C. 1979 c. 219, as amended.

PART II – GENERAL

201. No land within the City shall be subdivided until final approval by the Approving Officer has been obtained.
202. The Approving Officer shall approve or reject every application for the subdivision of land.

PART III – SUBDIVISION DESIGN AND LAYOUT

301. The minimum area, width, frontage and depth of parcels to be created by subdivision shall be as provided in the current Zoning Bylaw.
302. Every parcel to be created shall abut on a street.
303. Parcels that abut a street at both front and rear shall not be permitted unless, in the opinion of the Approving Officer, such an arrangement is essential:
- (a) To provide access to other parcels;
 - (b) To provide a consistent or continuous pattern of streets; or
 - (c) To complement a future pattern of subdivision.
304. The Applicant for subdivision shall ensure that:

- (a) The layout of all highways required in connection with the subdivision are in accordance with the design criteria specified in Schedule C of this Bylaw with respect to street and intersection geometrics, spacing, angle, location and grade;
- (b) A secondary access for emergency vehicles is available to any street in the subdivision which has a length greater than 150m; provided that if, in the opinion of the Approving Officer, adequate secondary access will become available within a reasonable time due to future subdivision or other factors, this requirement may be waived;
- (c) Walkways are provided where required to provide a logical and continuous pedestrian circulation system through the subdivision and the City;
- (d) Lanes are provided where, in the opinion of the Approving Officer they are necessary for land service, continuity with existing lanes, or secondary access;
- (e) Lane intersections have triangular corner cutoffs measuring not less than 3m each way from the corner;
- (f) Land for public open space is provided within the subdivision where, in the opinion of the Approving Officer there is insufficient land in the vicinity of the proposed subdivision for public park and open space;
- (g) Proper consideration has been given to the preservation of natural drainage courses by right-of-way or dedication of land to ensure that up-stream and downstream drainage problems do not occur as a result of the subdivision.

PART IV – SERVICING REQUIREMENTS

- 401. (a) All works and services required in this Part shall be designed and constructed in accordance with the design criteria, specifications and standard drawings included in Schedule C and D of this Bylaw.
- (b) Repealed.
- 402. The Applicant shall provide without compensation:
 - (a) Land up to a depth of 20m for the purpose of a highway allowance within the subdivision; or,
 - (b) Land up to a depth of 10m for the purpose of widening to 20m a highway that borders or is within a subdivision.

403. All highways within or immediately adjacent to a subdivision shall be dedicated and cleared to the minimum right-of-way width as set out in Schedule B of this Bylaw for the classification of highway and the zoning of the land to be subdivided.
404. All highways within or immediately adjacent to a subdivision shall be designed and constructed to the minimum standards of pavement width, number of sidewalks, street lighting and design speed as set out in Schedule B of this Bylaw.
405. Underground electrical and telephone wiring shall be a requirement for all newly created highways within a subdivision and for all existing highways within or immediately adjacent to a subdivision; provided that if the subdivision consists of residential infill development of not more than 3 lots along a highway which already has overhead wiring adjacent to the subdivision, underground wiring will not be a requirement along that highway.
406. Every lot created by a subdivision shall be connected to a suitable point on the City water system through a complete and fully operational system of watermains, valves, valve chambers, hydrants and other appurtenances provided by the Applicant.
407. Every lot created by a subdivision shall be connected to a suitable point on the City sanitary sewer system through a complete and fully operational system of mains, manholes, necessary pumping stations and other appurtenances provided by the Applicant; provided that for those lots which are exempted by the Zoning Bylaw from the requirement for connection to a sewer, this requirement shall be waived if approval for an alternate means of sewage disposal has been obtained from the appropriate authority.
408. Every lot created by a subdivision shall be connected to a suitable point on the City drainage system through a complete and fully operational system of mains, manholes, pumping systems, catch-basins and other appurtenances provided by the Applicant; provided that, where the subdivision consists of infill development of not more than 3 lots along an existing highway with ditches, the Approving Officer may approve drainage connections direct to the existing ditches where the construction of a storm sewer system would not be technically feasible at this time.
409. Where the Applicant is required under Sections 406, 407, or 408 to construct any trunk water, sanitary sewer or storm sewer mains beyond the boundaries of his subdivision or to provide the mains with excess capacity to the benefit of other lands, the City may enter into an agreement with the owner of the lands to be subdivided to share all or part of the cost of any such trunk water, sanitary sewer, or storm sewer mains between:
- (a) The City and the owner of the land proposed to be subdivided; or,

- (b) The owner of the land proposed to be subdivided and the owners of any other land that will benefit from such mains.
- 410. An agreement made pursuant to the provisions of Section 409 (b), shall not require any payment to be made by the City; but all amounts required shall be advanced by the Applicant to be later reimbursed by the City from funds later collected from the owners of benefiting lands upon their subdivision.
- 411. Where the Applicant benefits from trunk water, sanitary sewer, or storm sewer mains installed pursuant to the terms of an agreement made under Section 409 the Applicant shall be required to pay to the City the Applicant's pro-rated share of the cost for the lands being subdivided, including interest thereon calculated at an annual rate of 10% from the date of completion of the mains to the date of connection by the Applicant.
- 412. Where works and services which would normally be required for the proposed subdivision under Sections 403, 404, 406, 407, or 408 are part of a program covered by a Development Cost Charge Bylaw, the Approving Officer may refuse to approve the subdivision until such time as the City has Development Cost Charge funds available to pay for its share of the cost of such works unless the Applicant agrees to provide the services in which case his costs shall be deducted from the Development Cost Charges normally payable for that service.
- 413. All works and services herein required to be constructed and installed at the expense of the Applicant in connection with the subdivision of any lands shall be constructed and installed prior to approval of the subdivision by the Approving Officer, unless the Applicant:
 - (a) Deposits with the City, the amount in cash estimated by the Approving Officer as the cost of installing and paying for all works and services required by this Subdivision Bylaw, and enters into an agreement with the City to have the City do the work; or
 - (b) Deposits with the City cash or an irrevocable Letter of Credit from a bank or other financial institution in the amount of 115% of the cost estimated by the Approving Officer of installing and paying for all works and services required by this Subdivision Bylaw, and enters into an agreement with the City to do the work by a specified date in accordance with this Bylaw or forfeit the amount secured by the deposit to the City.
- 414. Where the Applicant has deposited cash or a Letter of Credit pursuant to 413 (b):
 - (a) Ninety percent (90%) of the Letter of Credit deposited with the City will be returned to the Applicant when the constructed works have been completed in compliance with the requirements of this Bylaw and the agreement entered into in Section 414, and inspected and approved by the Engineer; and

- (b) Ten percent (10%) of the Letter of Credit deposited with the City will be returned to the Applicant one year after the date of approval of the works by the Engineer and the City shall deduct from this ten percent (10%) the cost of repairing any latent deficiencies in the said works which become apparent during the one year period.

415. Repealed.

416. Every Applicant for approval of a subdivision shall pay all school taxes and all municipal taxes, rates and charges, assessed and levied against the lands to be subdivided, and where such taxes, rates and charges for the then current year have not been assessed, levied and imposed on the said lands at the date on which the subdivision is submitted for final plan approval, pay the amount estimated by the Collector to be the total of the school taxes, municipal taxes, rates and charges to be assessed, levied and imposed on the said lands for the then current year.

417. Where application for final approval of a subdivision is made at any time between the 15th day of June and the 31st day of December in any year, the Applicant shall pay all school taxes and all municipal taxes, rates and charges assessed and levied against the lands to be subdivided and which are outstanding and owing at the date of such application, together with a deposit in cash, certified cheque or by irrevocable Letter of Credit issued by a bank, trust company or credit union and valid for not less than one year, in the amount estimated by the Collector to be the total of the school taxes, municipal taxes, rates and charges to be assessed, levied and imposed on the said lands for the next succeeding year; which deposit shall be held by the City and applied towards payment of the taxes, rates and charges to be assessed, imposed and levied on the said land in the next succeeding year, in the event that the subdivision approved is not registered prior to the preparation, completion and authentication of the assessment roll for that year.

418. Where any deposit made pursuant to Section 417 hereof is held by the City and the subdivision is registered and the new parcels created thereby are placed or are to be placed on the assessment roll for the next succeeding year, the said deposit shall be refunded to the Applicant by the Collector forthwith upon receipt of notification of the Assessment Authority that the subdivision is registered and the new parcels created thereby have been placed or will be placed on the assessment roll for the next succeeding year.

419. Every payment made pursuant to the provision of Section 416 hereof and every deposit made pursuant to the provisions of Section 417 hereof shall be deemed to be monies to be applied at a future date in payment of taxes pursuant to Section 439 of the "Municipal Act", and every such payment and deposit shall be accepted by the Collector subject to the provisions of Section 440 of the "Municipal Act".

420. Every Applicant shall, prior to approval of the subdivision plan and based on cost estimates acceptable to the Engineer, pay to the City an administration and inspection fee calculated in accord with the following schedule:

Estimated Cost of Providing All Works and Services Required By This Bylaw	Administration & Inspection Fees
\$100,000 & less	6% of estimated cost
\$100,001 to \$200,000	\$6,000 plus 4.5% of estimated cost above \$100,000
\$200,001 to \$300,000	\$10,500 plus 4% of estimated cost above \$200,000
\$300,001 to \$500,000	\$14,500 plus 3.5% of estimated cost above \$300,000
Over \$500,000	\$21,500 plus 2.5% of estimated cost above \$500,000

PART V – SUBDIVISION PROCEDURE

501. Prior to submitting a formal application for Subdivision Approval the Applicant may submit on a standard form obtained from the Approving Officer, an application for Preliminary Layout Review which shall state the name and postal address of the Applicant and the legal description and address of the parcel to be subdivided, and which shall be signed by the owner of the parcel.
502. The application shall be accompanied by a sketch plan drawn to a scale of not less than 1:2000 clearly indicating:
- (a) The dimensions and full legal description of the parcel or parcels to be subdivided;
 - (b) The arrangement of the parcels and highways which would be created by the subdivision including the widths of the proposed highways and the approximate dimensions of the proposed parcels and any proposed alterations of lot lines or subdivision of any existing parcels;
 - (c) Existing property lines and highways to be eliminated by the proposed subdivision;
 - (d) The relationship of the proposed subdivision onto adjacent highways and the connections of proposed new highways thereto;

- (e) Existing buildings accurately located and identified;
 - (f) Utility and other easements located and identified;
 - (g) Watercourses and waterfrontages;
 - (h) The intended use of each parcel to be created by the subdivision;
 - (i) The name and postal address of the Applicant.
503. The Approving Officer may require the Applicant for Preliminary Layout Review to furnish:
- (a) Such topographic information as he may require;
 - (b) Such additional information as may be required to determine the suitability of the area for subdivision or the suitability of the size, shape, and orientation of the parcels required.
- 504.
- (a) Within sixty (60) days of the receipt of the application for Preliminary Layout Review, or of any additional information required under this Bylaw, the Approving Officer shall, in writing, indicate whether or not the proposed layout is acceptable for submission for Subdivision Approval.
 - (b) No letter shall be issued under this Section and no Tentative Approval shall be given under Section 512 unless the Applicant first executes an agreement in the form attached as Schedule “E” to this Bylaw, confirming that Bylaws adopted by the Council under Part 29 of the “Municipal Act” prior to approval of the subdivision plan shall have effect with respect to the proposed subdivision.
505. The Approving Officer may suggest revisions to the layout which, if incorporated into the plan, would enable the Applicant to apply for Subdivision Approval.
506. Acceptance of the preliminary layout by the Approving Officer shall:
- (a) Be considered only as acceptance in principle;
 - (b) Not exempt the Applicant from securing both tentative plans approval and final approval prior to the deposit of the subdivision plan in the Land Title Office;
 - (c) Not bind the Approving Officer to grant either Tentative Plan Approval or final approval;

- (d) Be subject to all City Bylaws and City plans governing the proposed subdivision.
507. An application for Subdivision Approval shall be submitted in writing on a standard form available from the Approving Officer and shall state the name and postal address of the Applicant as well as the owner and the legal description and address of the parcel to be subdivided, and shall be signed by both the Applicant and the owner or be accompanied by some other valid proof that the Applicant is authorized to act as agent for the owner for the purpose of subdivision.
508. An application for Subdivision Approval may be submitted whether or not the Applicant has previously applied for Preliminary Layout Review.
509. Repealed.
510. The application shall be accompanied by:
- (a) Two white paper copies of a subdivision plan prepared by a BC Land Surveyor which shall show areas and dimensions of all lots being created; and, if not already submitted for Preliminary Layout Review, then
 - (b) Other information as required in Section 502 (e) to (i) of this Bylaw.
 - (c) A conceptual servicing plan prepared by a Professional Engineer indicating that the proposed subdivision shall be serviced in accordance with design criteria stipulated in this Bylaw. This requirement may be waived by the Approving Officer for small in-fill subdivisions.
 - (d) An itemized estimate prepared by a Professional Engineer of the cost of providing all works and services for the subdivision as required by this Bylaw. This requirement may be waived by the Approving Officer for small in-fill subdivisions.
511. Compliance with Sections 507 to 510 of this Bylaw constitutes the tendering of the subdivision plan for examination and approval for the purposes of the “Land Title Act”.
512. Within 2 months of the receipt of an application for Subdivision Approval or the receipt of any additional information which may be required under the Bylaw, the Approving Officer shall in writing:
- (a) Grant conditional or unconditional Tentative Plan Approval, or
 - (b) Refuse Tentative Plan Approval stating explicitly the reason or reasons for refusal; or

- (c) Notify the Applicant that Tentative Plan Approval is being withheld pending modification of the plan as he may require.
- 513. Where Tentative Plan Approval is withheld the Applicant may, within 90 days, re-submit to the Approving Officer for approval a revised plan of subdivision without paying a further examination or application fee.
- 514. The Approving Officer shall, if satisfied that plans submitted under the Subsection 513 of this Bylaw meet all the requirements of this Bylaw, grant Tentative Approval within seven days of the receipt of the revised plans.
- 515. In all cases of Tentative Approval, the Approving Officer shall explicitly state in writing all the requirements to be met before final approval can be given.
- 516. Tentative Approval shall:
 - (a) Be considered as certification to the Applicant by the Approving Officer that all requirements for final subdivision plan approval have been met other than those listed in the letter of Tentative Approval;
 - (b) Not exempt the Applicant from securing final approval prior to the deposit of the subdivision plan in the Land Title Office; and
 - (c) Be effective only for a period of 90 days, provided that, upon written application from the Applicant, the Approving Officer may extend the Tentative Approval for a further 90 days.
- 517. Upon receipt of tentative Subdivision Approval the Applicant shall submit for final approval one linear, two transparencies and at least five paper prints of the subdivision plan prepared by a BC Land Surveyor in a form acceptable to the Land Title Office, accompanied by:
 - (a) Written notification by a Professional Engineer to the Approving Officer certifying completion of all works required under Part IV of this Bylaw, or a signed agreement in accordance with Section 414 of this Bylaw together with all monies and Letters of Credit payable;
 - (b) A certification from the Collector stating that all taxes which have been assessed or estimated on the land proposed for the subdivision have been paid and that the provisions of Section 417 or Section 418 of this Bylaw, whichever is applicable, have been fulfilled;
 - (c) Payment of any applicable Development Cost Charges and the administration and inspection fee required under Section 420 of this Bylaw; and

- (d) Confirmation that all other conditions specified in the letter of Tentative Approval has been fulfilled.
518. Repealed.
519. Forthwith upon receipt of the material required in Section 517 of this Bylaw, the Approving Officer shall in writing:
- (a) Grant final approval; or
 - (b) Notify the Applicant that final approval is being withheld, stating explicitly the reason or reasons therefore.
520. Repealed.
521. Final approval shall be certified by the return to the Applicant of the subdivision plan required under Section 517 of this Bylaw, signed and dated by the Approving Officer in accordance with the provisions of the “Land Title Act”.
522. A subdivision plan shall be tendered for deposit in the Land Title Office within 2 months from the date of approval or within such other period as may be prescribed under the “Land Title Act” after which time approval is revoked unless the Registrar grants an extension of time.
523. The rejection of a plan by the Approving Officer, or the failure of the Approving Officer to act within the specified time limit, may be appealed in accordance with the provisions of the “Land Title Act”.

PART VI – PENALTIES AND PROCEDURAL PROVISIONS

601. Every person who violates or who causes or allows to be violated any of the provisions of this Bylaw shall be guilty of an offence against this Bylaw; and each day on which such violation occurs or is caused or allowed to continue shall constitute a separate offence.
602. Every person who violates any of the provisions of this Bylaw or who permits any act or thing to be done in contravention or in violation of any of the provisions of this Bylaw, or who neglects to do or refrains from doing anything required to be done by any of the provisions of this Bylaw, or who does any act which violates any of the provisions of this Bylaw shall be guilty of an offence punishable on summary conviction and shall be liable to a fine of not more than \$2,000.00 or to imprisonment for not more than six months, or to both, the penalties being enforced and the fines and costs being recoverable upon summary conviction in the manner provided by the “Offence Act” RSBC 1979, c. 305 as amended.

603. The City Engineer and his lawful deputy or any other person Council may designate to act in his place may enter at all reasonable times upon the lands for which application to subdivide has been made in order to ascertain whether the provisions of this Bylaw are being obeyed.
604. No person shall obstruct or seek to obstruct the entrance into any place of any person acting pursuant to Section 603 of this Bylaw.
605. If any portion of this Bylaw is found invalid by a decision of a Court of competent jurisdiction the invalid portion shall be severed without affecting the remainder of the Bylaw.
606. The “Subdivision Bylaw, 1985, No. 2126” is repealed.
607. This Bylaw may be cited for all purposes as the “Subdivision Servicing Bylaw, 1987, No. 2241”.

Read a first time by the Municipal Council this 9th day of February, 1987.

Read a second time by the Municipal Council this 9th day of February, 1987.

Read a third time by the Municipal Council this 16th day of March, 1987.

Reconsidered finally passed and adopted by the Municipal Council of The Corporation of the City of Port Coquitlam this 23rd day of March, 1987.

L.M. TRABOULAY
Mayor

R.A. FREEMAN
City Clerk

RECORD OF AMENDMENT

Bylaw No.	Amended Sections
2302	417
2443	401, 415, 420, 510, 517, 518, 520
2535	1, 504, Sch. E
2687	420
2907	509
3235	2.11

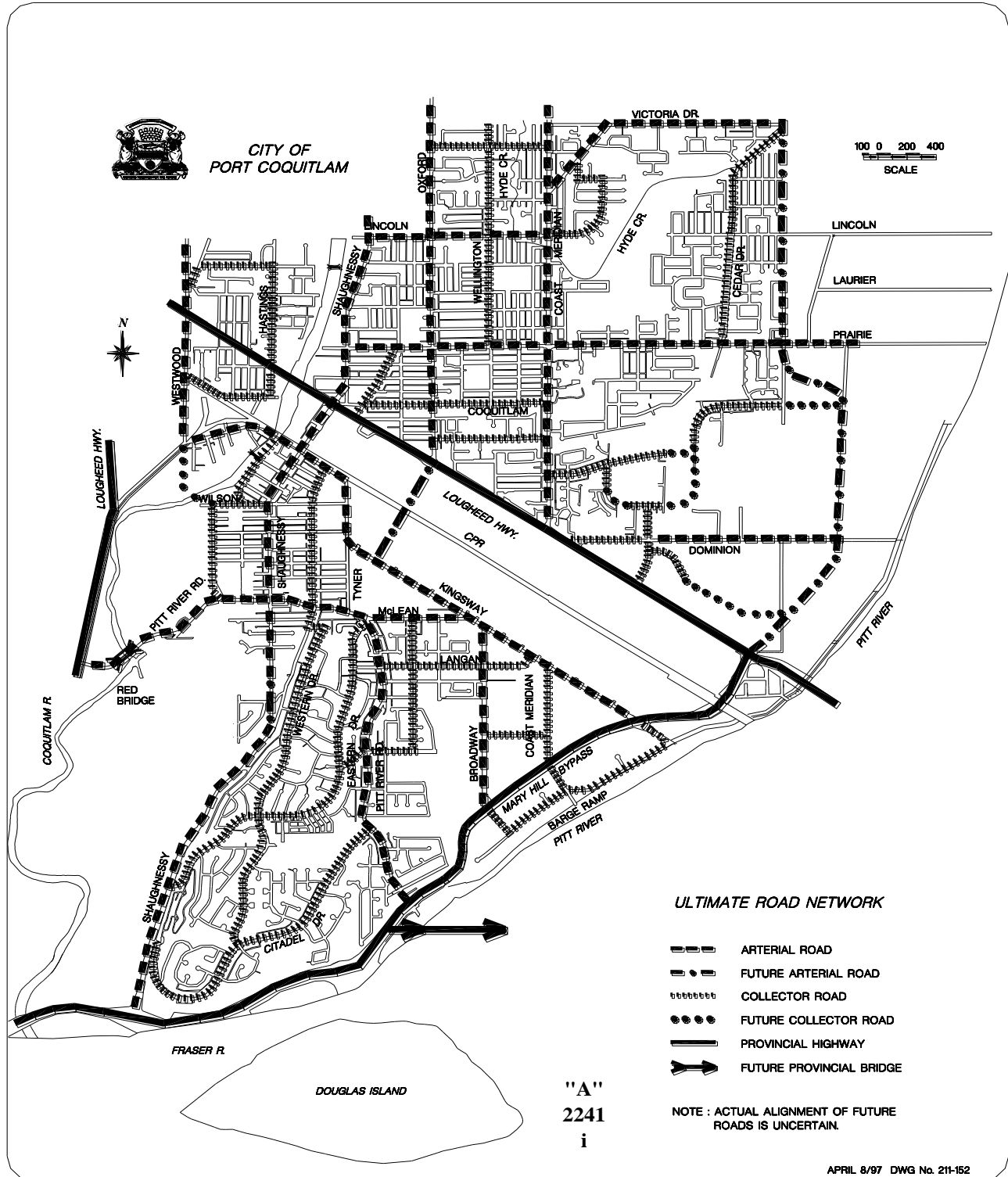
NOTE:

Schedules “A” and “B” follow.

Schedule “C” – Design Criteria – (**54 pages**), and
Schedule “D” – Construction Specifications – (**122 pages**), and
Schedule “E” – Waiver Agreement

are distributed to technical personnel and reference sources only. Copies are available from the City Clerk’s Office on request.

SCHEDULE A

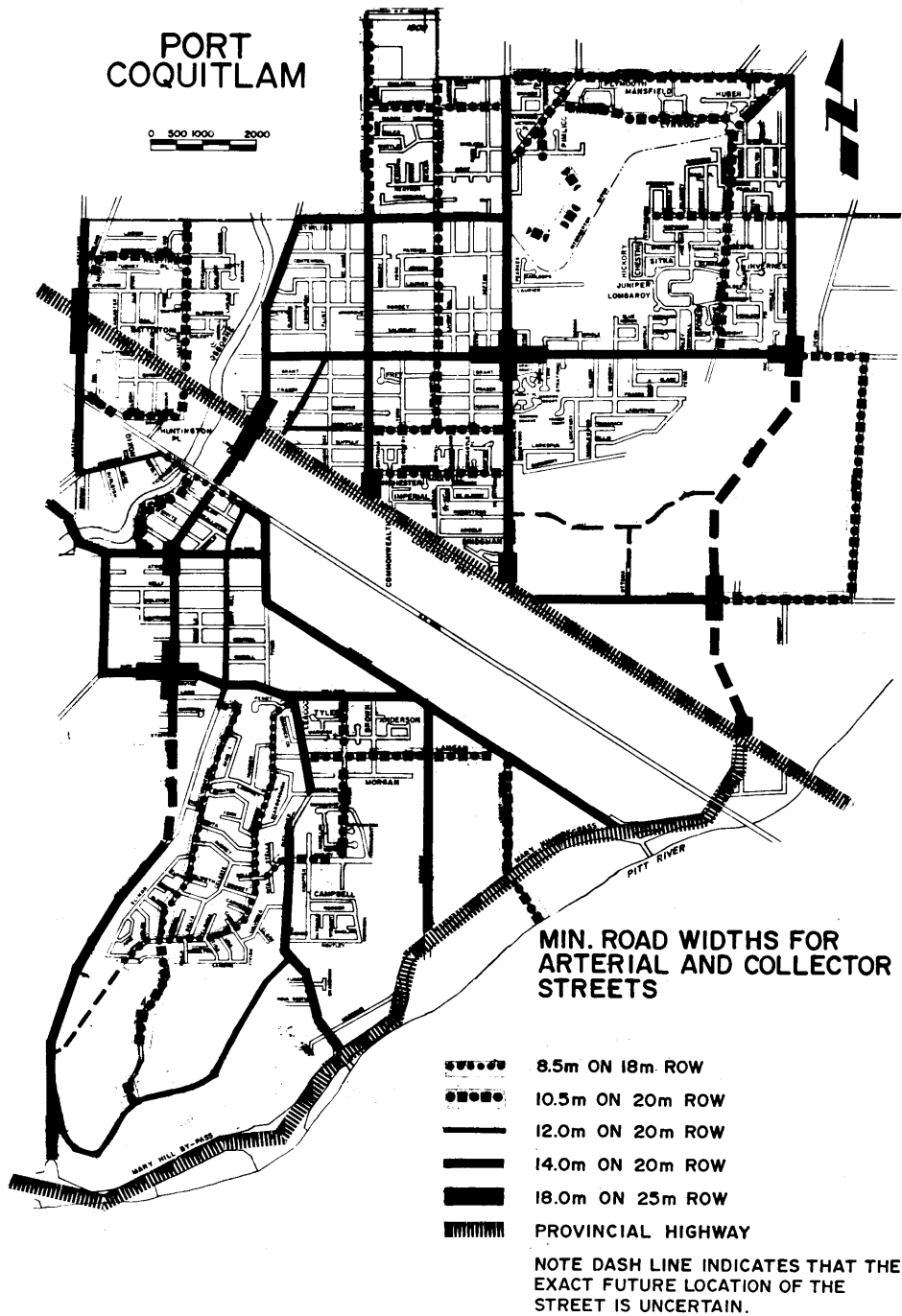


APRIL 8/97 DWG No. 211-152

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SCHEDULE B



SCHEDULE B

DATE : JUNE 3, 1985. DWG. NO. 211-153
REV.1 DEC. 1, 1986.

SCHEDULE B

MINIMUM STANDARDS FOR HIGHWAYS CONSTRUCTED

Road Classification	Land Use Zoning (Note 1)	Right-of-Way Width (m)	Pavement Width (m)	Sidewalks	Lighting (lux) (Note 3)	Design Speed (km/h) (Note 4)
Short cul-de-sacs (Note 5)	A-1, RS-3	15	7.5	-	2	50
Short cul-de-sacs (Note 5)	RS-1, RT-1, RS-2	15	7.5	-	4	50
Local	A-1, RS-3	15	8.5	-	2	60
Local	RS-1, RT-1, RS-2, C-1	15	8.5	1 (Note 2)	4	50
Local	RM-1, RM-2, RM-3, RM-4	20	10.5	1	6	50
Local	C-2, C-3, C-4, CS-1, CS-2, CS-3	20	10.5	2	9	50
Local	M-1, M-2, M-3	18	8.5	-	4	50
Collector	A-1, RS-3	(Note 6)	(Note 6)	1 (Note 2)	4	60
Collector	RS-1, RS-2, RT-1, RM-1, RM-2, C-1	(Note 6)	(Note 6)	1	6	60
Collector	RM-3, RM-4	(Note 6)	(Note 6)	2	9	60
Collector	C-2, C-3, C-4, CS-1, CS-2, CS-3	(Note 6)	(Note 6)	2	12	60
Collector	M-1, M-2, M-3	(Note 6)	(Note 6)	1 (Note 2)	6	60
Arterial	A-1, RS-3	(Note 6)	(Note 6)	1	6	70
Arterial	RS-1, RT-1, RS-2, C-1, RM-1, RM-2	(Note 6)	(Note 6)	2	10	60
Arterial	RM-3, RM-4	(Note 6)	(Note 6)	2	14	60
Arterial	C-2, C-3, C-4, CS-1, CS-2, CS-3	(Note 6)	(Note 6)	2	20	60
Arterial	M-1, M-2, M-3	(Note 6)	(Note 6)	1	10	60

“B”

2241

SCHEDULE B

MINIMUM STANDARDS FOR HIGHWAYS CONSTRUCTED

NOTES TO TABLE 1

1. Where a portion of a highway passes through several land use zones, the predominant land use zone will govern the design.
2. The requirement for a sidewalk may be waived where it would not form part of a route leading to a school or other major pedestrian generator or be on a bus route.
3. Lighting levels given are for average illumination on the roadway when light source is at lowest output and luminaire in dirtiest condition. Uniformity ratios of lighting should be 3:1 average to minimum except 6:1 average to minimum in single family residential areas. On roads of pavement width 10.5m or wider, lighting should be on both sides of road for better distribution. Care should be taken to ensure that the spacing of lights allows the intersections and pedestrian walkways to be lit.
4. The design speed governs vertical and horizontal geometrics. Values of all parameters should be taken from the Road and Transportation Association of Canada “Geometric Design Standards” manual.
5. The term “short cul-de-sacs” is applicable only to straight cul-de-sac roads with a maximum length of 50m measured to the center of the turnaround.
6. The right-of-way width and pavement width of arterial and collector streets is dependent on overall traffic characteristics rather than adjacent land use. The applicable widths can be obtained by reference to Port Coquitlam drawing number 211-153 attached as part of Schedule B of this Bylaw.
7. Where subdivision takes place on one side only of a required highway, the minimum standards for highways may be modified so that:
 - (a) Where the full right-of-way width does not exist, the roadway shall be offset in the right-of-way and enough additional right-of-way dedicated to allow construction of one-half of the required pavement width plus one meter of pavement;
 - (b) Where the full right-of-way width does exist, but no roadway has been constructed, the roadway shall be completed to a width of one meter less than the ultimate road width;
 - (c) Where there is an existing roadway of insufficient width or strength, sufficient additional right-of-way shall be dedicated and the roadway shall be constructed complete to the minimum standards.

SCHEDULE C
TO
SUBDIVISION
BYLAW NO. 2241

DESIGN CRITERIA

DESIGN CRITERIA
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4	Roadworks
5	Sanitary Sewer System
6	Storm Drainage System
7	Street Lighting System

COMMON

SECTION 1

1.1 General

1.1.1 Interpretation

In this schedule, where the words “Professional Engineer” or “Consultant Engineer” are used, they shall mean a competent Professional Engineer registered in the Province of BC and hired by the Developer for the purpose of designing the works required under this Subdivision Bylaw. Where the words “Standard Drawings” are used, they shall mean the Standard Drawings forming part of Schedule D of this Subdivision Bylaw.

1.1.2 Use of Design Criteria Mandatory

All works to be constructed under this Bylaw shall be designed by a Professional Engineer in accordance with the Design Criteria and Construction Specifications set out in this Bylaw. Where conditions arise which are not covered by the Design Criteria or Construction Specifications, it shall be the responsibility of the Professional Engineer to consult with the City Engineer prior to completing the design. The first submission of the Design Drawings shall be accompanied with a declaration from the Design Engineer to the effect that he has read this Bylaw No. 2126 with the latest revisions and that his design of the proposed works is in general conformance with this Bylaw with the exception as noted (if any).

1.1.3 Engineer’s Seal Indicates Compliance

The Professional Engineer’s seal on the drawing submitted to the City Engineer for approval will certify that the design has been carried out in compliance with the Design Criteria and Construction Specifications and in accordance with accepted engineering standards of the day.

1.1.4 Design Drawings

All Design Drawings prepared by the Consultant Engineer for submission to the City Engineer shall conform to the minimum drawing standards specified in Section 2 of this Schedule.

1.2 Approval Procedure

1.2.1 Works Required

Upon tentative Subdivision Approval, the Developer will be issued with a sketch plan showing the works required to be constructed under this Bylaw. This sketch plan is intended only as a guideline to the Developer and is not an engineered

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design drawing. This sketch plan will normally be given by the Developer to his Consultant Engineer to allow the Professional Engineer to commence the design of the required works in accordance with this Bylaw.

1.2.2 Initial Design

Upon receipt of the sketch plan, the Consultant Engineer will arrange for any necessary surveys, soil tests, feasibility studies, etc. in order to prepare the required Design Drawings. “As Constructed” information on existing underground utilities may be obtained from the Engineering Department.

The Consultant Engineer will be responsible for performing all the necessary calculations and field verifications to assure himself that all the designs for the required works conform to the Design Criteria and Construction Specifications set out in this Bylaw. Deviations from the sketch plan will be accepted, providing they accomplish the same purpose and are agreed to by the City Engineer.

1.2.3 Submission of Drawings

The Consultant Engineer shall submit a minimum of one complete set of sealed paper prints of the Design Drawings to the City Engineer for review.

1.2.4 Checking of Drawings

The City Engineer will check the Design Drawings for compliance with City standards and the subdivision requirements but will not check the adequacy of the engineering design. Any errors or omissions will be the responsibility of the Consultant Engineer who sealed the drawings.

1.2.5 Unacceptable Drawings

If the City Engineer finds that the Design Drawings are not acceptable, the one marked-up set of drawings will be returned to the Consultant Engineer for correction.

1.2.6 Resubmission of Drawings

When resubmitting corrected drawings, the Consultant Engineer shall return the marked-up check print to the City to allow for quick comparison.

Normally drawings are dealt with by the City in the order they are submitted. However, priority will be given to first submissions.

1.2.7 Approvals of Other Agencies

It is the responsibility of the Consultant Engineer to obtain all the necessary approvals from other agencies who may be involved. These could include

Federal and Provincial Fisheries, Ministry of Environment, the GVRD, BC Hydro, the National Energy Board, etc. Where an application to an agency must be made by the City, the Consultant Engineer shall supply the City with the necessary copies of drawings and any other supporting information for the application.

Normally these applications would not be made until the City has notified the Consultant Engineer that the Design Drawings are acceptable.

1.2.8 Notice of Acceptability of Design Drawing

Upon notification that the Design Drawings are acceptable to the City Engineer, the Consultant Engineer will be asked to submit six complete sets of paper prints. One set will be stamped as having been reviewed by the City and returned to the Developer to allow him to proceed with the contracting of the work. It is the responsibility of the Developer to ensure that the required works are constructed in accordance with the stamped set of Design Drawings.

1.2.9 Other Utilities

It will be the responsibility of the Consultant Engineer to coordinate the design and location of BC Hydro, BC Telephone, Cablevision, and natural gas underground utilities with the appropriate authorities.

1.3 Utility Offsets

1.3.1 Wherever practical, utility layouts shall conform to the offsets illustrated in the City's Standard Drawings for the class of road being constructed.

Where the standard offsets are not practical due to existing utilities in the ground or other considerations the following principles shall apply to the choice of offsets:

- 1.3.1.1 Water and sewer mains to be separated by minimum 3 meters.
- 1.3.1.2 No utilities to be located directly under or within 0.5m of the curb or sidewalk alignment.
- 1.3.1.3 Keep water mains outside the traveled portion of the roadway.
- 1.3.1.4 Keep manholes out of wheel paths on the roadway.
- 1.3.1.5 Minimum clearance from face of curb to any fixed object to be 0.3m.

1.4 **Typical Details**

Prior to commencing design, the Consultant Engineer shall familiarize himself with Schedule D – Construction Specifications of this Bylaw, particularly the typical details of various municipal works shown on the Standard Drawings.

DESIGN DRAWING STANDARDS

SECTION 2

2.1 General

All drawings shall be done in metric units on A1 size sheets, 594mm x 841mm outside dimensions, using a high grade tracing paper or polyester film with ½ plan and ½ profile. Plan section to be on top of sheets. Profile will have 2mm vertical x 20mm horizontal grid.

Design Drawings may be done in pencil and freehand lettering or ink and/or Leroy mechanical lettering provided that they are clearly legible. Minimum lettering height to be 2.5mm. Line weights and letter sizes to be in accordance with Table 1 of this Section.

Each set of Design Drawings shall be preceded with a title sheet containing a site plan showing the location of the development, drawing index, and City of Port Coquitlam project number.

2.2 Consultant's Title Block

All drawings shall have the following information:

Consultant's name, address and telephone number, client's name, drawing title, drawing number, City of Port Coquitlam project number, date of drawing, scale, Consultant Engineer's seal, and drawing revision information including date of revision.

2.3 Preparation of Drawings

All dimensions on plan and profile shall be in metres. The plan view shall show the legal layout of roads and properties, with all legal descriptions, dimensions (to the nearest 0.01m) and bearings taken from registered legal plans. It will also show house numbers and all registered right-of-ways. The names of streets will be indicated outside of the road right-of-way boundaries.

On profiles, all elevations used will be geodetic and rounded off to the nearest 0.005m.

On profiles the starting chainage station 1 + 00 shall coincide with an accented vertical line on the grid and lines up vertically with the 1 + 00 station on the plan view. Chainage stations will be a maximum of 20 meter intervals (1 + 20, 1 + 40, etc) and rounded off to the nearest 0.1m.

Bench marks shall be detailed and noted on the drawings with respect to location and elevation. Survey monuments and temporary bench marks shall be shown on the plan view.

The plan view shall be drawn at a scale of 1:500. The profile shall be drawn to scales horizontal 1:500; vertical 1:50. All symbols to be used on the drawings shall be as per Figure 211-39 of this section. All offsets of services, existing and proposed, shall be indicated to the nearest 0.1m.

2.4 **Storm Sewer Works**

The plan view shall show all of the following existing:

Water, sanitary sewer and connections, storm sewers and connections, catch-basins, ditches, driveway culverts and their sizes, poles, manholes, hydrants, water valves and other surfacial features such as trees, retaining walls and hedges which may be affected by proposed construction, base-line of survey, edges of existing road and driveways, gas and underground electrical and telephone ducts.

Each service shall be referenced to property lines and sized if different than standard service connection sizes. All sizes shall be in millimeters. The proposed storm sewer shall be drafted in bold lines and the offset of proposed works shall be circled. Basement and crawl space elevation of existing houses and average ground elevation of vacant lots shall be shown. The invert and approximate depth for each proposed connection shall be “boxed in” for each property.

The profile view shall show chainages and profile along the base line complete with elevations, elevations of existing ditch invert, culvert inverts and storm sewers, existing services crossed by proposed works and their elevations.

The full bore capacities of pipes and design flow, grade, length and pipe specifications (ie. type and class of pipe) shall be clearly stated. In cases where Storm Water Management Methods are applied, it shall show all data pertaining to the design of the proposed storm sewer including the hydraulic grade lines of minor system if sewers are surcharged and of the major system.

2.5 **Roadworks**

The plan view shall show all of the following existing:

Water, sanitary sewer and connections, storm sewers and connections, catch-basins, ditches, driveway culverts and their sizes, poles, manholes, hydrants, water valves and other surfacial features such as trees, retaining walls and hedges which may be affected by proposed construction, base-line of survey, edges of existing road and driveways, gas and underground electrical and telephone ducts.

Each service shall be referenced to property lines and sized if different than standard service connection sizes. All sizes shall be in millimeters. The proposed roadworks shall be drafted in bold lines and shall be shaded lightly on the reverse side of drawing.

The profile view shall show chainages and profile along the base line complete with elevations of existing ground along base line and proposed road elevations. It shall also show all required data pertaining to the design of the proposed road.

2.6 Sanitary Sewer Works

The plan view shall show all of the following existing:

Water, sanitary sewer and connections, storm sewers and connections, catch-basins, ditches, driveway culverts and their sizes, poles, manholes, hydrants, water valves and other surfacial features such as trees, retaining walls and hedges which may be affected by proposed construction, base-line of survey, edges of existing road and driveways, gas and underground electrical and telephone ducts.

Each service shall be referenced to property lines and sized if different than standard service connection sizes. All sizes shall be in millimeters. Basement and crawl space elevations of existing houses shall be shown and average ground elevation of vacant lots shall be shown. The proposed sanitary sewer and connections shall be drafted in bold lines and the offset of the proposed sanitary sewer shall be circled. The invert and approximate depth for each proposed connection shall be “boxed in” for each property.

The profile view shall show chainages and profile along the baseline complete with elevations, existing services crossed by proposed works and their elevations. It shall also show all data pertaining to the design of the proposed sanitary sewer including the size, full bore flow in l/s (liters per second), design flow, grade, length and pipe specifications, (ie. type and class of pipe).

2.7 Waterworks

The plan view shall show all of the following existing:

Water, sanitary sewer and connections, storm sewers and connections, catch-basins, ditches, driveway culverts and their sizes, poles, manholes, hydrants, water valves and other surfacial features such as trees, retaining walls and hedges which may be affected by proposed construction, base-line of survey, edges of existing road and driveways, gas and underground electrical and telephone ducts.

Each service shall be referenced to property lines and sized if different than standard service connection sizes. All sizes shall be in millimeters. The proposed waterworks shall be drafted in bold lines and the offset of the proposed works shall be circled. All fittings and thrust restraint means to be used shall be “boxed in” for each location. Details of valves, fittings and thrust blocks may require blow up sketch for clarification.

The profile view shall show chainages and profile along the baseline complete with elevations and existing services crossed by proposed works and their elevations. It shall also show all data pertaining to the design of the proposed water main, including the size,

points where the grade changes, grades and profile of proposed works, test points and pipe specifications (ie. type and class of pipe).

The maximum static pressure which the watermain will be subjected to shall be shown as a separate note on the drawing.

When thrust blocks are specified on the drawing which are different than the sizes specified in the Standard Drawings, a note should be included on the drawing indicating the design criteria assumed in sizing the thrust block areas (ie. test pressure, type of soil and bearing pressure assumed in design calculations).

2.8 Streetlight Works

The drawings shall only include plan views, no profile being required. The plan view shall show all existing underground services, poles, edges of roads and lanes, sidewalks, ditches and other surfacial features such as trees, retaining walls and hedges which may be affected by proposed construction. All sizes shall be in millimeters. The proposed streetlight works shall be drafted in bold lines and the offset of the proposed ducts to be circled. Each proposed street light location shall be referenced to lateral property lines. The size and type of poles, wattage and type of luminaires, number and size of wires and ducts, proposed hydro connections and junction boxes shall be shown. The proposed numbers for each street light pole shall also be shown.

2.9 Sidewalks

The drawings shall include both plan and profile views. The profile view shall show elevations of top of existing curb and proposed curb side edge of sidewalk. If curbs are non-existent, elevations of road crown and proposed curb side edge of sidewalk shall be shown instead.

The plan view shall show the same existing information as for street light works. In addition, the proposed sidewalk shall be drafted in bold lines and shaded on reverse side of drawing. The offset of the proposed sidewalk shall be circled.

When sidewalks are constructed in conjunction with roadworks, the above requirements for sidewalks may be replaced by typical road cross-sections.

2.10 Cross-sections

Regarding roadworks and sidewalks, typical and unusual cross-sections shall be provided. For roadworks, this will involve details across the full width of the road allowance regardless of whether a full or partial width of road construction is proposed. The cross-sections shall show property lines, final fill and cut slopes, ditches, edges of existing road, center line of road. Distances and elevations of each break in the cross-section shall be clearly shown.

The proposed roadworks shall be drafted in bold lines with the emphasis on the finished surface of the road. Elevations of the proposed road cross-sections shall be indicated. If the proposed road centerline is different than the road right-of-way centerline, it shall be clearly shown.

For sidewalks, cross-sections showing only the side of the road where the work is proposed shall be required. The proposed sidewalk shall be drafted in bold lines. Cross-sections shall be drafted using scales as follows:

Horizontal	1:100	Vertical	1:20
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Elevations shall be rounded off to the nearest centimeter.

2.11 As Constructed Drawings

As Constructed Drawings shall consist of all the Design Drawings accurately revised to reflect actual construction changes in the field. In addition to one complete set of As Constructed Drawing prints sealed by a Professional Engineer, a digital copy of each sheet of drawing shall be submitted to the City as official records. The digital copy shall be submitted in a format compatible with AutoCAD 2000.

TABLE 1
LINE WEIGHTS AND LETTER SIZES

- (a) Use pen size 1 (0.50 metric) for property lines and right-of-ways.
- (b) Use pen size 3 x 0 (0.25 metric) for existing utilities.
- (c) Use pen size 4 x 0 (0.13 metric) for existing dimensions and offsets.
- (d) Use pen size 3 (0.70 metric) for proposed works.
- (e) Use letter size Leroy template 120 (3.1mm) and pen size 0 (0.35 metric) for existing lot and legal plan numbers.
- (f) Use letter size Leroy template 140 (3.5mm) and pen size 1 (0.50 metric) for proposed lot and legal plan numbers.
- (g) Use letter size Leroy template 100 (2.5mm) and pen size 0 (0.35 metric) for lot dimensions, offsets of utilities, sizes of utilities, elevation figures and notes.
- (h) Use letter size Leroy template 240 (6.1mm) and pen size 3 (0.70 metric) for street names.
- (i) Use letter size Leroy template 290 (7.5mm) and pen size 4 (1.00 metric) for drawing numbers.

CITY OF PORT COQUITLAM

LEGEND FOR CONSTRUCTION DRAWINGS

EXISTING	PROPOSED	
		PAVEMENT
		CURBS
		BENCH MARK - GEODETTIC DATUM
		TEMPORARY BENCH MARK - GEODETTIC DATUM
		SANITARY SEWER & INSPECTION CHAMBER
		STORM SEWER
		DITCH
		SIDEWALK
		WATERMAIN
		HYDRANT
		STANDPIPE
		WATER VALVE
		AIR VALVE
		WATER METER
		PERMANENT & TEMPORARY BLOW-OFF
		UNDERGROUND B.C. TELEPHONE
		UNDERGROUND B.C. HYDRO
		GAS MAIN
		U/G DUCTS TRAFFIC & STREET LIGHTS
		CATCH BASIN
		ORNAMENTAL STREET LIGHT BASE
		UTILITY POLE
		JUNCTION BOX
		ORNAMENTAL STREET LIGHT
		UTILITY POLE W/LIGHT

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WATER DISTRIBUTION SYSTEM

SECTION 3

3.1 Sizing of Watermain

Watermain shall be sized in accordance with the City's Water Distribution System Computer Model which has incorporated the following design parameters:

3.1.1 Design Flow

The design flow for watermain shall be based on the greater of the following:

either (a) **Peak Hour Demand:**

2,100 liters per capita per day for residential areas, and 60,000 liters per hectare per day for commercial and industrial areas;

or (b) **Peak Day Demand Plus Fire Demand:**

1,400 liters per capita per day for residential areas, and 40,000 liters per hectare per day for commercial and industrial areas plus the applicable fire demand at a location where the pressure drop would be most critical.

3.1.2 Fire Demand

Fire demands shall be determined based on the latest edition of the Insurance Bureau of Canada's publication "Water Supply for Public Fire Protection – A Guide to Recommended Practice". However, the fire demands so determined shall not be less than the minimum fire demands shown below corresponding to the various developments:

<u>Type of Development</u>	<u>Minimum Fire Demand</u>
Single Family Residential	60 liters/sec
Apartments	120 liters/sec
Townhouses	120 liters/sec
Commercial	150 liters/sec
Institutional Buildings	150 liters/sec
Industrial	190 liters/sec

3.1.3 Design Computations

Use the Hazen-William's Formula:

$$Q = \frac{CD^{2.63}S^{0.54}}{278,780}$$

Where: Q = Rate of flow in liters per second
D = Nominal pipe diameters in mm
S = Slope of hydraulic grade line in m/m
C = Roughness coefficient (100 for mains up to 200mm diameter and 110 for mains greater than 200mm)

3.1.4 Water Pressure

The water distribution system shall be designed to supply water at pressures within the following ranges:

Minimum pressure at peak hour demand	=	210 KPa
Maximum pressure at low demand	=	1050 KPa
Minimum pressure at the fire test location under peak day demand excluding hydrant losses	=	210 KPa

3.1.5 Minimum Pipe Sizes

Distribution mains – 150mm in residential areas
and 200mm in industrial areas

Fire hydrant connection – 150mm

3.2 Practical Design Considerations

3.2.1 Looping of Watermains

Except in cul-de-sacs of less than 150m in length, all watermains shall be looped.

3.2.2 Blow-off Assemblies

All dead end water mains whether permanent or temporary shall be provided with blow-off assembly as shown on the Standard Drawings.

3.2.3 Location

(a) Service connections: normally at center of lot frontage.

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- (b) Separation from sanitary sewer: minimum separation of watermains from sanitary sewers or services shall be as outlined in Section 5 – Sanitary Sewers.

3.2.4 **Minimum Depth of Cover**

Mains and services shall be of sufficient depth to:

- (a) Prevent freezing.
- (b) Clear other underground utilities.
- (c) Otherwise not less than 1.0m.

3.2.5 **Valving**

In general, valves shall be located as follows:

- (a) in intersections in a cluster at the pipe intersection with a minimum of:
 - (i) 3 valves at “X” intersection
 - (ii) 2 valves at “T” intersection
- (b) not more than 200m apart;
- (c) not more than one hydrant isolated;
- (d) the location of the gate valves shall be such that interruptions to water supplies to adjoining properties are minimized in the event that isolation of a section of main becomes necessary.

Gate valves of the same diameter as the nominal pipe size shall be used for watermains up to and including 400mm diameter. On watermains 450mm and larger, gate valve sizes may be reduced by one-third rounded off to the nearest nominal valve size.

Butterfly valves with mechanically assisted operating gear boxes may be substituted for gate valves 450mm diameter and larger.

3.2.6 **Hydrant Spacing**

Fire Hydrants shall be located in general at street intersections and spaced as follows:

- (a) Not more than 150m apart nor 100m from the furthest dwelling;
- (b) In accordance with the latest edition of “Water Supply for Public Fire Protection – A Guide to Recommended Practice” published by the Insurance Bureau of Canada;

- (c) 0.6m from the property line.

The final location of hydrants is subject to the approval of the City's Fire Chief.

3.2.7 Hydrant Connections

Hydrants shall be connected and secured in the following manner:

- (a) By flanged joints where hydrant is connected to valve on main;
- (b) By tie rods and thrust blocks where hub joints are used.

