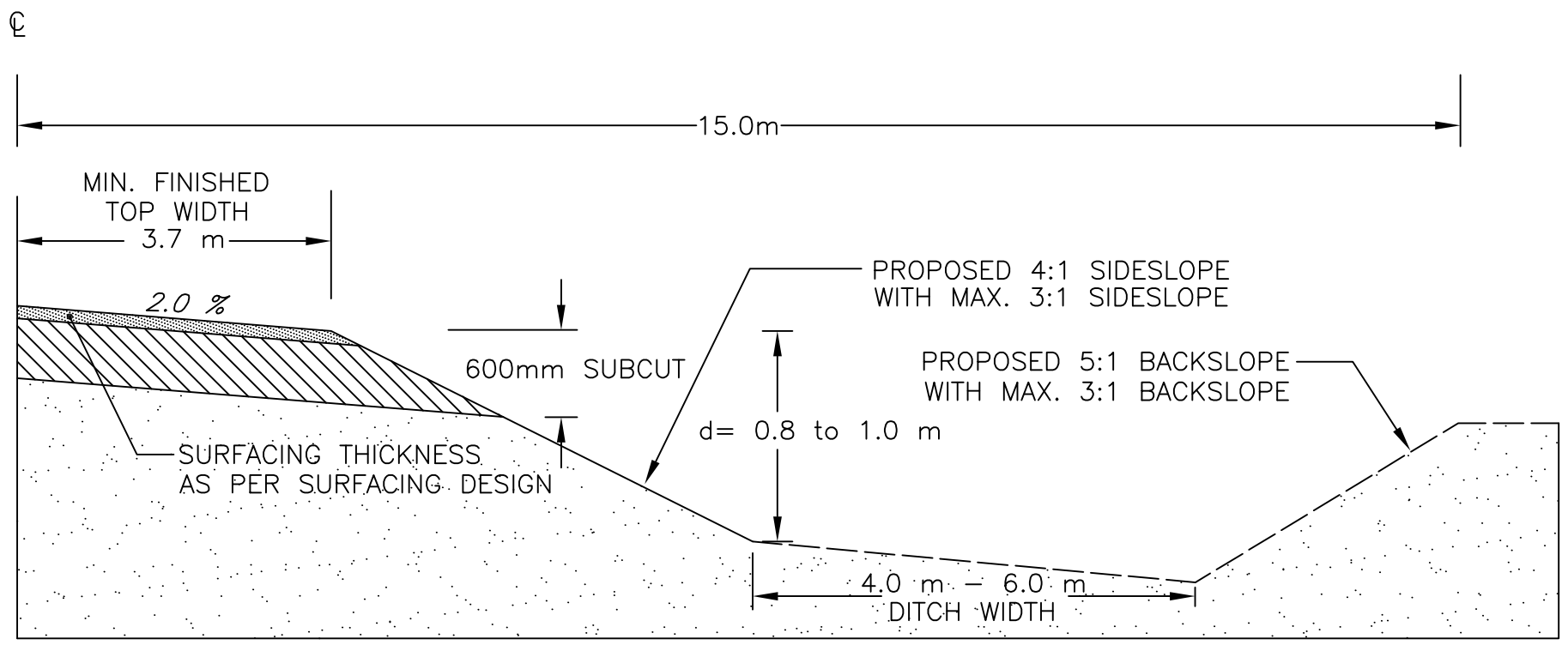
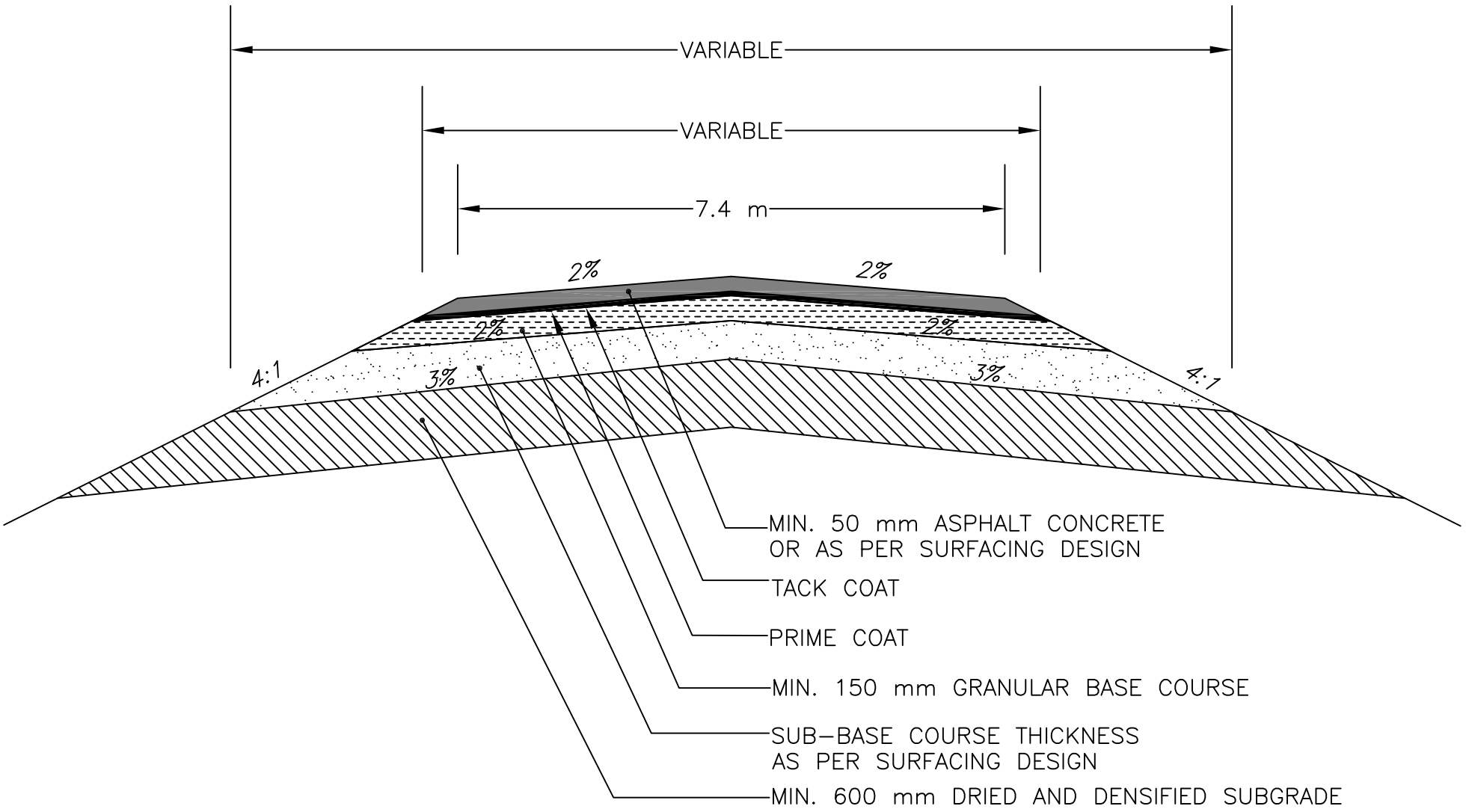