3.2.8 Service Connection

The minimum size of water service connections shall be 19mm. Service connections 50mm and larger shall be connected to the watermain with a tee and a gate valve complete with 50mm square operating nut and valve box assembly. Service connection installation details shall conform to the Standard Drawings. The Consultant Engineer is required to arrange for the necessary soils tests to determine whether or not the installation of copper service pipes is appropriate for the area. Polybutylene or Polyethylene service pipes as specified in Schedule "D" should be used in corrosive soils.

3.2.9 Thrust Blocking

Concrete thrust blocking shall be provided at bends, tees, wyes, reducers, plugs and caps. The size of thrust blocks shall not be less than the minimum values corresponding to the test pressure and soil types specified in the Standard Drawings. In all cases, the Consultant Engineer shall be responsible to verify that the minimum sizes shown in the Standard Drawings are adequate for his design. If larger thrust blocks are required, he shall clearly specify the size of thrust blocks for the various types of soil conditions and the design pressure on the Design Drawings.

3.2.10 Minimum Pipe Grade

Watermains shall be designed with a minimum grade of 0.1%.

3.2.11 Air Valves

Air valves shall be installed at all summits in the main and also at abrupt changes in vertical grade from steep to flat sections. The air valves shall be double acting air release and vacuum valves sized according to normal and extreme operating conditions expected.

3.2.12 Test Points and Chlorination

For the purpose of hydrostatic pressure testing and chlorination, the Consultant Engineer shall specify the locations of all test points on the Design Drawings. Test points shall be installed at locations where complete chlorination of the newly constructed main is possible. There should be at least one test point installed on each isolable section of watermain. Test points shall consist of a minimum size of 19mm Corporation Stop. A Corporation Stop installed for the purpose of an air valve may be used as a test point or a bleeding point.

3.2.13 Fire Line Connections

It shall be the Consultant Engineer's responsibility to adequately size the fire line connections. Fire line connections shall be terminated at the property line with a check valve.

3.2.14 Pipe Materials and Specifications

See Construction Specifications.

3.2.15 Structural Design

The structural design of watermains shall be the responsibility of the Consultant Engineer. Live loads on the watermain conduit shall include Highway loads on the pipe and an impact factor of 1.5. Ductile iron and Polyvinyl Chloride (PVC) A.W.W.A. C-900 pipes shall be considered as rigid and flexible conduits respectively when selecting the design methods. The minimum Class of Bedding and the limit of the trench width at the top of the pipe shall be as shown on the Standard Drawings. In cases where more stringent construction requirements are necessary to achieve the required field supporting strength of the watermain conduit, the designer shall specify both the Class of Bedding and the maximum trench width at the top of the pipe on the Design Drawings.

ROADWORKS

SECTION 4

4.1 General

4.1.1 Classification

Refer to the definitions under the Interpretation Section of the City of Port Coquitlam Subdivision Bylaw and to Schedule A which shows the designated arterial and collector road system within the City.

4.1.2 Widths

Roads shall be designed to the right-of-way and pavement widths required in Schedule B Table 2 of this Bylaw for the appropriate classification and type of land use. Normally, the required width will be shown on the sketch plan sent to the Developer with the letter of Tentative Approval.

4.2 Geometrics

4.2.1 General

Roadway geometrics are to be governed by the design speed required for each type of road as designated in Schedule B Table 2 of this Bylaw. Values of all the parameters with the exception of grades should be in accordance with the RTAC manual of Geometric Design Standards for Canadian Roads and Streets. Some of these parameters are summarized in the tables below along with revised grade standards.

Classification	Design Speed km/h	Max Grade		Min Stopping m	Max Superelev %	Min* Radius m
		Desir %	Absol %			
Arterial	60	6	9	85	6	130
Collector	60	8	10	85	6	130
Local	40	10	12	45	**	50
	50	10	12	65	**	90

* Where grades exceed maximum desirable the minimum radius for horizontal curves must be increased.

** Not applicable for local streets.

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4.2.1.1 Grade

Desirable minimum gutter grade shall be 0.50% with absolute minimum being 0.30%.

Maximum grade for downhill cul-de-sacs shall not exceed 8%.

Absolute maximum grade may only be used where:

- i) Desirable grade cannot be obtained due to topographical constraints;
- ii) The geometric design of intersections can be improved by increasing grade on minor street to avoid compromising design of major street.

4.2.1.2 Vertical Curvature

Classification	Design Speed km/h	K Values			
		Crest Curves		Sag Curves	
		Min	Desir	Min	Desir
Arterial and Collector	60	15	20	10	20
Local	40	4	5	4	7
	50	7	10	6	11

Use of K values below desirable may only be used where justified by topographical constraints and in the case of sag curves where street lighting is provided.

Vertical curve length is calculated by the equation:

$$L = KA$$

Where: L – Length in meters
A – Algebraic difference in grades in percent
K – Given in above table

Vertical curves may be omitted where the algebraic difference in grades does not exceed 2% for local streets and 1% for other streets.

4.2.1.3 Cross-Slopes

Roadways shall generally be constructed using a centerline crown.

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Under adverse topographic conditions, offset crown or cross fall may be used.

Minimum cross-slopes shall be 2.5%, with a maximum 4%.

Centerline valley shall be used for lanes and local roads in mobile home subdivisions or in other similar developments.

4.2.2 Intersections

4.2.2.1 General

Intersections shall be as near as possible to right angles. The minimum angle of intersection shall be 70° and the maximum angle 110°. Intersections on horizontal curves will normally not be acceptable.

The minimum spacing between tee intersections along a street shall be 60m.

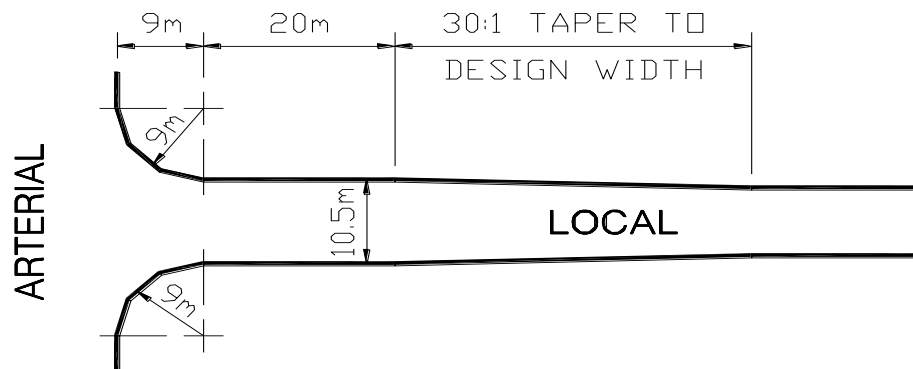
At every unsignalized intersection the crossing site distance requirements shall be checked. If these requirements cannot be met alternate design shall be submitted by the Consultant Engineer to the City Engineer for consideration.

4.2.2.2 Curb-return Radii at Intersections

Street	Intersecting Street	Minimum Radius
Collector	Arterial	9.0m
	Collector	7.5m
Local	Arterial	9.0m
	Collector	7.5m
	Local	6.0m

4.2.2.3 Local Streets Intersecting with Arterials

Intersecting local streets shall have a minimum width of 10.5m for a distance of 20m from the major street curb return.



4.2.2.4 Vertical Curvature at Intersections

Providing the minor intersecting street is marked as a STOP, the following K values may be used for the minor street:

Classification	K Values			
	Crest Curves		Sag Curves	
	Min	Desirable	Min	Desirable
Collector	4	6	4	6
Local	2	4	2	4

Use of K values below desirable may only be used where justified by topographical constraints and in the case of sag curves where street lighting is provided.

4.2.2.5 Cross-slope at Intersections

At intersections the cross fall of the minor street shall be varied to suit the cross fall of the major street.

The maximum rate for changing cross fall at intersections shall be as follows:

Collector 4% in 30m
Local 6% in 30m

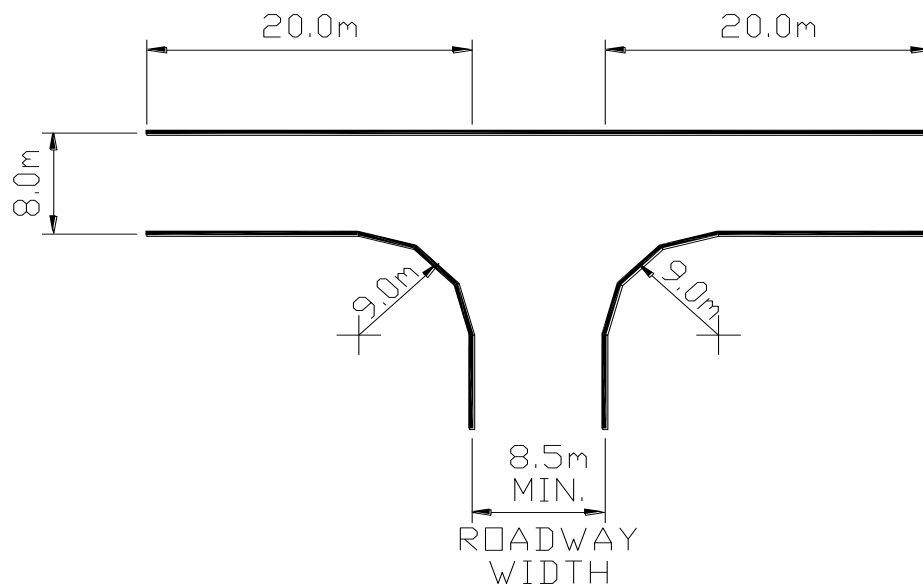
4.2.3 Cul-de-sacs

The maximum length of cul-de-sac measured from the centerline of the intersecting street to the center of the cul-de-sac shall not exceed 150 meters. Cul-de-sac shall conform to the minimum dimensions given in the following table:

Circular or Circular Offset Cul-de-sac Dimensions

Classification	R/W Radius m	Outer Edge of Pavement Radius m
Local Residential with center island *	16	14.0
Local Residential without island	14	12.0
Industrial ** without island	17	14.5

- * A cul-de-sac with a center island shall have a minimum road width of 9 meters.
- ** Tee or Hammerhead type may be used for industrial cul-de-sacs and shall have the following minimum dimensions.



4.2.4 Clearances

4.2.4.1 Clearance at Bridges

Horizontal clearance in meters from edge of travel lane:

Classification	Overpass Lane Edge to Rail or Parapet		Underpass Lane Edge to Abutment or Wall	
	With Sidewalk*	No Walk	With Sidewalk*	No Walk
Arterial	2.5	1.75	2.5	2.5
Collector	2.5	1.0	2.5	1.75
Local	2.25	1.0	2.5	1.25

* Sidewalk – minimum 1.5m wide and minimum 150mm above roadway grade.

Minimum vertical clearance from finished road grade to bottom of underpass or bridges is 4.9m.

4.2.4.2 Aerial Utilities

Type	Vertical Clearance *
Communications and guy wires	4.6m
Hydro conductors 0 – 750 V	4.6m
Hydro conductors 750 – 22000 V	5.0m
Hydro conductors 22000 – 90000 V	5.5m

* From final ground surface (subject to change by Hydro and Telephone Authorities).

4.2.4.3 Signs and Poles

Horizontal clearance from edge of travel lane to edge of pole or sign:

- Roadways without curbs 2.0m.

- Roadways with curbs 0.3m minimum. 1.0m preferable except where sidewalk is adjacent to curb in which case 1.76m is preferable.

Use of minimum clearance to be justified by safety appurtenances such as poles with break-away or frangible bases or sign poles of light weight fabrication.

Horizontal clearance between lighting pole and hydro pole shall be 2.5m.

Vertical clearance between lighting pole and hydro lines of 750 – 22000 V shall be 2.5m.

4.2.4.4 Trees

Horizontal clearance from edge of travel lane to roadside edge of tree trunk shall be 2.0m.

Horizontal clearance from edge of driveway, curb return or above ground utility to tree trunk shall be 2.5m.

Vertical distance from tree branches to the finished road grade shall be greater than 4.9m.

4.3 Sidewalks and Walkways

4.3.1 Independent Walkways

4.3.1.1 Grades

Where walkways are not an integral part of a roadway the following shall apply:

R/W Width*	Pavement Width**	Maximum Longitudinal Grade		Cross Slope		
				Min	Maximum	
		Desir	Absol		Desir	Absol
2.5m	2.3m	7%	9%	2%	4%	6%

* Where walkway serves as emergency vehicle access a right-of-way width of 3.5m is required.

** The portion of the walkway in the boulevard area shall be flared outwards at 45 degrees to meet the back of the curb or sidewalk as appropriate.

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Absolute grade and cross slopes may be used only where desirable values cannot be obtained due to topographical constraints.

In cases when the Absolute grades will be exceeded, concrete steps complete with handrails conforming to the latest edition of the Workers' Compensation Board Regulations shall be installed as part of the walkway.

For pedestrian bridges or underpasses the minimum unobstructed width shall be 2.5m.

4.3.1.2 Fencing

Unless otherwise specified, walkways shall be provided with a 1.5m high chain link fence on each side located 0.2m from the side property line. The fence shall terminate at the road property line at each end.

4.3.1.3 Bicycle Baffles

Bicycle baffles shall be placed at each end of the walkway. If the walkway also serves as emergency vehicle access, the bicycle baffles shall be hinged at the fence line as shown in the Standard Drawing.

4.3.2 Sidewalks on Road Right-of-Way

4.3.2.1 Widths

The requirement for sidewalks shall be determined according to the standards of Schedule B Table 1 based on the land use and the classification of road.

Widths of sidewalks shall be in accordance with the following table:

Classification	Land Use **	Minimum Width	
		Adjacent To Curb	Separate From Curb
Arterial	Low Density Residential	Not Desirable	1.5m
	High Density Residential	Not Desirable	1.8m
	Commercial	2.5m	1.8m
	Industrial	Not Desirable	1.5m
Collector	Low Density Residential	Not Desirable	1.5m
	High Density Residential	1.8m	1.5m
	Commercial	1.8m	1.8m
	Industrial	Not Desirable	1.5m
Local	Low Density Residential	1.5m	1.5m
	High Density Residential	1.5m	1.5m
	Commercial	1.8m	1.8m
	Industrial	Not Desirable	Not Desirable

Generally sidewalk alignment constraints shall be identical to those of the adjacent roadway.

Cross-slope shall be 2% towards the gutter or ditch on the roadway.

**Land use refers to the predominant land use within the specific block.

4.3.2.2 Wheelchair Ramps

Wheelchair ramps shall be formed at all intersections where curbs separate sidewalks or walkways from roadways. Wheelchair ramps shall normally be located at the mid point of the curb return.

4.4 Driveways

4.4.1 General

The selection of the location of driveways shall be based on the City's Highway Use Regulation Bylaw No. 2011 with the latest revisions. Items pertaining to the location of driveways not specified in Bylaw No. 2011 shall be based on the latest

edition of Guidelines for Driveway Design and Location, an Institute of Transportation Engineers Recommended Practice Manual unless conditions dictate otherwise.

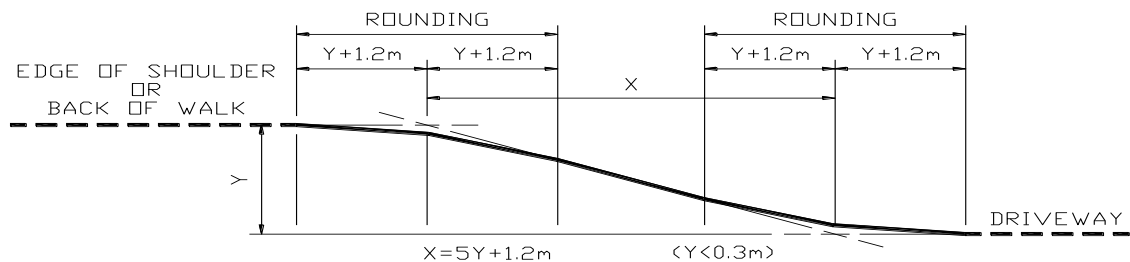
4.4.2 Widths at Property Lines

Land Use	Minimum Width	Maximum Width
Residential: Individual Driveway Common Driveway	3.5m 6.0m*	7.0m 9.0m*
Commercial and Industrial (one-way)	4.5m*	9.0m*
Commercial and Industrial (two-way)	6.0m*	15.0m*

* Driveways may be treated as intersections and curb returns used.

4.4.3 Driveway Profile

Where driveways involve an elevation difference in excess of 0.3m, the following profile can be used to define the maximum grade and vertical curvature. (Note that grades shall not exceed 20% in any case).



Above profile may be used for both positive or negative grades by reversing driveway road location.

4.5 Pavement Structures

4.5.1 General

Pavement design shall be based on one of the following methods:

- (1) Past history of successful pavements in adjacent similar areas.
- (2) For new roads or total reconstruction of existing roads, any design method covered in Part 5 “Structural Design” of the RTAC Pavement Management Guide. Pavement design shall include consideration of the subgrade soil type, frost susceptibility, moisture conditions and subgrade drainage provisions.
- (3) For existing roads where only overlay is needed, the design methods covered in The Asphalt Institute’s latest edition of Manual MS - 17 Asphalt Overlays and Pavement Rehabilitation.

4.5.2 Road Design Criteria

Design life for all classifications of roads shall be minimum 20 years.

Where the Benkelman Beam design method is used, the design deflections (mean plus two standard deviations) shall be as follows:

Local & Lanes	1.5mm
Collector	1.3mm
Arterial & Industrial	0.85mm

Where existing pavements are to be overlaid, the minimum thickness of asphaltic concrete pavement overlay shall be at least two times the maximum aggregate size, but in no case to be less than 25mm.

4.5.3 Pavement Structure

Regardless of the method used for pavement structure design, pavement structures shall be at least equal to or greater than the minimum pavement structures shown below.

Minimum pavement structures shown below are based on the in-situ soil classification as defined in the Unified Soil Classification System. (See Figure 4.5.3).

Soils at the subgrade level having classifications of MH, CH, OH, and P+ require special treatment or total removal and replacement with soil having a higher classification.

4.5.4 Minimum Pavement Structure Using Asphaltic Concrete Pavement

Road Classification	Minimum thickness with subgrade soil Classif SC & better	Minimum thickness with subgrade soil Classif ML/CL/OL
Local & Lanes	65mm * asphaltic concrete 75mm base course 150mm sub base	65mm * asphaltic concrete 75mm base course 300mm sub base
Collector	75mm ** asphaltic concrete 75mm base course 175mm sub base	75mm ** asphaltic concrete 75mm base course 300mm sub base
Arterial & Industrial	100mm *** asphaltic concrete 100mm base course 200mm sub base	100mm *** asphaltic concrete 150mm base course 300mm sub base

- * To be placed in two lifts;)
40mm and 25mm) 2nd lift to be placed after the
- ** To be placed in two lifts;) installation of all underground
- 50mm and 25 mm) services and construction of
- *** To be placed in two lifts;) buildings
- 50mm and 50mm)

NOTE: The requirement for placing asphalt concrete in two lifts may be waived by the City Engineer in cases where he considers it to be impractical to do so (ie. minor road widening).

4.5.5 Minimum Structures for Sidewalks, Walkways, and Driveways

All sidewalks, walkways and driveways shall be constructed of Portland Cement Concrete. Composition of the concrete structure shall be as follows:

Item	Structure
Sidewalk, walkways except those adjacent to mountable curbs	100mm portland cement concrete 75mm base course
Driveway Crossings	150mm portland cement concrete 75mm base course
Sidewalk adjacent to mountable curbs	125mm portland cement concrete 75mm base course

4.6 Lighting

4.6.1 Level of Illumination

Lighting shall be designed in accordance with Schedule B Table 2 for the road classification and surrounding land use and the criteria outlined in Section 7.

4.6.2 Spacing

Regardless of the minimum spacing required, all lighting shall be laid out in such a way that there is a street light within 6m of the intersection of streets and of street and walkway, measured from the projection of the intersection property lines.

4.7 Bridges

All bridge design shall be in accordance with National Standard of Canada, SCA Standard CAN 3-S6-M78.

Roadway bridges shall be designed to a minimum loading of MS 200.

Illumination for bridges and underpasses shall be 50% higher than the approach lighting intensity for various road classifications as given in Table 2 Schedule B of this Bylaw.

4.8 Concrete Curbs

The type of curbs to be used shall be determined from the following table:

Classification		Curb Type
Arterial & Collector		Curb with gutter, barrier
Local:	Low Density	Curb with gutter, mountable
	High Density	Curb with gutter, barrier

Curb on pavement shall be used only for islands or medians where fill materials are placed directly behind the curb.

Reverse gutter sections shall be used where the road cross-slope falls away from the curb.

Concrete curb may be cast monolithically with sidewalks where they are adjacent.

FIGURE 4.5

Unified Classification System for Soils

MAJOR DIVISION			GROUP SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA
COARSE-GRAINED SOILS (MORE THAN 50 PERCENT BY WEIGHT LARGER THAN 0.075mm SIEVE)	GRAVELS MORE THAN HALF COARSE. GRAINS LARGER THAN 4.75mm SIEVE	CLEAN GRAVEL (LITTLE OR NO FINES)	GW	WELL GRADED GRAVELS LITTLE OR NO FINES	CONTENT OF FINES LESS THAN 5 PERCENT
			GP	POORLY GRADED GRAVELS AND GRAVEL SAND MIXTURES LITTLE OR NO FINES	
		DIRTY GRAVEL (WITH SOME FINES)	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12 PERCENT
			GC	CLAYEY GRAVELS, GRAVEL-SAND-(SILT) CLAY MIXTURES	
	SANDS MORE THAN HALF FINE. GRAINS SMALLER THAN 4.75mm SIEVE	CLEAN SANDS (LITTLE OR NO FINES)	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	CONTENT OF FINES LESS THAN 5 PERCENT
			SP	POORLY GRADED SANDS, LITTLE OR NO FINES	
		DIRTY SANDS (WITH SOME FINES)	SM	SILTY SANDS, SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12 PERCENT
			SC	CLAYEY SANDS, SAND-(SILT) CLAY MIXTURES	
FINE-GRAINED SOILS (MORE THAN 50 PERCENT BY WEIGHT PASSING 0.075mm SIEVE)	SILTS LOW COMPRESSIBILITY	$W_L < 50\%$	HL	INORGANIC SILTS & VERY FINE SANDS ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY	CLASSIFICATION IS BASED UPON PLASTICITY CHART
		$W_L > 50\%$	HI	INORGANIC SILTS, MICACEOUS OR DIATOHACEOUS, FINE SANDY OR SILTY SOILS	
	CLAYS HIGH COMPRESSIBILITY	$W_L < 30\%$	CL	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY OR SILTY CLAYS, LEAN CLAYS	
		$30\% < W_L < 50\%$	CI	INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS	
		$W_L > 50\%$	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
	ORGANIC SILTS AND CLAYS	$W_L < 50\%$	OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	
		$W_L > 50\%$	OH	ORGANIC CLAYS OF HIGH PLASTICITY	
	HIGHLY ORGANIC SOILS		PT	PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG OUTDOOR ODOUR, AND OFTEN FIBROUS

SANITARY SEWER SYSTEM

SECTION 5

5.1 Design Parameters

5.1.1 Per Capita Flow

New systems shall be designed on the basis of an average daily per capita flow of not less than 360 liters/day. For existing systems, an additional per capita allowance shall be made where the measured average annual flow exceeds this value and immediate remedial measures are not proposed.

5.1.2 Peaking Factor

Population densities corresponding to various Zoning designations are given in Table 1 of this section – Population Densities by Zoning Designation. The peaking factor shall be determined from Figure 5.1.1 based on the population density x gross area to be developed. For design populations less than one thousand, the peaking factor shall remain constant at 2.5.

5.1.3 Infiltration

Average infiltration rate = 0.1 litres per second per hectare.

5.1.4 Design Flows

Residential Design flow $Q_r = (\text{population} \times \text{per capita flow} \times \text{peaking factor}) + \text{infiltration}$.

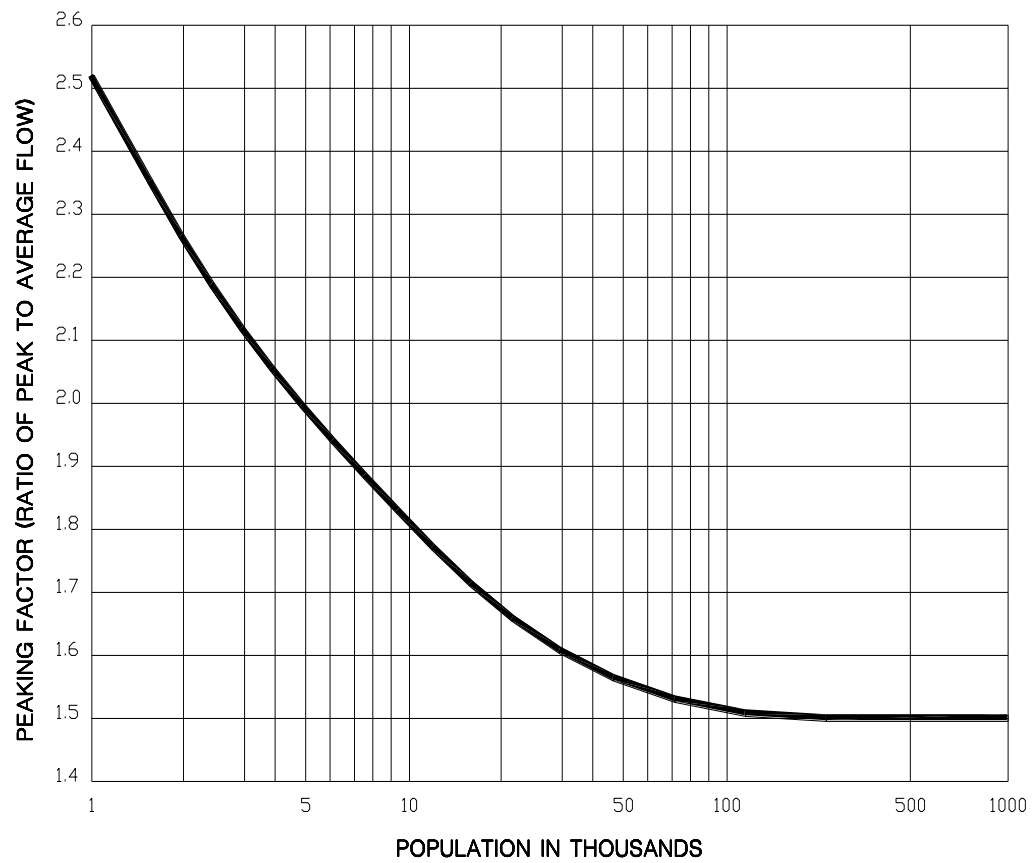
Industrial design flow Q_i shall be calculated based on the projected employee population and types of industries proposed for the area. Special consideration shall be given to the design of sanitary sewers for areas where heavy water consumption industries are proposed.

TABLE 1 – POPULATION DENSITIES BY ZONING DESIGNATION

ZONING		dupha	ppdu	ppha
A-1	Agricultural	0.50	3.2	2
RS-1	Single Family Residential	20.00	3.2	64
RS-2	Single Family Residential	27.00	3.2	86
RS-3	Single Family Residential	2.50	3.2	8
RT-1	Two Family Residential	27.00	3.2	86
RM-1	Multiple Family Residential	20.00	3.2	64
RM-2	Multiple Family Residential	27.00	3.2	86
RM-3	Multiple Family Residential	45.00	2.5	112
RM-4	Multiple Family Residential	102.00	1.5	153
C-1	Local Commercial	20.00	2.0	40
C-2	Neighbourhood Commercial	-	-	90
C-3	Community Commercial	-	-	90
C-4	Town Center Commercial	-	-	90
CS-1	Service Commercial	-	-	70
CS-2	Service Station Commercial	-	-	50
CS-3	Tourist Recreation Commercial	-	-	70
M-1	General Industrial	-	-	45
M-2	Heavy Industrial	-	-	45
M-3	Special Industrial	-	-	60
P-1	Civic Institutional	-	-	50
P-2	Special Institutional	-	-	50
P-3	Commercial Recreational	-	-	50

Note: dupha - dwellings per hectare (net)
ppdu - population per dwelling
ppha - population per hectare (net)

FIGURE 5.1.1



RELATIONSHIP OF CONTRIBUTORY POPULATION TO THE
RATIO OF PEAK TO AVERAGE SEWAGE FLOW
(GVS&DD Rawn Report 1953)

5.1.5 Pipe Sizing Formula

For gravity sewers use Manning's formula:

$$Q = \frac{AR^{0.667}S^{0.5}}{n}$$

Where Q = Design flow in m³/s

A = Cross sectional area in m²

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

S = Slope of hydraulic grade line in m/m

n = Roughness coefficient

= 0.013 for all pipes acceptable for use in sanitary sewers

NOTE: Reduction in pipe sizing shall not be made downstream irrespective of increase in carrying capacity of sewers due to increase in grade.

5.1.6 Velocity

Gravity sewers minimum V = 0.61 m/s @ design flow

There are no maximum allowable velocities, however, where grades exceed 15%, the design engineer shall address sewer scour and anchoring problems and modify the sewer design to suit local conditions.

5.1.7 Minimum Pipe Diameter

Collector sewer 200mm

Service connections 100mm

5.1.8 Minimum Pipe Grade

Terminal sections of sewers near the sewer catchment boundaries shall have a minimum grade of 1%. The following are minimum pipe grades for the remaining gravity sewer system. Steeper grades are desirable. Under special conditions, if detailed justifiable reasons are given, slopes slightly less than the following may be permitted but in no case will velocities below 0.46 m/s be permitted. It must be recognized that decreased slopes may cause additional sewer maintenance expense.

<u>Pipe Diameter, mm</u>	<u>Minimum Grade, m/100m</u> (n = 0.013)
100 Service Connections	1.25
200	0.40)
250	0.28)
300	0.22) velocity =
350	0.17) 0.61 m/s
375	0.15)
400	0.14)
450	0.12)

5.1.9 **Minimum Depth of Cover**

Sewers shall be of sufficient depth to:

- (a) Permit gravity service connections to existing basements.
- (b) Properly service all of the tributary lands upstream of the future sewer extension point.
- (c) Prevent freezing.
- (d) Clear other underground utilities.
- (e) Prevent damage from live surface loading. Normally the minimum depth to satisfy this criteria is 1.0m.

5.1.10 **Distance Between Manholes**

<u>Pipe Size, mm</u>	<u>Maximum Distance, m</u>
375 and smaller	125
450 to 750	155
900 and larger	185

Manholes are also required at every pipe size change, every line or grade change which cannot be accommodated by the allowable radius of curvature and every intersecting sewer. The upper end of the sanitary sewer where further extension of the sewer is infeasible shall be terminated with a standard 1050mm benched manhole.

At manholes where future sanitary sewer extensions are likely, one pipe length shall be extended beyond the manhole with the end capped as stub for future tie-in.

5.1.11 **Radius of Curvature**

Minimum radius = 60m

Maximum joint deflection shall be as recommended by pipe manufacturer.

Only one vertical or one horizontal curve is permitted between manholes.

5.1.12 **Hydraulic Losses Across Manholes**

The following criteria shall be used:

- (a) The crown of the downstream pipe shall not be higher than that of the upstream pipe.
- (b) Minimum drop in invert levels across manholes:
 - i) Straight run - no drop required
 - ii) Deflections up to 45° - 20mm drop
 - iii) Deflections 45° to 90° - 30mm drop
- (c) An outside drop pipe shall be installed when the drop between inverts exceeds 0.6m. See Standard Drawings.

5.1.13 **Sewer Location**

- (a) Service connections: normally at 2.0m from low side of lot boundary.
- (b) Separation from water mains:
 - i) Minimum 3.0m horizontally.
 - ii) Minimum 0.5m vertical clearance below water mains and in separate trench if 3.0m horizontal clearance is not possible.
- (c) Sanitary sewers may be laid in a common trench with storm sewers. However, in these cases, the design engineer must make adequate checks to ensure that a minimum clearance of 0.4m is maintained between pipes and that conflicts do not exist at wye connections, manholes and utility crossings.

5.1.14 **Service Connections**

Sanitary connections are to be installed with inspection chambers as shown on the Standard Drawings.

All service connections shall enter the main between 2 and 10 o'clock position above the springline at the top of the pipe. Connections to new mains shall be made using manufactured wye fittings. Connections to existing mains shall be made using manufactured saddles. Single connections shall be permitted only.

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5.1.15 Pipe Materials and Specifications

See Construction Specifications.

5.1.16 Structural Design

The structural design of sanitary sewer and force-main installations shall be in accordance with the latest edition of ASCE Manuals and Reports on Engineering Practice No. 37 – Design and Construction of Sanitary and Storm Sewers. Live loads on the sewer conduit shall include Highway H-20 loading and an impact factor of 1.5. The minimum Class of Bedding and the limit of the trench width at the top of the pipe shall be as shown on the Standard Drawings. In cases where more stringent construction requirements are necessary to achieve the required field supporting strength of the sewer conduit, the Consultant Engineer shall specify both the Class of Bedding and the maximum trench width at the top of the pipe on the Design Drawings.

5.1.17 Sanitary Connections and Building Elevations

Every existing property that is passed in the extension of the sanitary sewer system shall be provided with a sanitary sewer connection. The Consultant Engineer shall send a registered letter to the owner of each such property to ensure that the connection is installed at a location acceptable to the owner. Copies of the correspondence shall be forwarded to the Engineering Department for record purposes. For new lots in a subdivision and for existing lots when the property owner gives his permission, the connection shall be extended 1.5 meters into the property. Elsewhere the service connection to existing properties will be terminated at the property line with the inspection chamber located as shown on the Standard Drawings.

The design elevation of the inspection chamber for each property shall be specified on the Design Drawings. In selecting the invert of the chamber, the following must be taken into account:

- (a) Gravity connection to all known outlets is possible.
- (b) Gravity connection to possible house connections passing under the foundation footings is possible. An allowance of a minimum 0.5 meters below basement slab elevation to invert of connection at that point is required.
- (c) The minimum and maximum depths of the inspection chamber crown at the property line shall be 1 meter and 3 meters respectively.
- (d) In servicing a property where no dwelling exists, the invert of the inspection chamber shall be 1.5 meters lower than the average ground elevation at the 7.5 meter setback from the front property line unless topographic constraints make this depth impractical.

5.1.18 Service Connection Entering Manholes

Service connections entering manholes shall not be in an adverse direction to the flow in the sewer main nor shall the crown of the connection be at a lower elevation than the crown of the highest sewer main.

5.2 Sewerage Pumping Station

- (a) All sewerage pumping stations shall consist of a minimum of two pumps.
- (b) In sizing the wet well the Consultant Engineer must take the size of the proposed pumps to be used into consideration. The wet well should not be so small that the cycle time for the operation of the pumps would be so short that it is less than the pump supplier's recommended minimum time between successive pump starts (normally not less than 3 minutes at peak flow conditions). Nor shall the wet well be so large that anaerobic conditions will set in resulting in the generation of obnoxious odours. Extra storage shall also be included to permit the retention of one hour of contributory sewage at maximum flow as a safety feature in the event of power failures. In calculating the extra storage required it may be assumed that the level of sewage in the wet well at the start of power failure is at the mid-point between the lead pump start and pump cut-off level.
- (c) Detailed calculation for sizing of the pumps and wet wells are to be submitted along with the Design Drawings.
- (d) The Consultant Engineer shall specify the levels at which the various float controls for the operation of the pumps and alarms are to be located.
- (e) All dead spaces in the bottom of the wet well shall be eliminated (normally by concrete benching).
- (f) Details of the pump station shall conform to the latest edition of the Workers' Compensation Board regulations.

5.2.1 Dry Well Installations

- (a) Pumps shall be selected based on the following criteria:
 - each pump shall be capable of handling the maximum anticipated sewerage flow into the pump station
 - must pass maximum 75mm solids
 - must operate close to the maximum efficiency point for the pump during average operating conditions
 - must be able to operate on 3 phase power
- (b) Level Controls – Flygt float level type (mercury), or ultrasonic explosion proof with a resolution of +- 1% with alarm (light).

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- (c) All interior wiring explosion proof Class 1, Division 2, as required by Electrical Inspector.
- (d) Control panel mounted in dry well or in suitable Kiosk at ground level on concrete pad.
 - i) Extra plug-in required for small tools.
 - ii) Crouse Hinds receptable and transfer switch suitable for standby power.
 - iii) With Kiosk, underground wiring from Hydro pole to Kiosk.
 - iv) Equipped with hour meters for each pump.
- (e) Check Valves shall be Terminal City outside weight and lever type.
- (f) An explosion-proof exhaust fan, activated by opening entrance cover and of sufficient capacity to exchange the total volume of air inside the well with fresh air within 3 minutes.
- (g) Sump pump for interior of dry well discharging above the design top sewage level in the wet well.
- (h) Aluminum ladder, or galvanized or aluminum rungs for access to pumps.
- (i) For metal stations suitable cathodic protection shall be provided.
- (j) All equipment must be CSA approved.
- (k) An explosion proof light with protective cover activated by entrance cover.
- (l) Entrance cover must be water proof and supplied with suitable lock:
 - i) Either aluminum cover or iron cover with a counter weight for easy opening.
 - ii) Entrance tube must not be more than 1 meter above ground.
- (m) All equipment shall have at least a one year guarantee.
- (n) Suitable waterproof coating for interior and exterior of station, where applicable.
- (o) Gate valve on the force main from the pump station is required.
- (p) Bell mouth on pump intake.

- (q) Provision for standby pumping; with a lockable cap, quick coupling and adapter flange of the “Kamlock” type or similar housed separately in a manhole adjacent to the pump station.
- (r) Telemetrics for high-level alarm, pump or power failure, or any cause of malfunction alarm tied into the City’s telemetry system.
- (s) Roof and cover designed to withstand Highway H-20 loads if located within a potential traveled portion of the road allowance.
- (t) Provision for standby power; ie. automatic standby generator.
- (u) All electrical designs and installations shall be to the satisfaction of the Provincial Electrical Inspector.

5.2.2 Wet Well Installations

- (a) Items f, g, k, p, and t of Section 5.2.1 shall not be required; all others would apply.
- (b) Pumps should be submersible, no extended shaft-type installation.
- (c) Energy dissipator for incoming flow shall be required if their omission will result in the adverse operation of the pumps or excessive maintenance.

5.2.3 Operating Manuals

Four complete sets of operational instructions, including emergency procedures, maintenance schedules, warranty certificates and electrical drawings shall be delivered to the Engineering Department along with engineering As-built drawings after the installation of the pump station.

5.3 Force-Mains

The pipe materials and specifications for sanitary force-mains shall conform to the Construction Specifications.

5.3.1 Pipe Sizing Formula

For force-mains use Hazen-Williams formula:

$$Q = \frac{CD^{2.63}S^{0.54}}{0.00374}$$

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Where Q = Rate of flow in L/s
 D = Internal pipe diameter in m
 S = Slope of hydraulic grade line in m/m
 C = Friction coefficient
 = 120 for all pipes acceptable as sewage forcemains

5.3.2 **Velocity**

At the lowest pump delivery rate (ie. occurring at the pump cut-off level), a minimum velocity of 0.76 meters per second shall be maintained in the force-main. The maximum velocity occurring in the force-main shall not exceed 3.5 meters per second.

5.3.3 **Air Relief Valve Assembly**

An air relief valve assembly consisting of a saddle, brass nipples, Mueller Mark II Oriseal isolating valve and automatic sewage air relief valve housed in a manhole shall be placed at high points in the force-main to prevent air locking.

5.3.4 **Connection to Manhole**

Force-mains shall enter the receiving manhole at a point not greater than 450mm above the highest pipe crown in the manhole. The direction of the force-main shall not be adverse to the flow through the manhole.

5.3.5 **Size**

Minimum size of force-main shall be 100mm diameter.

STORM DRAINAGE SYSTEM

SECTION 6

6.1 General

The extent of the tributary drainage areas of the storm drainage system under design shall normally be in accordance with the natural contours of the land. However, it must be stressed that it is the Consultant Engineer's responsibility to confirm the extent of the drainage areas with the City Engineer prior to design, and to incorporate the designs for the minor and major flows into an ultimate overall coordinated drainage system.

Storm drainage systems shall be designed using either the conventional method or the storm water management concept as specified by the City Engineer in the tentative Subdivision Approval requirements.

6.1.1 Conventional Method

Design shall be based on the Rational Formula. This method is limited to the design of the Minor System for storms of 1 in 10 year return only.

6.1.2 Storm Water Management Concept

This method involves the employment of one of the Hydrograph Methods stated herein (see Item 6.3.1.2). Dependent upon the hydraulic capacity of the downstream drainage system, the design under this concept may require the provision of detention facilities to limit the peak runoff after development to that which occurred before development. Under this concept, the integrated design of both the Minor and Major systems are necessary.

6.2 Minor and Major Systems

The design of each new drainage under the Storm Water Management Concept System shall consist of the following components:

- (a) The Minor System shall consist of pipes, open channels and water courses which convey flows of a 5-year return frequency. The system shall include driveway culverts.
- (b) The Major System is the route followed by runoff waters when the capacity of Minor System is exceeded. It shall consist of surface flood paths, roadways and water courses which convey flows of a 100-year return frequency. The system shall include culverts crossing roadways.

6.3 Design Parameters

6.3.1 Design Flows

Design flows shall be computed using one or more of the following methods:

6.3.1.1 Rational Formula

$$Q = \frac{AIR}{360}$$

Where Q = Design flow in m³/s
A = Drainage area in ha
I = Rainfall intensity in mm/hr
R = Runoff coefficient (see Item 6.3.5)

The Rational Formula is applicable to small watersheds (approximately 8 ha or less) with drainage systems not including detention facilities.

6.3.1.2 Hydrograph Methods

Hydrograph methods are required for larger areas and for any drainage system including detention facilities. Acceptable calculation methods include the following:

(a) Manual Methods:

- i) Modified Rational Method
- ii) Soil Conservation Service Graphical Method

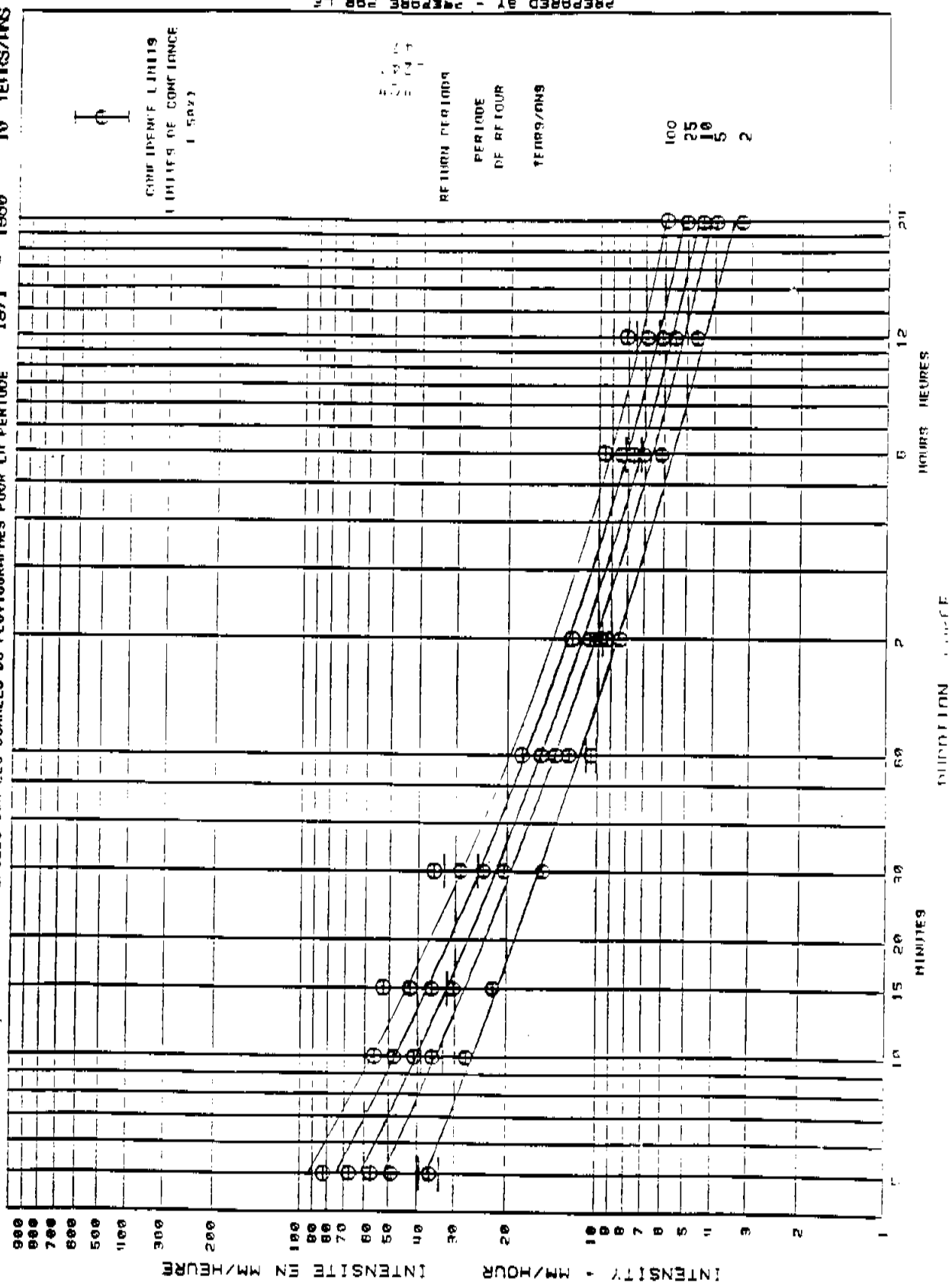
(b) Computer Modelling:

- i) University of Ottawa Storm Water Management Model (OTTSWMM)
- ii) Illinois Urban Drainage Area Simulator (ILLUDAS)
- iii) Other storm water management models which have been validated with actual rainfall-runoff measurements in surrounding municipalities.

6.3.2 Rainfall Intensity/Duration/Frequency (IDF) Curves

IDF Curves shown in Figure 6.3.2.1 shall be used for all calculations requiring such information. Additional rainfall data for the City of Port Coquitlam may be obtained from the Regional Office of Atmospheric Environment Service of Environment Canada.

RETENUE DE L'INTENSITE, LA DUREE ET LA FREQUENCE DES CHUTES
 BASED ON RECORDING RAIN GAUGE DATA FOR THE PERIOD-
 BASEES SUR LES DONNEES DU PLYVIOGRAPHES POUR LA PERIODE
 FORT COQUITLAM CITY YARD
 1971 - 1980 10 YEARS/ANS



6.3.3 Rainfall Return Frequency

The following return frequencies shall be used for design:

(a) **Minor Systems:**

- i) Conventional Design - 10-year return
- ii) Storm Water Management - 5-year return

(b) **Major Systems:** - 100-year return

6.3.4 Time of Concentration

Use the following formula:

Where: $T_C = T_I + T_F$
 T_C = Time of concentration for use as duration on IDF curve to get rainfall intensity.
 T_I = Inlet time (Minimum: 10 minutes)

For undeveloped areas, use Uplands Method to obtain T_I .

T_F = Flow time in channels and pipes based on Manning's Equation.

6.3.5 Runoff Coefficients (For Rational Formula)

Type of Area	Coefficient		
	<u>Low</u>	<u>High</u>	<u>Standard</u>
Low density housing	0.30	0.50	0.40
Medium density housing	0.55	0.65	0.60
High density housing	0.60	0.80	0.70
Park or golf course	0.15	0.25	0.20
Churches or schools	0.60	0.85	0.75
Roof or pavements	0.90	1.00	0.95
Grassland	0.15	0.30	0.20
Cultivated	0.30	0.50	0.40
Woodland	0.10	0.40	0.25

Low values are applicable to areas with high soil permeability and gentle slopes (5% or less).

High values are applicable to areas with low soil permeability and steeper slopes (greater than 5%).

Standard values are for general application.

6.3.6 Hydraulic Calculations

6.3.6.1 Storm Sewers and Open Channels

Use Manning's Formula:

$$Q = \frac{AR^{0.667}S^{0.5}}{n}$$

Where

Q	=	Design flow in m ³ /s
A	=	Cross sectional area in m ²
R	=	Hydraulic radius (Area/wetted Perimeter) in m
S	=	Slope of hydraulic grade line in m/m
n	=	Roughness coefficient
	=	0.013 for concrete pipe
	=	0.024 for corrugated steel pipe (unpaved)
	=	0.02 for gravel lined channels
	=	0.013 for concrete or asphalt lined channels
	=	0.05 for natural streams and grassed channels

6.3.6.2 Culverts

Use the applicable inlet control or outlet control methods referred to in the latest editions of:

- (a) Handbook of Steel Drainage and Highway Construction Products, by American Iron and Steel Institute.
- (b) Handbook of Concrete Culvert Pipe Hydraulics, by Portland Cement Association.

6.3.7 Velocity and Pipe Grade

Storm sewers minimum $V = 0.75$ m/s at half or full flow. The minimum pipe grades shall correspond to the minimum velocity. Steeper grades are desirable.

There are no maximum allowable velocities; however, where grades exceed 15%, the design engineer shall address sewer scour and anchoring problems and modify the sewer design to suit local conditions.

6.3.8 Minimum Depth of Cover

The minimum depth of cover shall be as follows:

- (a) Culverts across roads and driveways: minimum 0.3m provided that pipe has been designed to withstand deadload and H-20 highway loads complete with impact factor of 1.5.
- (b) Storm sewers shall not be of sufficient depth to:
 - i) Permit gravity service connections to adjoining properties.
 - ii) Properly service all of the tributary lands upstream of the future storm sewer extension point.
 - iii) Prevent damage from live surface loading. Normally the minimum depth to satisfy this criteria is 1.0m.

6.3.9 Minimum Pipe Diameter

(a)	Storm Sewers	250mm
(b)	Culverts	(i) crossing roads 450mm
		(ii) crossing driveways 300mm
(c)	Catch-basin Leads	150mm
(d)	Service Connections	100mm

6.3.10 Distance Between Manholes

<u>Pipe Size, mm</u>	<u>Maximum Distance, m</u>
375 and smaller	125
450 to 750	155
900 and larger	185

Manholes are also required at every pipe size change, every line or grade change which cannot be accommodated by the allowable radius of curvature and every intersecting sewer. The upper end of the storm sewer where further extension of the sewer is infeasible shall be terminated with a standard 1050mm benched manhole.

At manholes where future storm sewer extensions are likely, one pipe length shall be extended beyond the manhole with the end capped as stub for future tie-in.

6.3.11 Minimum Radius of Curvature

Minimum radius = 60m for pipes up to 600mm diameter. 22 1/2° mitres may be used for larger pipes.

Maximum joint deflection shall be as recommended by the pipe manufacturer.

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Only one vertical or one horizontal curve is permitted between manholes.

6.3.12 Hydraulic Losses in Manholes

The following criteria shall be used:

- (a) The crown of the downstream pipe shall not be higher than that of the upstream pipe.
- (b) Minimum drop in invert levels across manholes:
 - i) Straight run - no drop required
 - ii) Deflections up to 45° - 20mm drop
 - iii) Deflection 45° to 90° - 30mm drop
- (c) An outside drop pipe shall be installed when the drop between inverts exceeds 0.6m. See Standard Drawings.

6.3.13 Sewer Location

- (a) Service Connections: normally at 2.5m from low side of lot boundary.
- (b) Separation from water mains if possible:
 - i) Minimum 3.0m horizontally.
 - ii) Minimum 0.5m vertical clearance below water mains.
- (c) Sanitary sewers may be laid in a common trench with storm sewers. However, in these cases, the Consultant Engineer must make adequate checks to ensure that a minimum clearance of 0.4m is maintained between pipes and that conflicts do not exist at wye connections, manholes and utility crossings.

6.3.14 Service Connections

For new lots in a subdivision and for existing lots when the property owner gives his permission, the connection shall be extended 1.5 meters into the property. Elsewhere the service connection to existing properties will be terminated at the property line.

Where a concentration of ground water exists, storm connections to these areas (ie. other utility trenches) shall be provided.

All service connections shall enter the storm sewer between 2 and 10 o'clock position above the springline at the top of the pipe. Connections to new sewer shall be made using manufactured wye fittings. Connections to existing mains

shall be made using manufactured saddles. Single connections shall be permitted only.

6.3.15 Pipe Joints

All storm sewer pipe joints shall be installed without gaskets except where the pipe is installed in sandy or silty soil conditions. If soil conditions are in doubt, gaskets are to be specified on the Design Drawings.

6.3.16 Catch-basins

Catch-basins shall be provided at regular intervals along roadways, at intersections, and at low points.

Catch-basins shall be spaced to drain a maximum area of 500 m² on road grades up to 5% and 400 m² on steeper grades.

Catch-basin grates are to be set 13mm below the gutter line. The gutter and blacktop are to be shaped to form a dish around the grate.

6.3.17 Pipe Materials and Specifications

See Construction Specifications.

6.3.18 Structural Design

The structural design of storm sewer installations shall be in accordance with the latest addition of ASCE Manuals and Reports on Engineering Practice No. 37 – Design and Construction of Sanitary and Storm Sewers. Live loads on the sewer conduit shall include Highway H-20 loading and an impact factor of 1.5. The minimum Class of Bedding and the limit of the trench width at the top of the pipe shall be as shown on the Standard Drawings. In cases where more stringent construction requirements are necessary to achieve the required field supporting strength of the sewer conduit, the Consultant Engineer shall specify both the Class of Bedding and the maximum trench width at the top of the pipe on the Design Drawings.

6.3.19 Storm Connections and Drainage of Adjoining Properties

Every existing property that is passed in the extension of the storm sewer system shall be provided with a minimum of one storm sewer connection. In cases where several drain tiles outlet into an existing ditch from one property, these tiles shall be connected to the new storm sewer. Where there exists no storm drains or tiles from an adjoining property, the Consultant Engineer shall send a registered letter to the owner of each such property to ensure that the new connection is installed at a location acceptable to the owner. Copies of the correspondence shall be forwarded to the Engineering Department for record purposes.

The design elevation and depth of service connections at the property line for each property shall be specified on the Design Drawings. In selecting the invert of the service connections, the following must be taken into account:

- (a) Gravity connection to all known outlets is possible (where doubt exists regarding the depth of outlets, install the connections as deep as possible).
- (b) Drainage of all existing buildings is possible.
- (c) In servicing a property where no dwelling exists, the invert of the service connection shall be 1.5 meters lower than the average ground elevation at the 7.5 meter set back from the front property line unless topographic constraints make this depth impractical.

6.3.20 Service Connections Entering Manholes

Service connections entering manholes shall not be in an adverse direction to the flow in the sewer main.

6.3.21 Inlet and Outlet Structures

6.3.21.1 General

The Standard Drawing shall be used as a guide for designing inlet and outlet structures for storm sewers and culverts. Temporary inlet and outlet structures may be constructed of sand/cement mix bags provided that provincial and federal regulations are met. However, permanent structures shall be constructed of reinforced concrete.

6.3.21.2 Structural and Erosion Protection Design

The structural and erosion protection requirements for inlet and outlet structures shown on the Standard Drawings are the minimum requirements only. It is the Consultant Engineer's responsibility to verify that these minimum requirements are adequate for any proposed inlet and outlet structures shown on the Design Drawings. If more stringent requirements are necessary to meet the design operating conditions the Consultant Engineer shall provide complete details of the inlet and/or outlet structures on the Design Drawings.

6.3.21.3 Trash Screens and Safety Grillages

Trash screens and safety grillages as shown on the Standard Drawings shall be installed at inlets and outlets respectively for all storm sewer pipes over 450mm in diameter.

Special designs will be required for inlet and/or outlet structures which are different than those shown on the Standard Drawings.

6.3.21.4 Safety Handrails

Handrails as shown on the Standard Drawings shall be installed at inlets and outlets where the depth to the channel bottom exceeds 1.5m.

6.3.22 On Site Considerations

6.3.22.1 Site and Lot Grading

As part of the drainage system Design Drawings, the proposed site and lot grading plan for all developments shall be included. The grading plan shall show as a minimum the proposed elevations at intersections of property lines and the general direction of surface run-off within the site of the proposed development as well as the adjoining properties. In preparing the grading plan, the Consultant Engineer must ensure that adequate provisions are made to prevent the occurrence of drainage problems on adjoining properties. Normally, each lot should be graded to drain to the municipal storm drainage system, independent of adjacent lots where possible.

The grading plan shall also show the minimum habitable floor elevations on those properties located along a major flood route. The minimum habitable floor elevation thus shown must not be lower than the Major System Hydraulic Grade Line.

6.3.22.2 Foundation Drains

A gravity connection to the municipal storm drainage system may be made only where the habitable portion of a dwelling is above the Major System Hydraulic Grade Line. Otherwise, only a pumped connection will be permitted.

On side-slope developments double storm sewers may be required to permit a gravity connection to the lots located on the down slope side of the road.

6.3.22.3 Roof Drainage

- (a) Provided that a site is graded away from the building and such that surface water does not flow to adjacent lots, roof drainage may be discharged to the ground and dispersed via splash pads at the downspouts.

- (b) If site grading in accordance with (a) above is not possible, roof drainage shall be discharged into the municipal drainage system.
- (c) On flat roofs, controlled-flow roof drain devices may be installed to provide temporary storage and retard the discharge to the ground or storm sewer system.

6.3.23 Major System Design Considerations

6.3.23.1 Major Flow Routing

All overland flows shall have specifically designed flow routes located within municipal rights-of-way. The major flow routing shall normally be provided along roads and in natural water courses. In some cases (ie. at sags in roads) it may be necessary to route the major flow across country within a designated right-of-way.

When economical, the Consultant Engineer is urged to consider the enlargement of the pipes and culverts, which form a part of the Minor System to accommodate the major flow.

At intersections when the major flow route passes, care shall be taken to lower the intersection to allow flows to pass over the cross street. Where the major flow route turns at intersections, additional care in the intersection grading design is required.

In areas where normal major flow routes cannot be provided, the Minor System shall be increased in size to accommodate the major flows.

6.3.23.2 Stormwater Storage Alternatives

The basic requirements for the temporary storage of stormwater include the identification of a suitable location of defined area and volume, with a restricted outlet designed to maintain the discharge to the downstream drainage system at a pre-determined rate (usually the pre-development run-off rate for a 5 year return period).

The following are acceptable stormwater storage alternatives:

- (a) Roof storage with controlled outflow drain.
- (b) Parking Lot Ponding – paved parking lots can be used as storage in many areas. The allowable depth is a function of safety and convenience to users. Depths not exceeding 150mm are generally acceptable. Flow Control Chambers housing a relatively maintenance free flow control device complete with an

emergency release spillway shall be used in conjunction with this storage.

- (c) Dry Detention Basin – a detention basin will normally be designed as an off-stream facility. The basin shall have minimum freeboard of 0.3m and a maximum depth of 1.0m. The maximum side slope shall be 4 horizontal to 1 vertical. Flow Control Chambers as detailed in (b) above shall be used in conjunction with this storage.

6.3.24 Need for Perforated Drains

During his site investigations the Consultant Engineer is reminded that he must consider whether or not there will be a need for perforated drains to be installed behind the proposed curbs or sidewalks to intercept water. If there is a need, he shall clearly show this requirement on his Design Drawings. Should the Consultant Engineer fail to identify the need for such drains, the City Engineer may order such drains to be installed during the construction period or during the 1 year maintenance period thereafter should it become evident to him that such drains are required in order to protect the City's or the public's interests. The costs associated with the installation of such drains when ordered by the City Engineer shall be assumed by the Developer.

STREET LIGHTING SYSTEM

SECTION 7

7.1 General

For the design requirements of street lighting corresponding to the Road Classification and Land Use Zoning, refer to Schedule B, Table 1 of the City's Subdivision of Land Bylaw. Unless otherwise stated herein, the design of street light systems shall conform to the latest edition of the American National Standard – Practice for Roadway Lighting published by the Illuminating Engineering Society.

7.2 Materials and Construction Specifications

See Construction Specifications.

7.3 Light Sources

The source of light shall be high pressure sodium; 100 watt for Local and 150 watt for Collector and Arterial Roads.

7.4 Stubs for Future Extension

A stub for future extension shall be provided at all temporary terminal street light poles.

7.5 Pre-ducting for Future Servicing

In areas where road paving is required, provision shall be made for future extension of the power distribution system to the opposite side of the roadway by providing ducts and fish-wires across the roadway and terminating in a junction box before the roadway is paved.

7.6 Numbering of Street Lighting Poles

Prior to the preparation of Design Drawings for the Street Lighting System, the Consulting Engineer shall contact the City's Engineering Department to obtain the correct numbering of each Street Lighting Pole to be installed. Such numbering shall be clearly indicated on the Design Drawings.

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TO
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BYLAW NO. 2241

CONSTRUCTION SPECIFICATIONS

CONSTRUCTION SPECIFICATIONS

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CONSTRUCTION SPECIFICATIONS

Common

SECTION 1

1.1 General

1.1.1 Interpretation

In these specifications, where the word “Developer” is used it shall mean the Applicant for subdivision and shall include any contractor or person acting on his behalf for the provision of the works required under Part IV of the Subdivision Bylaw.

1.1.2 Design Criteria

The Developer shall be responsible for provision of design and engineered drawings of the works required under this Subdivision Bylaw in accordance with the design criteria set out in Schedule C of this Bylaw. Compliance with the design criteria shall be certified on the construction drawings by the seal and signature of a competent Professional Engineer registered in the Province of BC.

1.1.3 Drawings

All work to be constructed under these Construction Specifications shall be constructed in accordance with Design Drawings prepared by a competent Professional Engineer.

No construction shall take place until such drawings have been issued for construction by the City Engineer. The issue of such drawings for construction in no way constitutes Subdivision Approval.

Where there is a conflict between the Design Drawings and these Construction Specifications or Standard Drawings, the Design Drawings shall take precedence.

The Developer shall check all drawings carefully and advise the City Engineer of any errors or omissions immediately upon discovery.

1.1.4 Lines, Grades and Datum

All work shall be constructed to the lines and grades given on the Design Drawings as “Issued for Construction” by the City Engineer.

Elevations shown on the Design Drawings are referred to Geodetic Datum as the plane of zero elevation. Prior to the commencement of the installation of services the Developer shall employ a B.C.L.S. or registered BC Professional Engineer to

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set permanent type bench marks to Geodetic Datum at a maximum spacing of two hundred (200) meters within the subdivision. The maintenance of these bench marks will be the responsibility of the Developer until the end of the one year maintenance period.

1.1.5 Existing Monuments, Benchmarks, Pins and Stakes

Existing survey monuments, property stakes and pins, and benchmarks shall be fully protected and preserved. If they are damaged or disturbed by the Developer he shall, unless the City Engineer has declared the monument or benchmark to be redundant, bear all costs (including any fees payable to BC Land Surveyors) incurred in re-establishing them.

1.1.6 Schedule

Before commencement of the works the Developer shall make arrangements with the City to hold a pre-construction meeting at the site with an Engineering Inspector of the City. At this time, the Developer shall submit a construction schedule satisfactory to the City Engineer showing the completion dates of the various parts of the work. While some variation of this construction schedule necessitated by unforeseen conditions or circumstances is acceptable, the average rate of progress of each portion of work shall be maintained in close conformity with the schedule.

1.1.7 Testing of Completed Works and Materials

Should doubts arise with respect to whether or not the completed works and/or services meet the Design Criteria or Construction Specifications of this Bylaw, the City Engineer may order that Quality Assurance Tests be carried out by an independent Consulting Engineering Firm. The costs of such test(s) shall be paid by the Developer in the event that the test results fail to meet the Design Criteria or Construction Specifications. Otherwise, the costs of such test(s) will be paid by the City.

The Developer shall also supply representative samples of materials as and when requested by the City Engineer for the purpose of testing, at no cost to the City.

1.1.8 Personnel and Equipment for Measurement, Inspection and Testing

The Developer shall provide at his own expense, a competent labourer and whatever equipment is required by the City Engineer in connection with the survey, measurements, checking, inspections and testing of the works. This labourer shall be made available upon request during normal working hours.

1.1.9 Services for Developers' Plant and Equipment

The Developer shall be responsible for the supply, maintenance and removal of whatever electric, telephone, water or disposal facilities he requires for his plant and/or equipment for either domestic or construction purposes.

1.1.10 Progress of Work

The Developer shall perform his work on each section of sewer main, watermain, roadway, sidewalk and curb and gutter continuously until completion.

For sanitary and storm sewer mains, the term "section" shall mean that portion of work from manhole to manhole inclusive.

For watermain, the term "section" shall mean that portion of work between any adjacent line valves.

For roadway, sidewalk, curb and gutter, the term "section" shall mean that portion of work between intersections.

1.1.11 Inspection

During installation and construction, the Developer shall call for periodic inspection of the work at the following minimum stages and more frequently if deemed necessary by the City Engineer:

- (a) Prior to covering of each underground utility and service connection.
- (b) At the completion of subgrade preparation.
- (c) At the completion of base compaction.
- (d) Prior to curbing and sidewalk construction.
- (e) Prior to paving.

1.1.12 Hours of Work

Unless otherwise approved by the City Engineer, the Developer shall not execute any work requiring the City's inspection outside the normal working hours of the City's Engineering Inspectors.

1.1.13 Testing

Unless otherwise authorized by the City Engineer, testing of all newly constructed water, sewer or storm sewer mains shall be completed prior to connection to any existing City mains.

Testing of mains and service connections to the property line shall be done after roadbase construction.

1.1.14 Corrective Action by City

In the case of any situation created by the Developer's work where delay could cause potential safety hazards to the public or property damage, corrective actions may be taken by the City without notice being sent to the Developer, and all expenses in connection therewith shall be charged to the Developer.

1.1.15 Clean-up

(a) Initial Clean-up

The Developer shall at all times conduct the work in an orderly and tidy manner and shall remove any accumulation of rubbish or other materials as the work progresses.

(b) Final Clean-up

Upon completion and before final acceptance of the work, the Developer shall remove or otherwise dispose of all rubbish, surplus or discarded material, falsework, forms, temporary structures and all his equipment and machinery, and shall leave the work in a clean and tidy condition.

(c) Final Surface Restoration

All existing signs and posts, curbing, sidewalks, drainage ditches and culverts, shrubs, fences and other surface features that have been removed, damaged or disturbed by the construction process shall be restored or replaced by the Developer to a condition equivalent or better to that which existed before the work began.

Existing signs and posts so removed, damaged or disturbed shall be reinstated immediately.

Other restoration shall be completed no later than twenty (20) working days following the completion of construction. If the restoration is not completed within this time, the City reserves the right to complete the restoration and charge the cost of such work to the Developer.

1.1.16 Acceptance of Works and Services

No works and/or services will be accepted by the City until the installation of all required works and services have been satisfactorily constructed in accordance with the Design Drawings and Construction Specifications. The Developer will

continue to be fully responsible for the condition of works and services until such time that they are accepted by the City. Such acceptance, shall be signified by the issuance of an "Acceptance Certificate" by the City Engineer.

1.1.17 Public Safety and Avoidance of Damage to Property

The Developer shall comply with all the requirements of the *Workers' Compensation Act* of the Province. The Developer shall take all reasonable steps and precautions to eliminate injury to persons and to avoid or minimize damage to property, completed and partly completed works. This would include the provision and erection of suitable barricades, safety fences, warning signs, lighting, watchmen, etc. The Developer shall ensure that all work done shall be done in a manner that will avoid damage to adjacent property. Should the occasion arise, the Developer shall with all due dispatch discharge his obligations in respect of any injury or damage for which he is liable.

1.1.18 Damage to Existing Works and Services

Existing works and services which are damaged by the Developer as a result of his own operations or those of his workmen, agents or subcontractors shall be reinstated by the City at the cost of the Developer unless otherwise approved by the City Engineer. The work of reinstating shall include not only the reinstatement of that portion of the works and/or services that are damaged, but also the supply and installation of new materials where the existing material is deemed unsuitable for re-use by the City Engineer, retesting of the service, rechlorination, etc., and any other work that requires to be done in the opinion of the City Engineer, for the satisfactory reinstatement of the works and/or services so damaged.

1.1.19 Supply of Materials

- (a) All materials required for the works, shall be supplied by the Developer and shall conform with these Construction Specifications.

The Developer shall notify the City Engineer of the source or sources of materials to be supplied. Such notifications shall be given sufficiently far in advance of delivery to enable the City Engineer to make inspection of the materials at the source.

- (b) Any materials which do not conform to the requirements of these Construction Specifications, or are unsuitable for the purposes for which they are intended shall be rejected. Rejected materials shall not be incorporated into the required works and/or services and shall be replaced by the Developer at his own expense with materials meeting these Construction Specifications.

1.1.20 Responsibility for and Storage of Materials

The Developer shall be responsible for all materials and shall safely store same until the materials are incorporated in the works and/or services.

The Developer shall not unreasonably encumber the site with his materials or equipment at any time.

1.1.21 Faulty Work

Any works or services not constructed in accordance with the Design Drawings or these Construction Specifications will not be accepted. Also, if there is evidence of any fault, defect or damage from any cause whatever, which may prejudicially affect the strength, durability or appearance of any section of the works and/or services, the Developer shall, at his own expense, satisfactorily correct such faults, defects or damage. The City Engineer may require that all or a portion of said section of the works and/or services be removed and subsequently reconstructed in accordance with the Design Drawings and these Construction Specifications.

1.1.22 Latent Defects Appearing During One-Year Maintenance Period

Any latent defects appearing from the time that all works and services are accepted by the City to one year thereafter shall be corrected to conform to the Design Drawings and these Construction Specifications. To this end, the City Engineer may require that all or a portion of these works and/or services showing signs of latent defects be removed and subsequently reconstructed to his satisfaction.

1.1.23 Design Errors and/or Omissions

By reviewing the Design Drawings for general conformance with City requirements and issuing these Drawings for construction, the City has neither certified that the design of the works and/or services are correct nor accepted in whole or in part the responsibility for the proper design of the works and/or services. The Professional Engineer preparing the Design Drawings is fully responsible for his work.

Any design errors and/or omissions found during construction of the works and/or services shall be rectified at the cost of the Developer.

1.1.24 Weather Conditions

The City Engineer may decide that adverse weather conditions do not permit certain portions of the work to be completed within the true meaning and intent of the Construction Specifications and the Design Drawings and he may order the Developer to discontinue work on these portions of the work. The Developer

shall comply with such order and shall stop work on those portions of the work and shall not continue work on those portions until he has received permission from the City Engineer to proceed. It shall be clearly understood that the Developer shall have no claim whatsoever against the City for any delays due to stoppage of work by the City Engineer due to adverse weather conditions.

1.1.25 Accuracy of Setting-out and Positioning

- (a) The survey for setting-out and positioning of the works shall be carried out with accuracy and every care shall be taken to avoid accumulative errors.
- (b) The maximum permissible errors in the constructed portion of the principal structures and pipes are given in Table 1.1.25 of this Section. The Developer should note that all portions of the works and services must be set out and positioned to comply with these permissible error limits. If, due to any act or default on the part of the Developer, the structures and pipes are not constructed within the limits of the specified permissible errors, then the Developer shall, at his own expense, reconstruct or otherwise bear the cost of such remedial or extra work required to bring the completed works and services to within these permissible error limits.

1.1.26 Access to Properties

Unless alternate arrangements satisfactory to those adversely affected have been made by the Developer, pedestrian and vehicular access to properties shall be maintained at all times.

1.1.27 Supply of Water for Flushing and Testing

The normal supply of water is from the nearest fire hydrant to the construction site. Before operating any fire hydrant the Developer shall:

- (a) Obtain written permission from the City's Fire Department.
- (b) Keep such written authorization at the construction site as proof that such permission has been obtained.
- (c) Give the City Engineer minimum 24 hours prior notice of the times and dates when the use of such hydrants will take place.

Any fire hydrants so used shall not be opened and closed by the Developer without the supervision of the City's Engineering Inspector.

TABLE 1.1.25 – PERMISSIBLE ERRORS

TYPE OF CONSTRUCTION	MAX. VERTICAL VARIATION FROM DESIGN ELEV.	MAX. HORIZONTAL VARIATION FROM DESIGN ALIGNMENT	STRAIGHTNESS (measured with a 3m straight edge)
WATER MAIN	50mm	100mm	Unless the pipes are laid on a curve as designed no point shall deviate more than 6mm from a straight line as measured with a 3m straight edge (excluding any bell or joint).
SANITARY SEWER MAIN	10mm	100mm	Same as for Watermain
STORM SEWER	20mm	100mm	Max. Deviation 15mm
ALL SERVICE CONNECTIONS AND CATCH-BASIN LEADS	50mm	100mm	N/A
ALL MANHOLES AND CATCH-BASIN RIMS	13mm	25mm	N/A
WALK/CURB & GUTTER	10mm	25mm	Max. Deviation 6mm
TRAFFIC LIGHT OR ST. LIGHT STANDARDS	10mm	25mm	The centerline of the shaft portion of the pole shall not deviate more than 10mm in any direction from a plumb vertical line.
ELECTRICAL CONDUITS	25mm	25mm	Max. Deviation 75mm
ASPHALT PAVEMENTS	20mm (provided this does not result in drainage problems)	25mm	6mm

1.2 Construction

1.2.1 Equipment

All equipment used and methods employed in the carrying out of the work shall be subject to the approval of the City Engineer. Machines with steel tracks, cleats, lugs, flat steel pads, grousers or other gripping devices which may cause damage to any roadworks will not be allowed on asphaltic pavements, curbs or sidewalks at any time. Care must be taken where heavy rubbered tired units are turning so that no damage occurs to the pavement.

1.2.2 Proving of Existing Utilities

At the commencement of construction, the Developer shall test dig and prove the existing underground utilities to confirm the assumed line and elevation. This is particularly important for proposed tie-in and crossing points. Should discrepancies between the findings of these test digs and the Design Drawings occur, the Developer shall notify the City Engineer immediately and cease construction pending the revisions to the Design Drawings and further instructions to proceed by the City Engineer.

Should discrepancies arise due to neglect on the part of the Developer to prove existing utilities, the Developer shall, at his cost, modify the utilities constructed by him in a manner satisfactory to the City Engineer. This may involve the removal and subsequent reconstruction and retesting of the utilities.

1.2.3 Clearing and Grubbing of Rights-of-Way

- (a) Where full width road construction is proposed:

Unless otherwise shown on the Design Drawings or instructed by the City Engineer, the entire road right-of-way width shall be cleared and grubbed of all brush, trees, vines, roots, stumps, organic materials and other items which may subsequently cause settlements to occur, obstructions to visibility, damage to underground utilities, or other problems. Such brush, trees, vines, roots, stumps, organic materials and other items shall be stockpiled off the road right-of-way and then disposed of in a manner approved by the City Engineer. Topsoil, turf and other excavated fill material may be graded out over the Developer's lots outside of the road allowance provided that the final elevations of these lots are not in variance with the Design Lot Grading Plan.

- (b) Where partial road construction is proposed:

All the provisions of sub-paragraph 1.1.19(a) apply but only to half of the right-of-way on the same side as where the partial road construction is proposed.

- (c) Where utilities are constructed within utility rights-of-way:

A strip shall be cleared and grubbed to sufficient width to permit proper access of plants and equipment, excavation of the trench, installation of the utilities and to accommodate the excavated material suitable to be re-used as backfill. Stumps which lie within the utility right-of-way shall be completely removed together with their roots. All brush, trees, vines, roots, stumps, and other unsightly material shall be removed from the utility right-of-way and then disposed of in a manner approved by the City Engineer. Final surface restoration shall consist of the minimum of grading to permit positive drainage and seeding.

The Developer is reminded that the “City of Port Coquitlam Fire Prevention Bylaw, 1968, No. 902” as amended applies to all land clearing operations and outdoor fires in the connection therewith and if the special written permit referred to in Section 4 of that Bylaw is not issued, for any reason whatsoever, no outdoor fires shall be set and no material shall be burned upon the land being cleared.

1.2.4 Disposal of Surplus Materials

Surplus spoil resulting from the excavation of roads, trenches, etc. and not used for backfilling shall be disposed of in a manner approved by the City Engineer.

1.2.5 Setting Out

The setting of all line and grade stakes necessary for setting out the work will be the responsibility of the Developer. These stakes may be checked by the City Engineer or his duly authorized agents or representatives at any time and any such checks made shall in no way relieve the Developer of the responsibility of the final installation of services to the horizontal and vertical alignment as shown on the Design Drawings.

If batter boards are used to transfer grades from the reference grade stakes, there shall be a minimum of three batter boards in place at any one time. Batter boards shall be a minimum length of 0.5 meters and supported firmly at both ends. Batter boards used to transfer a grade to a pipe at the bottom of a trench shall be placed in such a way as to straddle the trench and sightings shall be taken from a position vertically in line with the pipe.

A LASER unit may be used in place of batter boards.

If, as a result of conditions encountered during the construction of the works and/or services, it becomes necessary to change the alignment or grade, the City reserves the right to make such changes as are considered necessary or desirable.

1.2.6 Crossing Existing Roads

Where it is necessary to trench along or across a paved surface the pavement will first be cut by hand or mechanical means in straight lines parallel to the trench centerline. The total cut width of pavement is not to be greater than that which is necessary for trench excavation under existing conditions and shall not in any case exceed the specified maximum trench width at ground surface as shown on Standard Drawing 102. The Developer shall dispose of pavement that has been cut out to permit trenching. The road pavement shall be reinstated immediately after backfilling with a cold patch to continuously provide for a smooth running surface until all settlement has taken place. The Developer shall finally reinstate the road pavement with hot mix asphalt cement meeting these Construction Specifications when all settlement has taken place and not before one (1) month after the cold patch has been installed.

1.2.7 Blasting

Blasting will be permitted only after securing a Blasting Permit in accordance with City Bylaw No. 17 as amended and permission from the City Engineer. Any damage caused by blasting shall be repaired by the Developer at his expense. The method and procedure employed for blasting shall be in accordance with Provincial and Municipal regulations. The Developer shall not do any blasting without first obtaining adequate insurance to cover any loss of life or damage to properties that may result from this work. The City Engineer in giving permission for blasting, does not in any way assume responsibility for injury, loss of life or damage that results therefrom, and such consent shall not be construed as approval of the methods employed by the Developer in blasting; the sole responsibility therefore being that of the Developer.

1.2.8 Dewatering and Drainage

- (a) The Developer shall bear all costs in connection with the effective dewatering of excavations and all other pumping and drainage necessary for the proper construction of the works, including keeping the pipes, structures and trenches free of undesirable accumulations of ground water, surface water or rain water.
- (b) The Developer shall exercise caution to make sure that foundation problems with existing structures and proposed works do not result from his selected methods of dewatering excavations. Discharge from trench pumps, well points, etc. shall be located and controlled in such a manner as not to cause loss or damage, nuisance on roads or walks, or injury to the public.
- (c) Existing culverts, flumes and other structural drainage facilities are classified as existing structures and as such shall be protected and supported as specified for existing structures and as follows:

Existing culverts, enclosed drains, flumes and ditches and other drainage structures affected by the work shall be kept clear of excavated material at all times during construction. When it is necessary to temporarily remove an existing drainage structure, the Developer shall provide suitable temporary ditches or other approved means of handling the drainage during construction. Culverts and drain pipes shall be replaced at the time of trench backfilling and shall be adequately supported with compacted granular bedding and replaced in a condition which is at least equal to that which existed prior to the commencement of construction.

- (d) If well pointing is used to dewater excavations, pumping shall be continued until backfilling operations have been completed. Thereafter, pumping shall be gradually stopped for the portions backfilled to allow a gradual rise in the water table level.
- (e) The Developer is warned that certain pipe and structures are subject to flotation until backfilling and construction is completed. The Developer shall take all possible steps to ensure that excavations are continuously dewatered and that all possible precautions necessary to prevent flotation of any pipe or structure are taken.

1.2.9 Excavations

The trenches and pits shall be excavated to the required depths, alignments and grades as shown on the Design Drawings. Wherever and whenever necessary for the safety of men working in the excavation or for the proper and efficient construction of the work, the Developer shall employ either singly or in combination adequate and proper means of shoring, bracing and sheeting of the excavations and of de-watering them. Unless otherwise specifically shown on the Design Drawings issued for construction by the City Engineer or approved by the City Engineer during construction, the Developer, in carrying out excavation operations, shall adhere to the following:

1.2.9.1 Width of Excavations

The width of excavations at the bottom shall be sufficient to allow the pipes to be readily and properly laid and jointed or the structures in the excavation to be properly constructed. The width of excavation at the top shall be kept to the minimum consistent with the depth of bury and natural angle of repose of the material. The width of all pipe trenches measured at the top of the pipe shall not exceed the dimensions shown on Standard Drawing 102. In the event that this criteria must be exceeded, the Consulting Engineer must be contacted immediately by the Developer for the purpose of assessing whether or not the field support strength of the completed utility is adequate for the assumed design loads. The City Engineer may require a written certification from

the Consulting Engineer confirming that the field support strength is indeed adequate before accepting the completed utility services.

1.2.9.2 Braced and Sheeted Excavations

Trenches shall be sheeted and braced as required by the *Workers' Compensation Act* and as may be necessary to protect life, property, and structures adjacent to the work, or to maintain trench widths within the specified limits. Trenchwall sheeting and bracing shall be located no closer than 150mm to the widest section of any installed pipe.

Vertical trench timber or sheeting shall, whenever possible, be placed so that it does not extend below the springline of the pipe being installed. When it is necessary to place sheeting or timber below the pipe springline, as in the case of overexcavation for trench bottom stabilization, the sheeting shall be raised in 600mm lifts and all backfill placed below the level of the pipe springline shall be thoroughly compacted to 95% Modified Proctor Density to fill the voids left by the raised sheeting on each lift.

Trench sheeting and bracing may be removed where its removal will not result in damage to adjacent structures, otherwise it shall be left in place. When sheeting and bracing is left in place it shall be cut so that no sheeting remains closer than one meter to the finished ground surface.

1.2.9.3 Trenching by Machine or By Hand

The use of trench excavation machinery will be permitted except where its operations will cause damage to trees, buildings, or other existing structures above or below ground. At such locations hand methods shall be employed to avoid such damage.

1.2.9.4 Manner of Piling Excavated Material

All excavated material shall be piled in a manner that will not endanger the work and will avoid obstructing roads, surface drainage ditches, sidewalks, driveways and access routes. Gutters, ditches and culverts shall be kept unobstructed unless other provisions satisfactory to the City Engineer are made for street or land drainage.

Hydrants under pressure, valve pit covers, valve boxes, curb stop boxes, postal boxes or other utility controls shall be unobstructed and accessible during the construction period at all times.

1.2.9.5 Limitation of Open Trench

Trenches shall be excavated only as far in advance of the pipe laying operation as safety, traffic and weather conditions permit and, in no case, shall the excavation exceed 50 meters. Before stopping work on the last day of work before each weekend or holiday, the contractor shall completely backfill every trench.

1.2.9.6 Excess Excavation Below Grade

If any excavation is inadvertently taken out to a greater depth than shown on Standard Drawing 102 or additional excavation is required to remove soft material unfit to support pipes or other structures, the Developer shall at his own cost refill such excess excavations with granular material thoroughly compacted to 95% Modified Proctor Density.

1.2.10 Preparation of Trench Bottom, Bedding, Cushion and Backfill Procedures

For definition of various terms in this section, refer to Standard Drawing No. 102 and Section 1.3.4(e) Granular and Fill Material Designations.

Trenches for all pipes shall be excavated to provide for the installation of the pipes at the elevations shown on the Design Drawings and in accordance with the typical trench cross sections as shown on Standard Drawing No. 102. Where rock is encountered in the trench, it shall be removed to a minimum of 150mm behind the walls and bottoms of the trench cross-section. When the bottom of the excavated trench at subgrade is unstable and cannot support the pipe or backfill uniformly, the Developer shall, at his cost, overexcavate into the subgrade, remove and dispose of all unstable material and refill the overexcavated void with granular material compacted to 95% Modified Proctor Density. In instances where overexcavation becomes impractical, the Developer shall immediately contact his Consultant Engineer for the purpose of assessing the trench subgrade conditions and subsequently prepare an alternate design to provide uniform support for the pipe or backfill. This alternate design is subject to the acceptance of the City Engineer.

Once the trench subgrade is satisfactorily prepared granular bedding as specified shall be spread across the full width of the bottom of the trench prior to pipe laying to a minimum depth of 100mm (Note: this layer of bedding material below the pipe may be omitted only for ductile iron pipe provided that hardpan or rock is not encountered in the trench bottom). The bedding shall then be carefully raked or screeded to the correct grade below the design elevations of the pipe invert. Before the final raking or screeding, it shall be tamped by either mechanical or hand means to a compaction of not less than 95% Modified Proctor Density.

Prior to the final placement of the pipe, bell or couling holes shall be dug such that the full barrel of the pipe is supported along its entire length by the bedding layer below the pipe. After the pipe is laid, granular bedding shall be placed on both sides of the pipe to the level of the springline. This bedding material shall be compacted either by mechanical or hand means in layers not exceeding 150mm and to a density not less than 95% Modified Proctor.

Above the compacted bedding material a pipe cushion layer consisting of select native backfill material as specified if the pipe is installed in the boulevard, or granular bedding material as specified if the pipe is installed within any traveled portion of the ultimate roadway (including driveways and shoulders), shall be placed to a level not less than 300mm above the top of the pipe.

If the pipe is installed within the roadway, the pipe cushion material shall be placed in lifts not greater than 300mm and carefully compacted by hand tamping to a minimum density of 80% Modified Proctor.

After the placement of the pipe cushion layer, the remainder of the trench may then be backfilled with native material if located in the boulevard. If the pipe is installed within any traveled portion of the ultimate roadway, the trench shall be backfilled with granular backfill as specified to the level of the road sub-base prior to the road pavement structure construction. The granular backfill shall be placed in lifts not greater than 375mm and compacted with mechanical tampers to a minimum density of 95% Modified Proctor.

1.2.11 Installation of Utility Pipes

Unless otherwise specified in the Design Drawings or these Construction Specifications and Standard Drawings, all sanitary and storm sewer pipes, water pipes, electrical conduits, manholes, inspection chambers, catch-basins, and other utility service appurtenances shall be stored, handled, and installed in accordance with the Manufacturer's Specifications and Instructions. Special requirements which the Developer must adhere to are as follows:

- (a) All pipes and joint materials shall be kept clean as far as practical before, during and after pipe laying.
- (b) When pipe laying is not in progress, the open ends of all pipes shall be kept sealed to prevent the entrance of trench water and foreign matter into the pipe.
- (c) The Developer shall not drain trench water through the completed or partly completed portions of the utility system without authorization from the City Engineer.
- (d) During the course of storm and sanitary sewer installations, factory manufactured wyes shall be provided for all service connections and

catch-basin leads. It is the responsibility of the Developer to record the chainage of these wyess.

- (e) When installing service connections or catch-basin leads into the sanitary or storm sewer, a forty-five degree long radius bend shall be inserted into the factory manufactured wye at the main before the remainder of the service connection or lead is installed. The service connections shall terminate in a removable cap or plug such that infiltration or exfiltration will not occur.
- (f) The ends of the service connections at the property line shall be identified by a colour coded piece of 50 x 100mm wood extending from the ends of the connection to a minimum height of 600mm above the surrounding ground elevation as follows:

Water	--	Blue
Sanitary	--	Red
Storm	--	Green

The length of the 50 x 100mm stake shall be clearly indicated near the top of the stake.

- (g) For sanitary and storm sewer connections, approximately 0.3 meters of the pipe ends shall be painted red and green enamels respectively for further identification.

1.2.12 Concrete Encasement

Concrete encasement of pipe shall be installed as shown on Standard Drawing 103. Backfill material shall not be placed until the concrete has taken its initial set and in no case less than one hour.

1.2.13 Carrier Pipe

The installation of carrier pipes shall be as shown on the Design Drawings. The utility pipe inside the carrier pipe shall be blocked to ensure that the design line and grade is maintained. Wooden skids used for pushing the utility pipe inside the carrier may be used for this purpose. Once the utility pipe is laid to design line and grade, the annular space between the utility and carrier pipes shall be completely filled with fine sand. The ends of the carrier pipe shall then be sealed with sandbags.

1.2.14 Manholes

(a) **General**

Manholes shall be constructed as shown on the Standard Drawings with such construction proceeding concurrently with the laying of the pipe.

(b) **Base Slabs**

All water shall be removed from the excavations prior to placing concrete for the base slab. The base slab shall be supported with a 150mm of 25mm gravel compacted to 95% Modified Proctor Density. If the material in the bottom of the trench is unsuitable for support, the bottom shall be over excavated to firm base and backfilled to the required grade with 25mm gravel compacted to 95% Modified Proctor Density. The base shall be constructed such that the first section of the precast ring can be set plumb.

(c) **Inlets and Outlets**

Flexible joints exterior to the manhole shall be provided on all pipes entering and leaving manholes as shown on the Standard Drawings. For Polyvinyl Chloride and Polyethylene sewer pipes, a factory supplied “manhole adapter ring” shall also be used to connect these pipes to the manhole walls.

Invert elevations of the outlet and all inlets shall be set at the elevations and grades as specified on the drawings with tolerances as specified for pipe laying. The Developer shall carefully check the invert levels of all pipes in the manhole before and after the placing of concrete around the pipes and subsequently, any variation from the specified elevation or grade shall be corrected by the Developer.

Inlets shall be installed as shown on the drawings. Capped inlets or stubs shall be sealed to prevent the entrance of silt and other foreign material into the manhole and properly braced to withstand the hydrostatic head for testing of the sewers.

(d) **Benching of Manhole Inverts**

The inverts of the channel shall be formed to a half round shape so that the bases of the channels suit the sizes of sewers entering and leaving the manhole. The material used for benching and finishing shall be mortar as specified. The channel walls above the pipe center line shall be carried upwards as close to vertical as possible and then rounded at the level of the crown of the pipe. The channel inverts shall be sloped to match the inverts of the sewers entering and leaving the manhole. Where sewers

enter or leave the manhole at an angle to the main sewer or where the main sewer flow changes direction at the manhole the channels shall be rounded and curved towards the direction of the main sewer pipe leaving the manhole. Channels joining sewers of different sizes shall be gradually tapered throughout their lengths. All channeling and benching shall have a smooth finish obtained by steel troweling. Any channeling or benching that lacks neatness and acceptable workmanship qualities shall be rejected.

(e) **Precast Manhole Riser Sections**

Manhole riser sections shall be set plumb with joints sealed with factory supplied rubber rings or mortar to prevent the infiltration of ground water.

(f) **Manhole Frames and Covers**

The cast iron frame and cover shall be installed by the Developer upon a collar consisting of a minimum of one, or a maximum of three precast concrete spacer rings to bring the manhole cover to the final road grade. All spaces between the spacer rings shall be filled with mortar. The mortared joints shall be raked and pointed. The top of the frames shall be set to the finished grade elevations shown on the Design Drawing and in cases where a second lift of asphalt concrete is to be placed, the manhole frame shall initially be set to match the top elevation of the first lift and subsequently be raised to the finished elevation when the second lift is laid. If the top of the manhole frame and cover are to be set on a slope then the slope shall correspond to the slope of the adjacent finished pavement or boulevard grade as per design.

(g) **Control of Debris in Manholes**

All grout and concrete which falls into the finished channeling and benching shall be promptly removed before it has hardened to avoid indentations or projections which would affect the sewerage flow and/or cause solid matter carried by the sewerage to be arrested. All debris entering manholes shall be promptly removed.

1.3 **Materials**

1.3.1 **General**

All materials incorporated into the work shall conform to these Construction Specifications and when referenced to in these specifications conform to the latest edition of the specifications or standards published by the following organizations:

ASTM	-	American Society for Testing Materials
AWWA	-	American Water Works Association

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AASHO	-	American Association of State Highway Officials
CSA	-	Canadian Standards Association
ACI	-	American Concrete Institute
ASA	-	American Standards Association

The specifications and standard published by the above organizations and other specified specifications and standards regarding materials, and acceptance or rejection are hereby made part of these specifications as far as they are applicable to and not inconsistent with these Construction Specifications.

Materials incorporated in the work and not specifically covered in these Specifications shall be of high quality and acceptable to the City Engineer. Unless otherwise specified, all materials shall be new.

1.3.2 Concrete Materials

(a) Concrete General

All concrete constituents and construction methods including mixing and delivery shall meet CSA CAN3-A23-I-M77 standards and conform to the following requirements:

(i) Water

The water used in mixing or curing concrete shall be clean and free from salt, oil, acids, alkalis, and organic or other deleterious substances.

(ii) Aggregates

The size and distribution of aggregates shall meet CSA Standard A23.2-M2A.

(iii) Admixture

No admixture, other than an air-entraining agent, will be permitted except on the written authority of the City Engineer. All concrete shall be air entrained. Air content shall range between 5% and 8% of total volume.

(b) 30 MPa Concrete

Shall be ready mixed concrete with a minimum 28 day compressive strength of 30 MPa. The minimum cement content shall be 380 kg per cubic meter of concrete. The maximum aggregate size shall be 20mm.

(c) **25 MPa Concrete**

Shall be ready mixed concrete with a minimum 28 day compressive strength of 25 MPa. The minimum cement content shall be 340 kg per cubic meter of concrete. The maximum aggregate size shall be 20mm.

(d) **20 MPa Concrete**

Shall be ready mixed concrete with a minimum 28 day compressive strength of 20 MPa. The minimum cement content shall be 270 kg per cubic meter of concrete. The maximum aggregate size shall be 40mm.

(e) **Concrete Testing**

The City Engineer MAY require testing of the concrete by a qualified independent testing laboratory at the Developer's cost to ensure that it meets the appropriate specifications stated herein. When concrete tests are ordered, field cured specimens consisting of two separate samples in standard test cylinders shall be provided by the Developer for each 100 cubic meters of concrete placed, but not less than one set of specimens for each day's work. For miscellaneous work involving small pours approximately one set of specimens shall be provided for each 10 cubic meters of concrete poured. Testing procedures shall conform to CSA Standard CAN3-A23.2-M77 Methods of Test for Concrete.

(f) **Mortar**

Shall comply with CSA Standard A8-M.

(g) **Reinforcing Steel**

Reinforcing steel shall be deformed, intermediate grade, as specified in CSA G.30.1. The detailing of reinforcing shall conform to the ACI Manual 315.

(h) **Form Release Compound**

Shall consist of an approved non-staining mineral oil or other liquid designed to prevent sticking of concrete to forms.

(i) **Curing Compound**

Shall conform to ASTM Designation C309 and must contain fugitive dye.

1.3.3 Asphalt Materials

(a) Asphalt Cement

Shall conform to the following specifications:

	CHARACTERISTICS	ACCEPTABLE VALUES	ASTM TEST METHOD
(i)	Penetration @ 25° C (100 g, 5 sec)	85-100 deci-mm	D5
(ii)	Viscosity @ 135° C	Min. 170 Centistokes	D2170
(iii)	Ductility @ 25° C	Min. 100 cm	D113
(iv)	Flash Point (Cleveland Open Cup)	Min. 232° C	D92
(v)	Penetration @ 25° C after thin film oven test (100 g, 5 sec)	Min. 47% of original	D5
(vi)	Solubility in CCl ₄	Min. 99.5%	D4

(b) Coarse Aggregates

Coarse aggregate shall be clean, hard, tough, durable highly angular crushed stone or crushed gravel conforming to the requirements of the specifications for Coarse Aggregate for Bituminous Paving Mixtures (ASTM Designation D692). Aggregate shall be secured from a source known to be satisfactory for this purpose and shall be processed by a properly equipped and operated plant. Not less than 60% by weight of the coarse aggregate fragments retained on the 4.8mm sieve shall have two or more fractured faces (supersedes paragraph 5 – ASTM D692).

(c) Fine Aggregates

Fine aggregate shall comply with the requirements of the Specifications for Fine Aggregate for Bituminous Paving Mixtures (ASTM Designation D1073).

(d) Mineral Filler

Mineral Filler shall comply with ASTM D242 Specification.

(e) **Grading Limits**

The mineral aggregates and filler, composing the dry mix, shall be combined to produce a uniform blend complying with the grading limits given in Table 1. Dry mix grading requirements given in Table 1 supersedes those presented in the ASTM Specifications. All percentages shown are on a weight basis.

(f) **Asphalt Mix Designs**

Asphalt mix in the terms of these specifications shall be hot mix, hot-laid asphaltic plant mix consisting of coarse and fine aggregate, with or without mineral filler, and with all aggregate particles uniformly coated with asphalt cement.

There shall be two strength classifications:

- (i) Class A – For collector and arterial roads
- (ii) Class B – For residential streets and temporary asphalt curbs

Mixes for each class of asphaltic concrete shall meet the Marshall Test (ASTM D1559) design criteria shown in Table 2.

The Developer may be required by the City Engineer to submit a job “mix formula” designed by a qualified testing laboratory to establish an optimum asphalt content for the mix prior to paving. This mix design shall be selected to meet the requirements of Table 1 and Table 2.

TABLE 1 – GRADING LIMITS**COMBINED AGGREGATE IN THE DRY MIX**

Name	25mm Mix	19mm Mix	13mm Mix	10mm Mix	Cold Mix	Asphalt Curb Mix
Minimum Lift	50mm	50mm	35mm	25mm	--	--
Maximum Lift	150mm	150mm	75mm	--	--	--
Sieve Size	Percent passing by weight					
25mm	100					
19mm	75-100	100			100	
13mm	55-85	78-100	100		80-100	
9.5mm	48-74	68-88	82-100	100	70-90	100
4.8mm	34-56	48-68	58-78	85-100	50-70	70-85
2.4mm	22-43	35-55	42-63	80-95	35-50	50-70
1.2mm	16-34	25-45	30-52	70-89	---	---
0.6mm	10-24	16-34	20-40	55-80	18-29	---
0.3mm	7-17	10-24	13-30	30-60	13-23	18-32
0.15mm	4-12	6-16	8-20	10-35	8-16	---
0.075mm	1-7	3-10	4-10	4-14	4-10	5-15
Approx. asphalt cement content for mix proportioning (% Total Mix)	4-7%	4.5-7%	5-7.5%	7-11%	*4-10%	6-10%

*NOTE: Liquid Asphalt shall be used and shall comply with the latest specifications published in the Asphalt Institute Specifications Series No. 2 (SS-2).

TABLE 2
PHYSICAL REQUIREMENTS FOR ASPHALT PAVEMENT

Property of Laboratory Compacted Paving Mixture	ASTM TEST METHOD	PAVEMENT CLASS	
		A	B
Number of Blows – each face of test specimen	D1559	75	50
Marshall Stability in Newtons @ 60 degrees Celsius (minimum)	D1559	4,448	3,336
Flow Index – Units of 0.25mm	D1559	8-16	8-18
* minimum % Voids in mineral aggregate	D2726 D1188		
25mm Mix		13	13
19mm Mix		14	14
13mm & 10mm Mix		15	15
** % Air Voids in Compacted Mix	C127 C128		
25mm Mix	D170	3-8	3-8
19mm Mix	D854	3-5	3-5
13mm Mix	D1188	3-5	3-5
10mm Mix		3-8	3-8

* % Voids in mineral aggregate to be calculated on the basis of ASTM bulk specific gravity for the aggregate.

** Portion of asphalt cement absorbed into aggregates to be allowed for when calculating % air voids.

1.3.3 Asphalt Materials (continued)

(g) Asphalt Mix Testing

The Engineer may require tests of the asphalt mix to be made by a qualified testing laboratory at the Developer's expense to ensure that it meets specifications.