Rural Municipality of Corman Park

PUBLIC WORKS
COUNTRY RESIDENTIAL - TYPICAL CROSS SECTION SUBGRADE

DATE: 2017	SCALE: NTS	DRAWN BY: WOOD E&I



Rural Municipality of Corman Park

PUBLIC WORKS
COUNTRY RESIDENTIAL - TYP. SURFACING
ASPHALT CONCRETE

DATE: 2017	SCALE: NTS	DRAWN BY: WOOD E&I

1. Description

- Road design and construction standards for paved (asphalt concrete) subdivisions and special roads as designed within the Rural Municipality of Corman Park, No. 344 (Municipality).

2. Miscellaneous

- For the purposes of this document, the term “proponent” shall be used to address duties that shall be undertaken by the owner, developer, contractor and engineer interchangeable.
- During construction, the proponent shall be responsible for all traffic accommodation measures. This shall include but not limited to:
  - Proper signing of all access roads whereby traffic (construction or local) may access existing Municipality roads.
  - Traffic gravel shall be applied, if or as necessary for local traffic.
  - Proper measures shall be taken to ensure that local traffic can safely interact with construction equipment.
- The proponent shall ensure that all necessary Haul Road Agreements are in place including any provisions for dust control prior to the hauling of materials.
- Dust control to be applied on any approved detour routes.

3. Required Right-Of-Way Standards

- Minimum allowable Right-of-Way (ROW) purchased shall be 30.0 meters (m).
- The proponent shall be responsible for the purchase of all ROW.
- The minimum allowable ROW for cul-de-sacs and turnabouts purchased shall be 60.0 m with a minimum of 15.0 m radius for the driving surface.
- The road shall be designed and constructed in the center of the Right-Of-Way unless with special permission of the Municipality.

4. Road Widths and Geometric Standards

4.1. Finished Road Width and Height

- The finished asphalt driving surface (paved width before the start of the asphalt slope) shall be as follows:
  - For fill heights of 3.0 m or less (where the road surface is from 0.0 m to 3.0 m in height), a 7.4 m finished road top width (asphalt) shall be required.
  - For fill heights greater than 3.0 m (where the road surface is from 3.1 metres in height or more), a 8.0 m finished road top width (asphalt) shall be required.
- The road cross-fall (slope) shall be constructed to 2.0% with any curves must be constructed with the proper super-elevation.

- The average shoulder elevation of the road surface should be approximately 0.8 m to 1.0 m above the adjacent ground except in cut areas.
- The subgrade surface shall not be less than 1.5 m above high water level on the ground water table. (ie: level to which free water would rise in a hole sunk in the ground).