A minimum of one test of the asphalt mix may be required for each 300 tonnes of mix placed. Each test will include a core for field density and a mix example for Marshall lab testing of the physical properties of the mix. Testing procedures will conform to the following:

- (i) Sieve analysis of aggregates – ASTM D136
- (ii) Determination of Bitument content – ASTM E2172
- (iii) Bulk density of compacted asphaltic concrete paving mixtures – ASTM 2726
- (iv) Marshall procedures for preparation and testing of bituminous mixtures – ASTM 1559
- (v) Sampling Mineral Aggregates – ASTM D75
- (vi) Sampling Bituminous Mixtures – ASTM D979
- (vii) Specific Gravity of Aggregates – ASTM C127 & ASTM C128
- (viii) Quantity of Bitumen Absorbed by Aggregates “Maximum Specific Gravity of Bituminous Mixtures” – ASTM D2041

Any variation from the mix composition in the grading of the aggregate, as shown by sieve analysis of extracted aggregate, of more than plus or minus 5 percent in the total passing the 2.4mm sieve, or plus or minus 2 percent in the total passing the 0.075mm sieve, or any variation from the mix composition in the asphalt content as indicated by extraction tests of the finished mixture of more than 0.3 percent (approximately two standard deviations by statistical analysis) shall be corrected and, if uncorrected, shall be cause for rejection of the mix.

The results of all tests shall be made available to the City Engineer.

(h) Prime Coat

The material used for the prime coat shall be that known as MC30.

(i) **Tack Coat**

The material used for the tack coat shall be that known as SS-1 or SS-1h. The emulsion shall comply with the latest ASTM specifications.

(j) **Asphalt Base Course**

The material used for the asphalt base course shall be any one of the 25mm, 19mm, 12mm, 10mm asphalt mixes specified herein.

(k) **Asphalt Surface Course**

The material used for the asphalt surface course shall be either 13mm or 10mm asphalt mixes specified herein.

1.3.4 **Granular and Fill Materials**

(a) **Granular Materials**

(i) **19mm Minus Mulch**

Crushed Gravel shall be composed of inert, durable material, reasonably uniform in quality and free from soft or disintegrated particles. In the absence of satisfactory performance records over a five year period for the particular source of material, its soundness shall be tested according to ASTM test procedure C88. Maximum weight average losses for coarse and fine aggregates shall be 20% when magnesium sulphate is used.

All crushed gravel when tested according to ASTM C136 procedures shall have a gradation which conforms to the following gradation limits and 60% of the material passing each sieve must have one or more fractured faces. The Plasticity Index for crushed gravel shall not exceed 6.0.

<u>% Passing by Weight</u>			<u>Sieve Size (mm)</u>
		100%	Passing 19
75%	-	100%	Passing 13
60%	-	90%	Passing 9.5
40%	-	70%	Passing 4.8
28%	-	53%	Passing 2.4
17%	-	38%	Passing 1.2
10%	-	28%	Passing 0.6
5%	-	20%	Passing 0.3
3%	-	13%	Passing 0.15
2%	-	10%	Passing 0.075

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(ii) **32mm Minus Mulch**

Shall conform with specification for 19mm crushed gravel except that gradation shall be as follows:

<u>% Passing by Weight</u>			<u>Sieve Size (mm)</u>
		100%	Passing 32
80%	-	100%	Passing 25
66%	-	100%	Passing 19
50%	-	85%	Passing 13
30%	-	55%	Passing 4.8
13%	-	34%	Passing 1.2
8%	-	25%	Passing 0.6
5%	-	17%	Passing 0.3
2%	-	8%	Passing 0.075

(iii) **25mm Minus Gravel**

Shall consist of granular material which when tested according to ASTM C136 procedures shall have a gradation which conforms to the following gradation limits:

<u>% Passing by Weight</u>			<u>Sieve Size (mm)</u>
		100%	Passing 25
70%	-	100%	Passing 13
40%	-	85%	Passing 4.8
26%	-	75%	Passing 2.4
15%	-	65%	Passing 1.2
8%	-	55%	Passing 0.6
3%	-	43%	Passing 0.3
2%	-	27%	Passing 0.15
0%	-	8%	Passing 0.075

(iv) **75mm Minus Gravel**

Shall consist of granular material which when tested according to ASTM C136 procedures shall have a gradation which conforms to the following gradation limits:

<u>% Passing by Weight</u>			<u>Sieve Size (mm)</u>
		100%	Passing 75
75%	-	100%	Passing 50
60%	-	100%	Passing 40
40%	-	80%	Passing 19
20%	-	45%	Passing 4.8
4%	-	20%	Passing 0.6
0%	-	10%	Passing 0.075

(v) **13mm Sand**

Shall be free from organic and other foreign materials. The sand may be uncrushed pit run sand provided it conforms to the following gradation limits when tested according to ASTM C136 procedures:

<u>% Passing by Weight</u>			<u>Sieve Size (mm)</u>
		100%	Passing 13
35%	-	100%	Passing 4.8
20%	-	70%	Passing 2.4
13%	-	50%	Passing 1.2
8%	-	35%	Passing 0.6
5%	-	25%	Passing 0.3
2%	-	15%	Passing 0.15
0%	-	8%	Passing 0.075

(vi) **River Sand**

Shall be free of organic and other foreign materials and shall conform to the following grading limits when tested according to ASTM C136 procedures:

<u>% Passing by Weight</u>			<u>Sieve Size (mm)</u>
		100%	Passing 19
80%	-	100%	Passing 4.8
20%	-	80%	Passing 0.6
0%	-	20%	Passing 0.15
0%	-	10%	Passing 0.075

(vii) **Pit Run Gravel**

Shall be a mixture of sand and gravel free from clay lumps, organic material and other deleterious substances. It shall conform to the following grading limits when tested according to ASTM C136 procedures:

<u>% Passing by Weight</u>			<u>Sieve Size (mm)</u>
		100%	Passing 125
90%	-	100%	Passing 75
60%	-	100%	Passing 25
25%	-	100%	Passing 4.8
12%	-	80%	Passing 2.4
5%	-	45%	Passing 0.3
3%	-	8%	Passing 0.075

(viii) **Coarse 19mm Bedding Gravel**

Shall consist of granular material which when tested according to ASTM C136 procedures shall have a gradation which conforms to the following gradation limits:

<u>% Passing by Weight</u>			<u>Sieve Size (mm)</u>
		100%	Passing 19
95%	-	100%	Passing 15
50%	-	95%	Passing 9.5
25%	-	50%	Passing 4.75
10%	-	30%	Passing 2.0
0%	-	10%	Passing 0.425

(b) **Testing Granular Materials**

The City Engineer may require a sieve analysis test to be performed by a qualified testing laboratory at the Developer's expense on all granular materials prior to their incorporation into any work.

(c) **Native Material**

Shall be any excavated soil from the job site free of rocks greater than 250mm, roots and stumps. In addition, native material shall be readily compactible and shall not be impractical to control its water content.

(d) **Top Soil**

Top soil shall conform to the following specifications:

Top soil is a mineral soil from the surface layer or “A Horizon” of Solum and classified as “Loam”.

Humus	- 25% to 35% by volume
Sands	- 35% to 55% by volume
Silts and Clays	- 20% to 30% by volume

Acidity shall be in the range of pH5 to pH7.

Topsoil shall be free of roots, stones, and extraneous material, easily workable, fertile and weed free.

(e) **Granular and Fill Material Designations**

(i) **Backfill**

Native Backfill:

Shall be native material.

Granular Backfill:

Shall be any of the specified granular materials except river sand.

(ii) **Pipe Bedding**

Shall be 25mm minus gravel, 13mm sand, 19mm minus mulch or 32mm minus mulch for relatively dry trenches where the control of water and compaction of these materials to the specified density is practical. Otherwise, coarse 19mm bedding gravel shall be used where a free draining material is more practical.

(iii) **Subgrade Fill**

Shall be any of the specified granular materials. However, if River Sand is used, it must be laterally confined.

(iv) **Sub-base**

Granular Sub-base (also referred to as road sub-base):

Shall be any of the specified granular materials except River Sand.

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(v) **Granular Base**

Granular Base (also referred to as road base):

Shall be 19mm minus mulch.

(vi) **Pipe Cushion**

Shall be 19mm minus mulch, 32mm minus mulch, 25mm minus gravel, or 13mm sand.

(vii) **Gravel Shoulder Capping**

Shall be 19mm minus mulch or 32mm minus mulch.

1.3.5 Other Materials

1.3.5.1 Manholes

(a) **Manhole Sections**

Manhole sections and riser rings shall, unless otherwise shown on the Design Drawings, be precast reinforced spun concrete conforming to ASTM C478 complete with ladder rungs.

(b) **Manhole Diameter**

The inside diameter of manholes shall conform with the following:

<u>Diameter of Largest Pipe Entering Manhole</u>	<u>Diameter of Manhole</u>
450mm and less	1050mm
525mm to 600mm	1200mm
675mm to 750mm	1350mm
900mm to 1050mm	1500mm
Greater than 1050mm	Riser manhole (precast)

(c) **Concrete Lids/Covers**

Concrete lids/covers shall be reinforced precast slabs designed to withstand H-20 loading conditions.

(d) **Cast Iron Frame and Cover**

Cast iron frames and covers shall be Mainland Foundry Heavy Duty frame and cover, #3r-12 and #3r-12A; or Dobney Foundry frame and cover, C18 and C18A with words “SANITARY SEWERS” or “STORM SEWERS” as appropriately marked in 25mm letters.

(e) **Ladder**

Entrance tube and riser section ladder rungs are to be installed on the inside of the manholes, as shown on the Standard Drawings.

The rungs shall be either,

- (i) 20mm galvanized cold rolled steel, hot dipped after bending (CSA – G164) and either welded to the reinforcing bars and cast with the manhole sections or grouted into 25mm diameter by 100mm deep cast or drilled holes in the manhole section with an epoxy cement, or
- (ii) minimum 20mm aluminum alloy #6351 – T6 (CSA – S157 and NBC 1977), complete with polyethelene anchor insulating sleeves and installed in 25mm precast or drilled holes in the manhole sections.

1.3.5.2 **Chain Link Fence**

(a) **General**

All frames to be galvanized steel, min galvanizing to be 488 gm/m². Each knuckle to be independently tied and set flush with the top rail. Minimum height to be 1.5m. (For details see Standard Drawing No. 308).

(b) **Materials**

(i) **Fabric**

9 gauge (3.55mm) galvanized 50mm mesh.

(ii) **Top Rail**

42mm O.D., 3.55mm wall thickness, galvanized steel pipe connected with slip-on sleeves c/w expansion sleeves every 30m.

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(iii) **Mid Rail**

42mm O.D., 3.55mm weld thickness galvanized steel pipe c/w rail ends. Installation on panels only.

(iv) **End & Corner Posts**

73mm O.D., 5.15mm wall thickness, galvanized steel pipe imbedded 900mm in concrete.

(v) **Line Posts**

48mm O.D., 3.68mm wall thickness, galvanized steel pipe imbedded 760mm in concrete.

(vi) **Gates**

Sizes as Required

Frames 42mm O.D., 3.55mm wall thickness, galvanized steel pipe.

(vii) **Fittings**

To be manufactured from galvanized steel and have a 633 gm coating per m² of surface. All fittings to be tack welded to posts. Welds to be covered with two coats of zinc rich paint.

(viii) **Tension Wire**

6 gauge (4.50mm) galvanized steel affixed to chain link fabric by hog rings.

(ix) **Tie Wire**

9 gauge aluminum wire every 300mm for lineposts and every 450mm for top rail.

(x) **Tension Bar**

.048 x .19 tension bar zinc coated 633 gm/m².

(xi) **Tension Bands**

Shall be spaced not more than 380mm apart on terminal posts.

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CONSTRUCTION SPECIFICATIONS

Waterworks

SECTION 2

2.1 General

Although this section specifically covers those portions of the work that are unique to Waterworks, it must be read in conjunction with the Standard Drawings section and the section entitled “Common” for details on those items which are applicable to Waterworks but are not included in this section.

2.2 Materials

2.2.1 Main Line Pipe

Shall be either:

- (a) Ductile Iron Pipe conforming to AWWA C151 and Cement Mortar Line conforming to AWWA C104 complete with single rubber gasket Bell Tite or Tyton joints; or
- (b) Polyvinyl Chloride (PVC) Pressure Pipe conforming to AWWA C900 minimum Class 150 and permanently colour coded turquoise blue.

Any pipes showing probable signs of damage shall be rejected. In the case of PVC pressure pipe signs of ultra-violet ray degradation, excessive deformation, or surface defects on the pipe are grounds for rejection.

2.2.2 Service Connection Pipe

- (a) 19mm to 50mm: shall be copper type K for normal soils and polybutylene conforming to AWWA C902 or polyethylene conforming to ASTM 2306, series 160 tubing C.S.A. certified B137.1 for corrosive soils. In addition, polybutylene and polyethylene pipes shall have copper size outer diameters and have the necessary standards or their equivalents printed on the pipes.
- (b) Larger than 50mm to 100mm: shall be 100mm diameter Class 52 Ductile Iron Pipe conforming to AWWA C151 and Cement Mortar Lined conforming to AWWA C104.
- (c) Larger than 100mm: shall be same specifications as mainline pipe.

2.2.3 Fittings

Shall conform to AWWA C110. With the exception of caps, joints shall be single rubber gasket Bell Tite or Tyton, Flange, or Ter-Mech. All fittings supplied to City crews for tie-ins shall have Ter-Mech joints.

All caps temporary or otherwise shall have joints of the Ter-Mech type and a minimum of 38mm tapped opening complete with the necessary nipples, elbow, riser pipe and cap as a bleed point.

Flange gaskets shall be manufactured from natural rubber and shall be 3.175mm thick with a layer of cotton on both sides.

2.2.4 Bolts, Tie Rods and Nuts

Shall conform to ASTM Specifications for steel bridges and buildings, serial designation A-7. All bolts shall have American Standard screw threads, coarse thread series. The fit shall be Class 2 (Free Fit). All tie rods shall be bitumen coated with ROCO tar or approved equal.

2.2.5 Gate Valves

All gate valves 100mm in diameter or larger shall conform to AWWA C500 with cast iron body, bronze mounted solid wedge or double disc non-rising stem type with hub or flange ends and shall open counter-clockwise.

All gate valves shall be supplied with tie-lugs.

Gate valves used for blow-off assemblies shall be minimum 50mm in diameter with 50mm square operating nut and constructed similar to larger valves conforming to AWWA C500.

All valves shall have the manufacturer's name and catalogue number moulded as an integral part of the valve housing.

The following companies supply gate valves meeting these specifications and are therefore approved for installations:

Canada Valve
McAvity
Terminal City
Jenkins
Crane

2.2.6 Air Valves and Fittings

Air Valves shall be Apco stainless steel ball and double acting (vacuum and air release). Bushings, reducers and unions to be used in the valve connection shall be brass manufactured to ASA specifications A40.2 using ASTM B62 Bronze. Nipples shall be standard brass and threaded in iron pipe threads at both ends.

2.2.7 Fire Hydrants

Shall be Terminal City C71P complete with two hose nozzles and one pump nozzle conforming to AWWA C502 for fire hydrants and the following supplementary details:

- (a) Nozzle Diameters: Hose – 65mm nominal
 Pump – 100mm nominal
- (b) Nozzle configurations shall conform to BC Standards for Fire Hydrants.
- (c) A gasket shall be provided with each nozzle.
- (d) Colour: Finished paint above ground shall be red monamel marine General Paint #17-208.

2.2.8 Check Valves

Shall be Terminal City 1030 kPa Swing Check Valve or equivalent acceptable to the City Engineer.

2.2.9 Curb and Corporation Stops

Shall conform to AWWA C800 Specifications for threads.

Curb stops shall be inverted key type manufactured with 50mm flat base and full size port.

The following companies supply Curb and Corporation Stops meeting these specifications and are therefore approved for installations:

Mueller
Ford
McDonald

2.2.10 Service Saddles

Are not normally accepted for new waterline construction. However, if installed in accordance with manufacturer's specifications and if each service saddle installation is witnessed by the City's Engineering Inspector, then service saddle

connections will be accepted. Contractors considering the installation of service saddles for Polyvinyl Chloride Pressure Pipe shall ensure that the saddles will in fact:

- (a) Provide full support around the circumference of the pipe.
- (b) Have a bearing/contact area of sufficient width along the axis of the pipe of minimum 50mm.
- (c) Be tightened to the torque specified by the supplier.

Service saddles for Polyvinyl Chloride Pressure Pipe shall not:

- (a) Have lugs that will dig into the pipe when saddle is tightened.
- (b) Have a u-bolt type of strap that does not provide sufficient bearing area.
- (c) Have a clamping arrangement that is not fully contoured to the outside diameter of the pipe.

2.2.11 Valve Boxes

- (a) Main Line Box – shall be “Robar” style cast iron type supplied by K. Cartage Ltd. or approved equivalent.
- (b) Service Line Box – shall be Type “LR-13” supplied by Hanley & Gibson Ltd.

2.3 Construction

2.3.1 Connection to City Water Distribution System

- (a) Refer to Section 1.2.2 – Proving of Existing Utilities.
- (b) All connections to existing watermains shall be made by City crews. The Developer shall make all necessary prior arrangements with the City through the City’s Engineering Inspector for scheduling of this work to prevent any construction delays.

2.3.2 Pipe Handling, Storage and Installations

- (a) Ductile Iron Pipes – shall conform to AWWA C600 unless otherwise specified in these Construction Specifications.

(b) Polyvinyl Chloride Pressure Pipe

- (i) Mainline – shall conform to the Uni-Bell Plastic Pipe Association Technical Bulletin UNI-B-3-79 – Recommended Standard for the Installation of Polyvinyl Chloride (PVC) Pressure Pipe unless otherwise specified in these Construction Specifications.
- (ii) Direct Tapped Service Connections – shall conform to the Uni-Bell Plastic Pipe Association Technical Bulletin UNI-B-8-79 – Recommended Practice for the Direct Tapping of Polyvinyl Chloride (PVC) Pressure Water Pipe. Backfilling of the service connection where it is tapped into the watermain shall not be done until it is inspected and approved by the City’s Engineering Inspector. Coupons resulting from Direct Tapping shall be retained by the contractor and handed over to the Engineering Inspector for inspection.
- (iii) Saddled Service Connections – shall conform to the Pipe Supplier’s Installation Manual. THE DEVELOPER SHOULD NOTE THAT THIS TYPE OF SERVICE CONNECTION TO THE MAIN WILL NOT BE ACCEPTED BY THE CITY UNLESS IT IS INSTALLED IN ACCORDANCE WITH THE SUPPLIER’S INSTRUCTIONS AND IS WITNESSED BY THE CITY’S ENGINEERING INSPECTOR DURING THE ENTIRE INSTALLATION PROCEDURE. If saddled service connections are used their locations shall be recorded on the As-constructed Drawings.

In cases where C-900 pipes are to be installed the Developer must furnish proof to the City Engineer that the installation crew has received training from the pipe supplier on the handling and installation of the pipe including service connections. C-900 pipes shall not be installed without such proof of training.

2.3.3 Valves and Fittings

Shall be installed at the precise locations indicated on the Construction Drawings and jointed to the pipe in the manner specified for the pipe joints. Half pipe lengths or other short lengths may be used at both sides of all such fittings to position fittings correctly. Pipes shall be cut and the ends machined or beveled as required to facilitate jointing.

2.3.4 Test and Bleed Points

Test and/or bleed points consisting of 19mm diameter Corporation cocks shall be provided where indicated on the Design Drawings.

2.3.5 Hydrants

Hydrants shall be installed and located as shown on the Design Drawings and in the Standard Drawings. They shall be set plumb and such that the pumper nozzle faces and is at right angles to the road centerline. No fittings shall be allowed between the hydrant valve and the hydrant.

2.3.6 Testing, Flushing and Sterilization

2.3.6.1 General

Before flushing and testing, the Developer shall ensure the proposed waterworks are completely finished with the exception of the tie-in connections which will be done by City crews. The Developer is responsible to make arrangements with the City's Engineering Inspector to witness the entire flushing, testing and sterilization procedure.

2.3.6.2 Cleaning and Flushing Lines

Upon the completion of construction of a section, which shall be defined as the pipes and waterworks appurtenances located between any two consecutive line valves, the Developer shall by flushing or the use of mechanical equipment as necessary, remove all sand, dirt and foreign material from the interior of the watermains. The ultimate disposal of the water used for flushing watermains shall be the responsibility of the Developer. The disposal of the flush water shall be controlled in such a manner as not to cause loss or damage, nuisance on roads or walks, or injury to the public.

2.3.6.3 Testing of Watermains and Appurtenances

Upon the completion of construction of a section (as defined in 2.3.6.3) including cleaning and flushing, the section shall be made ready for hydrostatic testing.

The Hydrostatic Test (Pressure and Leakage) shall conform to the procedures outlined in AWWA C600 and the following supplementary requirements:

- (a) The working pressure shall be that shown on the Construction Drawing Notes or otherwise specified by the City Engineer.
- (b) The maximum length of a section to be tested shall not exceed 300 meters.

Should any section of the pipeline fail to meet the testing criteria the Developer shall take whatever steps are necessary to locate and correct

the leaks. The entire hydrostatic test procedure shall then be repeated until the testing criteria as set out in AWWA C600 have been satisfactorily met.

2.3.6.4 Sterilization and Final Flushing

After the City's Engineering Inspector has certified that the watermain and appurtenances have passed the hydrostatic test, sterilization and final flushing of the watermain and appurtenances shall be carried out by the Developer.

The sterilization procedures shall conform to AWWA C601 – Standard for Disinfecting Watermain.

Should the chlorine residual measured near the end of the sterilization process be less than the minimum acceptable as set out in AWWA C601, then the entire sterilization procedure shall be repeated by the Developer until the minimum acceptable chlorine residual is obtained.

Upon the satisfactory completion of the sterilization procedures, the watermain shall be finally flushed to clear them of any residual chlorine before they are handed over to the City. The Developer is cautioned that it is environmentally unacceptable to discharge chlorinated water into storm sewers or drainage watercourses. The Developer may dispose of the chlorinated water in the City's sanitary sewer system with the approval of the City Engineer or by other means satisfactory to Federal, Provincial and Municipal authorities.

CONSTRUCTION SPECIFICATIONS

Roadworks

SECTION 3

3.1 General

Although this section specifically covers those portions of the work that are unique to Roadworks, it must be read in conjunction with the Standard Drawings section and the section entitled “Common” for details on those items which are applicable to Roadworks but are not included in this section.

3.2 Excavation Fill and Subgrade Preparation

3.2.1 Excavation and Filling

In carrying out excavation and filling operations, the Developer shall minimize the soiling of existing roads and any inconvenience to adjoining property owners. Salvaged excavated materials meeting these specifications may be used in the formation of fill or for other backfill purposes provided that contamination of such salvaged material is not evident.

3.2.2 Drainage

The Developer shall keep all portions of the work properly and efficiently drained during construction and until the completion of Roadworks. Obstructing or silting existing watercourses, ditches and other drainage works shall not be allowed. Wherever the presence of subsurface water creates an unstable condition in the subgrade this water shall be removed and directed to a storm drain or open ditch temporarily. Construction shall then cease until the Consultant Engineer has had the opportunity to investigate the subsurface water problem and submit to the City Engineer his report including recommendations for solving the subsurface water problem permanently. Construction can resume only on instructions from the City Engineer. Should perforated drains be ordered by the Consultant Engineer, it shall conform to the Standard Drawing for Perforated Drains unless otherwise specified by the Consultant Engineer and accepted by the City Engineer.

If the subgrade becomes saturated at any time due to inadequate drainage, the Developer shall remove the unsuitable material and replace it with compacted subgrade granular fill.

3.2.3 Subgrade Fill

Subgrade granular fill shall be used to build the road up to the sub-base level or to backfill excavated unsuitable material in the subgrade.

3.2.4 Subgrade Preparation

- (a) Shaping – The finished subgrade shall conform to the design grade lines and cross-sections to a tolerance of plus or minus 50mm.
- (b) Compaction – The finished subgrade regardless of whether in cut or fill shall be compacted to minimum 95% Modified Proctor density. If the soil contains moisture in excess of the optimum, it shall be aerated until the moisture content has been reduced to optimum. Water shall be added if required to achieve optimum moisture content for maximum compaction.
- (c) Test Digs and Other Tests – Prior to placement of sub-base material, test digs may be ordered by the City Engineer at various locations to verify that the quality of subgrade is consistent at greater depths. All costs for such test digs including subsequent backfilling and subgrade restoration shall be borne by the Developer. In addition, field density and moisture content tests may be ordered by the City Engineer to verify that the subgrade material is compacted to the moisture content and density specified.

3.3 Sub-base Construction

3.3.1 Placement

After the subgrade has been prepared as specified, the placement of granular sub-base material shall proceed as quickly as practicable to preserve the integrity of the subgrade. The sub-base material shall be placed in uniform layers not exceeding 375mm in thickness before compaction.

3.3.2 Compaction

Compaction of sub-base shall involve the use of steel wheeled, pneumatic-tired, or vibratory rollers. All sub-base layers shall be compacted to minimum 95% Modified Proctor density. If the sub-base material contains moisture in excess of the optimum, it shall be aerated until the moisture content has been reduced to optimum. Water shall be added if required to achieve optimum moisture content for maximum compaction.

3.3.3 Shaping

A blade grader shall be used concurrently with the compaction rollers to keep the finished surface of each layer even and uniform. The finished surface of the sub-base shall conform to the design cross-section and grades within a tolerance of plus or minus 25mm.

3.3.4 Cross-Sections

Levels at the center line and road edge of the finished sub-base shall be taken by the Developer at maximum 20 meter stations as a record of tolerance and as a check on the thickness of material placed. Such records shall be provided to the City Engineer on request.

3.3.5 Inspection

Before placement of the granular base layer the sub-base surface shall be finally graded and compacted to the design cross-section and grades and shall conform to the density requirements specified. A proof-rolling test may be ordered by the City Engineer at the cost of the Developer. If so, the sub-base shall show no visible subsidence or weave under the wheels of a loaded truck having a weight of 8.1 kg per mm width of tread. Any soft areas indicated shall be excavated and replaced with compacted granular sub-base material.

3.4 Base Construction

3.4.1 Placement

The granular base material shall be placed in uniform layers not exceeding 150mm in thickness before compaction.

3.4.2 Compaction

The base layer shall be compacted by rolling with a pneumatic-tired or vibrating rollers. Each layer shall be compacted to minimum 95% Modified Proctor density. If the base material contains moisture in excess of the optimum, it shall be aerated until the moisture content has been reduced to optimum. Water shall be added if required to achieve optimum moisture content for maximum compaction.

3.4.3 Shaping

The finished surface of the granular base course shall conform to the design cross-section and grades within a tolerance of plus or minus 15mm.

3.4.4 Cross-sections

Levels at center line and road edge shall be taken by the Developer at maximum 20 meter stations as a record of tolerance and as a check on the thickness of material placed. Such records shall be provided to the City Engineer on request.

3.5 Prime and Tack Coats

3.5.1 Prime Coats

The purpose of the prime coat is to waterproof the granular base surface and also to prepare it as a suitable base for the placement of asphalt pavement. The Prime Coat shall be sprayed evenly on the entire base surface at a rate of 1.8 liters per square meter. After application of the Prime Coat, all traffic shall be kept off the road until sufficiently dry so as not to pick up under traffic. The Prime Coat may be deleted by the City Engineer.

3.5.2 Tack Coats

The purpose of the tack coat is to treat the existing asphalt surface to ensure that an adequate bond will exist between it and the new overlay asphalt layer. Prior to placement of the Tack Coat, the entire existing asphalt surface shall be cleaned such that it is free of sand, silt, dust and other foreign material. The Tack Coat shall be sprayed evenly on the entire asphalt surface to be overlaid at a rate of 0.25 to 0.8 liters per square meter. Tack Coats may be applied on lightly damped surfaces but not on wet surfaces or surfaces with standing water.

3.5.3 Application

The Prime and Tack Coats shall be applied by means of a pressure distributor recommended by the Asphalt Institute. Smearing of or overspraying onto adjacent curbs, gutters, lawns, shrubbery or other street furnitures shall be avoided completely through the use of shields placed at the end of the spray bars.

3.6 Asphalt Pavement

3.6.1 Preparation for Paving

In preparation for asphalt paving, the Developer shall thoroughly familiarize himself with these specifications and the established paving practices which are described in the latest edition of ASPHALT PAVING MANUAL SERIES NO. 8 published by the Asphalt Institute. The Developer shall adhere to these specifications and established paving practices during the entire asphalt paving process.

Before any asphalt is placed, the Developer shall:

- (a) Carefully check the road cross-sections and grades to ensure they conform to design,
- (b) Correct any surface irregularities not conforming to design,

- (c) Thoroughly wash, brush and clean all contact surfaces, existing pavements, curbs, gutters, catch-basins, valve boxes, manholes, and any other surfaces against which the asphalt shall be placed. Following this cleaning operation, a thin surface coating of asphalt cement shall be brushed onto these contact surfaces,
- (d) Advise the City Engineer in writing 24 hours in advance.

3.6.2 Transportation of Hot-Mix Asphalt

The hot-mix asphalt shall be transported from the mixing plant to the job site in dump trucks with metal boxes previously cleaned of all foreign matters. The boxes shall be suitably insulated and each load shall be covered with canvas of sufficient size to protect the asphalt mixture from adverse weather and from excessive heat loss. The inside surface of all boxes used for hauling the mixture may be lightly lubricated with a lime water and soap solution just before loading, but excess of lubricants will not be permitted. No loads shall be sent out so late in the day as to interfere with the proper spreading and compacting the mixture during daylight unless artificial light satisfactory to the City Engineer is provided.

The hot-mix asphalt shall be continuously delivered to the paver at a temperature within the range of 140 to 160 degrees Celsius. Any mixture delivered to the job site outside of this temperature range shall be rejected.

3.6.3 Placement

The hot-mix shall not be placed upon a surface which has free water showing and shall not be placed during rain. It shall be placed on a properly prepared base surface. No hot-mix asphalt shall be laid when the air temperature is below 3° C for base course and below 5° C for surface course unless authorization is received from the City Engineer.

The hot-mix shall be spread in a continuous operation by means of a self-propelled paving machine having a screed or strike-off assembly capable of distributing and finishing a full 3 meter width without the use of side forms. The screed shall be adjustable to the required elevations. The term screed includes any cutting, crowding or other practical action which is effective without tearing, shoving or gouging, and which produces a finished surface of smooth and even texture. The paver shall be equipped with rolling, tamping, or other suitable compacting devices, and shall have equalizing runners or other compensating devices to adjust the grades, and shall also have distributing screws of the reversing type for placing the mixture in front of the adjusting screeds. The paver shall be set to operate continuously between the limits of 3 to 6 meters per minute.

Where it is impractical to use the above described paving machines in confined areas, the City Engineer may authorize the use of other smaller types of paving

machines, or he may allow the use of hand methods of spreading provided that the finished asphalt pavement conforms to these specifications.

3.6.4 Compaction

3.6.4.1 Equipment

Equipment used for the compaction of hot-mix asphalt shall consist of self-propelled steel (static or vibratory) and pneumatic tired rollers. During the placement of hot-mix asphalt the Developer shall furnish a minimum of two self-propelled rollers to roll and compact the mixture. One of the rollers must be of the pneumatic tired type weighing not less than 10 tonnes while the other must be either the static smooth steel wheeled type weighing not less than 9 tonnes or the vibratory type weighing not less than 7 tonnes. Additional rollers may be ordered by the City Engineer if paving is done in cold weather or a large quantity of asphalt is being placed.

Steel rollers shall be kept in a good operating condition, free from backlash and worn parts causing hesitations in the rolling movement. The rollers shall also be free from flat areas and dents that mar the pavement surface.

Pneumatic tire rollers shall be equipped with smooth wide tread compaction tires of equal size and diameter. The wheels shall not wobble.

Wheels on the rollers shall be kept properly moistened, but excess use of water or use of diesel oil or similar products adversely affecting the quality of the finished asphalt pavement will not be permitted.

3.6.4.2 Rolling/Compaction Operation

Rolling shall start as soon as the pavement will bear the roller without checking or undue displacement. Any area in the asphalt mat which becomes displaced under rolling, or any soft spots detected by the rolling operation shall at once be removed and replaced with fresh hot-mix asphalt.

The rolling operation shall start longitudinally from the low part or edge to the high part or edge continuously until no roller marks are left in the finished surface and no further compaction is possible. Alternate trips of the rollers shall be slightly different lengths. At unsupported edges the rollers shall cover the edge but shall not overhang by more than 50mm. The speed of any roller shall not exceed 5 kilometers per hour.

At all curbs, manholes and other appurtenances, and at all locations not accessible to the rollers, hand tampers shall be used to produce the density specified for asphalt pavements.

3.6.5 Joints

3.6.5.1 General

All joints shall be made carefully to insure that they are tight, well bonded and sealed. Transverse and longitudinal joints in successive layers shall be separated by a minimum horizontal distance of 600mm. In preparing the joints for rolling and compaction, they shall be properly “set up” with the back of the lute at the height and level necessary to achieve the maximum compression under rolling. Large aggregates raked from joints shall be discarded and not be thrown back into the adjoining asphalt mixture causing a pebbly and non-homogeneous surface.

3.6.5.2 Joints with Old Pavements

Joints between old and new pavements or between successive days’ work shall be carefully made in such manner as to ensure a thorough and continuous bond between the old and new surfaces. The edge of the previously laid asphalt shall be vertically cut back to the full depth pavement so as to expose a fresh surface. The vertical surface shall then be painted with a thin uniform coating of hot asphalt emulsion, after which the hot mixture shall be placed in contact with it and raked to a proper depth and grade for compaction.

3.6.5.3 Intersections

All intersections with crossroads shall be joined in such a manner as to provide a smooth riding transition between two pavements. The intersection shall be flared out on as large a radius of curvature as is possible on the existing base.

3.6.5.4 Driveways and Lanes

All private driveways joining the new pavement shall have a sufficient amount of hot-mix asphalt placed on them to form a smooth transition to existing or future driveway pavement. For gravel driveways and lanes this asphalt shall be placed by hand spreading methods in a wedge shape to extend at least two meters back from the longitudinal road pavement edge. In the case of a paved driveway or lane, the joint between the old and new pavements shall be made at the longitudinal pavement edge. All work described in this paragraph shall be completed at the same time as the new pavement.

3.6.6 Temporary Asphalt Drainage Diversion Curbs

In cases where a second lift of asphalt concrete will be placed, temporary asphalt drainage diversion curbs shall be constructed after the placement of the first lift of asphalt concrete. Such temporary curbs shall be constructed in a manner that they will not pose a safety hazard for the public and that they will divert road drainage into their respective catch-basins.

3.6.7 Inspection

The finished surface shall conform to the design profile and cross-section elevations within the allowable tolerances provided no “bird-baths” are created.

Any “bird-baths” or other surface defects discovered after the paving operation shall be corrected by the Developer as soon as practicable.

The asphalt pavement shall be compacted such that the density shall be not less than 97% of the maximum density obtained in a laboratory. When quality assurance tests are ordered for the asphalt pavement, there shall be a minimum of 5 specimens with the average of the 5 equal to or greater than 97% and with no individual specimen less than 95% of the maximum density.

3.7 Gravel Shoulder Capping

The area to be capped shall first be graded, leveled and compacted. The material shall then be placed on the shoulder and compacted by vibratory compactor to 95% Modified Proctor Density.

Shouldering gravel shall normally be unloaded from haul trucks into an approved shouldering machine. However, where shoulders are more than two meters wide and the Contractor can provide suitable dump and spreading equipment to ensure satisfactory distribution and grading without loss of material or damage to the bituminous mat, alternative methods of spreading shoulder material may be permitted.

Machines to be used for the application of shouldering material to the road shoulder may be self-propelled, towed or pushed. The machines shall travel along the paved surface of the roadway on pneumatic tires. It shall be provided with a forward facing hopper of sufficient width and capacity to accommodate all material to be unloaded from haul trucks without spillage onto the road.

The machine shall be so designed that it can spread shouldering material without segregation or tearing in widths adjustable from one half meter to such width as may be necessary to cover the existing shoulders to a maximum of 2 meters, and to depths between 200mm and 300mm having crossfall from horizontal to eight (8) percent. The machine operator shall be able to adjust the throttle, feed clutch and gear box, and strike off screed crossfall while the machine is in motion.

3.8 **Adjustment and Preservation of Street Appurtenances**

The Developer shall make all necessary adjustments pertaining to manholes, catch-basins, water valves, survey monuments and other appurtenances prior to paving over, filling over or otherwise interfering with street appurtenances.

However, before making such adjustments, the Developer shall meet with the City's Engineering Inspector and thoroughly explain what he intends to do. Failure on the part of the Developer to point out damaged street appurtenances prior to making adjustments to them will result in the Developer having to replace such damaged street appurtenances at his cost.

CONSTRUCTION SPECIFICATIONS

Walkways, Sidewalks, Curbs and Boulevards

SECTION 4

4.1 General

Although this section specifically covers those portions of the work that are unique to Walkways, Sidewalks, Curbs and Boulevards, it must be read in conjunction with the Standard Drawings section and the section entitled “Common” for details on those items which are applicable to Walkways, Sidewalks, Curbs and Boulevards but are not included in this section.

4.2 Materials

4.2.1 Concrete

Concrete used for walkways, sidewalks and curbs (including gutters) shall be air-entrained 25 MPa ready-mix concrete as specified in Section 1 of these Construction Specifications.

4.2.2 Expansion Joint Material

Material used for filling of expansion joints shall be 13mm non-extruding bituminous type conforming to ASTM D1751 for Preformed Expansion Joint Fillers.

4.3 Construction

4.3.1 Subgrade Preparation

The Developer shall excavate or fill with granular sub-base material to the design subgrade elevation (whichever is appropriate) and subsequently compact the subgrade to minimum 90% Modified Proctor Density. In some cases, it may be necessary to involve both excavation and filling during the subgrade preparation process. Unsuitable material is first removed by excavation followed by filling with granular sub-base material prior to compaction.

4.3.2 Base Preparation

Once the subgrade is prepared, granular base material shall be placed on it. This base material shall be spread evenly over the subgrade, shaped and compacted to conform with the design elevations and cross-sections for the base layer. The finished base layer shall have a minimum thickness of 75mm and be compacted to minimum 95% Modified Proctor density.

4.3.3 Forms

Either metal or wooden forms may be used. Forms shall be set to the required line and grade and must be adequately braced such that no displacement greater than 25mm occurs while or after concrete is placed.

Forms shall be coated with form release compound prior to placement of concrete. Any surplus of compound shall be removed.

4.3.4 Placing Concrete

The granular base layer shall be moistened before placing concrete. The concrete shall be placed inside the forms such that segregation of the aggregates does not occur. This may require consolidation by means of a mechanical vibrator.

Concrete shall not be placed during rain or on a saturated base or a base showing free standing water. Nor shall it be placed upon a frozen base. When it appears probable that the air temperature may fall below 3 degrees Celsius during the 24 hours immediately following the placement of concrete, the Developer must take special precautions against frost damage.

The exposed surfaces of all walkways, sidewalks and curbs (including gutters) shall conform to the design elevations and cross-sections within the allowable tolerances as specified.

The Developer shall be responsible for the protection of the work for damage resulting from inclement weather and all other possible sources of damage including vandalism. No concrete walkways, sidewalks or curbs (including gutters) will be accepted where foot marks, depressions, or other surface irregularities exist.

When an extruding machine is used, the finished structure shall be true to the design line, grade and cross-section. The appearance, quality and workmanship shall conform with the Specifications and Standard Drawings. Where the City Engineer is not satisfied with the finished work, he may order that the use of the extruding machine be discontinued and that the Developer finish the work by hand forming methods.

4.3.5 Joints

Expansion joints extending through the full cross-section of the sidewalk or walkway shall be placed adjacent to any building, structures, and other fixed objects and filled with 13mm expansion joint material. Expansion joints shall also be placed at each end of sidewalk crossings. Notwithstanding the aforesaid, the maximum spacing of expansion joints for sidewalks, walkways and curbs (including gutters) is 50 meters.

Contraction joints shall be made at 3 meter intervals to a depth of 2/3 of the sidewalk, walkway or gutter thickness.

Tooled dummy joints in sidewalks and walkways shall normally be made at 1.5 meters from contraction joints. However, when the remaining sidewalk or walkway length is 2.25 to 3 meters, one dummy joint separating the remaining length into two equal panels shall be made. When the remaining length is less than 2.25 meters, no dummy joint shall be made.

Dummy joints are not required for curbs.

4.3.6 Openings

The Developer shall carefully fit, cut, trim and trowel the concrete sidewalk, walkway or curbs (including gutters) around all openings, iron frames, valve boxes, lamp standard bases, hydrants, down pipes, sewer clean-outs or inspection chambers, utility poles and other surfacial features as directed by the City Engineer.

Around the base of all utility poles which encroach on the sidewalk, walkway or curbs (including gutters) a strip of 13mm pre-moulded joint material shall be placed.

4.3.7 Crossings

Residential and Commercial driveway crossings through sidewalks and/or curbs (including gutters) shall be installed as let-downs where shown on the Design Drawings or as directed by the City Engineer, and shall conform to the Standard Drawings and Schedule B – Regulations for the Location of Boulevard Crossings, Bylaw No. 2011.

Lane and industrial driveway crossings shall be constructed as intersections with the road including curb returns and wheelchair ramps as appropriate.

4.3.8 Curing Compound

A curing compound shall be applied to all exposed concrete surfaces, at the rate recommended by the Manufacturer.

4.3.9 Wheel Chair Ramps

Where shown on the Design Drawings or directed by the City Engineer, the Developer shall construct wheel chair ramps as detailed on the Standard Drawing. Where barrier curb exists at the ramp location, it shall be removed for the required length and a new section of curb poured to provide the required let-down and taper. New and old curbs shall be blended smoothly together.

4.3.10 Finishing of Sidewalks and Walkways

The exposed surface of sidewalks and walkways shall be steel trowelled and receive a medium broom finish. The edges shall be rounded and tooled to a width of 50mm around the extremities of each panel. All panel markings shall be as shown on the Standard Drawings.

Driveway crossings shall be finished by means of a successive series of tooled lines at 150mm spacing the entire width of the crossing as shown on the Standard Drawing.

4.3.11 Catch-basin Frames in Gutter Apron

The Developer shall install the cast iron catch-basin frames to conform to the curb and gutter section. It should be noted that spacer rings will be required between the top of the precast concrete catch-basin and the cast iron frame. Unless otherwise specified catch-basin frames shall be installed 13mm below gutter grade with the gutter apron trowelled smooth to match the top of the cast iron frame.

4.3.12 Boulevards

The area between the back of the sidewalk and the property line, or where there is no sidewalk, between the back of the curb and the property line, shall be filled with a minimum compacted thickness of 100mm top soil. The final surface of the boulevard shall be graded and rolled to conform to the design elevations and grades.

4.3.13 Chain-Link Fence and Bicycle Baffles

Refer to Standard Drawings for details.

CONSTRUCTION SPECIFICATIONS

SANITARY SEWERS

SECTION 5

5.1 General

Although this section specifically covers those portions of the work that are unique to Sanitary Sewers, it must be read in conjunction with the Standard Drawings section and the section entitled “Common” for details on those items which are applicable to Sanitary Sewers but are not included in this section.

5.2 Materials

5.2.1 Pipe and Fittings

- (a) Sewer Gravity Main Pipes shall conform to one of the following specifications and unless indicated otherwise on the Design Drawings shall be of a minimum strength class as follows:
 - **Concrete Pipe:** shall be reinforced ASTM C76 Class III fitted with Rubber Gaskets conforming to ASTM C443. Fittings shall meet minimum requirements specified for pipe.
 - **Polyvinyl Chloride Pipe** (up to 300mm in diameter only): shall have SDR 35 (ASTM D3034), integral bell and spigot ends with stiffened wall section and a formed groove for rubber gaskets. Rubber gaskets shall conform to ASTM F477. Fittings shall meet minimum requirements specified for pipe.
- (b) Service Connection Pipes and Fittings shall conform to the following specifications unless indicated otherwise:
 - (i) **Pipe:** Polyvinyl Chloride Pipe shall have SDR 28 (ASTM D3034), integral bell and spigot ends with stiffened wall section and a formed groove for rubber gaskets. Rubber gasket shall conform to ASTM F477.
 - (ii) **Fittings:**
 - Elbows - long sweep Polyvinyl Chloride (ASTM D3034)
 - Couplings - Polyvinyl Chloride (CSA-B 182.1 and ASTM C500).
- (c) Sewer Force Main Pipe shall conform to one of the following specifications:

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- Ductile Iron Pipe (AWWA C151)
- Polyvinyl Chloride Pipe minimum Class 150 (AWWA C900)
- High Density Polyethylene Pipe minimum Series 100 butt-fusion jointed.

5.2.2 Inspection Chambers

Service Inspection Chambers shall be as manufactured by Coroban Plastics Ltd., or LeRon Plastics Ltd. complete with riser pipe and cover including suitable rubber rings, and pre-plugged all as shown on the Standard Drawings.

5.2.3 Concrete

All mass concrete incorporated in the sanitary sewerage works shall be minimum 25 MPa concrete as specified.

5.3 Construction

5.3.1 Connection to City Sanitary Sewer System

- (a) Refer to Section 1.2.2 – Proving of Existing Utilities
- (b) Unless otherwise specified on the Design Drawings or unless a stub already exists for the extension of new sewers, all connections to the existing sanitary sewer system shall be made by City crews. The Developer shall make all necessary prior arrangements with the City through the City's Engineering Inspector for scheduling of this work to prevent any construction delays. Normally, before the Developer commences construction, City crews should break into the existing system and provide a stub for the Developer. When the Developer is permitted to connect to the existing sanitary sewer system, he must do so in the presence of the City Engineering Inspector. Under no circumstances shall the Developer proceed with such connections on his own accord.

5.3.2 Service Connections and Inspection Chambers

(a) Service Connections

Service connections shall be constructed as shown on the Standard Drawings. All connections shall be made from factory manufactured 45 Degree Wye type fittings. The Developer shall not allow existing properties to connect to the sewer system unless authorization is received from the City Engineer. With the exception of the turn around area at the end of cul-de-sacs, service connection trenches shall be excavated so that the trench lines are as near to right angles to the road right-of-way as practicable. The grade of the service connection shall be uniform from the

wye fitting to the inspection chamber or in the case of a Riser Type Service Connection, from the end of the riser to the inspection chamber. In no case shall the grade be less than 1.25 percent. IT SHALL BE THE DEVELOPER'S RESPONSIBILITY TO RECORD THE EXACT CHAINAGES OF THE WYES ALONG THE SEWER MAIN AND THE LOCATIONS OF SERVICE CONNECTIONS AT THE PROPERTY LINE FOR EACH PROPERTY, FOR SUBSEQUENT INCLUSION ON THE AS-CONSTRUCTED DRAWINGS.

Within the turn around area at the end of cul-de-sacs, service connections shall be tied to the clean-outs or terminal manhole whenever possible.

(b) **Inspection Chambers**

Inspection Chambers shall be set plumb at the location and elevation as shown on the Design Drawings. The covers shall be painted red. Where the inspection chamber cover is located in a driveway, or other traveled-upon surface a concrete box with cast iron lid shall be installed as shown on the Standard Drawing.

(c) **Construction**

The specifications for construction of service connections shall be the same as for sanitary sewer mains.

5.4 **Flushing Sewer System**

The Developer shall perform one complete flushing of every sewer line including force-mains and service connections with clean water upon the completion of the construction of the sanitary sewer system. An inspection of every manhole and inspection chamber shall be made and all gravel, sand, muck or other debris shall be removed before flushing. Flushing shall be carried out from manhole to manhole. The ultimate disposal of the water used for flushing sewer lines shall be the responsibility of the Developer. Flush water may be disposed into the existing storm sewer system provided that precautions satisfactory to the City Engineer are taken by the Developer to ensure that all gravel, sand and other debris are screened or filtered out first. Under no circumstances shall the flushing operation be carried out without the presence of an Engineering Inspector of the City.

5.5 **Inspection and Testing of Gravity Sewer Pipes**

5.5.1 **General**

Upon completion of the construction of the sanitary sewer system every manhole, clean-out and inspection chamber shall be inspected to ensure that all gravel, sand, dirt and other debris is removed. Straight sections of sewer mains shall be inspected by using flashlights and mirrors to detect such defects as cracked or

broken pipes, misalignment and obstruction in the sewers. Curved sections of sewer mains shall be inspected by passing a rubber ball through the mains. The alignment of all sanitary sewers and service connection pipes in the horizontal and vertical direction shall be within the allowable tolerances specified.

After the sanitary sewer mains and service connections have been inspected they shall be subjected to one of the following tests to be selected by the City Engineer dependent upon the ground water conditions:

- (a) Exfiltration Test
- (b) Infiltration Test

5.5.2 Exfiltration Test – Gravity Mains

The exfiltration test shall include the testing of the sewer main, service connections and manholes in each section. The test section shall be sealed at its lower and upper ends by means of removable water tight plugs. Where necessary, the top of the inspection chambers shall be provided with suitable removable water tight plugs. The section shall be filled with water to a minimum height of 1.2 meters above the crown of the pipe at the highest point in the section or 1.2 meters above the elevation of the ground water, whichever is the higher. Air shall be allowed to escape from inspection chambers that have been plugged during the filling of the water.

Any damage resulting to the section being tested as a result of testing shall be repaired by the Developer at his own expense. The test pressure shall be maintained for a minimum of 3 hours.

There shall be no allowable leakage from Polyvinyl Chloride Pipes. The allowable leakage from concrete pipes shall be calculated by using the following formula:

$$\text{Allowable Leakage} = \frac{H \times D \times L}{840}$$

(liters)

Where H = Duration of test in hours
 D = Pipe Diameter in millimeters
 L = Length of test section in meters

No additional leakage allowance shall be made for manholes in the test section.

The above exfiltration limits shall constitute the maximum total allowable exfiltration from sewer mains, service wyes, service lines, manholes and other sewer appurtenances existing along the test sections of pipe.

If a test section has an exfiltration amount in excess of the allowable, the Developer shall replace or repair the section of sewer. Such sections shall be retested until they meet the allowable leakage limits.

5.5.3 Infiltration Test – Gravity Mains

The infiltration test shall include the testing of the sewer main, service connections and manholes in each section or sections. The test section shall be sealed at the highest point with removable water tight plug. The leakage shall be measured by means of an approved weir or meter. The duration of the test shall be a minimum of one hour.

The allowable leakage shall be the same as that calculated for exfiltration less 25% if the external head is 600mm of water or less. The above infiltration limits shall constitute the maximum total allowable infiltration for the section.

If a test section has an infiltration amount in excess of the allowable, the Developer shall replace or repair the section of sewer, to meet the infiltration limits. Repaired sections shall be retested until they meet the allowable leakage limits.

5.5.4 Rubber Ball Test

The Contractor shall, in the presence of the City's Engineering Inspector, pass a rubber ball or test plug having a minimum dimension of 90 percent of the diameter of the sewer pipe completely through the curved pipes.

5.6 Testing of Force-Mains

After flushing, the main shall be subjected to a hydrostatic pressure test. The test pressure shall be twice the operating pressure with a minimum of 700 kPa.

Immediately prior to testing any section, all appurtenances shall be checked to ensure that they are prepared for the test. Air valves shall be opened while the mains are filled. If all the air from the test section cannot be expelled from existing fittings and appurtenances, the Developer shall tap the section in a manner acceptable to the City Engineer to expel the air.

The main shall then be filled with test water and brought to a pressure of 10% of test pressure at the testing point. Any air valves in the test section shall then be closed so that test pressures will not cause damage.

The pipeline shall then be brought up to the test pressure which shall be maintained for a period of not less than one hour. Accurate means shall be provided for measuring the quantity of water required to maintain full pressure on the line for the test period.

No pipe installation will be accepted until the leakage is less than the number of liters per hour as determined by the formula:

$$L = \frac{N \times D \times P}{65,200}$$

Where L = the allowable leakage in liters per hour
 N = the number of joints in the test section
 D = the nominal pipe diameter in millimeters
 P = the square root of the average test pressure during the
 leakage test in kilopascals

Should the test section fail to meet the maximum leakage specifications, the Developer shall take whatever steps are necessary to locate the leaks and correct them. The test procedure shall be repeated after repairs are made until satisfactory results are obtained.

CONSTRUCTION SPECIFICATIONS

Storm Drainage Works

SECTION 6

6.1 General

Although this section specifically covers those portions of the work that are unique to Storm Drainage Works, it must be read in conjunction with the Standard Drawings Section and the section entitled “Common” for details on those items which are applicable to Storm Drainage Works but are not included in this section.

6.2 Materials

6.2.1 Pipe and Fittings

- (a) Storm Sewer Main Pipes and Fittings shall conform to one of the following specifications and unless indicated otherwise on the Design Drawings, shall be of a minimum strength class as follows:
 - **Concrete Pipe:** shall be reinforced ASTM C76 minimum Class III. Non-reinforced ASTM C14 concrete pipe are not acceptable. Concrete pipes shall be installed with open or closed joints as specified on the Design Drawings. Rubber gaskets, for closed joints, shall conform to ASTM C443.
 - **Polyvinyl Chloride Pipe** (up to 300mm in diameter only): shall have SDR 35 (ASTM D3034), integral bell and spigot ends with stiffened wall section and a formed groove for rubber gaskets. Rubber gaskets shall conform to ASTM F477.
 - **Fittings:** shall be factory manufactured and shall meet the minimum requirements specified for the pipe.
- (b) Service Connection Pipes, Catch-basin Leads and Fittings shall conform to the same specifications as for Storm Sewer Main Pipes and Fittings with the exception of the following:
 - **Polyvinyl Chloride Pipe:** shall have SDR 28 (ASTM D3034), integral bell and spigot ends with stiffened wall section and a formed groove for rubber gaskets. Rubber gasket shall conform to ASTM F477. Fittings shall meet minimum requirements specified for pipe.
 - **Polyvinyl Chloride Elbows** shall be of the long radius bend type.

- (c) Culvert Pipes shall conform to the same specifications as for Concrete Storm Sewer Main Pipes except that closed joints shall be used. Corrugated Steel Pipes may also be used for culverts provided that they are surface coated with asphalt or asphalt saturated asbestos and conform to the material fabrication and inspection requirements of AASHTO Designation M36 and M167 respectively.

6.2.2 Catch-basin and Cover Slabs

- (a) Catch-basins shall be precast 600mm internal diameter reinforced concrete conforming to ASTM C478 supplied with cast-in bases and 1.2 meter section length.
- (b) Cover slabs for catch-basins shall be precast reinforced concrete circular slabs recessed at the outer edges to fit over the catch-basin barrel and designed for standard H20 Highway loading.

6.2.3 Catch-basin Frames and Grates

Shall be Dobney Type D with Frame B23 or B24 as appropriate or equivalent.

6.2.4 Lawn Basins and Grates

Shall be Langley Concrete and Tile Type-450mm complete with Dobney B22 Drainage Grate or equivalent. Concrete bases to be cast-in place.

6.2.5 Concrete Sand Bags

Shall be a jute or burlap bag filled to two-thirds capacity for installation with a mixture of one part Portland Cement to two parts sand thoroughly mixed. Ocean “Damcrete” bags or equivalent may be used in lieu.

6.2.6 Rock Rip-Rap

Shall be selected hard, durable, quarried rock at least 90% of which shall be larger than 0.004 cubic meters and only 10% larger than 0.015 cubic meters in size.

6.2.7 Filter Fabrics

Shall conform to the following requirements:

- (a) Tensile strength - ASTM D1682 test method to 250 Newtons
- (b) Bursting strength - ASTM D751 test method to 865 Kilopascals
- (c) Permeability - minimum 0.02 cm/sec

6.2.8 Drain Rock

Shall be 25mm to 50mm round or clear crushed rock with no fines or silts.

6.2.9 Reinforcing Steel for Head and Wing Walls

Shall be intermediate grade deformed bars minimum size of 15mm.

6.2.10 Concrete

All mass concrete incorporated in the storm drainage works shall be minimum 25 MPa concrete as specified.

6.3 Construction

6.3.1 Connection to City Storm Sewers

- (a) Refer to Section 1.1.2 – Proving of Existing Utilities.
- (b) Unless otherwise specified on the Design Drawings or unless a stub already exists for the extension of new sewers, all connections to the existing storm sewers shall be made by City crews. The Developer shall make all necessary prior arrangements with the City through the City's Engineering Inspector for scheduling of this work to prevent any construction delays. Normally, before the Developer commences construction, City crews should break into the existing storm sewer and provide a stub for the Developer. When the Developer is permitted to connect to the existing storm sewer, he must do so in the presence of the City Engineering Inspector. Under no circumstances shall the Developer proceed with such connections on his own accord.

6.3.2 Service Connections

Service connections shall be constructed as shown on the Standard Drawings. All connections shall be made from factory manufactured 45 Degree Wye type fittings. The Developer shall be responsible to locate and record the locations of such drains at the property line, and connect into the new storm sewer all existing drains from adjacent properties presently emptying into the ditch which will be subsequently filled after the installation of the new storm sewer. The costs of connecting existing drains into the new storm sewer as determined by the City Engineer will be reimbursed to the Developer upon the satisfactory completion of the storm drainage works. In the event that the Developer fails to connect an existing functional drain to the new storm sewer, he shall be held liable for any damage which may result from leaving such drains unconnected. Where the Developer suspects septic conditions of an existing drain from an adjoining property, he shall report his suspicions to the City Engineer.

With the exception of the turn around area at the end of cul-de-sacs, service connection trenches shall be excavated so that the trench lines are as near to right angles to the road right-of-way as practicable and the wye shall be installed slightly downstream of the service connection trenches at the storm sewer to suit. The grade of the service connection shall be uniform from the wye fitting to the property line or in the case of a Riser Type Service Connection, from the end of the riser to the property line. In no case shall the grade be less than 1.25 percent. IT SHALL BE THE DEVELOPER'S RESPONSIBILITY TO RECORD THE EXACT CHAINAGES OF THE WYES ALONG THE STORM SEWER AND THE LOCATIONS OF SERVICE CONNECTIONS AT THE PROPERTY LINE FOR EACH PROPERTY, FOR SUBSEQUENT INCLUSION ON THE AS-CONSTRUCTED DRAWINGS.

Within the turn around area at the end of cul-de-sacs, service connections shall be tied to the clean-out or terminal manhole whenever possible.

The specifications for construction of service connections shall be the same as for storm sewer pipes.

6.3.3 Catch-basins

Catch-basins shall be installed as shown on the Standard Drawings. The excavation for catch-basins shall be made sufficiently large to permit the proper installation of the precast catch-basin. The bottom of the excavation shall be cleared of all loosed and soft material. A minimum of 75mm of granular bedding material shall be placed under the catch-basin. The backfill and compaction shall be as specified for utility trenches.

6.3.4 Catch-basin Leads

The specifications for construction of catch-basin leads shall be the same as for storm sewer pipes. The minimum diameter lead to be used is 150mm. Unless otherwise specified on the Design Drawings, catch-basin leads shall be constructed perpendicular to the storm sewer with the leads connected to factory manufactured wyes located slightly downstream of the leads.

6.3.5 Ditch Cleaning or Regrading

As indicated on the Design Drawings, existing ditches shall be cleaned to remove silt, grass, weeds, bush or other obstructions and regraded as required. The Developer shall be responsible for all excavation and disposal of spoil.

6.3.6 Headwalls and Wingwalls

Cast-in-place concrete headwalls and wingwalls shall be constructed in accordance with the details shown on the Design Drawings.

Concrete sandbag headwalls and wingwalls are considered to be temporary structures and shall be constructed as shown on the Standard Drawings subject to modifications by the City Engineer to fit actual field conditions.

6.3.7 Safety Grillages and Trash Screens

Unless otherwise shown on the Design Drawings, safety grillages and trash screens shall be constructed as detailed on the Standard Drawings.

6.3.8 Sub-surface Perforated Drain Systems

In the event that sub-surface water is encountered during the construction of any portion of the works by the Developer which, in the opinion of the City Engineer, requires the installation of sub-surface perforated drain systems, the Developer shall comply with such instructions issued by the City Engineer, and install such drain systems in accordance with the Standard Drawings at his cost. Such drain systems shall be connected to the boulevard side of the nearest downstream catch-basin.

6.3.9 Rip-Rap

Rock rip-rap shall be placed to the thickness and the limits as detailed on the Design Drawings. Contact between adjacent rocks shall be kept free of mud, silt or other foreign material which may leech out in time causing movement of the rocks. Voids between large rip-rap shall be filled with tightly packed smaller rock spalls. Filter fabrics shall be placed on the slopes prior to the placement of rip-rap where erosion susceptible soils such as fine sands and silts are encountered.

6.4 Flushing Storm Drainage Works

The Developer shall perform one complete flushing of every storm sewer line and catch-basin leads with clean water up to the completion of the construction of the storm drainage works. An inspection of every manhole and catch-basin shall be made and all gravel, sand, muck or other debris shall be removed before flushing. Flushing shall be carried out from manhole to manhole. The ultimate disposal of the water used for flushing storm drainage works shall be the responsibility of the Developer. Flush water may be disposed into the existing storm sewer system provided that precautions satisfactory to the City Engineer are taken by the Developer to ensure that all gravel, sand and other debris are screened or filtered out first. Under no circumstances shall the flushing operation be carried out without the presence of an Engineering Inspector of the City.

6.5 Inspection and Testing of Storm Drainage Works

Upon completion of the construction of the Storm Drainage Works, every manhole and clean-out shall be inspected to ensure that all gravel, sand, dirt and other debris is removed. Straight sections of storm sewers shall be inspected by using flashlights and mirrors to detect such defects as cracked or broken pipes, misalignment and obstructions

in the pipes. Curved sections of storm sewers shall be inspected by passing a rubber ball having a minimum dimension of 90 percent of the diameter of the sewer pipe through the pipes. The alignment of all storm sewers and service connection pipes in the horizontal and vertical direction shall be within the allowable tolerances specified. Infiltration and exfiltration tests will not be required.

CONSTRUCTION SPECIFICATIONS

Street Lighting System

SECTION 7

7.1 General

Although this section specifically covers those portions of the work that are unique to Street Lighting Systems, it must be read in conjunction with the Standard Drawings section and the section entitled “Common” for details on those items which are applicable to Street Lighting Systems but are not included in this section.

7.2 Electrical Permits and Inspections

Prior to the construction of the Street Lighting System, the Developer shall obtain all necessary electrical permits from the Provincial Electrical Energy Inspection Division. Upon completion of the installation of the entire Street Lighting System the Developer shall obtain a certificate from the local inspector of the Provincial Electrical Energy Inspection Division and shall forward a copy of this certificate to the City Engineer in order to initiate the necessary arrangements with BC Hydro to energize the Street Lighting System.

In addition to meeting the requirements of the Provincial Electrical Energy Inspection Division, the Street Lighting System, in particular, the civil works portion shall be subject to the inspection of the City Engineer for conformity with the construction specifications stated herein.

7.3 Materials

7.3.1 Ornamental Street Light Poles

Poles shall be either the “post-top” type for use at the ends of cul-de-sacs where raised islands are proposed for the center of the turnaround area, or the “davit” type along the edges of roads. They shall conform to the Standard Drawings and the following:

- The overall height of the poles shall be either 7.5m or 9m as specified on the construction drawings.
- The pole structure shall be capable of sustaining loads produced by a wind velocity of 160 kilometers per hour acting upon the structure and luminaire.
- All shaft, arm and baseplate materials shall meet CSA Standard G40.21 44W as a minimum requirement.
- The minimum thickness for the shaft and arm material shall be 3mm.

“D”

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- The poles shall be octagonal in cross-section, anchor base type and of single piece construction. They shall be gradually tapered through the entire length with one continuous welded longitudinal seam grounded smooth without indentations or lumps.
- The poles shall be equipped with:
 - (a) a reinforced oval shaped hand-hole minimum 101mm x 178mm complete with cover plate;
 - (b) a grounding stud welded inside the pole within reach of the hand-hole;
 - (c) a non-clog drainhole at the base; and
 - (d) a 9.5mm x 38mm stud for ground connection
- The poles shall be painted inside and outside with one coat of protective primer and, in addition, two coats of finishing paint on the outside.

7.3.2 **Anchor Bolts**

Anchor bolts shall be a continuous section of intermediate grade deformed reinforcing steel bars 25mm in diameter and 1m in length. One end shall be threaded to a minimum of 50mm and a maximum of 75mm. They shall be “hot dipped” galvanized for a minimum distance of 150mm from the threaded end of the bolts. One American standard regular hexagonal nut, one cut washer, three leveling shims, and one friction fit nut cover shall be supplied with each anchor bolt. The nuts, washers and leveling shims shall also be “hot dipped” galvanized. The nut covers shall fit snugly over the anchor nuts and bolts and cover them entirely. The finish color of the nut covers shall be the same as the poles.

7.3.3 **Luminaires**

Luminaires shall be of the “post-top” or “davit” mounted typed as appropriate for the type of poles specified on the Construction Drawings. Luminaires shall be High Pressure Sodium type, rated at 120 VAC. 60 HZ with nominal wattage ratings of 100 or 150. The Luminaire shall be complete with integral ballast within a cast aluminum housing. The Luminaire shall conform to the Illuminating Engineering Society (IES) specifications (type, distribution and classification) as called for on the Construction Drawings. Specifications for specific components supplied with the luminaries are:

- (a) The top of the enclosure shall be provided with a leveling surface.

- (b) The enclosure shall be provided with an adjustable slipfitter mounting assembly designed to accommodate a 60mm O.D. Tennon.
- (c) A hand operable, front-positioned latch shall be provided for releasing the refractor assembly.
- (d) The enclosure shall be equipped with a “knock-out” twist lock receptacle for a photo-electric controller when requested.
- (e) The refractor shall be constructed of high impact resistant polycarbonate.
- (f) The optical system shall provide a lampholder of mogul screw base design and pulse rated for High Pressure Sodium operation.
- (g) The lampholder shall be easily adjustable to obtain the required IES Specifications.
- (h) The reflector shall be specular alzak aluminum and be filtered and gasketed to prevent the entrance of dust and corrosive atmosphere.
- (i) The ballast shall have class “H” (180° C) rated transformer insulation. It shall regulate the lamp output wattage within the applicable ANSI Trapezoid with a plus or minus 5% change in input voltage and provide a minimum lagging power factor correction of 90%. The ballast shall be capable of operating the lamp to -40° C. The ballast shall be supplied complete with a starting aid common to both 100 and 150 watt ballast and be of single screw mounting design. All electrical components shall be factory pre-wired and inter-connected using insulated “push-on” connectors. No “wire-nut” type connectors shall be used. The capacitors shall be non-PCB, and be of such design that the survival rate shall be not less than 90% after 60,000 hours of operation.

7.3.4 Lamps

Lamps shall be high pressure sodium clear lamps either 100 Watt or 150 Watt as specified by the Consultant Engineer.

7.3.5 Equipment in Service Pole Base

All components inside the service pole base as detailed on the Standard Drawings shall be CSA approved.

7.3.6 Ground Rods

Ground rods shall be CSA approved 19mm diameter steel 3m long with hot forged point. The top ends of the rods shall be galvanized for a minimum distance of 450mm.

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7.3.7 Photo Electric Controller

Photo-cell units shall be cadmium sulphide thermal delay type, for 120 or 240 volts operation. Load rating shall be minimum 1000 volt-amperes. The units shall have a built in surge protector and lightning arrestor. A twist-lock base shall be provided for mounting onto the service pole luminaire.

7.3.8 Conduits

Conduits shall be rigid DB2/ES2 Type (CSA Designation C22.2) unplasticized polyvinyl chloride pipe as supplied by Scepter Manufacturing Company Ltd., or equivalent acceptable to the City Engineer. Each standard length of pipe shall bear a CSA certificate label. Couplings, adaptors, and factory bends shall also be CSA approved rigid polyvinyl chloride as supplied by Scepter Manufacturing Company Ltd. or equivalent acceptable to the City Engineer. The cement used for conduit connections shall also be CSA certified for this type of conduit. The two nominal minimum sizes of conduits for use in Street Lighting Systems are:

- (a) 50mm – conduit between the service pole base and BC Hydro's service box; and
- (b) 32mm – all other conduits between pole bases.

7.3.9 Pole Bases

The service pole bases and street lighting pole bases shall be pre-cast with minimum compressive strength of 25 MPa. The components and dimensions of these pole bases shall be as detailed in the Standard Drawings.

7.3.10 Conductors

All conductor wires shall be stranded copper of the type acceptable to the Provincial Electrical Inspector. Conductors shall be insulated and color coded. Where a run includes two conductors, the colors shall be black and white. Where a run includes three conductors, the colors shall be black, white and red, except that black may be substituted for red for the service conductors only. White shall, in all cases, be used for the neutral conductor.

7.3.11 Pipe Bedding and Cushion

Material used for pipe bedding and cushion shall be 13mm sand as specified.

7.3.12 Paint

The pole structure including base and nut covers shall be covered with the following paint or equivalent acceptable to the City Engineer:

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1. **Primer:** One coat, inside and outside with BAPCO 26-440.
2. **Finishing:** Two coats on exterior with GENERAL PAINT Industrial Enamel National Blue 16-209+KX-4Y.

7.4 **Construction**

7.4.1 **Conduit Installations**

Street lighting conduits shall be installed in accordance with the Standard Drawings. To permit expansion and contraction, conduits shall be snaked slightly with the maximum deviation from the designed off-set not to exceed 75mm. During the trench backfill operation, 150mm wide power cable warning tapes, yellow in color, shall be placed 300mm below finish grade over all conduits.

All pre-ducting of road crossings shall be installed prior to paving.

At locations where conduits are to be installed in existing roads and driveways which are paved with concrete or asphalt, the City Engineer may require that the conduits be installed by tunnelling. Tunnelling may be carried out by pressing, driving or boring, using a drill or pipe.

7.4.2 **Conductors**

Before pulling conductors into a run of conduit, the conduit shall be blown out with compressed air, from both ends if necessary, then swabbed out, so as to remove all stones, dirt, water and other materials which may have entered. The conductors shall be pulled in slowly by hand or winch, in order to keep close control on pulling tension and prevent cutting the conduit at bends.

The Developer is reminded that it is his responsibility to install conductors inside the BC Hydro service conduit between the Hydro service box and the service pole base.

7.4.3 **Street Light Standards Pole Installation**

Poles shall be erected plumb, using the shims supplied if necessary. Plumbing shall be done with a 0.6m or larger spirit level attached to a proper size wedge to allow for the taper in the poles. No more than three shims shall be used for any one pole. Threads of each anchor rod shall be liberally coated with Dearborn Chemical Company No-Oxide grease, type G special or equivalent acceptable by the City Engineer, before pole erection. After pole has been erected and plumbed and anchor nuts tightened to the torque specified by the supplier, the anchor rods and nuts shall be completely covered with grease before the nut covers are placed over them.

In installing the street lighting standard poles, the Developer shall be responsible for the care of other overhead utilities or obstructions. In the event such utilities or obstructions must be temporarily or permanently removed, raised or lowered to avoid conflict with light standards, the Developer shall make the necessary arrangements with the utility or authority concerned. The expense of such removal, raising or lowering, shall be borne by the Developer.

7.4.4 Wiring at Pole Bases

Wiring and fittings at the Standard Hand-hole shall be as indicated on the applicable drawings. Feeders must be terminated and tapped as shown. Looping of feeder conductors with “T” taps shall not be permitted. The works shall be executed in a neat workmanlike manner particularly at the hand-hole where three or four sets of conductors enter the standard. All wiring shall be arranged so as to permit easy access to the fuseholder without disturbing other components or conductors. Each feeder joint shall be insulated with a minimum of four layers of 3M #33 insulating tape. Insulating materials of a deteriorating or moisture absorbing nature must not be used. The top or line entry to the fuseholder upon connection to the tap must be sealed with a moisture repelling, inert material.

Once the components inside the service pole base have been installed, the Developer shall immediately arrange with the City’s Engineering Inspector to have a municipal pad-lock installed to secure the opening panel.

7.4.5 Painting

The Developer shall paint all poles with one coat of primer and two coats of finishing paint as specified. No painting shall be done unless the surfaces are free from moisture or when the local Atmospheric Environment Services Department predicts frost within 24 hours of the proposed painting.

After the light standards have been erected and plumbed, the Developer shall wire-brush and touch up marks, scratches, rust spots and abrasions found in the prime coat, using primer paint as specified. Prior to proceeding with painting each of the finishing coats, the Developer shall obtain permission from the City Engineer.

7.4.6 Numbering of Poles

The poles shall be numbered on the roadside face of the pole, such numbers being determined as follows:

Example: 3
 21

Where: 21 indicates the hundred block of the street or avenue on which the pole is installed, and

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3 indicates the side of the street on which the pole is erected, and its sequence in the pole line in the block.

All poles on the north side of avenues and on the west side of streets shall be numbered odd.

All poles on the south side of avenues and on the east side of streets shall be numbered even.

The odd numbering in any given block shall commence with 1. The sequence shall then be 3, 5, 7... etc. to the end of the block, the numbers getting larger to the west or to the north. The even numbering in any given block shall commence with 2. The sequence shall then be 4, 6, 8... etc. to the end of the block, the numbers getting larger to the west and to the north.

The number shall be white in color and be placed a minimum of 2.1m above the top of the mounting base.

The minimum dimensions of each digit shall be 50mm high and 25mm wide.

CONSTRUCTION SPECIFICATIONS

SECTION 8

STANDARD DRAWINGS

INDEX

DRAWING NUMBERS

TITLE

101A	Road and utility locations for short cul-de-sacs
101B	Road and utility locations for local roads (15m ROW)
101C	Preferred road and utility locations for 8.5m road on 18m ROW
101D	Preferred road and utility locations for 10.5m road on 20m ROW
101E	Preferred road and utility locations for 12m road on 20m ROW
101F	Preferred road and utility locations for 14m road on 20m ROW
101G	Typical lane cross-section
102	Trench section for utility installations
103	Concrete encasement for underground utilities
201	Typical blow-off for watermain
202	Typical water service connection 19mm to 50mm
203	Typical gate valve installation
204	Typical fire hydrant detail
205	Thrust block details
206	Air valve chamber
207	Typical fireline and water service connection 100mm and larger
208	Temporary blow-off assembly*
301	Curb and gutter sections
302	Wooden road barrier
303	Wheelchair ramp details
304	Typical handrail details
305	Typical concrete walkway and emergency access
306	Driveway crossings
307	Typical sidewalk
308	Chain link fence details
309	Entrance restraint at emergency access*
401	Inspection chamber for 100mm sanitary sewer connection
402	Typical sanitary sewer service connections (riser and non-riser)
403	Typical manhole
404	Drop and interior ramp manholes
501	Typical storm sewer service connections (riser and non-riser)
502	Inlet structure
503	Outlet structure with safety grillage
504	Typical driveway culvert
505	Catch-basin and lawn basin – SEE DRAWING 510
506	Typical perforated drain systems
507	Typical cleanout detail*
510	Typical side inlet catch-basin*

“D”

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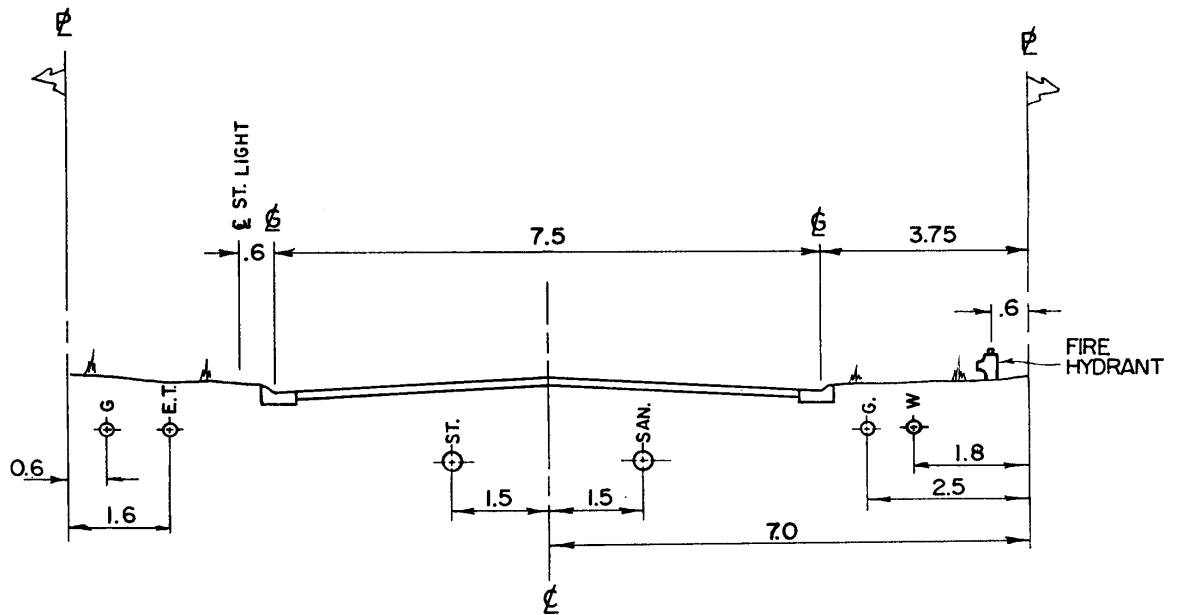
INDEX

DRAWING NUMBERS

TITLE

601	Pole base service detail
602	Concrete base for pole with service equipment
603	Standard base details for street light pole
604	Hand hole details
605	Service equipment in pole base
606	Typical street light poles
607	Typical street light luminaries
608	Wiring diagram for street lights
609	Junction box details
610	Base plates for street light poles

** Drawings in bold have been added after original bylaw was adopted.*



15 m R.O.W.
7.5m ROAD WIDTH

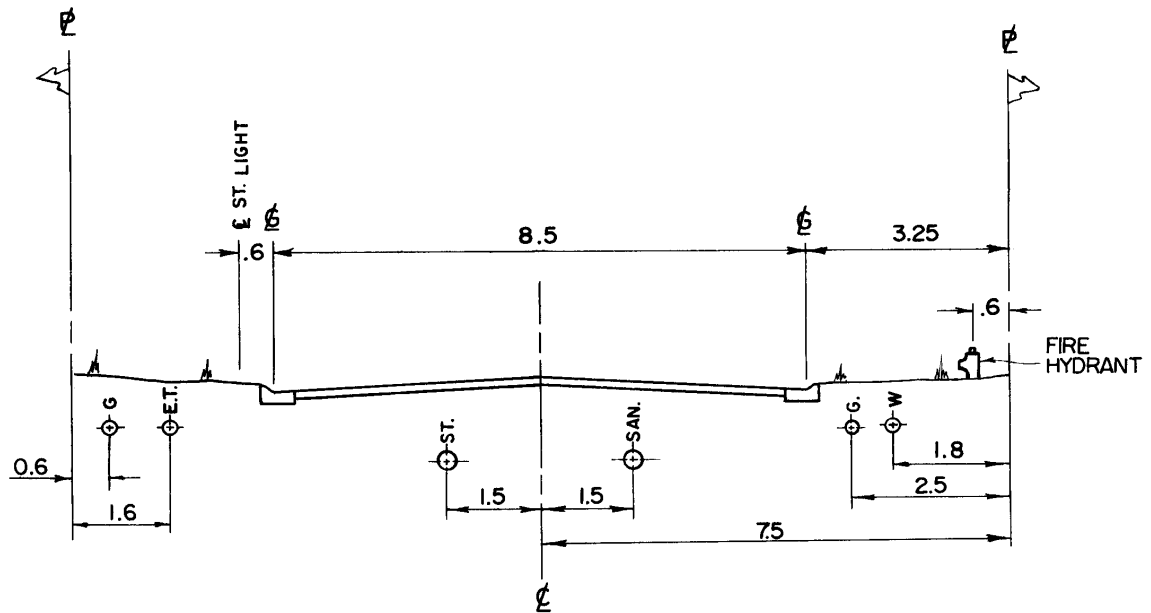
NOTES

1. ALL DIMENSIONS ARE IN METRES.
2. SPECIAL CONSIDERATIONS SHALL BE MADE BY THE CONSULTING ENGINEER TO FIT ALL UTILITIES WITHIN THE BOULEVARD AREA AT THE BULB END OF CUL-DE-SACS.

PORT COQUITLAM		ENGINEERING DEPT.		DATE: 86-02-14	DRAWING No. 101 A
TITLE: ROAD & UTILITY LOCATIONS FOR SHORT CUL-DE-SACS		APPROVED BY: T.M.C.	DESIGN BY:	DRAWN BY: R.M.	SCALE: N.T.S.

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15 m R.O.W.
8.5m ROAD WIDTH

NOTES

1. ALL DIMENSIONS ARE IN METRES.
2. SPECIAL CONSIDERATIONS SHALL BE MADE BY THE CONSULTING ENGINEER TO FIT ALL UTILITIES WITHIN THE BOULEVARD AREA AT THE BULB END OF CUL-DE-SACS.

PORT COQUITLAM

ENGINEERING DEPT.

DATE:
86-02-14

DRAWING No.
101 B

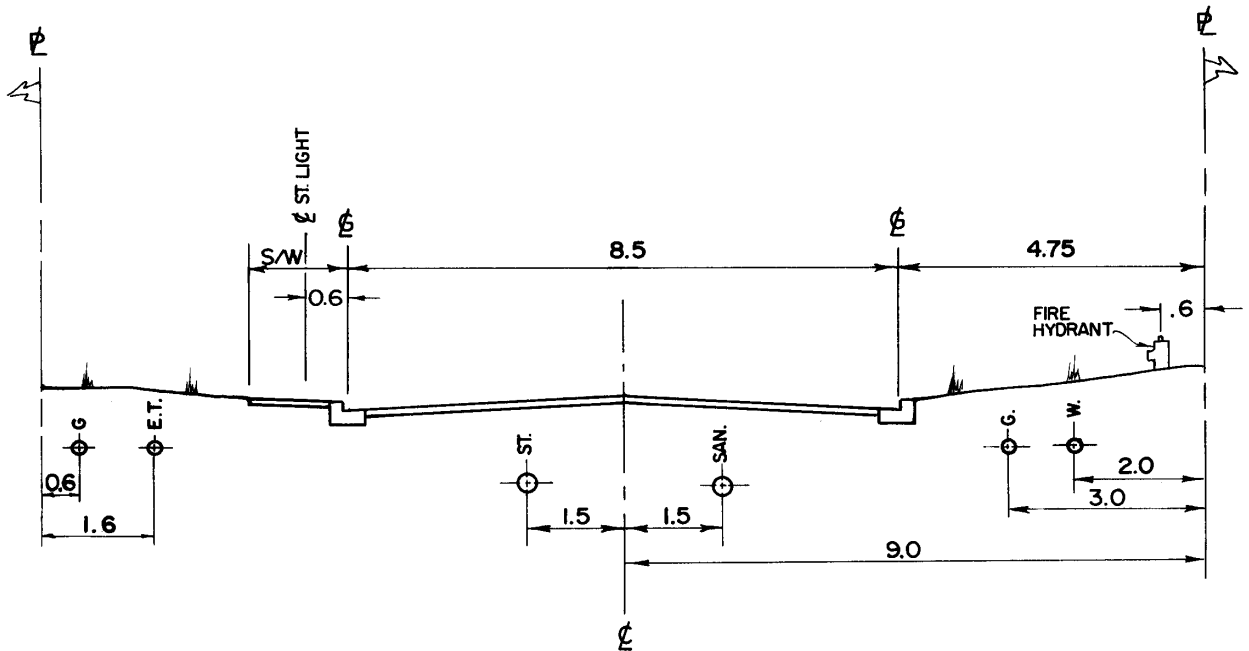
TITLE: ROAD & UTILITY LOCATIONS
FOR LOCAL ROADS (15m R.O.W.)

APPROVED BY:
TML

DESIGN BY:

DRAWN BY:
R.M.

SCALE:
N.T.S.

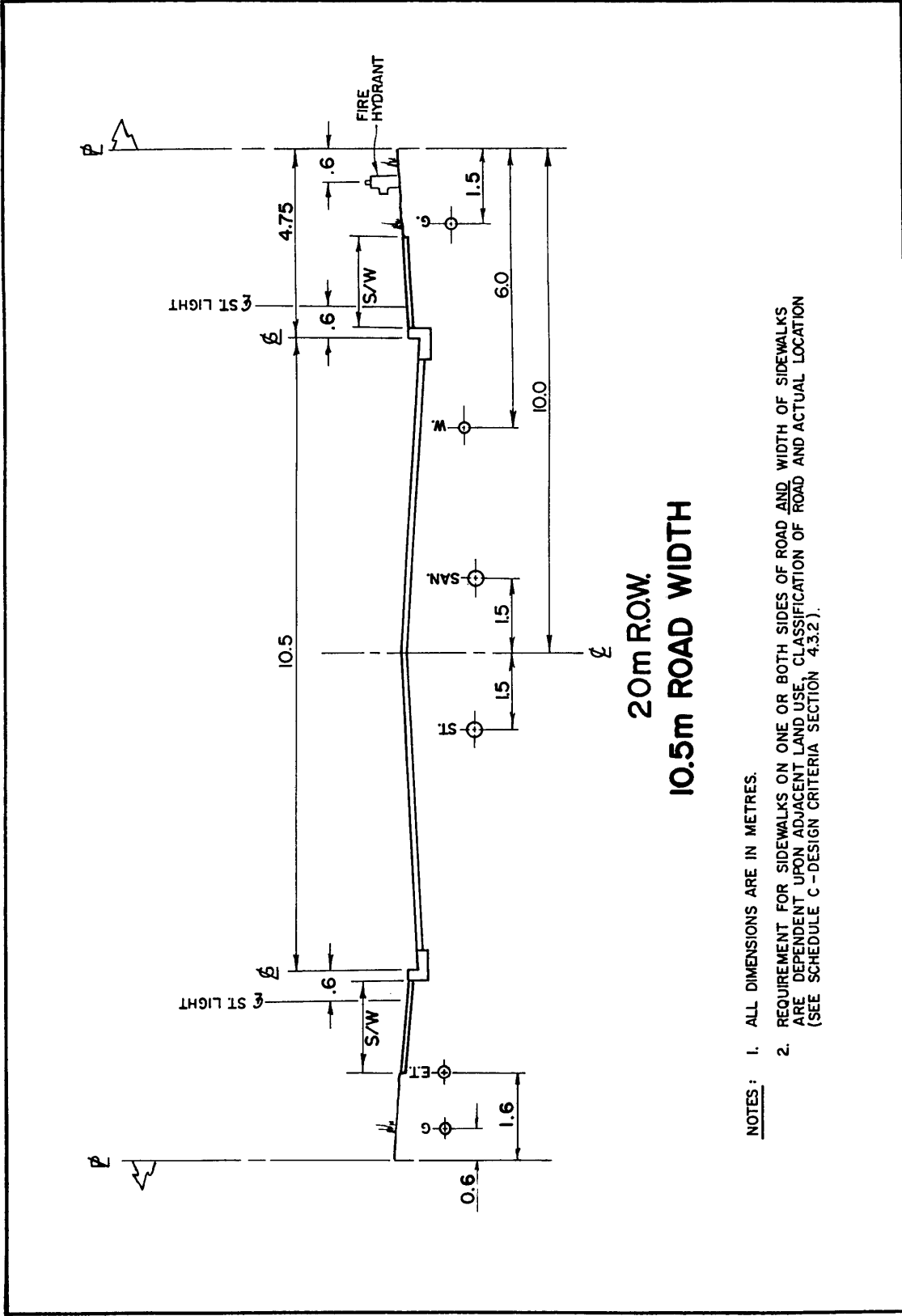


**18m R.O.W.
8.5m ROAD WIDTH**

NOTES

1. ALL DIMENSIONS ARE IN METRES.
2. CURB AND GUTTER TO BE OF THE BARRIER TYPE.
3. REQUIREMENT FOR SIDEWALK AND WIDTH OF SIDEWALK ARE DEPENDENT UPON ADJACENT LAND USE, CLASSIFICATION OF ROAD AND ACTUAL LOCATION (SEE SCHEDULE C-DESIGN CRITERIA SECTION 4.3.2).

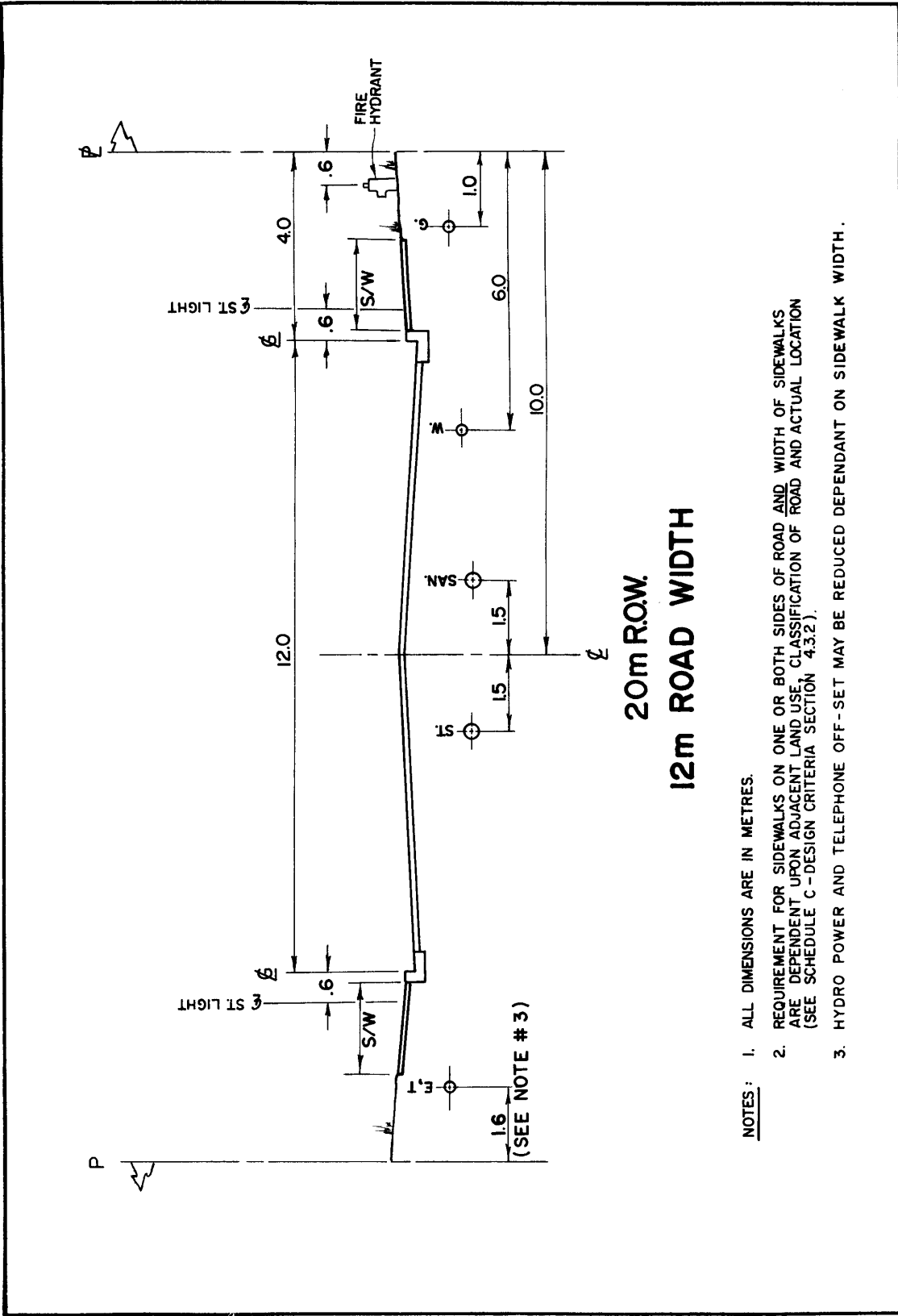
PORT COQUITLAM		ENGINEERING DEPT.		DATE: 86-02-14	DRAWING No. 101 C
TITLE: PREFERRED ROAD & UTILITY LOCATIONS FOR 8.5m ROAD ON 18m R.O.W.		APPROVED BY: <i>TYMG</i>	DESIGN BY:	DRAWN BY: R.M.	SCALE: N.T.S.



20m R.O.W.
10.5m ROAD WIDTH

- NOTES :
1. ALL DIMENSIONS ARE IN METRES.
 2. REQUIREMENT FOR SIDEWALKS ON ONE OR BOTH SIDES OF ROAD AND WIDTH OF SIDEWALKS ARE DEPENDENT UPON ADJACENT LAND USE, CLASSIFICATION OF ROAD AND ACTUAL LOCATION (SEE SCHEDULE C - DESIGN CRITERIA SECTION 4.3.2).

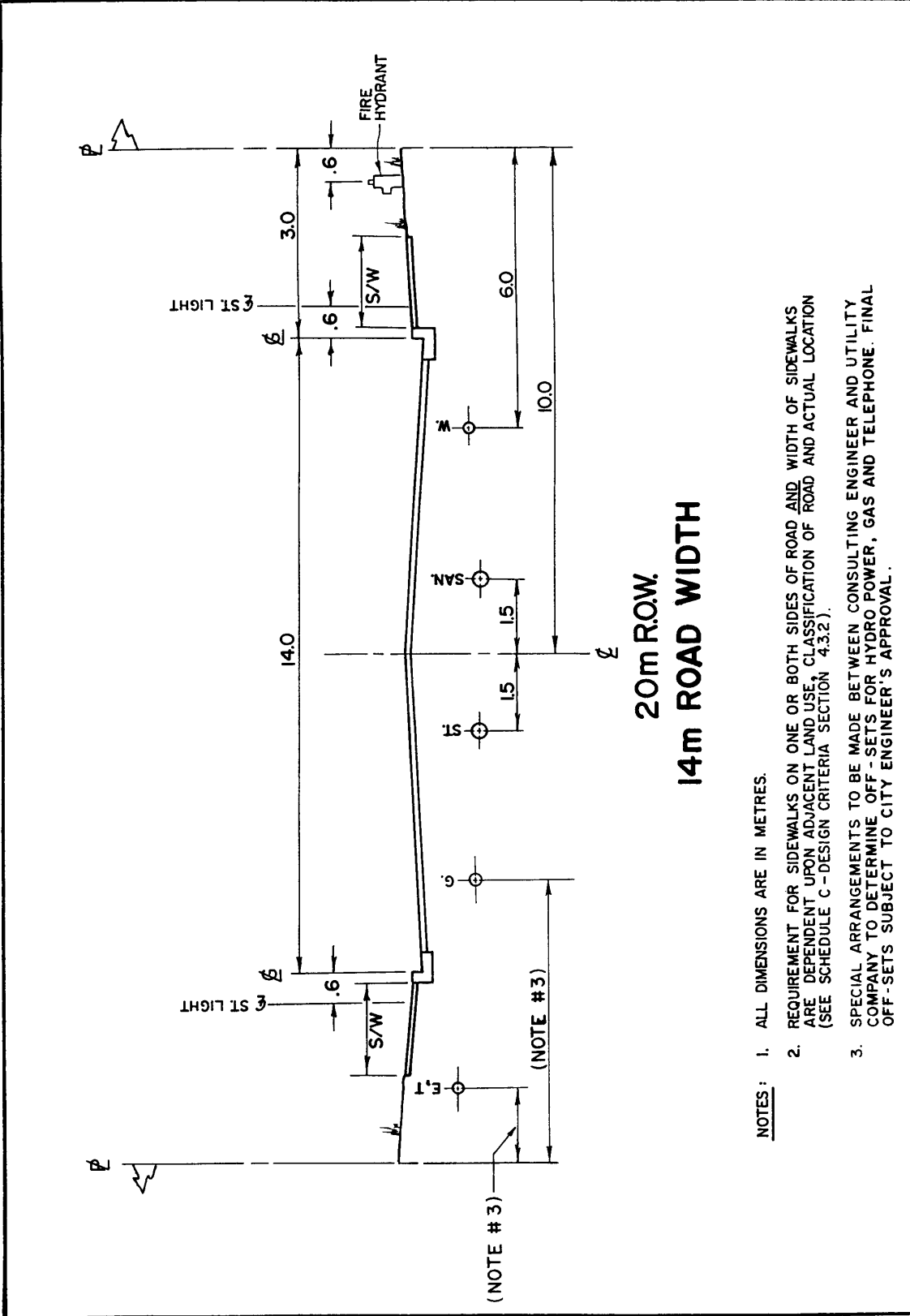
PORT COQUITLAM		ENGINEERING DEPT.	DATE: 86-02-14	DRAWING No. 101 D
TITLE : PREFERRED ROAD & UTILITY LOCATIONS FOR 10.5m ROAD ON 20m R.O.W.		APPROVED BY : <i>T.W.C.</i>	DRAWN BY : RM	SCALE : N.T.S.



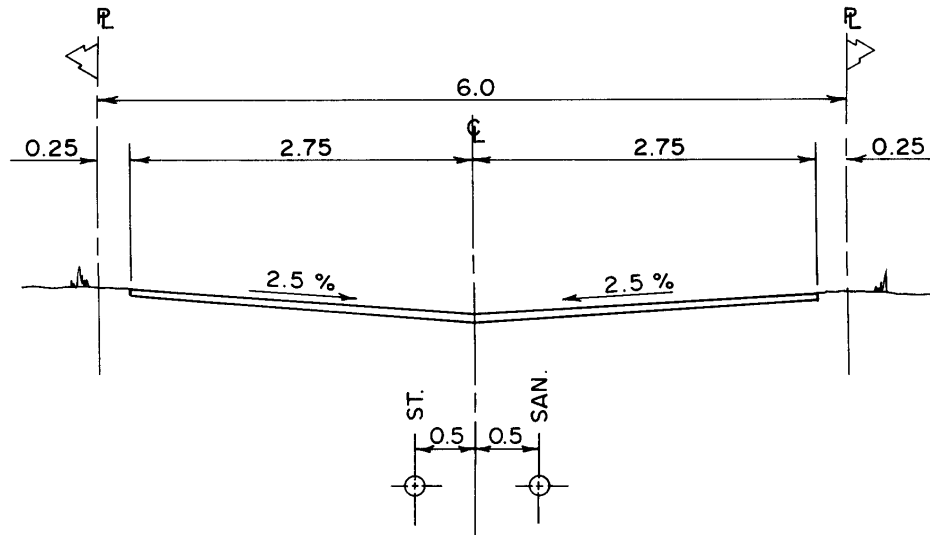
20m ROW. 12m ROAD WIDTH

- NOTES:
1. ALL DIMENSIONS ARE IN METRES.
 2. REQUIREMENT FOR SIDEWALKS ON ONE OR BOTH SIDES OF ROAD AND WIDTH OF SIDEWALKS ARE DEPENDENT UPON ADJACENT LAND USE, CLASSIFICATION OF ROAD AND ACTUAL LOCATION (SEE SCHEDULE C - DESIGN CRITERIA SECTION 4.3.2).
 3. HYDRO POWER AND TELEPHONE OFF-SET MAY BE REDUCED DEPENDANT ON SIDEWALK WIDTH.

PORT COQUITLAM		ENGINEERING DEPT.		DATE:	86-02-14	DRAWING No.	101 E
TITLE: PREFERRED ROAD & UTILITY LOCATIONS FOR 12m ROAD ON 20m R.O.W.		APPROVED BY:		DESIGN BY:	RM	DRAWN BY:	N.T.S.



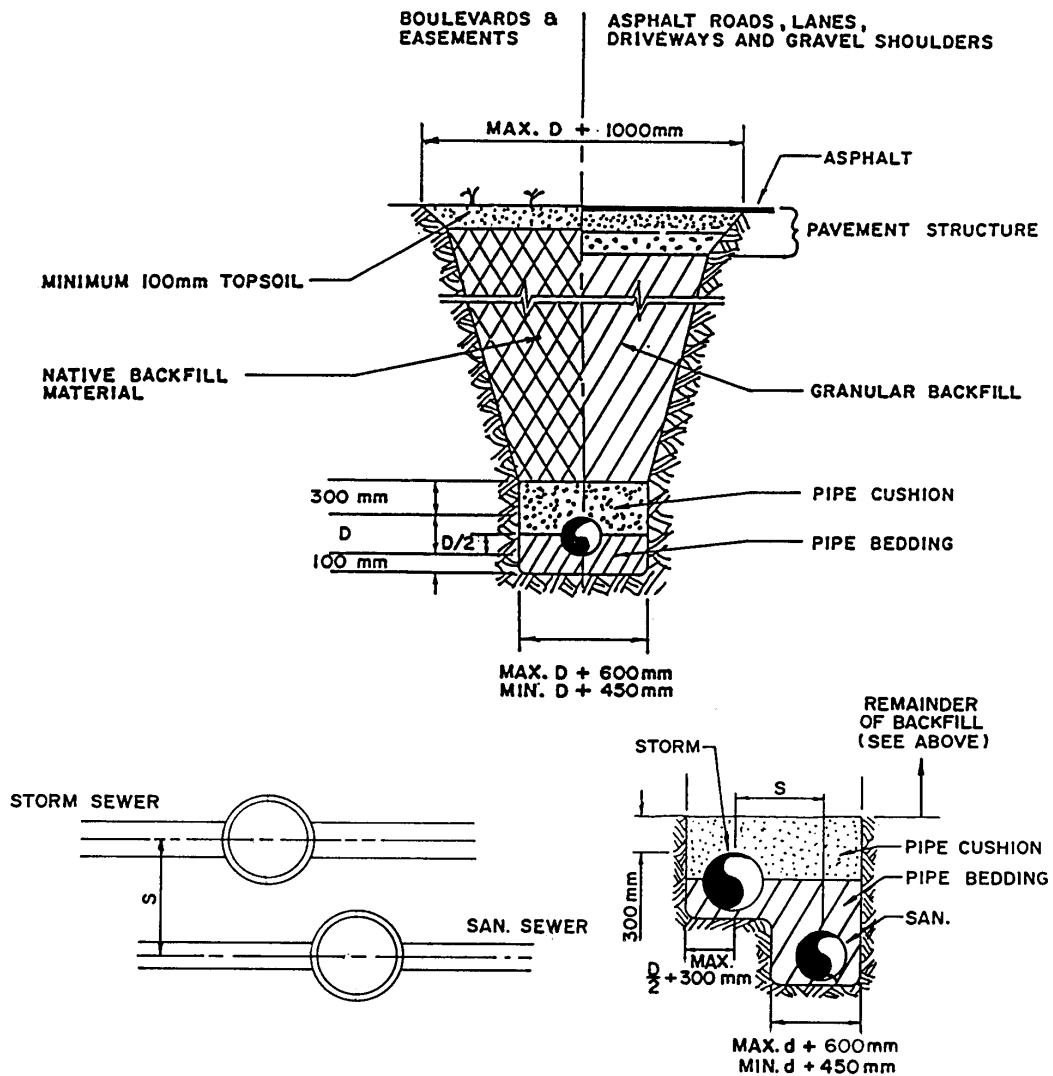
PORT COQUITLAM		ENGINEERING DEPT.		DATE: 86-02-14	DRAWING No. IOI F
TITLE : PREFERRED ROAD & UTILITY LOCATIONS FOR 14m ROAD ON 20m R.O.W.		APPROVED BY: <i>truc</i>	DESIGN BY: RM	DRAWN BY: RM	SCALE : N.T.S.



6 m R.O.W.
5.5 m LANE WIDTH

NOTES : 1. ALL DIMENSIONS ARE IN METRES.

PORT COQUITLAM		ENGINEERING DEPT.		DATE: 86-11-19	DRAWING No. 101 G
TITLE: TYPICAL LANE X - SECTION		APPROVED BY: KJ	DESIGN BY:	DRAWN BY: y d	SCALE: NTS

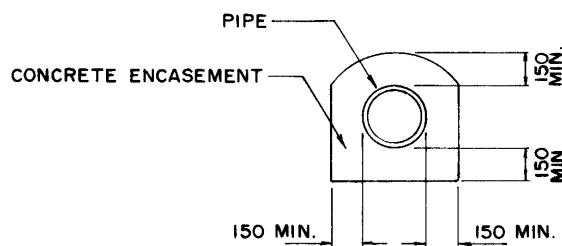
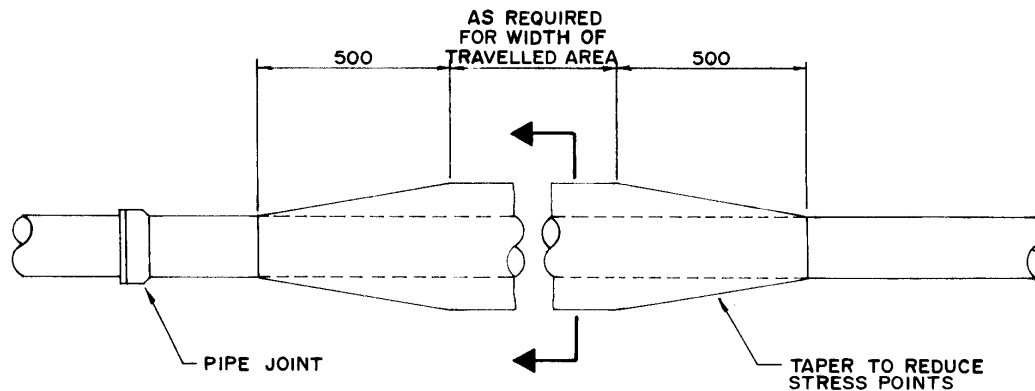


$$\text{MIN. SEPARATION (S)} = \frac{\emptyset \text{ STORM MANHOLE} + \emptyset \text{ SANITARY SEWER MANHOLE}}{2} + 300 \text{ mm}$$

COMMON TRENCH INSTALLATION

- NOTES :
1. BEDDING BELOW THE PIPE MAY BE OMITTED FOR DUCTILE IRON PIPE PROVIDED THAT HARD PAN OR ROCK IS NOT ENCOUNTERED AND THAT COWLING HOLES ARE DUG FOR BELLS.
 2. "D" & "d" REFERS TO OUTSIDE DIAMETER OF PIPE.
 3. "ø" REFERS TO OUTSIDE DIAMETER OF MANHOLE.

PORT COQUITLAM		ENGINEERING DEPT.		DATE :	DRAWING No. 102
TITLE : TRENCH SECTION FOR UTILITY INSTALLATIONS		APPROVED BY:	DESIGN BY:	DRAWN BY : LY	SCALE : N.T.S.



- NOTES : 1. CONCRETE ENCASEMENT ON ALL PIPE WITH LESS THAN 1.0m COVER IN TRAVELLED AREAS.
2. CONCRETE SHALL BE 25 MPa.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE INDICATED.

PORT COQUITLAM

ENGINEERING DEPT.

DATE :
85-07-25

DRAWING No.
103

TITLE : CONCRETE ENCASEMENT FOR
UNDERGROUND UTILITIES

APPROVED BY :
T.M.C.

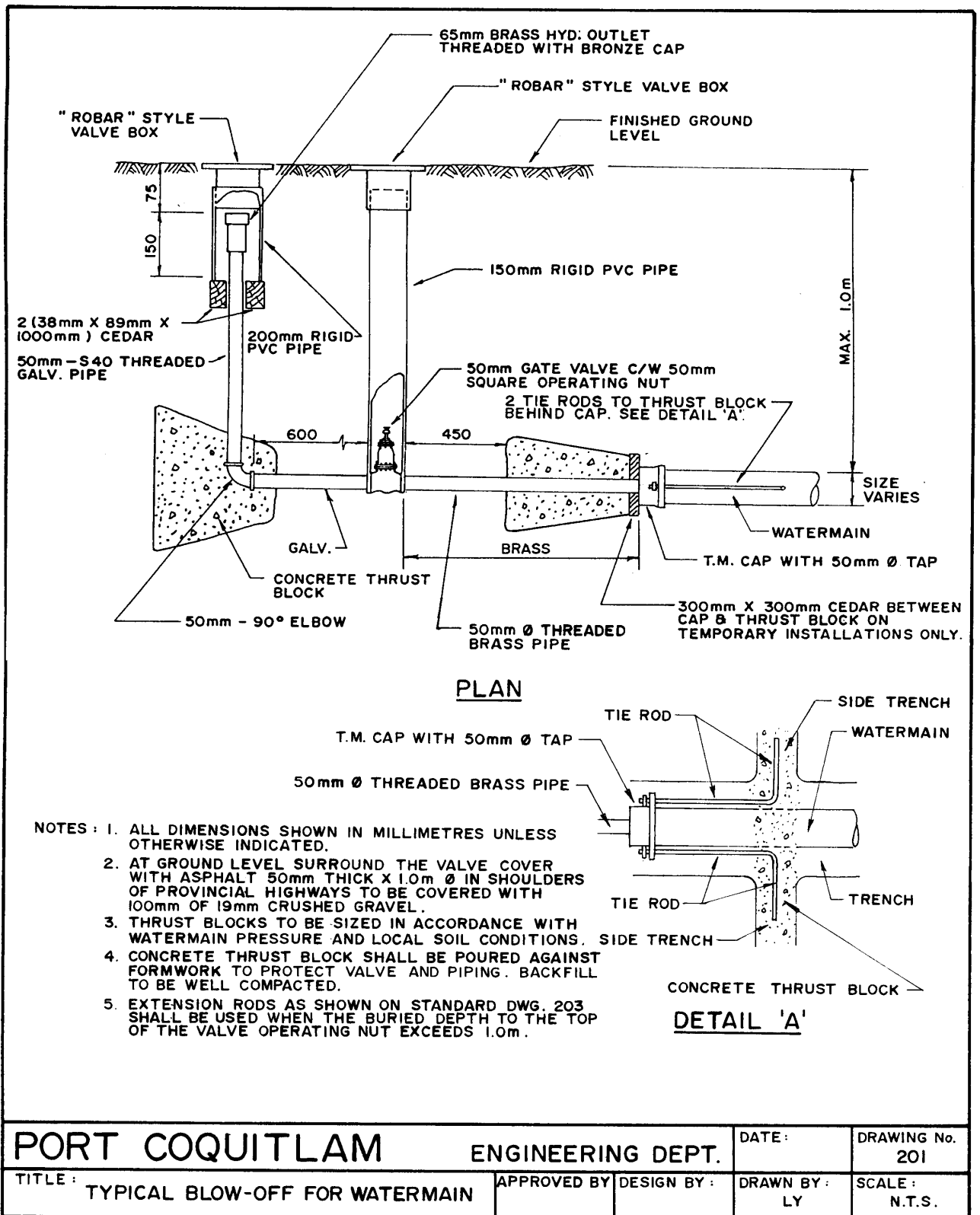
DESIGN BY :

DRAWN BY :
LY

SCALE :
N.T.S.

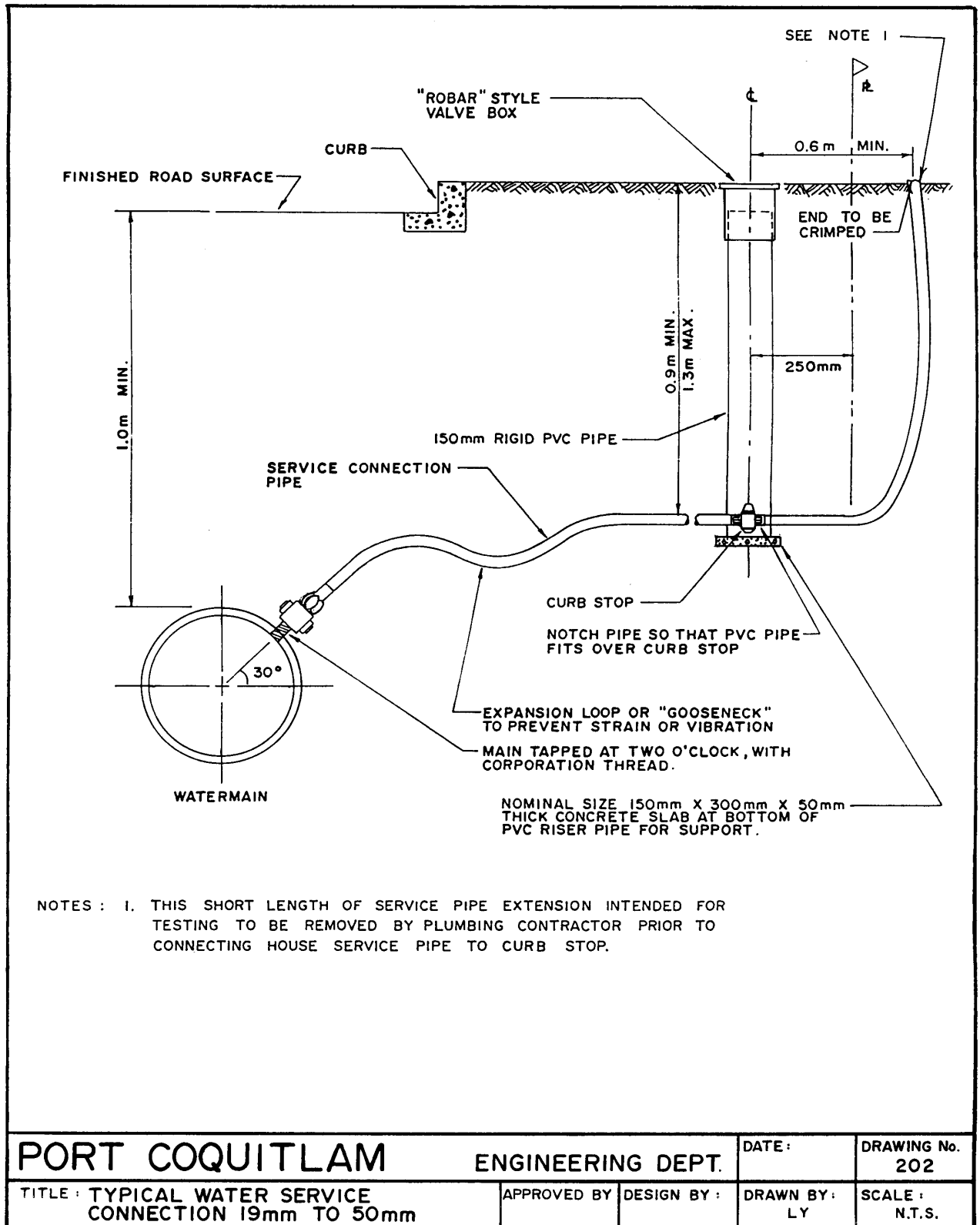
98

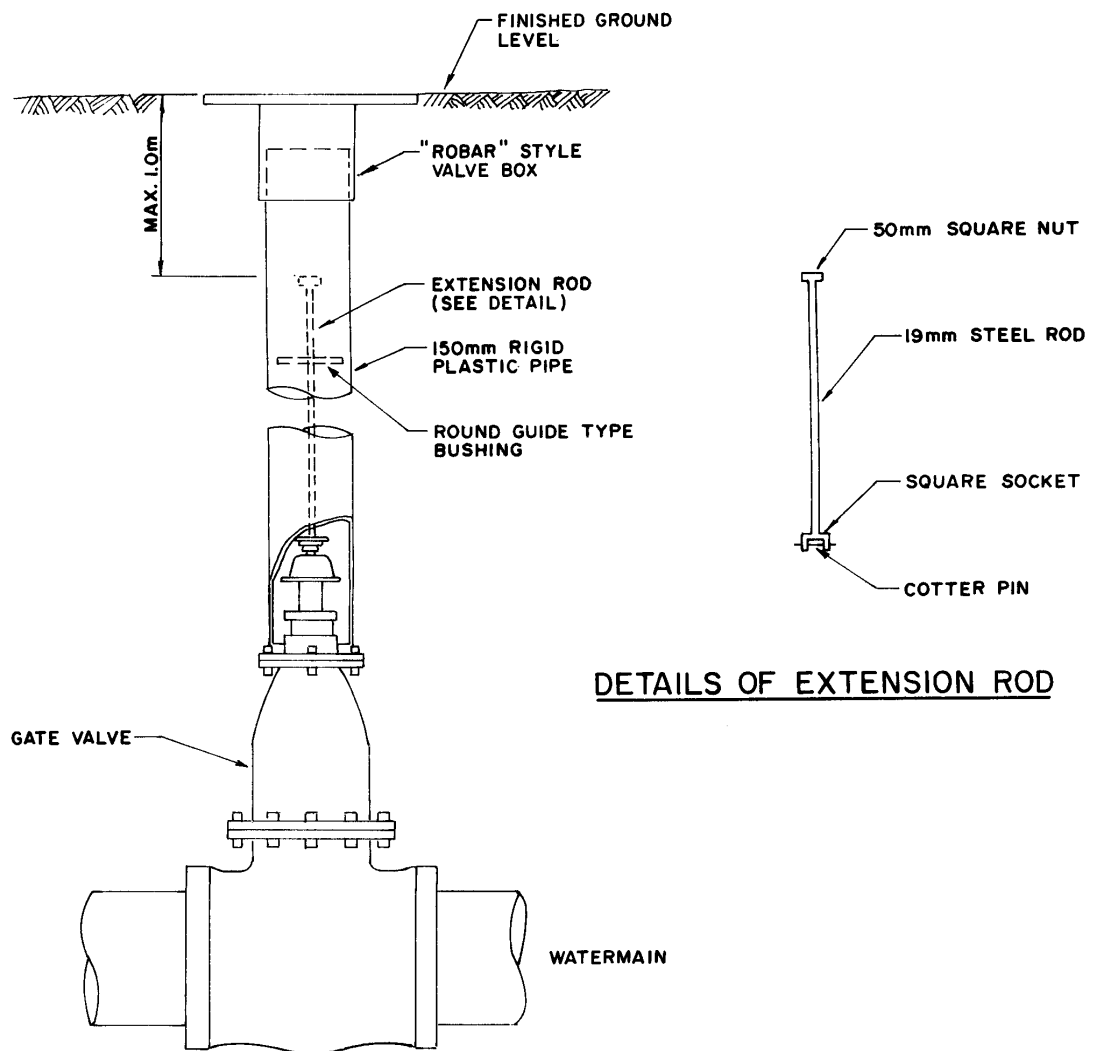
"D"
2241
84



103

"D"
2241
85





DETAILS OF EXTENSION ROD

NOTES : 1. EXTENSION RODS ONLY APPLICABLE WHEN BURY
DEPTH FROM TOP OF VALVE TO GROUND LEVEL
EXCEEDS 1.0m.

PORT COQUITLAM

ENGINEERING DEPT.

DATE :
85-02-6

DRAWING No.
203

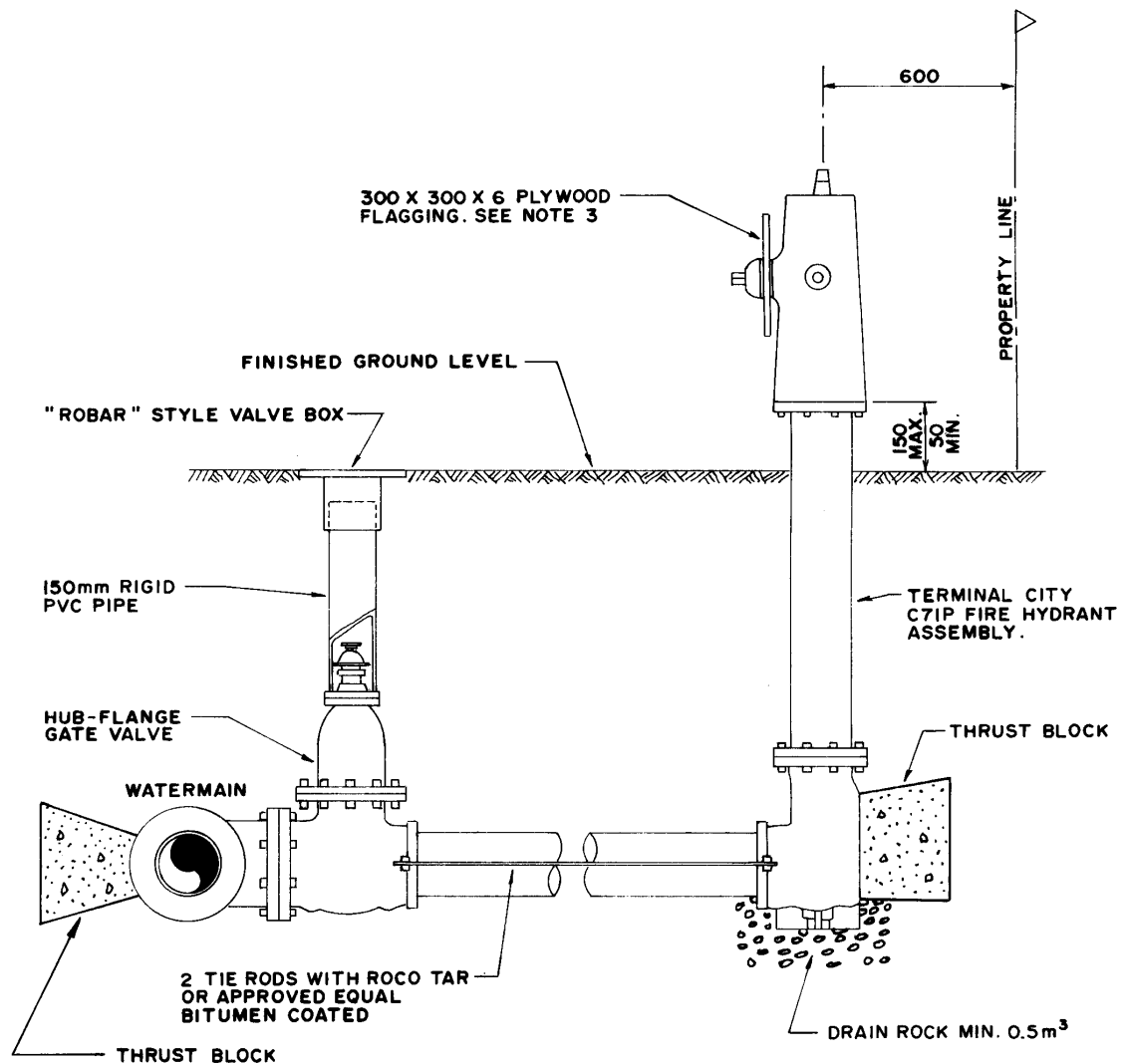
TITLE: TYPICAL GATE VALVE INSTALLATION

APPROVED BY:
me

DESIGN BY:

DRAWN BY:
LY

SCALE:
N.T.S.



- NOTES :
1. USE 19mm TIE RODS FOR PRESSURES 1 MPa AND UNDER.
USE 25mm TIE RODS FOR PRESSURES OVER 1 MPa.
 2. CHECK WITH HYDRANT MANUFACTURER FOR EXTENSION ON DEEP BURY.
 3. HYDRANT TO BE FLAGGED WITH A 300 X 300 X 6 PIECE OF PLYWOOD PAINTED FLUORESCENT ORANGE WHEN NOT CONNECTED TO MUNICIPAL SYSTEM.
 4. ALL DIMENSIONS SHOWN IN MILLIMETRES UNLESS OTHERWISE SHOWN.

PORT COQUITLAM

ENGINEERING DEPT.

DATE: 86-01-28

DRAWING No. 204

TITLE: TYPICAL FIRE HYDRANT DETAIL

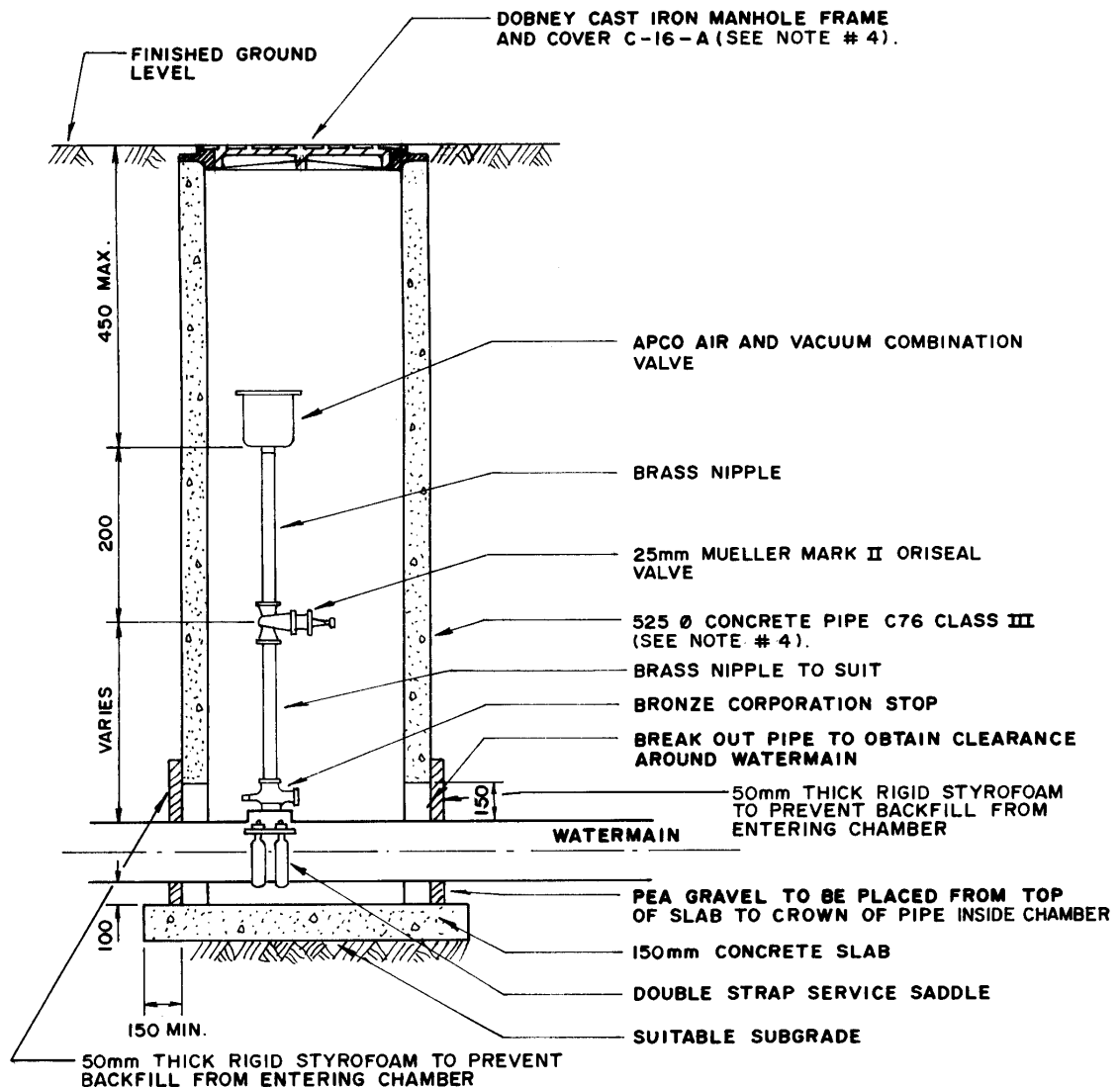
APPROVED BY: *TML*

DESIGN BY:

DRAWN BY: LY

SCALE: N.T.S.

CAPS PLUGS & TEES			90° ELBOWS		45° ELBOWS		22 1/2° ELBOWS		11 1/4° ELBOWS		VERTICAL BENDS						
MAX. ALLOWABLE SOIL BEARING PRESSURES	FITTING SIZE mm	THRUST KG	MIN. BLOCK BEARING AREA m ²	THRUST KG	MIN. BLOCK BEARING AREA m ²	THRUST KG	MIN. BLOCK BEARING AREA m ²	THRUST KG	MIN. BLOCK BEARING AREA m ²	THRUST KG	MIN. BLOCK BEARING AREA m ²	SEE 22 1/2° ELBOW	SEE NOTE #5	NOTES			
958 KILOPASCALS HARDPAN OR SHALE	100	1011	.010	1429	.015	1011	.010	547	.006	279	.003			1. CONCRETE THRUST BLOCKS SHALL EXTEND INTO UNDISTURBED SOIL. THRUST IN SOFT UNSTABLE SOILS WILL REQUIRE REMOVAL OF SOIL AND REPLACEMENT WITH COMPACTED AND MEASUREMENT OF SUFFICIENT STABILITY TO RESIST THRUST, OR OTHER THRUST RESTRAINT METHOD AS APPROVED BY THE CITY ENGINEER. 2. BLOCKING WILL BE REQUIRED FOR ALL ELBOWS, TEES, PLUGS, CAPS, PIPE DEFLECTORS AND OTHER FITTINGS ON LIVE MAINS WHERE TIE RODS ARE NOT PRACTICAL. 3. THRUST BLOCKS SHALL BE OF AT LEAST 2000 PSI STRENGTH CONCRETE OR HIGH EARLY STRENGTH CONCRETE AS SUBSTITUTE. 4. BLOCKING SHALL BE KEPT CLEAR OF BELLS AND NUTS. 5. AT VERTICAL BENDS BLOCKING SHALL BE OF SUFFICIENT WEIGHT TO RESIST OUTWARD THRUST DUE TO INTERNAL PRESSURE. SIZE DETERMINED BY DESIGN ENGINEER.) 6. THRUST BLOCKS FOR LARGER DIAMETER PIPES SHALL BE SPECIFIED BY DESIGN ENGINEER. 7. SIZES OF THE THRUST BLOCKS HAVE BEEN BASED ON A TEST PRESSURE OF 1.7 MPa.			
	150	2273	.023	3214	.033	2272	.023	1230	.013	627	.006						
	200	4042	.041	5715	.059	4041	.041	2187	.022	1115	.011						
	250	6315	.065	8929	.091	6314	.065	3417	.035	1742	.018						
	300	9094	.093	12858	.132	9092	.093	4921	.050	2508	.026						
575 KILOPASCALS HARD CLAY	100	1011	.017	1429	.024	1011	.017	547	.009	279	.005						
	150	2273	.039	3214	.055	2272	.039	1230	.021	627	.011						
	200	4042	.069	5715	.098	4041	.069	2187	.037	1115	.019						
	250	6315	.108	8929	.152	6314	.108	3417	.058	1742	.030						
287 KILOPASCALS SAND COARSE, LOOSE OR FINE COMPACT	300	9094	.155	12858	.220	9092	.155	4921	.084	2508	.043						
	100	1101	.035	1429	.049	1011	.035	547	.019	279	.010						
	150	2273	.078	3214	.110	2272	.078	1230	.042	627	.021						
	200	4042	.138	5715	.195	4041	.138	2187	.075	1115	.038						
96 KILOPASCALS SOFT CLAY	250	6315	.216	8929	.305	6314	.216	3417	.117	1742	.060						
	300	9094	.310	12858	.439	9092	.310	4921	.168	2508	.086						
	100	1101	.104	1429	.146	1101	.104	547	.056	279	.029						
	150	2273	.233	3214	.330	2272	.233	1230	.126	627	.064						
	200	4042	.414	5715	.585	4041	.414	2187	.224	1115	.114						
	250	6315	.647	8929	.914	6314	.647	3417	.350	1742	.178						
	300	9094	.931	12858	1.317	9092	.931	4921	.504	2508	.257						
PORT COQUITLAM														DATE: 85-02-18	DRAWING No. 205		
TITLE: THRUST BLOCK DETAILS														APPROVED BY:	DESIGN BY:	DRAWN BY:	SCALE: N.T.S.



- NOTES :**
1. AIR VALVE MUST BE ABOVE WATER TABLE.
 2. ALL DIMENSIONS SHOWN IN MILLIMETRES UNLESS OTHERWISE INDICATED.
 3. SIZE OF AIR VALVE TO BE SPECIFIED BY DESIGN ENGINEER, MIN. 25mm.
 4. MANHOLE FRAME AND COVER AND CONCRETE CHAMBER SPECIFIED HEREIN ARE FOR WATERMAIN MAXIMUM SIZE 200mm ONLY. FOR LARGER WATERMAINS SIZE OF CHAMBER MUST BE INCREASED TO ALLOW FOR MINIMUM 300mm CLEARANCE BETWEEN O.D. OF WATERMAIN AND I.D. OF CONCRETE CHAMBER.

PORT COQUITLAM

ENGINEERING DEPT.

DATE :

DRAWING No.

206

TITLE: AIR VALVE CHAMBER

APPROVED BY:

TMG

DESIGN BY:

DRAWN BY:

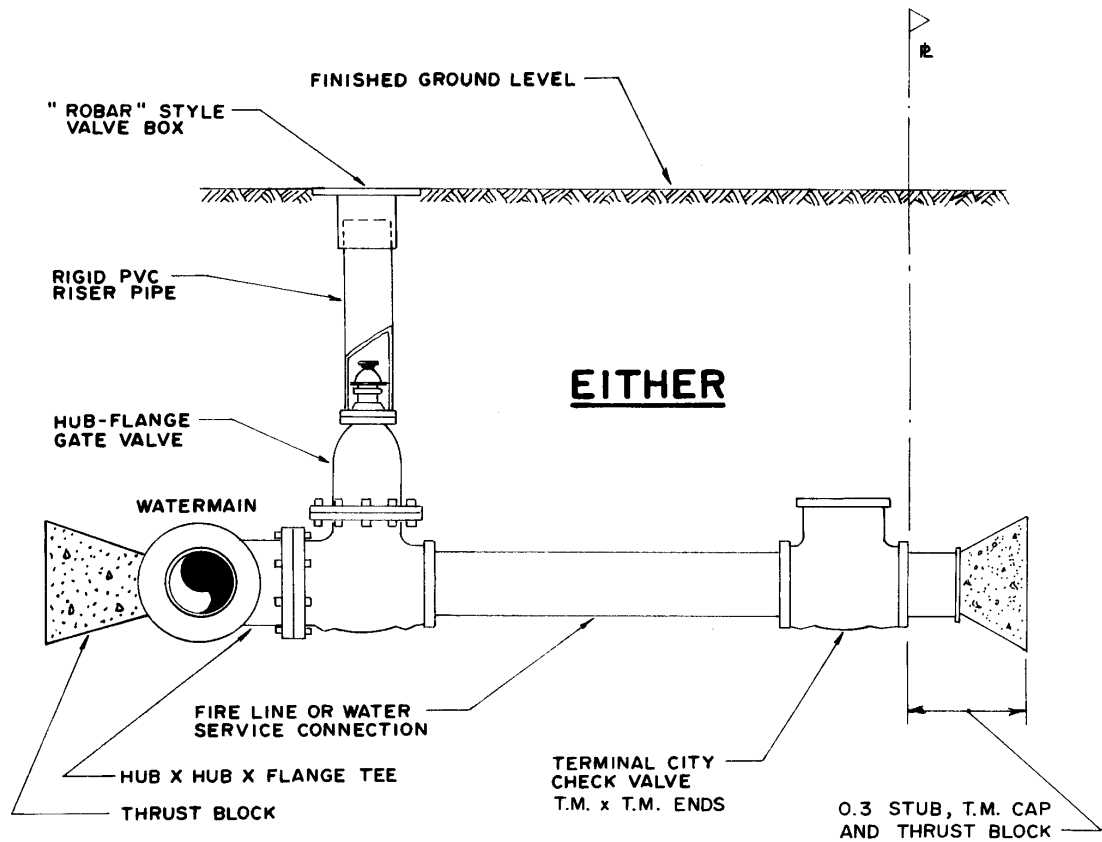
LY

SCALE:

N.T.S.

108

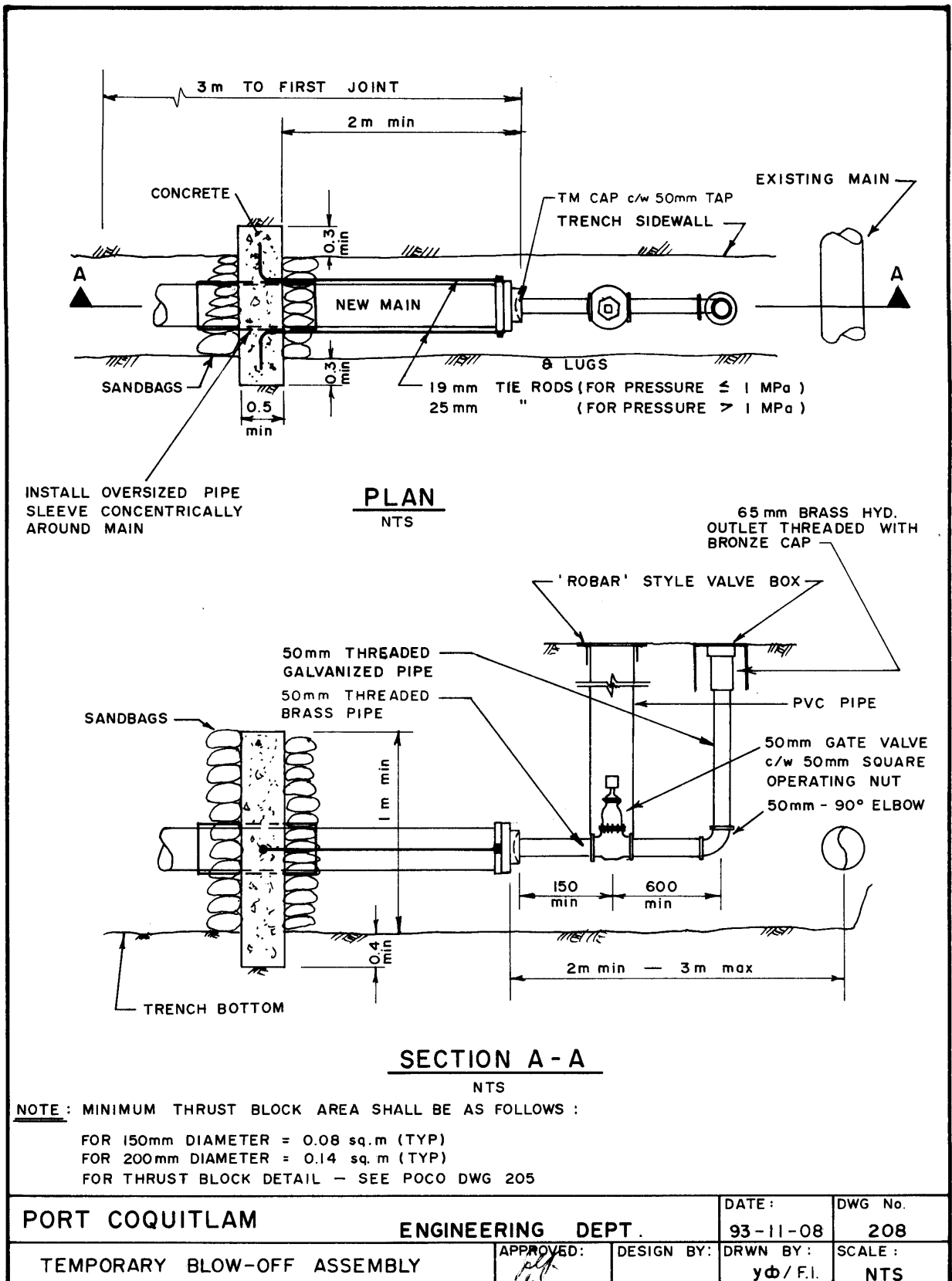
"D"
2241
90

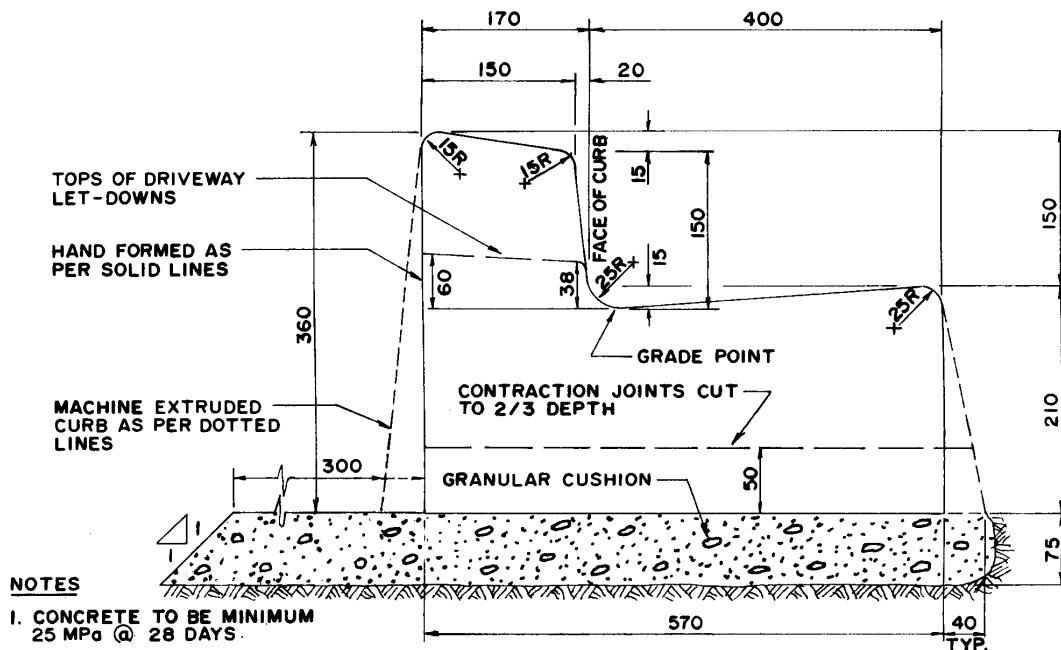


PORT COQUITLAM		ENGINEERING DEPT.		DATE:	DRAWING No.
TITLE: TYPICAL FIRE LINE AND WATER SERVICE CONNECTION 100mm AND LARGER		APPROVED BY: <i>T.M.C.</i>		DESIGN BY:	207
				DRAWN BY: LY	SCALE: N.T.S.

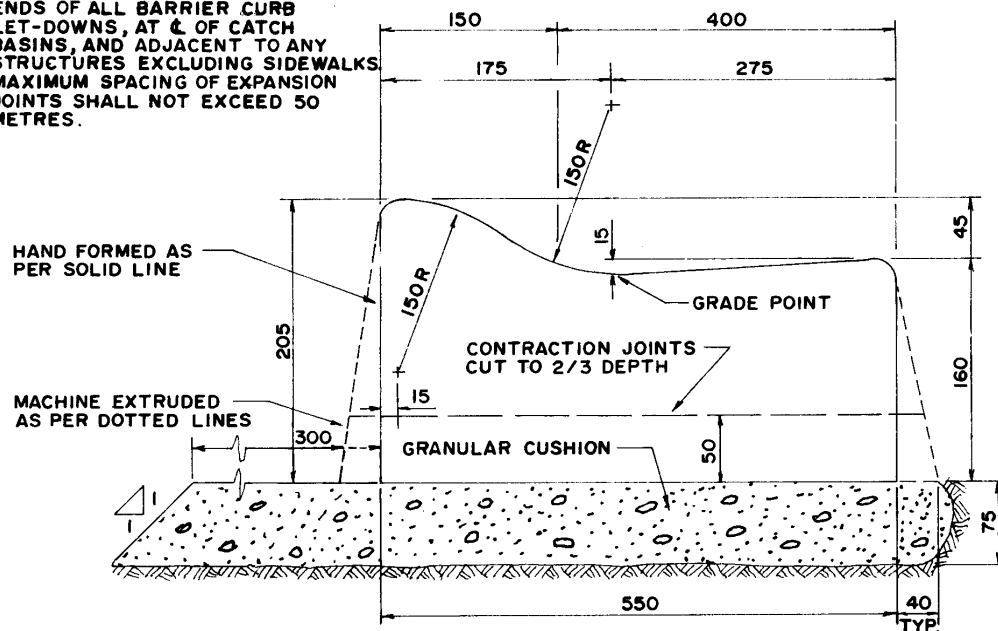
109

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91





BARRIER CURB AND GUTTER



MOUNTABLE CURB AND GUTTER

ALL DIMENSIONS SHOWN IN MILLIMETRES UNLESS OTHERWISE NOTED

PORT COQUITLAM

ENGINEERING DEPT.

DATE: 86-01-30

DRAWING No. 301

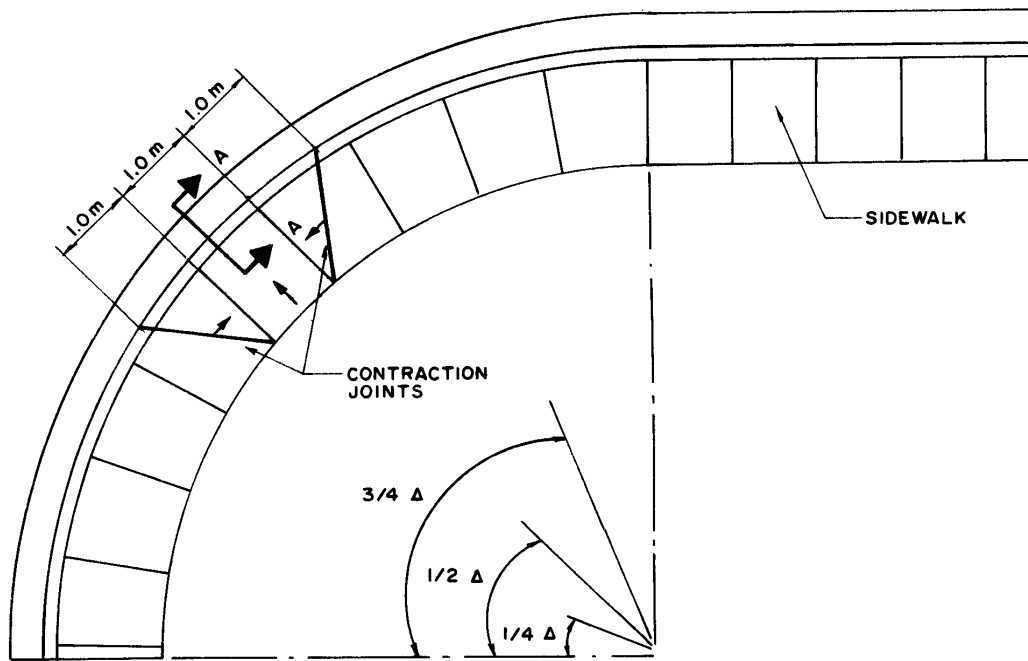
TITLE: CURB AND GUTTER SECTIONS

APPROVED BY: *Ting*

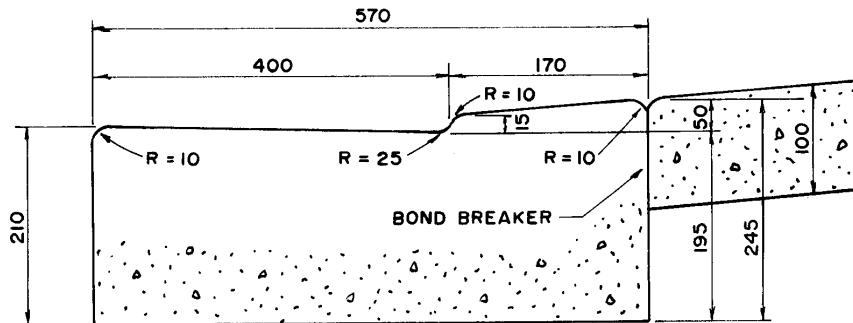
DESIGN BY:

DRAWN BY: LY

SCALE: N.T.S.



WHEELCHAIR RAMP



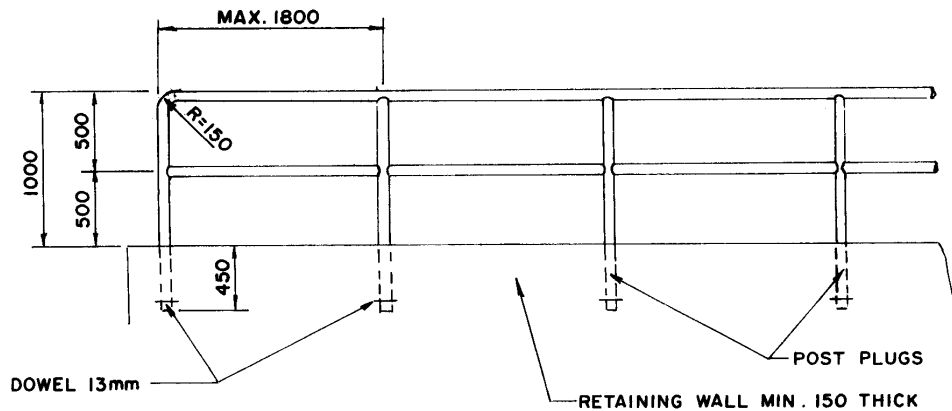
**SECTION A-A
CURB AND GUTTER AT WHEELCHAIR
RAMP IN CURB RETURN**

- NOTES : 1. ALL DIMENSIONS SHOWN IN MILLIMETRES UNLESS OTHERWISE INDICATED.
2. ALTERNATE LOCATIONS FOR Δ OF RAMP MAY BE AT $1/4 \Delta$ AND/OR $3/4 \Delta$ DEPENDENT ON LOCATION OF CROSSWALKS.
3. WHEELCHAIR RAMP EDGES & SURFACE TO BE FINISHED AS PER SIDEWALK.

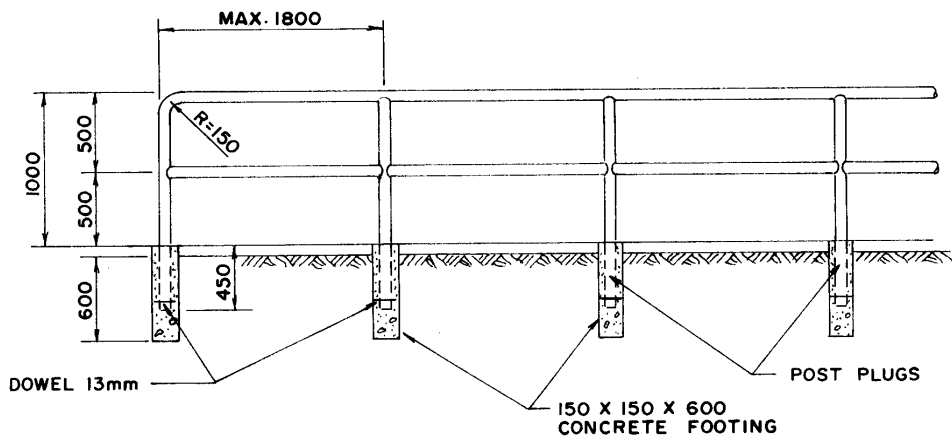
PORT COQUITLAM		ENGINEERING DEPT.		DATE : 86-01-30	DRAWING No. 303
TITLE: WHEELCHAIR RAMP DETAILS		APPROVED BY: TMC	DESIGN BY:	DRAWN BY: LY	SCALE: N.T.S.

115

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2241
95



HANDRAIL ON RETAINING WALL



HANDRAIL ON CONCRETE POSTS IN SIDEWALK OR DIRECTLY BEHIND SIDEWALK

- NOTES :
1. HANDRAIL SHALL BE OF 42 X 3.55 WALL STANDARD GALVANIZED STEEL PIPE.
 2. JOINTS TO BE MITRED AND WELDED AND ALL WELDS GROUND SMOOTH.
 3. SET POSTS 450mm INTO CONCRETE RETAINING WALL.
 4. ALL DIMENSIONS SHOWN IN MILLIMETRES UNLESS OTHERWISE NOTED.
 5. ALL WELDED AREAS SHALL BE FINISHED WITH ONE COAT OF PRIMER AND A SURFACE COAT OF ZINC RICH PAINT TO MATCH THE GALVANIZED FINISH OF THE STEEL PIPE.
 6. WHERE HANDRAILS ARE INSTALLED ON TOP OF WING WALLS, RAILINGS SHALL BE SLOPED TO MATCH SLOPE OF WING WALLS.

PORT COQUITLAM

ENGINEERING DEPT.

DATE:
85-08-20

DRAWING No.
304

TITLE: TYPICAL HANDRAIL DETAIL

APPROVED BY:
TMC

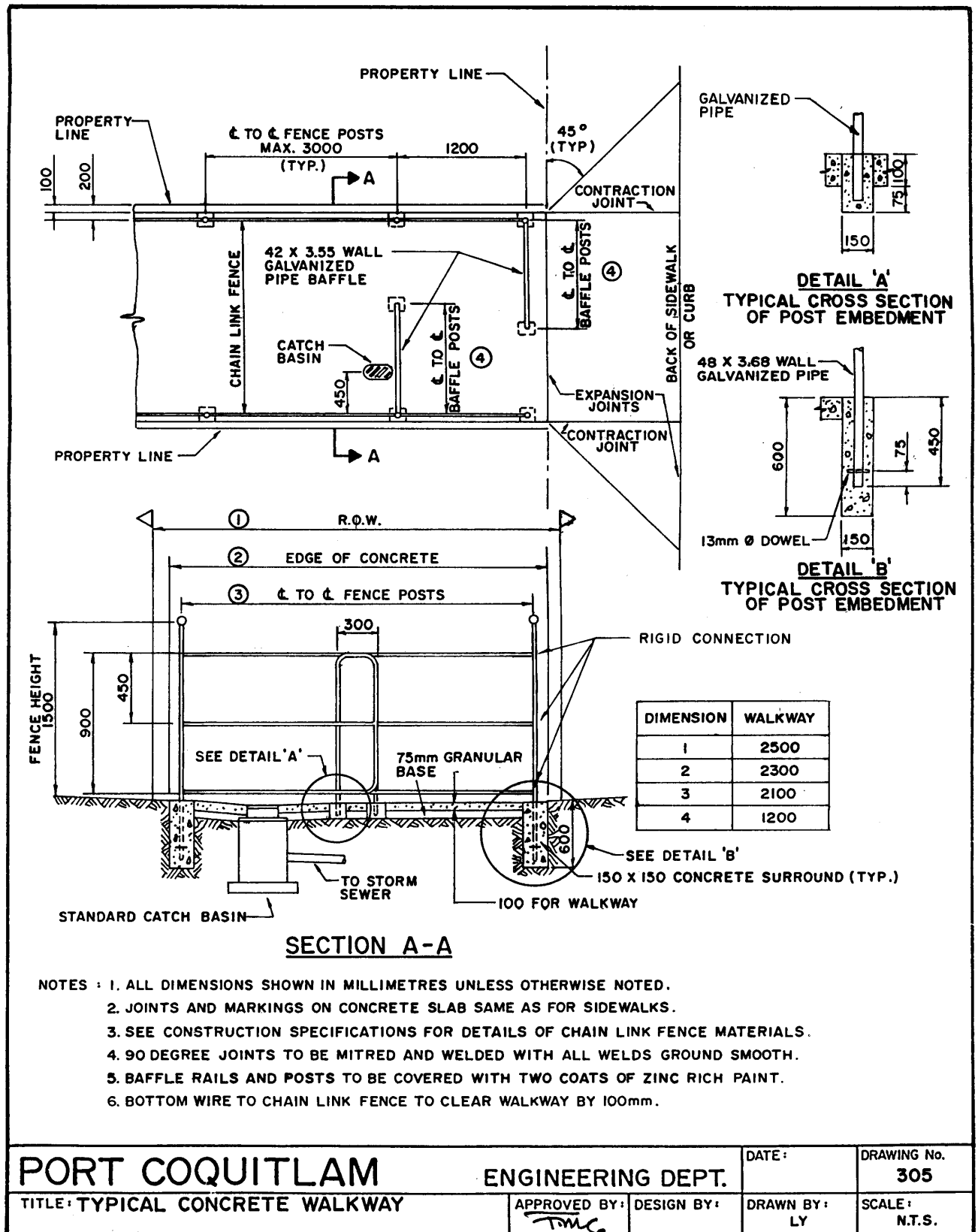
DESIGN BY:

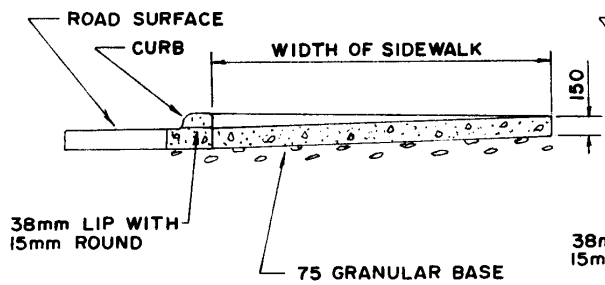
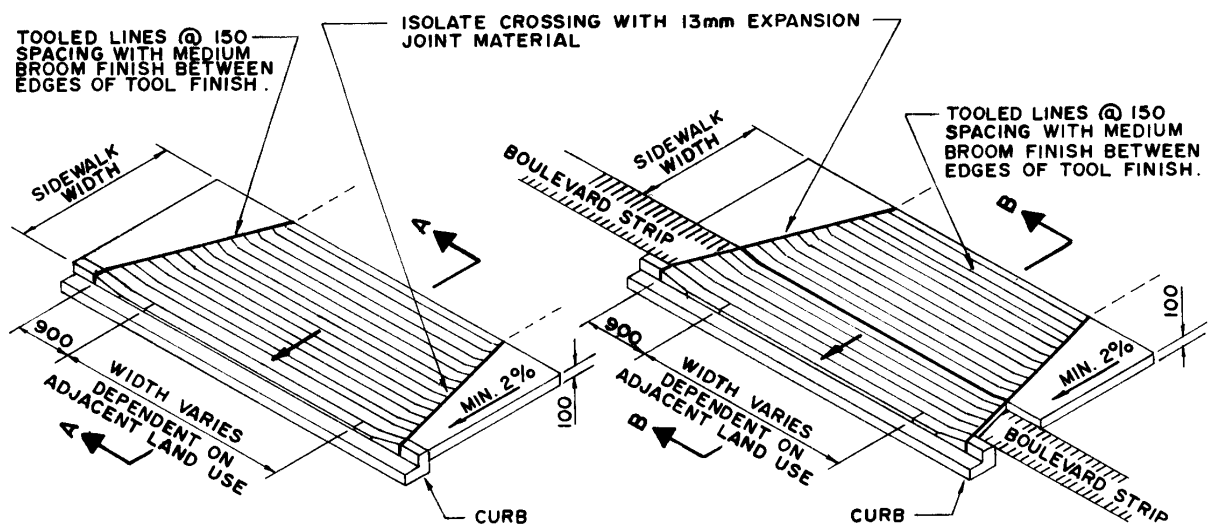
DRAWN BY:
LY

SCALE:
N.T.S.

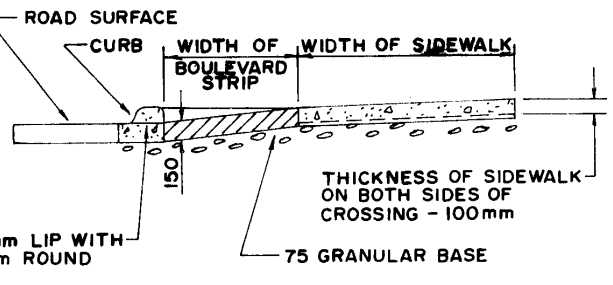
116

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2241
96





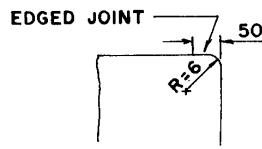
SECTION A-A



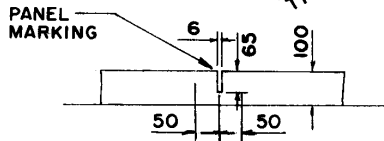
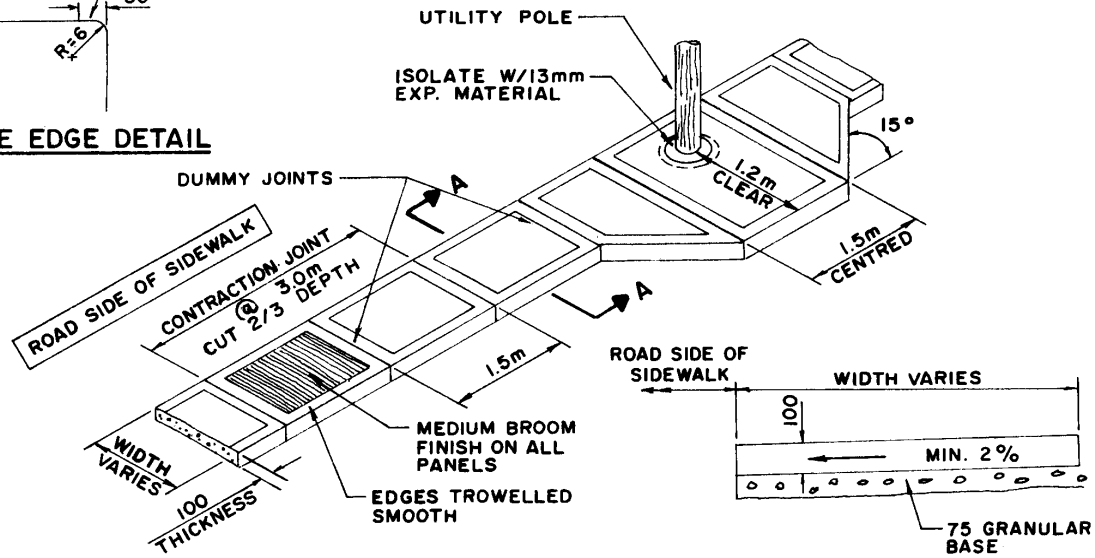
SECTION B-B

- NOTES :
1. ALL DIMENSIONS SHOWN IN MILLIMETRES UNLESS OTHERWISE INDICATED.
 2. LANE AND INDUSTRIAL DRIVEWAY CROSSINGS SHALL BE DESIGNED AS INTERSECTIONS WITH THE ROAD INCLUDING CURB RETURNS AND WHEELCHAIR RAMPS AS APPROPRIATE.
 3. SEE BY-LAW N° 2011 FOR PERMITTED LOCATIONS OF BOULEVARD CROSSINGS.
 4. FOR CROSSINGS WIDER THAN 6.0m A CONTRACTION JOINT CUT TO 2/3 DEPTH OF CROSSING TO BE INSTALLED AT CENTRE OF CROSSING PERPENDICULAR TO CURBS.

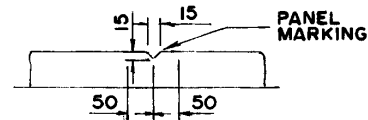
PORT COQUITLAM		ENGINEERING DEPT.		DATE: 86-01-28	DRAWING No. 306
TITLE: DRIVEWAY CROSSINGS		APPROVED BY: <i>TIME</i>	DESIGN BY:	DRAWN BY: LY	SCALE: N.T.S.



OUTSIDE EDGE DETAIL

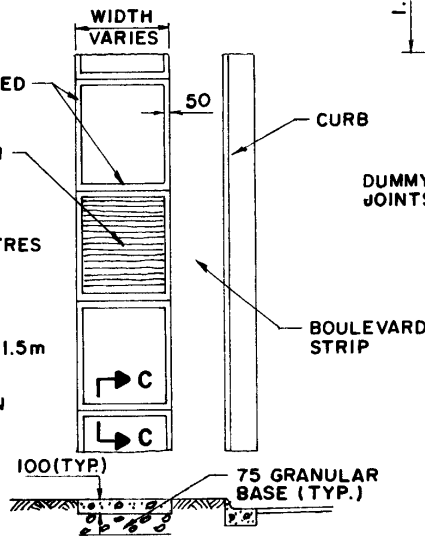
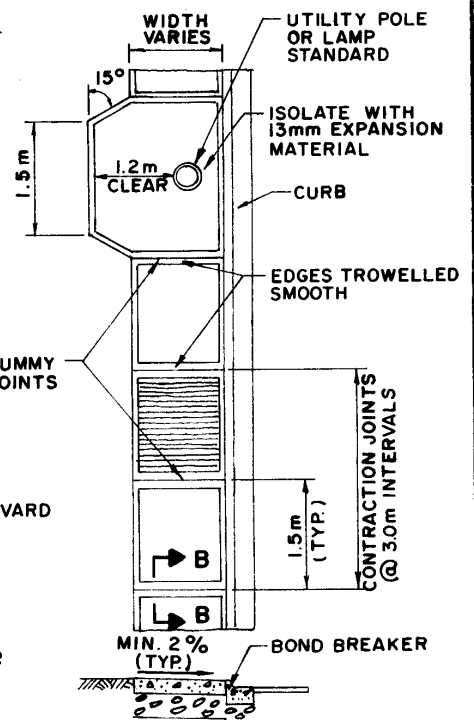


**SECTION C-C
CONTRACTION JOINT**



**SECTION B-B
DUMMY JOINT**

SECTION A-A



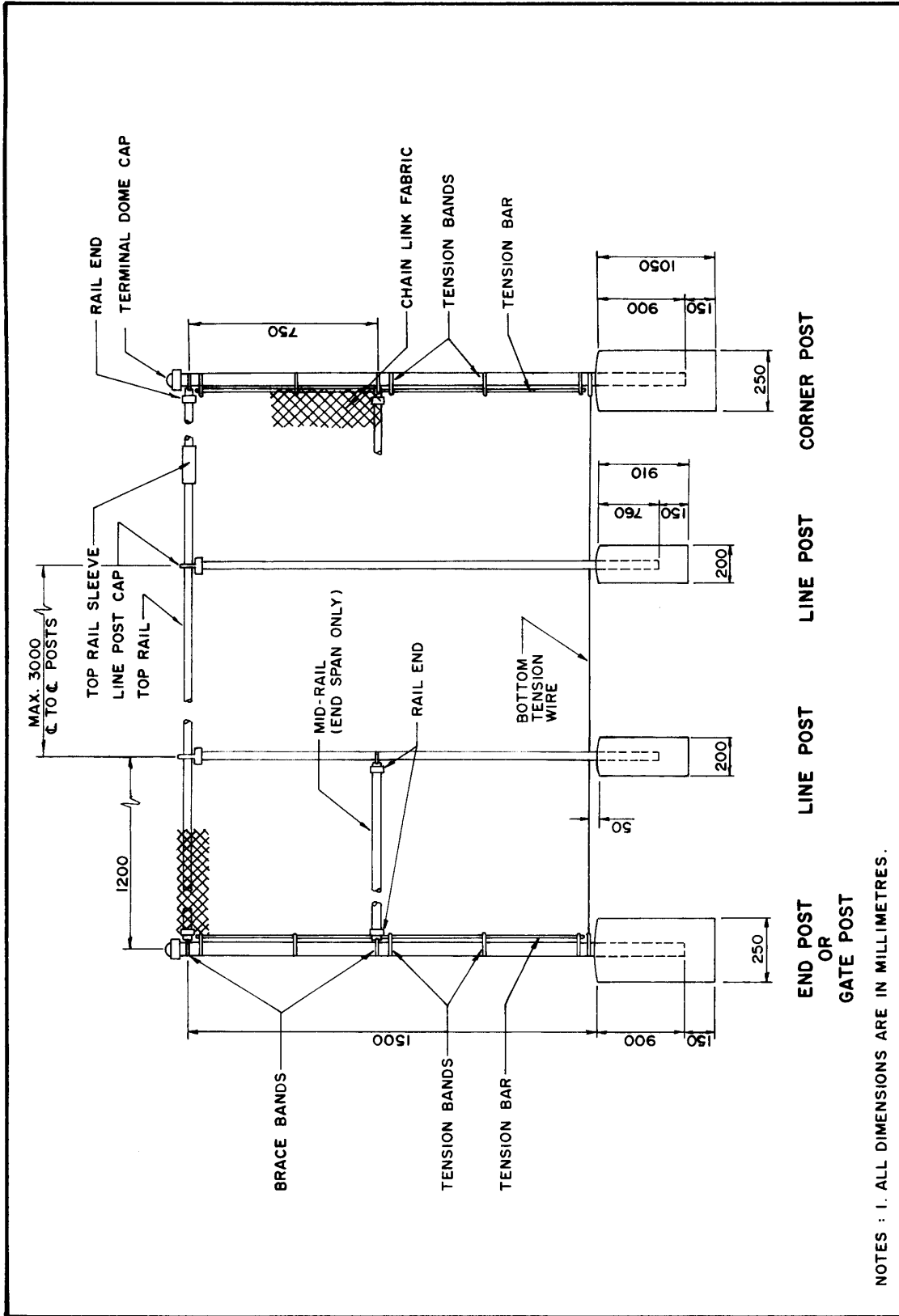
SEPARATE SIDEWALK

**SIDEWALK WITH
CURB & GUTTER**

NOTES

1. ALL DIMENSIONS SHOWN IN MILLIMETRES UNLESS OTHERWISE INDICATED.
2. MAXIMUM SPACING OF EXPANSION JOINTS IS 50 METRES.
3. WIDTH OF SIDEWALK VARIES FROM 1.5m TO 2.5m DEPENDANT UPON THE THE ADJOINING LAND USE AND ROAD CLASSIFICATION (SEE DESIGN CRITERIA)
4. THE MINIMUM THICKNESS OF SIDEWALKS IN DEVELOPMENT SITES WHERE MOUNTABLE CURBS ARE PROPOSED SHALL BE 125mm INSTEAD OF 100mm AS SHOWN HEREIN.

PORT COQUITLAM		ENGINEERING DEPT.		DATE: 86-01-28	DRAWING No. 307
TITLE: TYPICAL SIDEWALK		APPROVED BY: <i>me</i>	DESIGN BY:	DRAWN BY: LY	SCALE: N.T.S.



NOTES : 1. ALL DIMENSIONS ARE IN MILLIMETRES.

PORT COQUITLAM

ENGINEERING DEPT.

DRAWING No.
308

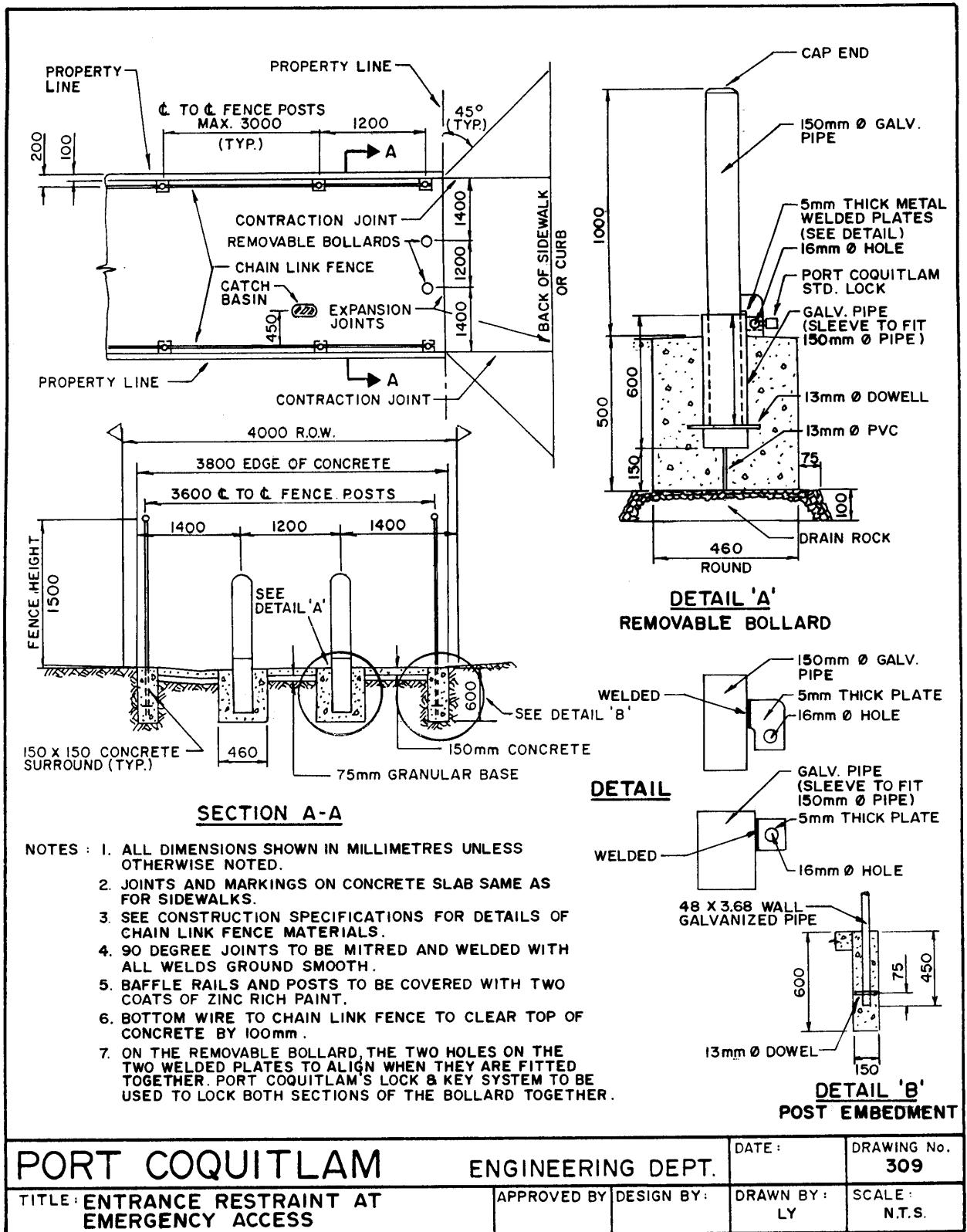
TITLE : CHAIN LINK FENCE DETAIL

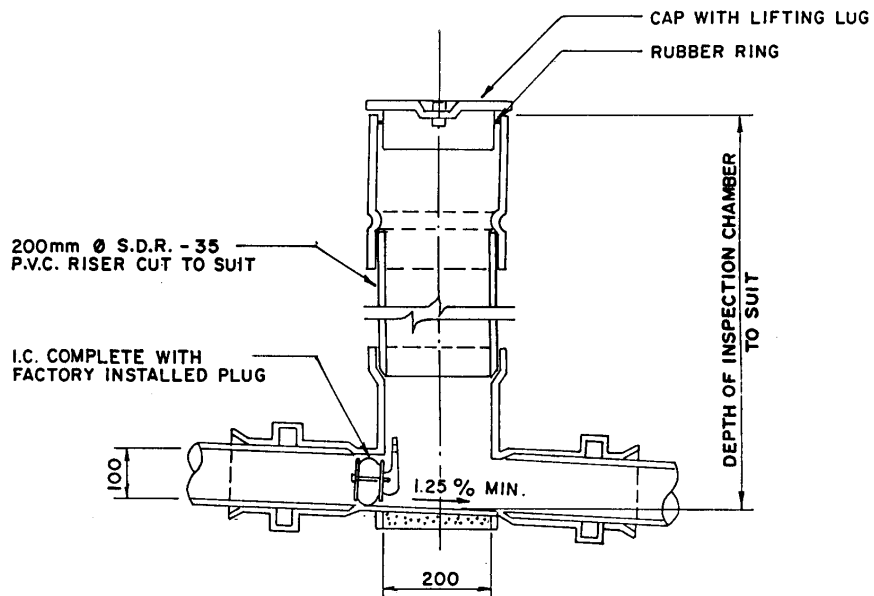
APPROVED BY : *[Signature]*

DESIGN BY : LY

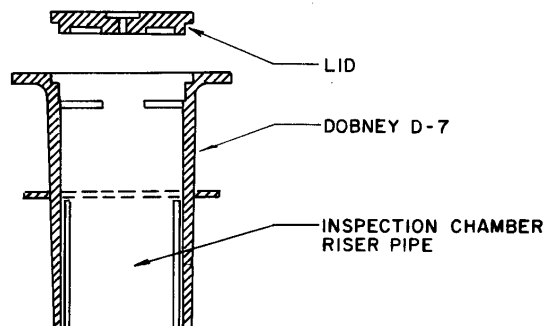
SCALE : N.T.S.

DATE : 86-02-14





PROFILE OF INSPECTION CHAMBER



INSTALLATION OF INSPECTION
CHAMBER IN DRIVEWAY, LANE & ROAD

- NOTES :
1. PAINT CAP AND BELL INSIDE AND OUTSIDE - 50mm BELOW CAP WITH RED PAINT.
 2. I.C. AND LID BY COROBAN OR LE-RON PLASTICS.
 3. ALL DIMENSIONS SHOWN IN MILLIMETRES UNLESS OTHERWISE INDICATED.

PORT COQUITLAM

ENGINEERING DEPT.

DATE :

DRAWING No.

401

TITLE : INSPECTION CHAMBER FOR 100mm
SANITARY SEWER CONNECTION

APPROVED BY :

DESIGN BY :

DRAWN BY :

SCALE :

LY

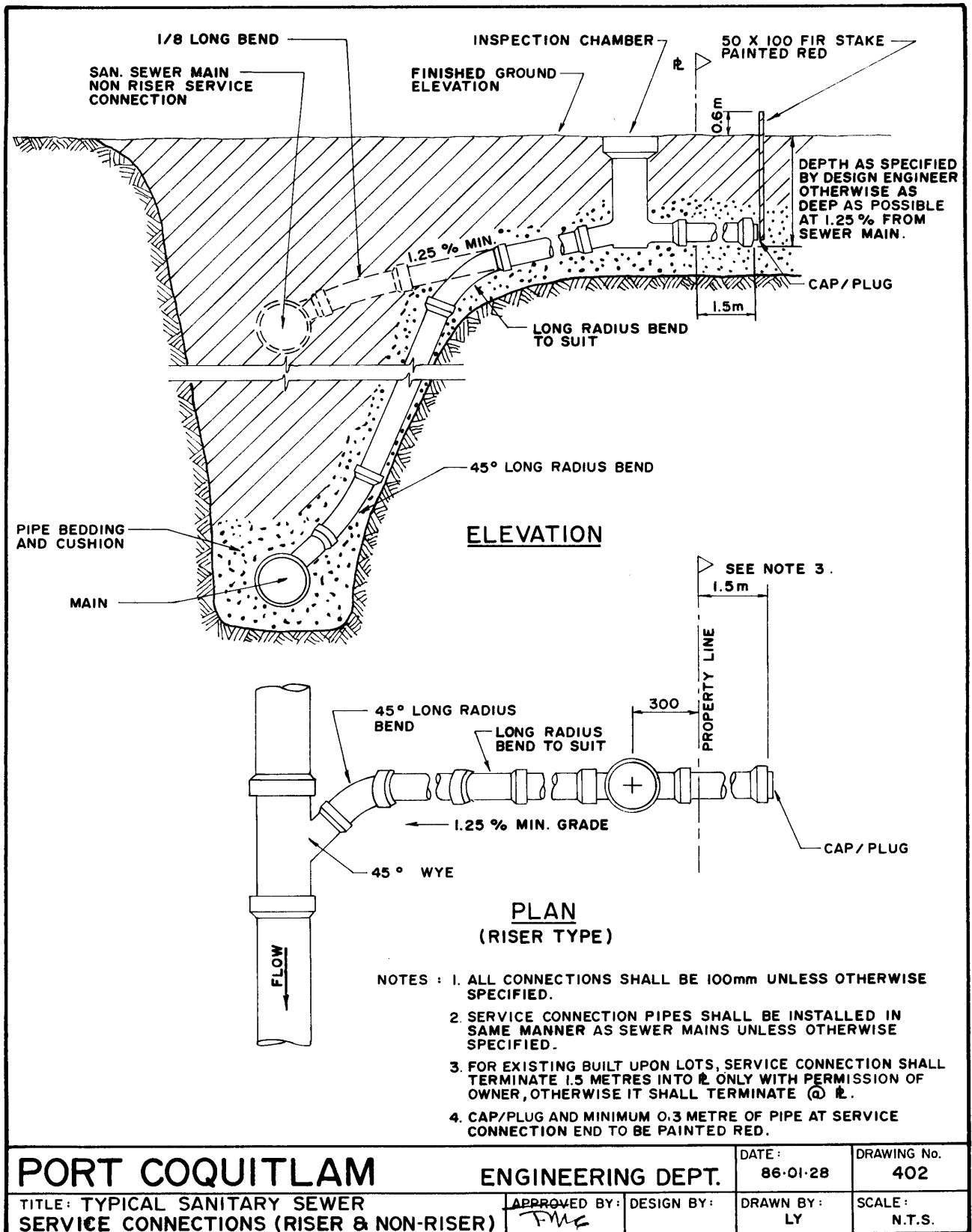
N.T.S.

125

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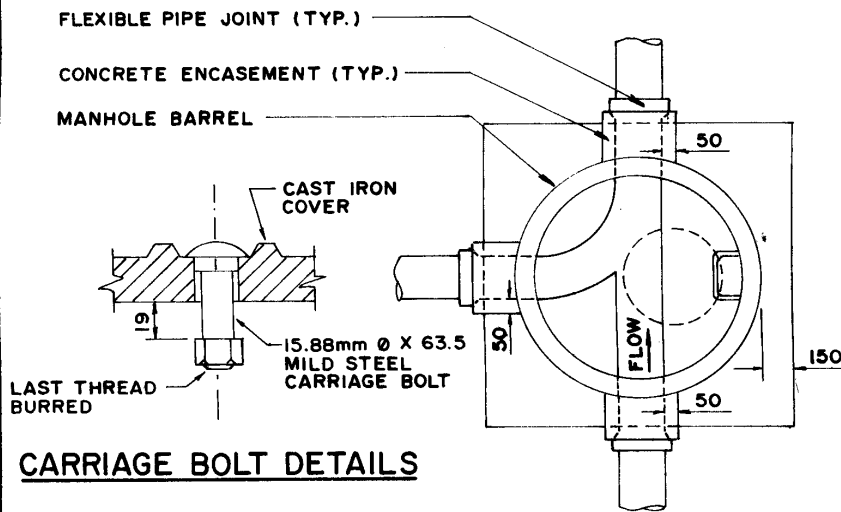
2241

102



126

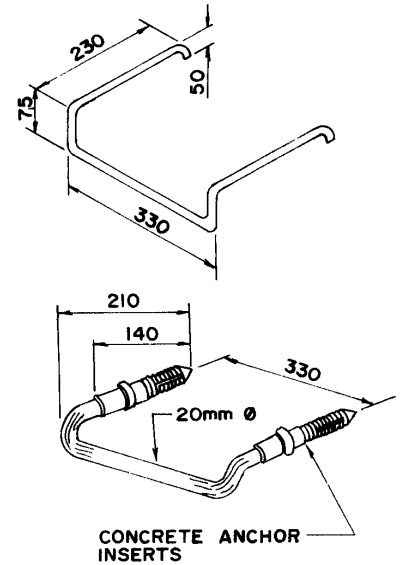
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2241
103



CARRIAGE BOLT DETAILS

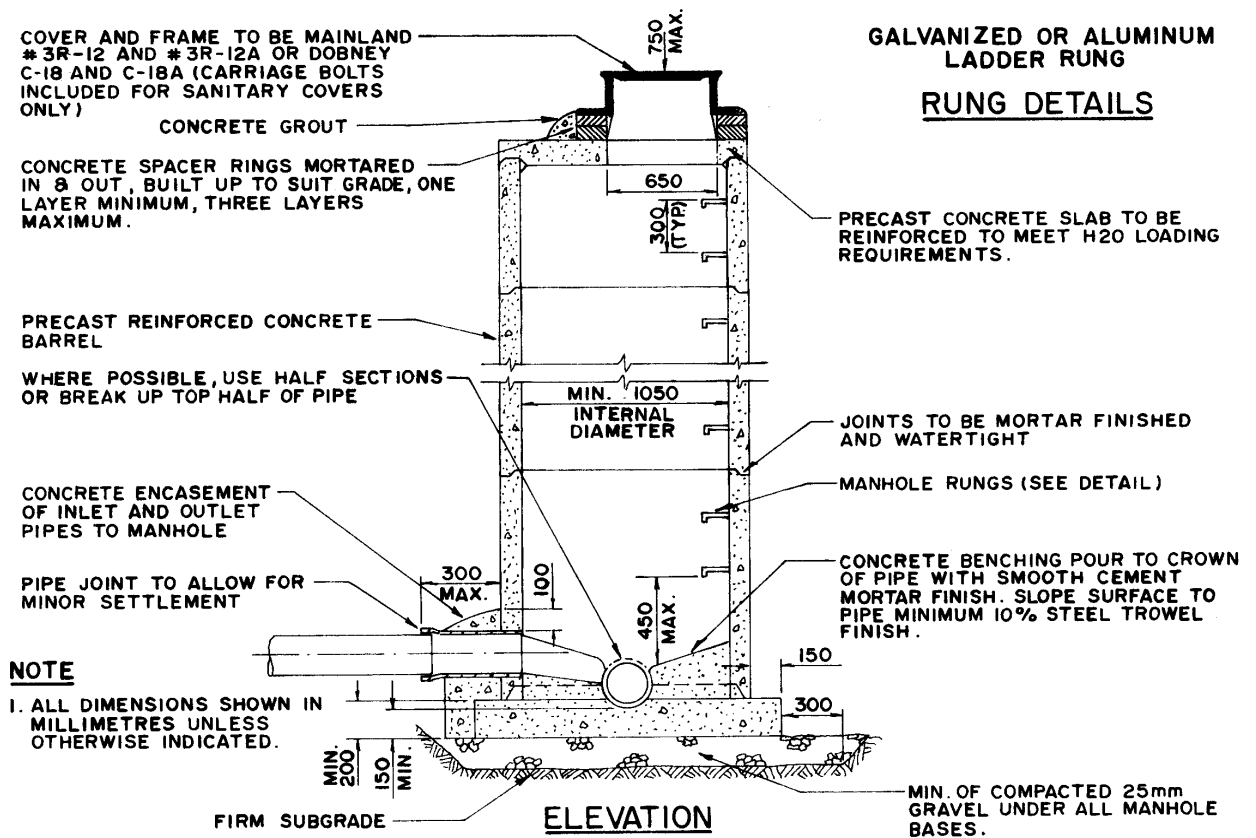
PLAN

GALVANIZED LADDER RUNG



GALVANIZED OR ALUMINUM LADDER RUNG

RUNG DETAILS



NOTE

1. ALL DIMENSIONS SHOWN IN MILLIMETRES UNLESS OTHERWISE INDICATED.

PORT COQUITLAM

ENGINEERING DEPT.

DATE: 85-03-21

DRAWING No. 403

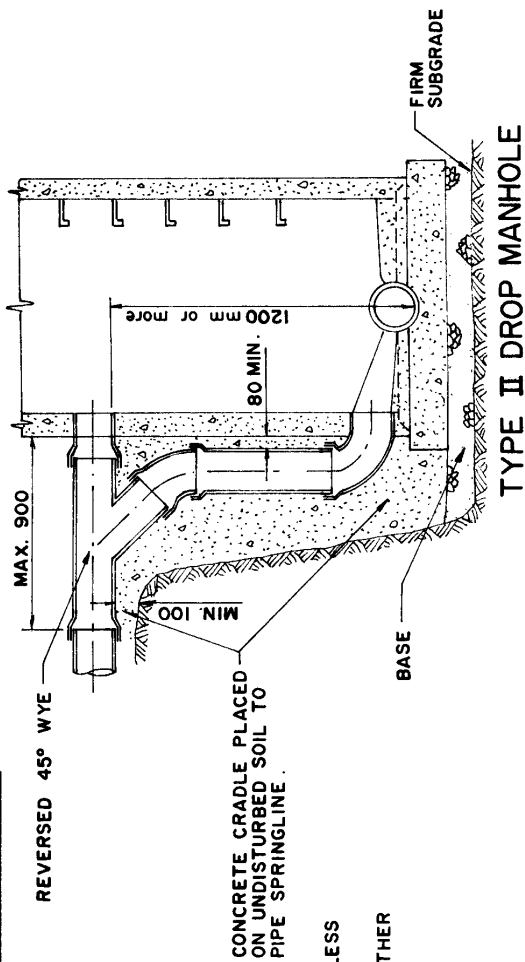
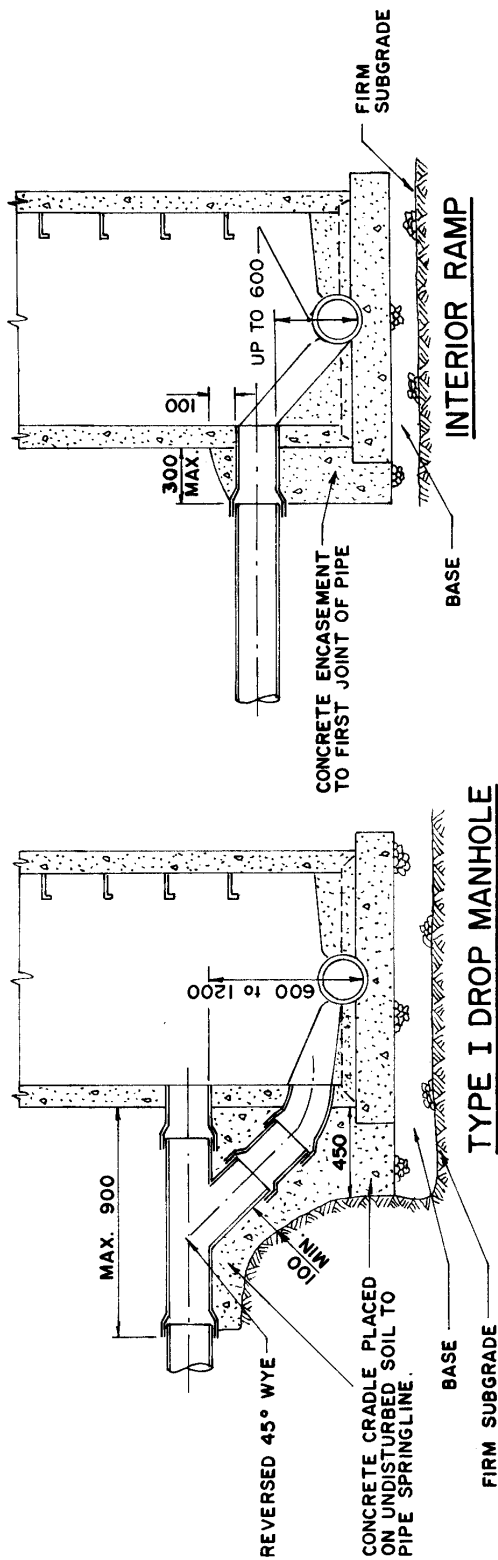
TITLE: TYPICAL MANHOLE

APPROVED BY: TMC

DESIGN BY:

DRAWN BY: LY

SCALE: N.T.S.



- NOTES : 1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE INDICATED.
2. REFER TO STANDARD DRAWING 403 FOR OTHER DETAILS OF MANHOLE CONSTRUCTION.

PORT COQUITLAM

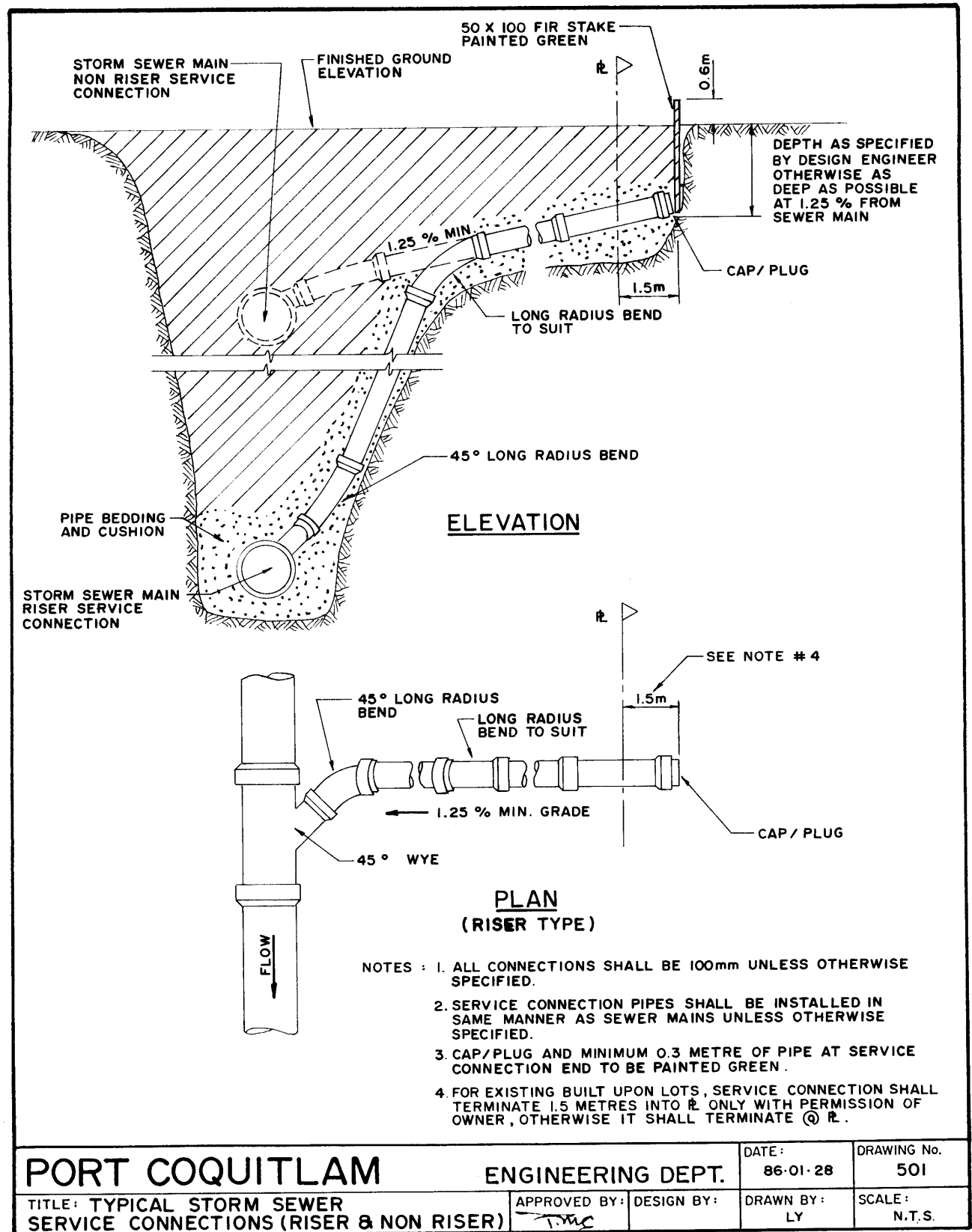
ENGINEERING DEPT.

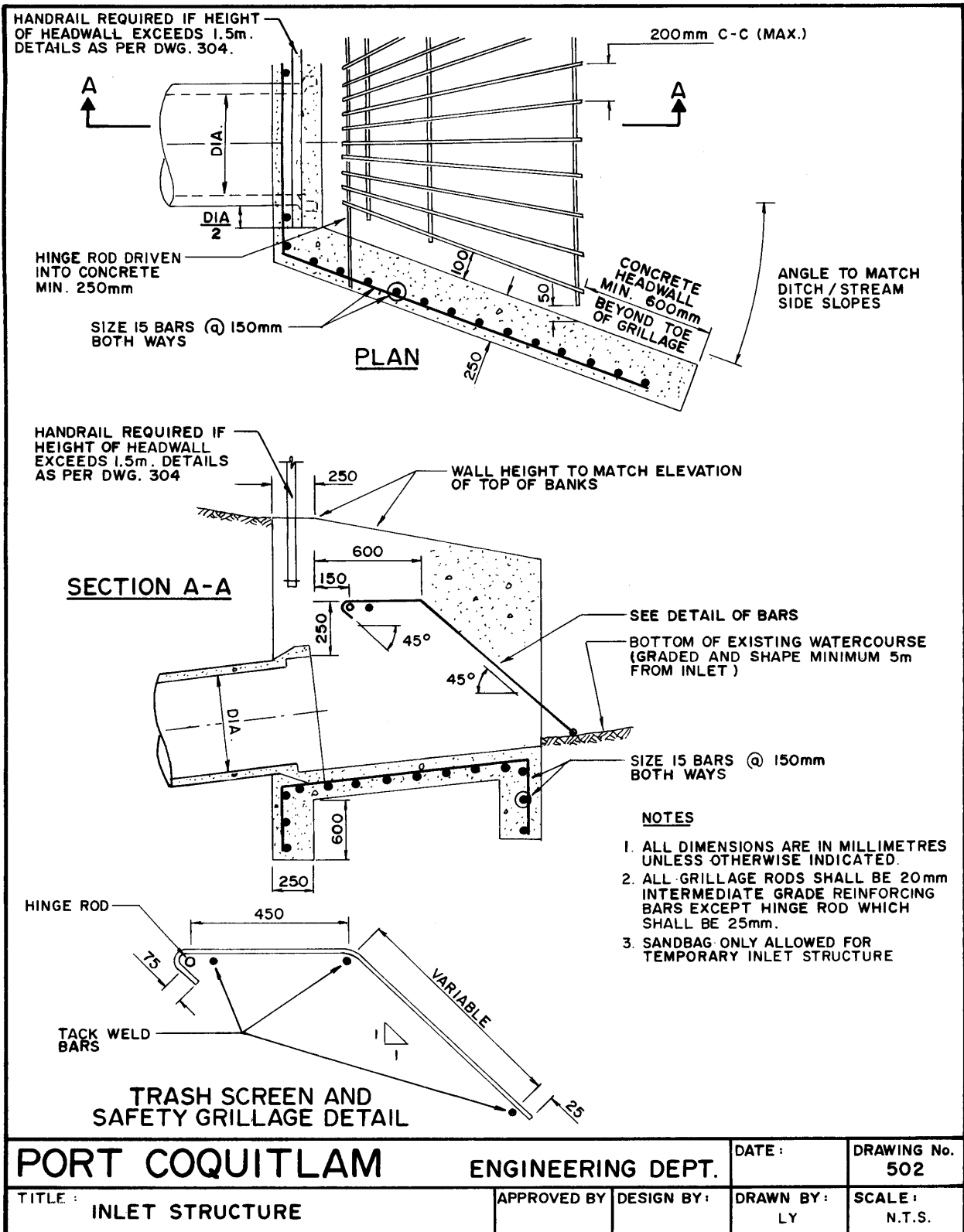
DATE: 86-11-19
DRAWING No. 404

TITLE : DROP AND INTERIOR RAMP MANHOLES

APPROVED BY: *[Signature]*
DESIGN BY: LY

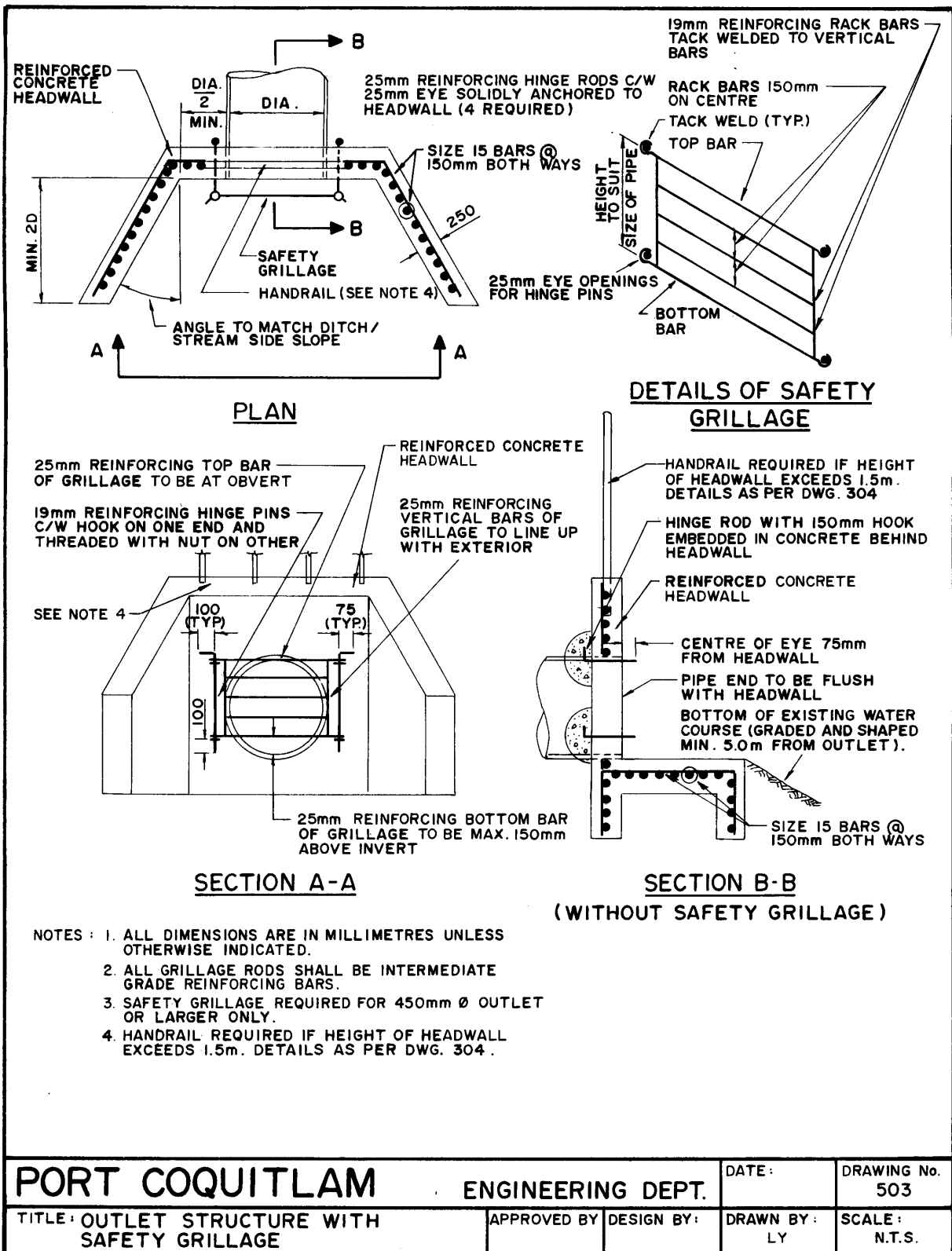
SCALE : N.T.S.

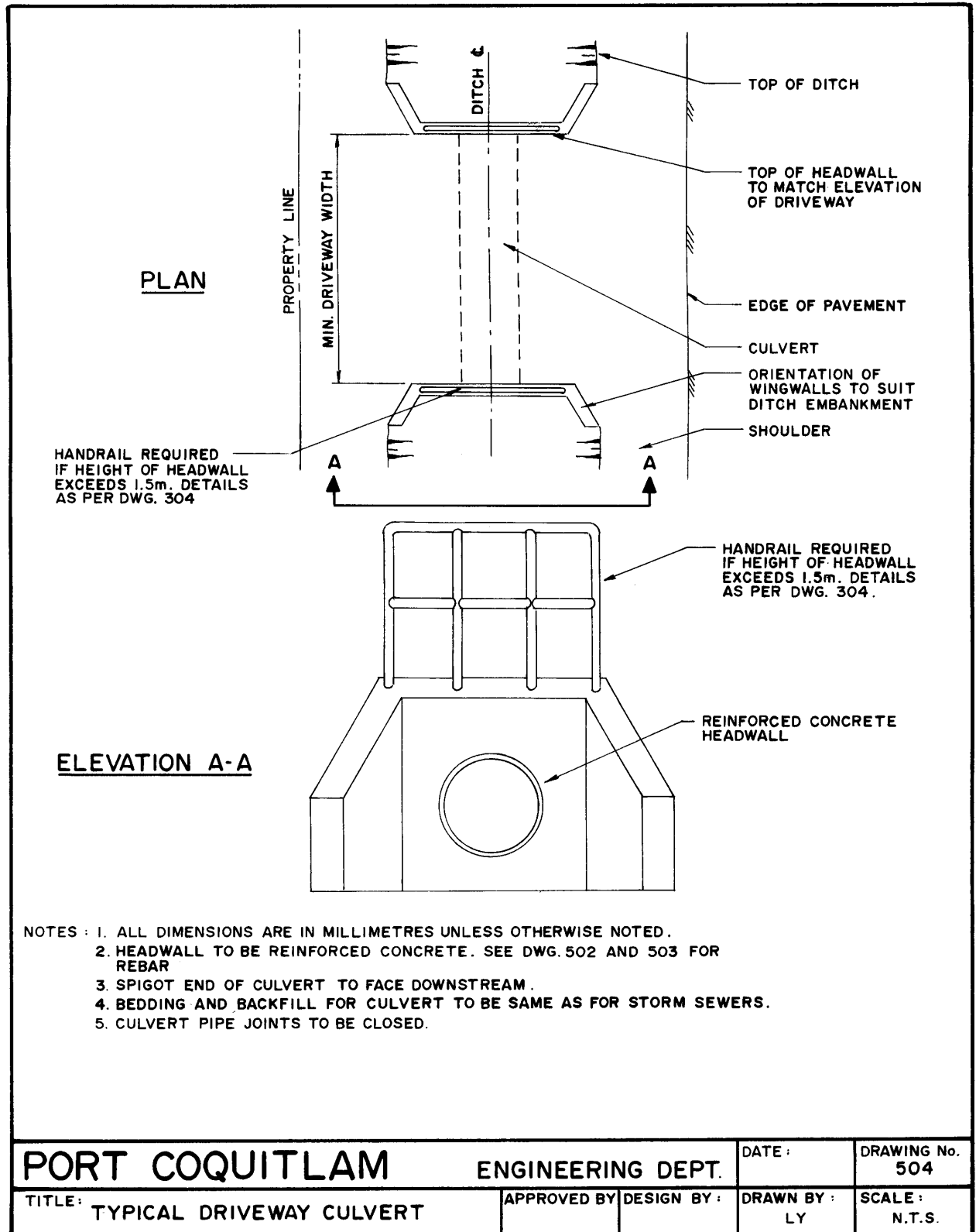


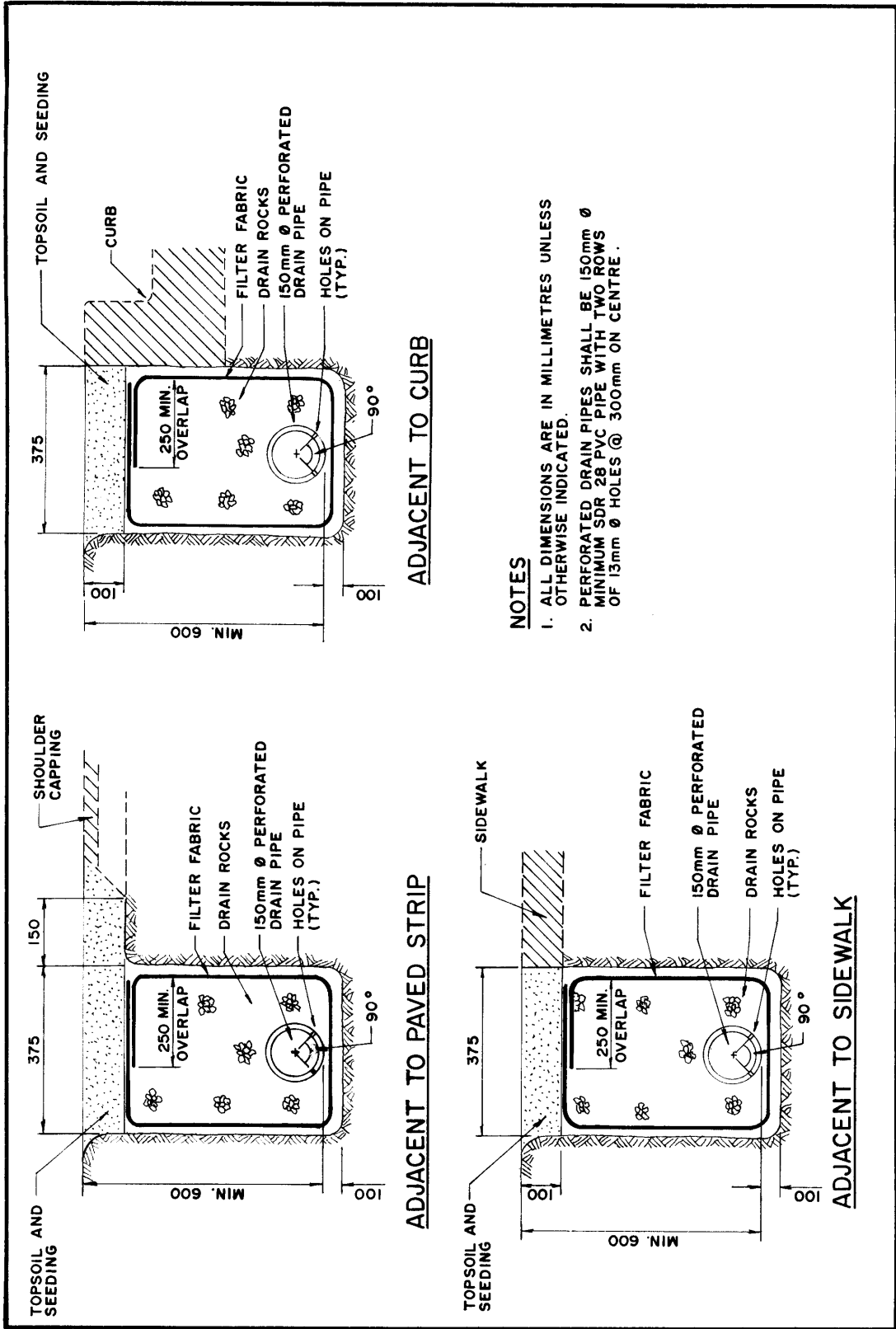


134

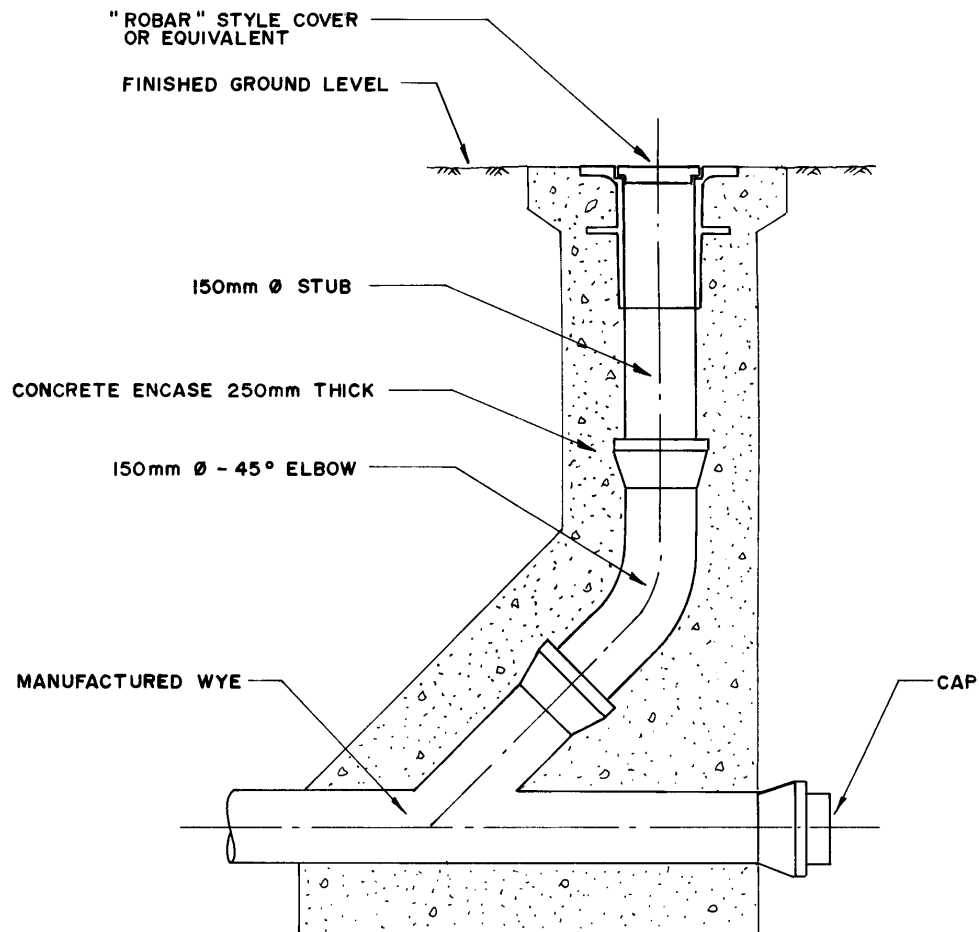
"D"
2241
107







PORT COQUITLAM			ENGINEERING DEPT.		DATE: 85-04-3	DRAWING No. 506
TITLE: TYPICAL PERFORATED DRAIN SYSTEMS			APPROVED BY: <i>tluc</i>	DESIGN BY: LY	SCALE: N.T.S.	



PORT COQUITLAM

ENGINEERING DEPT.

DATE :

DRAWING No.

507

TITLE : **TYPICAL CLEANOUT DETAIL**

APPROVED BY

DESIGN BY :

DRAWN BY :

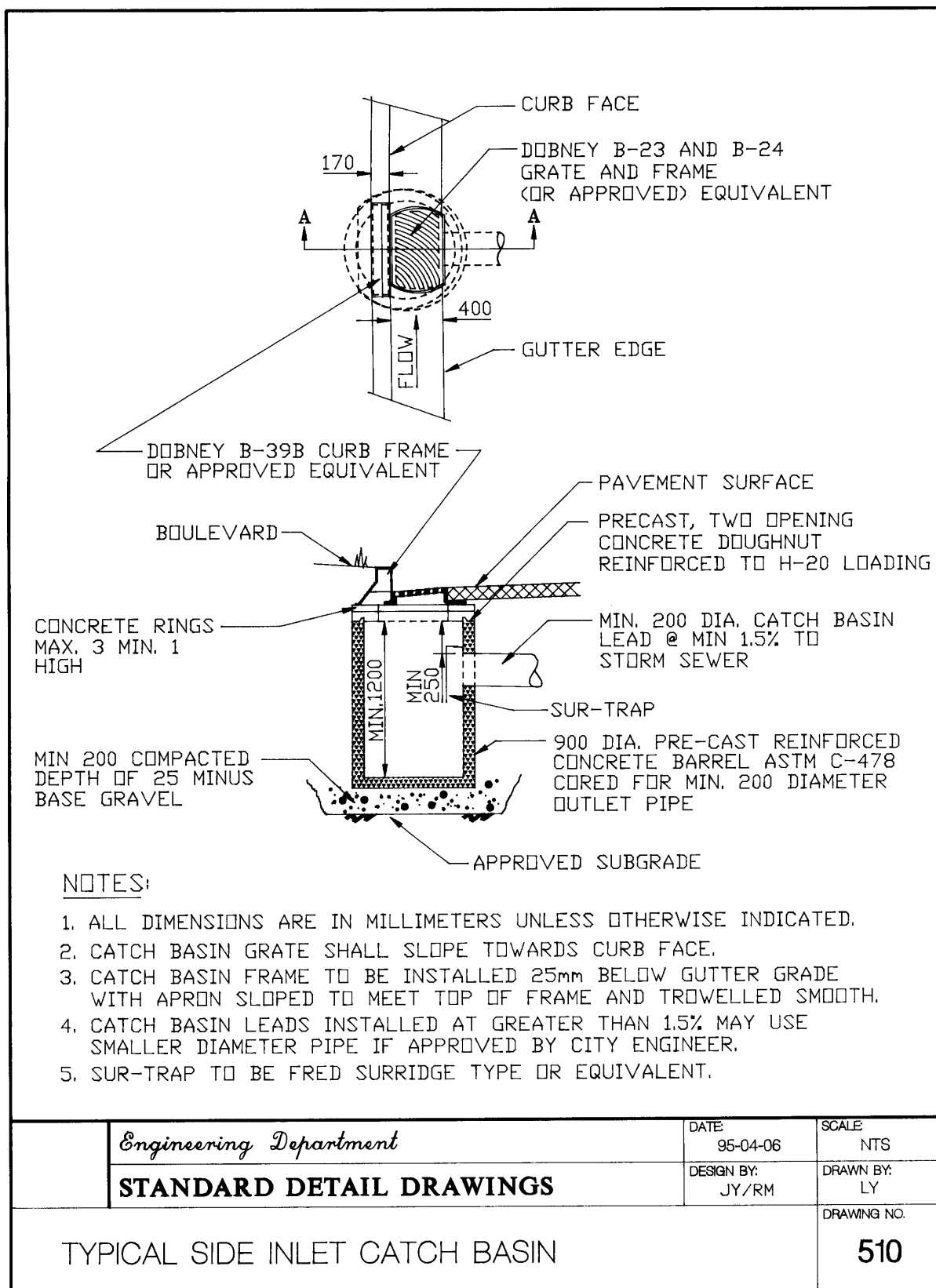
LY

SCALE :

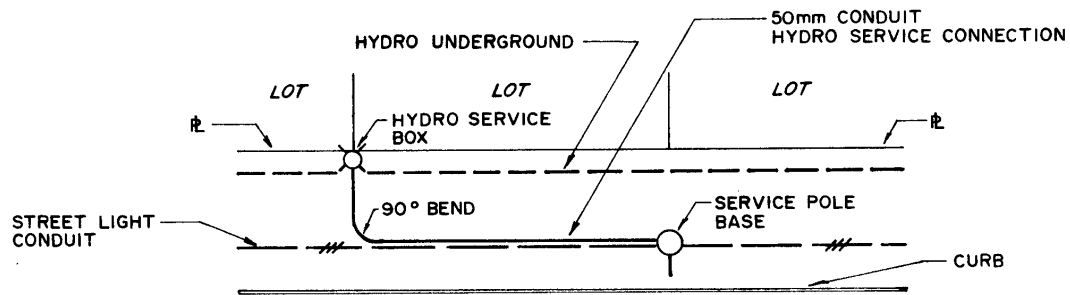
N.T.S.

139

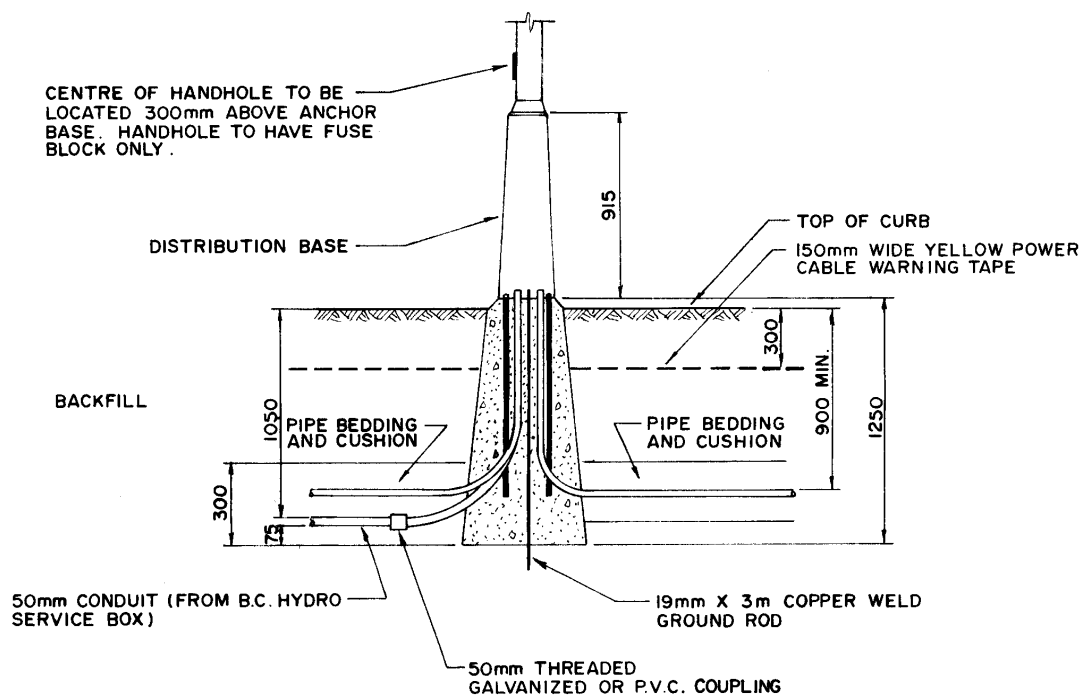
"D"
2241
111



DWG/STDDWG/CB-510



PLAN VIEW OF CONDUIT LOCATION



- NOTES :**
1. BASE ACCESS COVER TO FACE AWAY FROM ROAD CURB.
 2. POLE TO BE SHORTER BY 915mm TO MATCH SAME HEIGHT AS OTHER POLES ALONG ROAD.
 3. PHOTO-ELECTRIC CONTROLLER TO BE INSTALLED ON LUMINAIRE.
 4. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE INDICATED.

PORT COQUITLAM

ENGINEERING DEPT.

DATE :
86-01-28

DRAWING No.
601

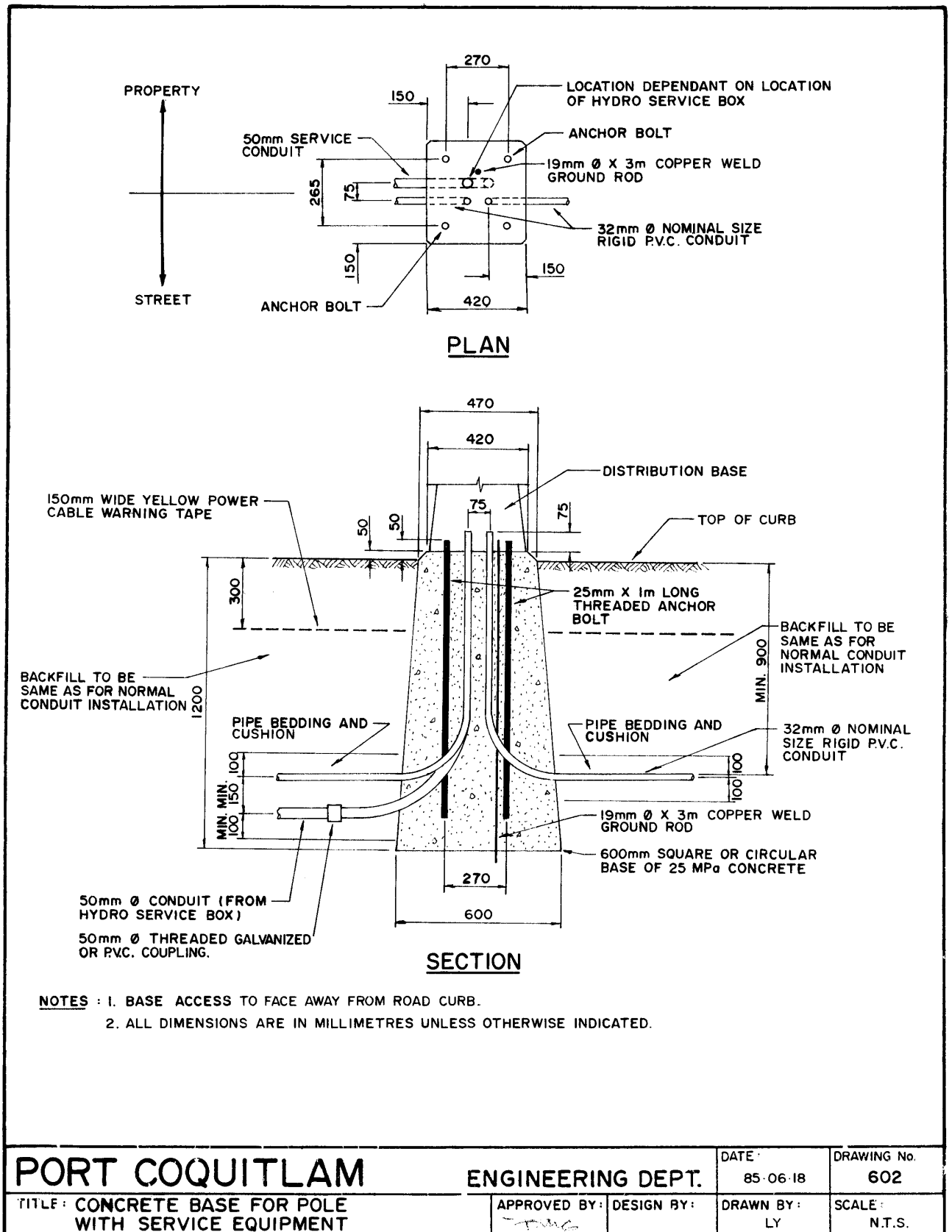
TITLE : **POLE BASE SERVICE DETAIL**

APPROVED BY:
T.M.S.

DESIGN BY :

DRAWN BY :
LY

SCALE :
N.T.S.

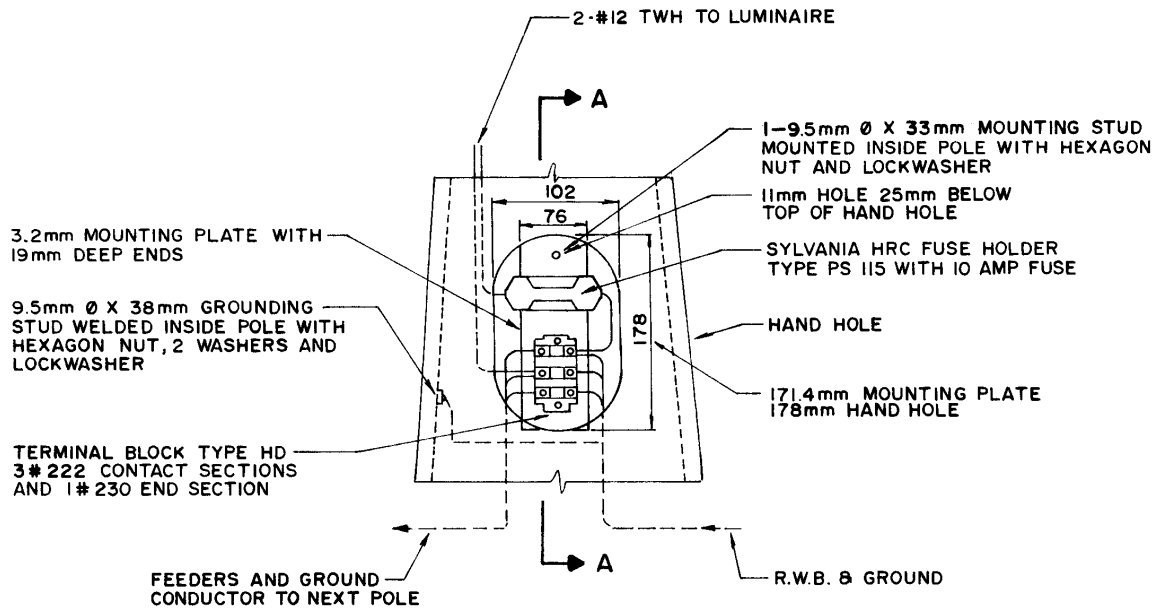


144

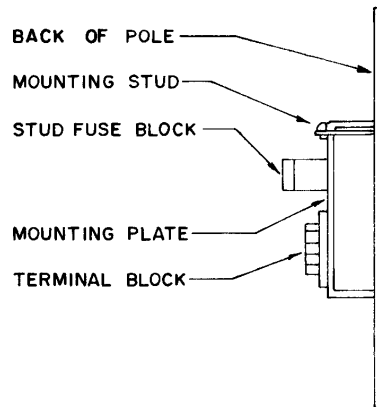
"D"
2241
114



PORT COQUITLAM		ENGINEERING DEPT.	DATE : 85-06-19	DRAWING No. 603
TITLE : STANDARD BASE DETAILS FOR STREET LIGHT POLE		APPROVED BY : T.M.C.	DESIGN BY :	DRAWN BY : LY
				SCALE : N.T.S.



HAND HOLE DETAILS



SECTION A-A

NOTES : 1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE INDICATED.

PORT COQUITLAM

ENGINEERING DEPT.

DATE :
85-06-20

DRAWING No.
604

TITLE : **HAND HOLE DETAILS**

APPROVED BY:
TMG

DESIGN BY :

DRAWN BY :
LY

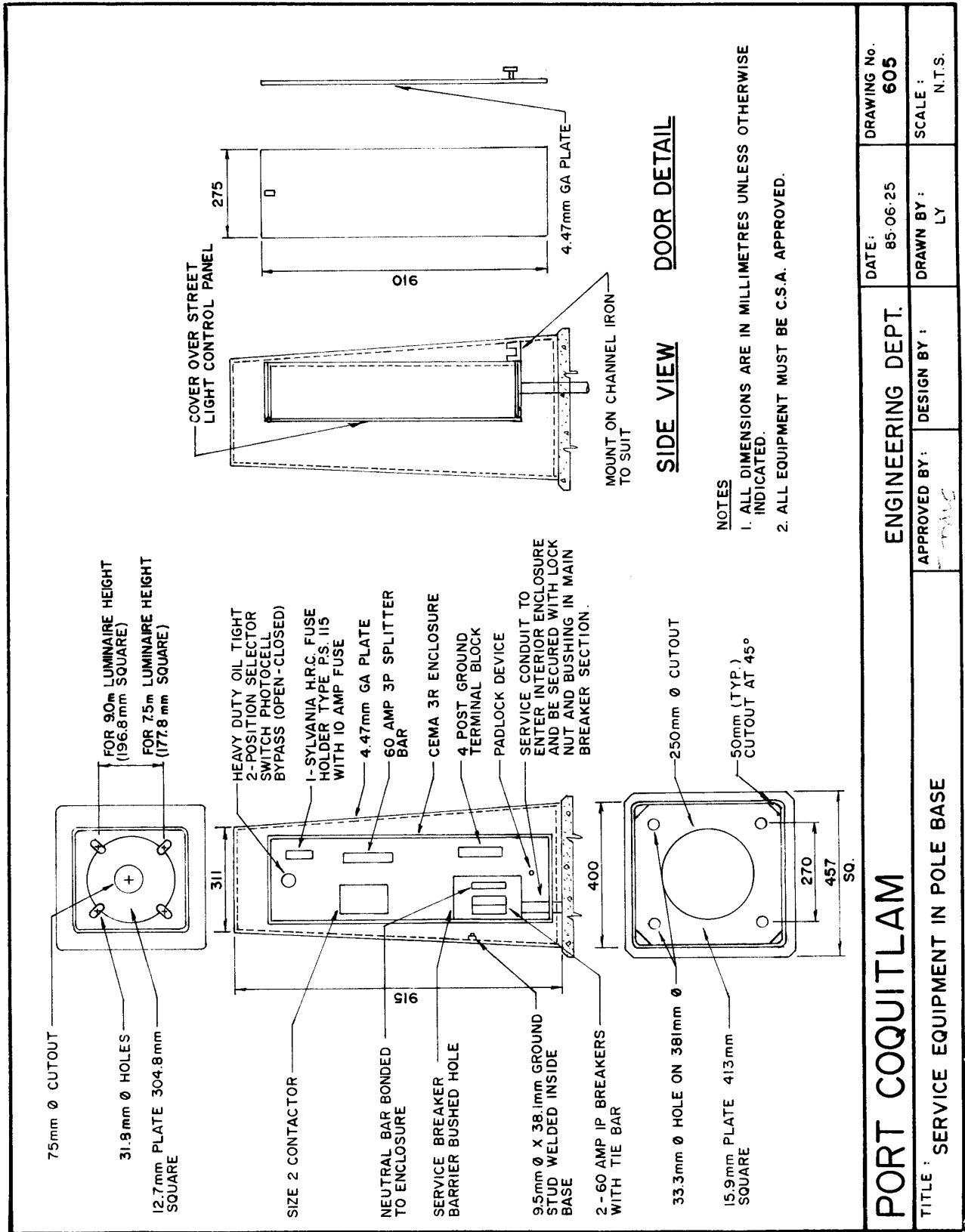
SCALE :
N.T.S.

146

"D"

2241

116



DRAWING No.

605

DATE: 85-06-25

ENGINEERING DEPT.

APPROVED BY:

DESIGN BY:

DRAWN BY:

LY

SCALE:

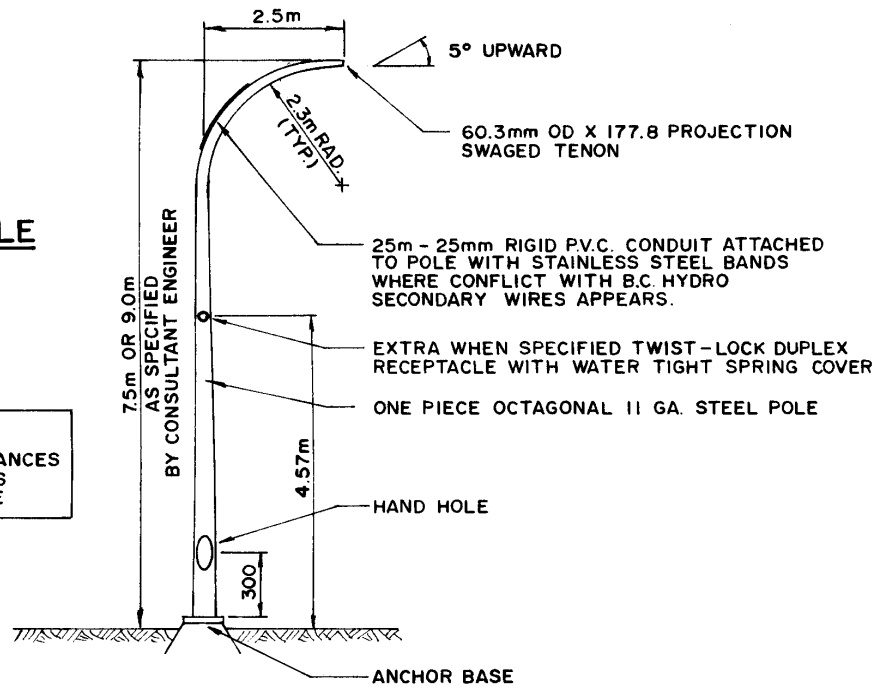
N.T.S.

PORT COQUITLAM

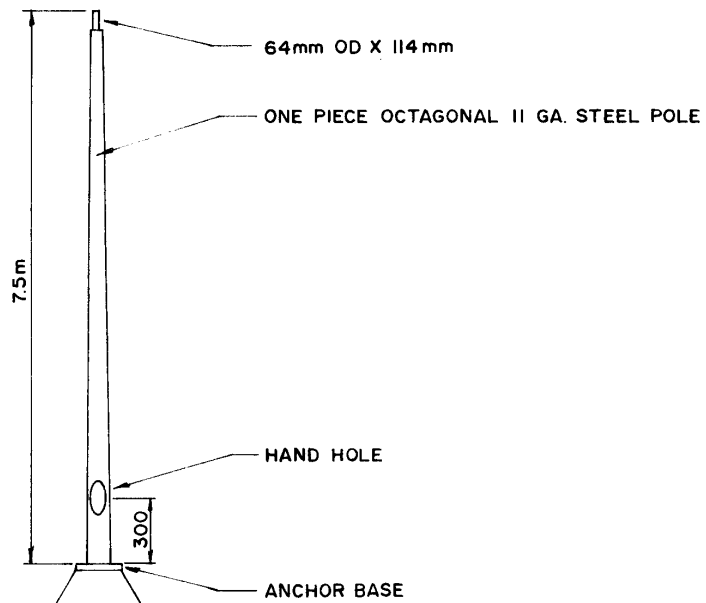
TITLE: SERVICE EQUIPMENT IN POLE BASE

DAVIT TYPE POLE

CAUTION NOTICE
STRICT ADHERANCE TO CLEARANCES
FROM HIGH VOLTAGE POWER AS
SPECIFIED IN ELECTRICAL CODE



POST TOP TYPE POLE



NOTES: 1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE INDICATED.

2. DAVIT TYPE POLES TO BE NORMALLY GESCAN CATALOGUE N° SD 258 EXCEPT AT SERVICE POLES WHERE POLES SHALL BE N° SD 308 OR EQUIVALENT ACCEPTABLE TO CITY ENGINEER.

3. POST TOP TYPE POLES TO BE GESCAN CATALOGUE SS25 OR EQUIVALENT ACCEPTABLE TO CITY ENGINEER.

PORT COQUITLAM

ENGINEERING DEPT.

DATE :
85-06-21

DRAWING No.
606

TITLE : TYPICAL STREET LIGHT POLES

APPROVED BY:
[Signature]

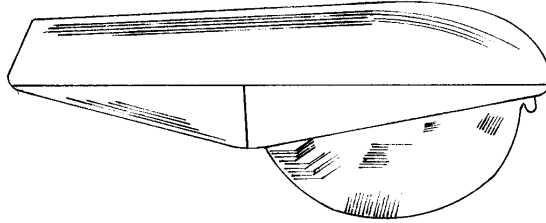
DESIGN BY :

DRAWN BY :
LY

SCALE :
N.T.S.

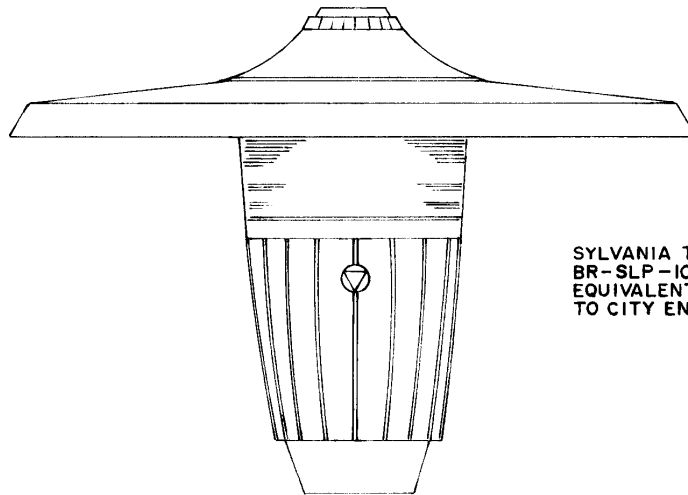
148

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2241
118



SYLVANIA LUMINAIRE
R37-P-S-100-L-120
OR
R37-P-S-150-L-120
AS SPECIFIED ON
CONSTRUCTION DRAWINGS
OR EQUIVALENT
ACCEPTABLE TO CITY
ENGINEER.

DAVIT TYPE LUMINAIRE



SYLVANIA TWISTPAK REFRACTOR
BR-SLP-100LX OR
EQUIVALENT ACCEPTABLE
TO CITY ENGINEER

POST TOP LUMINAIRE

PORT COQUITLAM

ENGINEERING DEPT.

DATE :
85-06-21

DRAWING No.
607

TITLE : TYPICAL STREET LIGHT LUMINAIRES

APPROVED BY:
T.M.C.

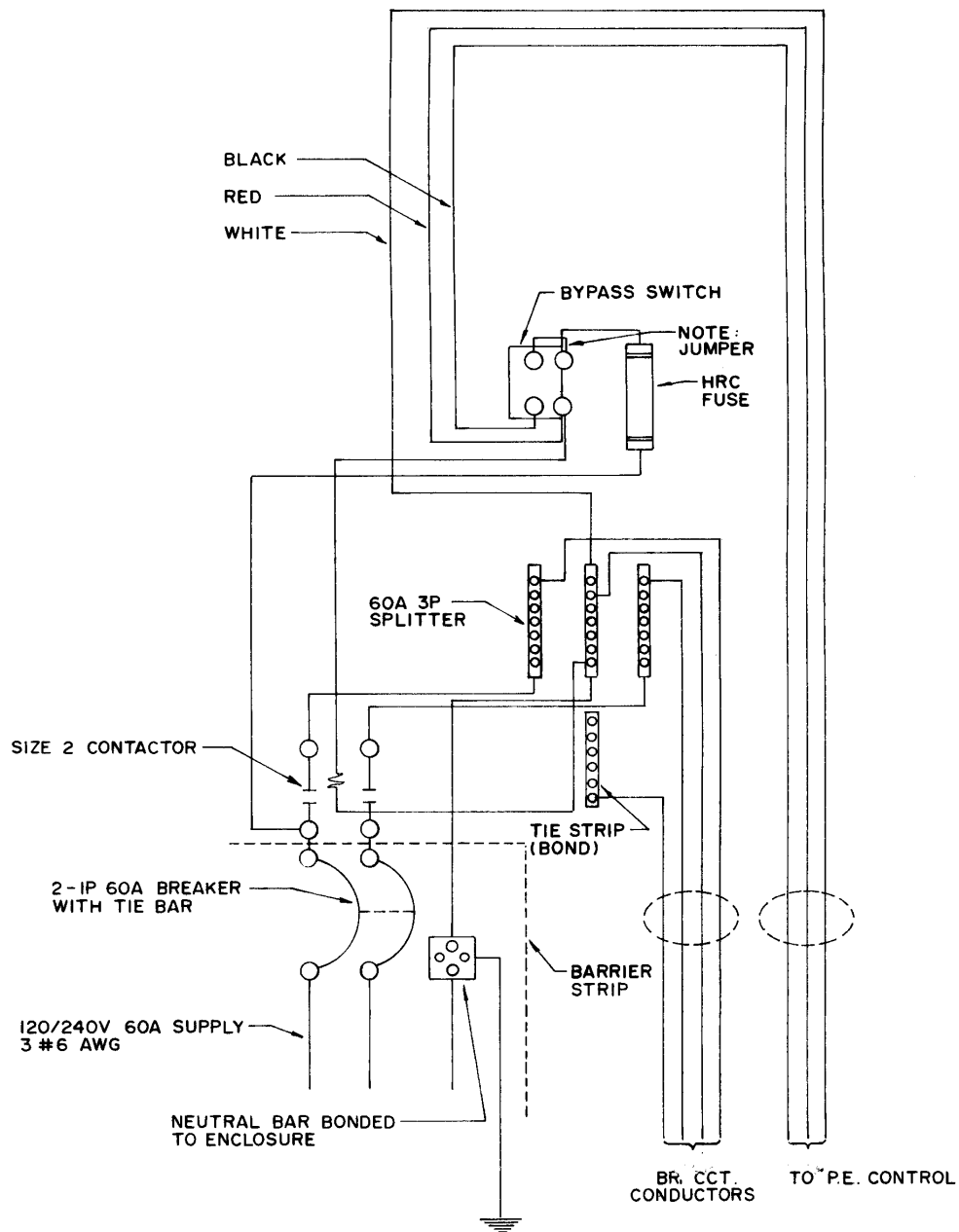
DESIGN BY :

DRAWN BY :
LY

SCALE :
N.T.S.

149

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2241
119



NOTE: 1. VERTICAL MOUNTING OF MAIN BREAKER ONLY WITH OFF IN THE DOWN POSITION.

PORT COQUITLAM

ENGINEERING DEPT.

DATE :
85-06-24

DRAWING No.
608

TITLE : **WIRING DIAGRAM FOR STREET LIGHTS**

APPROVED BY :
TMC

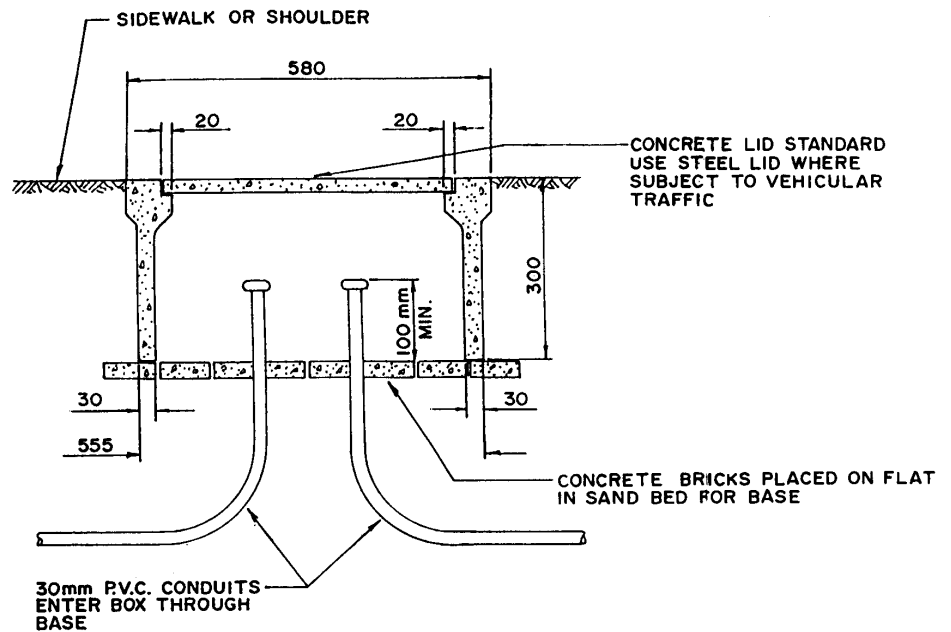
DESIGN BY :

DRAWN BY :
LY

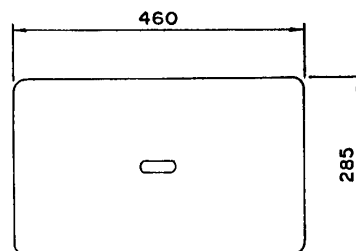
SCALE :
N.T.S.

150

"D"
2241
120



CONCRETE JUNCTION BOX DETAILS

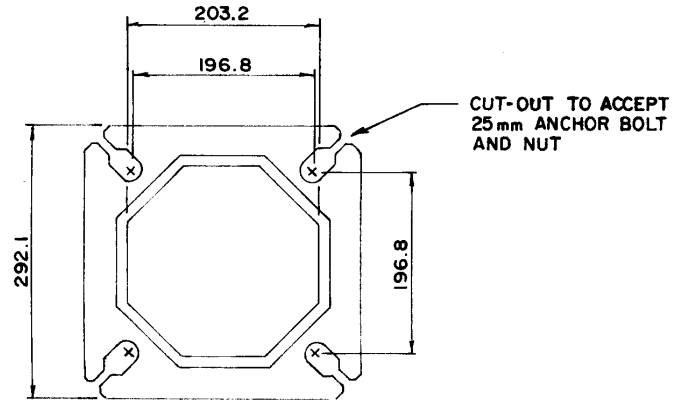
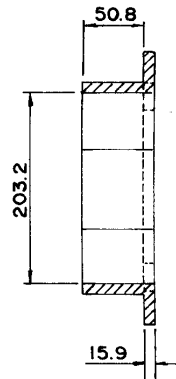


JUNCTION BOX LID

- NOTES : 1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE INDICATED.
2. BOXES TO BE SELF DRAINING.

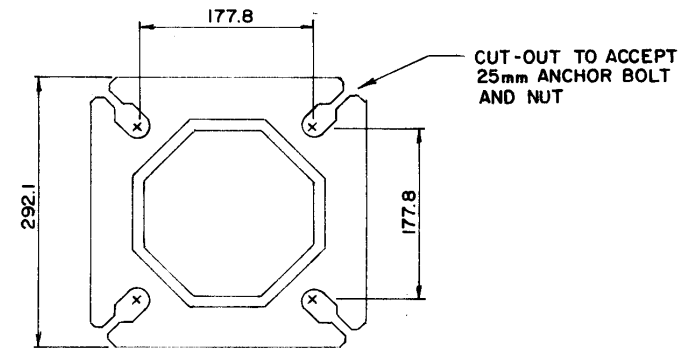
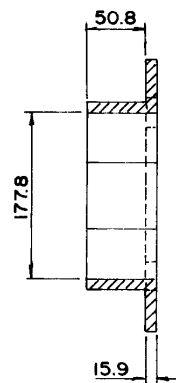
PORT COQUITLAM		ENGINEERING DEPT.		DATE : 85-06-27	DRAWING No. 609
TITLE : JUNCTION BOX DETAILS		APPROVED BY : <i>[Signature]</i>	DESIGN BY :	DRAWN BY : LY	SCALE : N.T.S.

SECTION A-A



ANCHOR BASE FOR 9.0m POLE

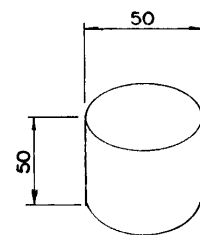
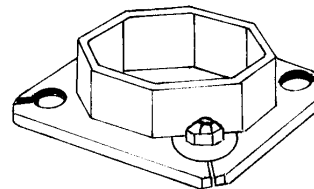
SECTION B-B



ANCHOR BASE FOR 7.5m POLE

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE INDICATED.
2. ANCHOR BASE TO BE WELDED TO POLE INSIDE AND OUTSIDE.



NUT CAP

PORT COQUITLAM

ENGINEERING DEPT.

DATE :
85-06-28

DRAWING No.
610

TITLE : BASE PLATES FOR STREET LIGHT POLES

APPROVED BY :
[Signature]

DESIGN BY :

DRAWN BY :
LY

SCALE :
N.T.S.

152

"D"
2241
122

**SCHEDULE E
TO
SUBDIVISION
BYLAW NO. 2241**

WAIVER AGREEMENT

DATE: _____

I/WE, _____ REGISTERED OWNER OR AUTHORIZED AGENT OF THE REGISTERED OWNER OF LAND LOCATED IN THE CITY OF PORT COQUITLAM AND LEGALLY DESCRIBED AS _____ AGREE THAT, AS A CONDITION OF OBTAINING PRELIMINARY REVIEW AND ANY TENTATIVE APPROVAL FROM THE APPROVING OFFICER FOR THE PROPOSED SUBDIVISION OF THE ABOVE DESCRIBED PROPERTY AS SET OUT IN THE SUBDIVISION APPLICATION DATED _____, 20____, ALL BYLAWS ADOPTED BY THE MUNICIPAL COUNCIL OF THE CORPORATION OF THE CITY OF PORT COQUITLAM UNDER PART 29 OF THE MUNICIPAL ACT PRIOR TO FINAL APPROVAL OF THE PROPOSED SUBDIVISION, SHALL HAVE FULL FORCE AND EFFECT WITH RESPECT TO THE PROPOSED SUBDIVISION.

IT IS FURTHER UNDERSTOOD AND AGREED THAT THE PROTECTION OF SECTION 993 OF THE MUNICIPAL ACT, (WHEREBY, IF A LOCAL GOVERNMENT ADOPTS A BYLAW UNDER PART 29 OF THE MUNICIPAL ACT, THAT OTHERWISE WOULD BE APPLICABLE TO A PROPOSED SUBDIVISION FOR A PERIOD OF 12 MONTHS AFTER IT WAS ADOPTED), IS HEREBY WAIVED IN RESPECT OF THE PROPOSED SUBDIVISION.

SIGNED THIS ____ DAY OF _____ 20____)

IN THE PRESENCE OF:)

WITNESS: _____)

ADDRESS: _____)

OCCUPATION: _____)

OWNER

OWNER