4.2. Surfacing and Hydraulic Design

- A grading, surfacing and hydraulic design shall be completed, signed and stamped by a Professional Engineer registered with the Association Of Professional Engineers and Geoscientists of Saskatchewan (APEGS) and licensed to practice (Permission to Consult in this field of expertise) within the Province of Saskatchewan.
- The surfacing structure shall be based upon the Saskatchewan Ministry of Highways and Infrastructure's Shell Curve method and shall be based on a 15 year design life (N_{15}).
- Soils testing shall be in accordance with the Saskatchewan Ministry of Highways and Infrastructure's Standard Test Procedures manual.
- Hydraulic structures (culverts) with significant flows shall be designed (sized) in accordance with the Saskatchewan Ministry of Highways and Infrastructures Hydraulic Manual and shall be based on a Q^{25} flow (1 in 25 year (1:25)) frequency.
  - The Municipality may request that the design be based on a Q^{50} flow (1 in 50 year (1:50)) frequency based on the location (proximity) of any residences upstream of the crossing.
  - The proponent shall apply for, and shall meet all of the listed requirements, an Aquatic Habitat Protection Permit (AHPP) from SaskWatershed Authority for hydraulic passages requiring such.

4.3. Sideslopes

- Sideslopes shall range from 3:1 to 4:1 depending upon situation and with approval from the Municipality.
  - The standard required sideslope shall be 4:1.
    - For road fills ranging from 0.0 to 3.0 m in height, the sideslope shall be 4:1.
    - For road fills ranging in height from 3.0 m to 4.0 m, the toe of slope shall be 12.0 m from shoulder of the road.
    - For road fills greater than 4 m the sideslope shall be 3:1.
  - If upon review by the Municipality, a sideslope of 3:1 may be allowed only with special permission from the Municipality.

4.4. Ditch Bottom Widths

- Ditch bottom widths shall be range from 4.0 to 6.0 m depending upon grade height and backslope requirements.
  - The desirable is 6.0 m for snow storage.

4.5. Backslopes

- Sideslopes shall range from 5:1 to 3:1 depending upon the situation and with approval from the Municipality.
  - The standard required back slope shall be 5:1.
    - A backslope of ranging from a minimum of 3:1 to the standard backslope of 5:1 will be allowed in conjunction with maximizing the ditch bottom width.

4.6. Maximum Road Gradient

- The maximum road gradient allowed shall be 5.0%.
- With special approval by the Municipality, a 6.0% gradient may be allowed.

4.7. Stopping Sight and Intersection Distances

- The stopping sight distance for intersections with any road shall be a minimum of 140 m. This is based upon the SARM guidelines for an 80 km/h road design.
  - For urban (low speed internal roads), reduced stopping sight distances will be utilized and approved based on design and operating speeds.
- The minimum length of road (constructed past an approach) shall be 100 m.
  - This is done in order to meet Stopping Sight Distances, snow and ice removal and road maintenance.
- For intersecting roads, the sight triangles shall be clear of any obstructions.
  - The sight triangle shall be a minimum of 85.0 m from the point of intersection on municipal roads and grid intersections and to a maximum of 140.0 m on primary grid roads using 80 km/h design speed.
    - For urban (low speed internal roads), the sight triangles will be utilized and approved based on design, operating speeds and applicable signing.

4.8. Existing Roads

- Consideration may be given within existing multi-parcel subdivisions for reduced finished road widths to a maximum of 7.4 m.

5. Snow Clearance Standards

- When shoulder grade elevation is 0.3 m or less above natural surface at 15.0 m to 20.0 m from center line then the backslope must be flattened using a variable slope of 5:1 to a maximum of 3:1.

6. Road Construction

6.1. Clearing and Grubbing

- Timber, brush, duff (vegetation), roots, logs and stumps shall be completely cleared from the surface of the Right-of-Way.
- Debris from clearing and grubbing operations shall not be used in the construction of embankments (any portion of the road structure).

- Debris from clearing and grubbing operations shall not be buried within the Right-Of-Way.

6.2. Removal and Replacement of Topsoil

- All topsoil within the Construction Footprint shall be removed and stockpiled.
  - The Construction Footprint is defined as the area within the cut or fill stakes.
- The Contractor shall install appropriate sediment control to ensure no sedimentation from topsoil stockpiles enters into adjacent water bodies.
- Upon completion of the construction, topsoil shall be replaced to a uniform depth over the Construction Footprint excluding the road surface.
  - The maximum compacted depth of topsoil replaced will be 100 mm.
- Stones (rocks) 75 mm or more in diameter shall be removed and disposed of from the topsoil replaced.

6.3. Drainage (culvert) Installations

- If the foundation is unsuitable, the bottom of the bed shall be sub-cut to a minimum of 0.3 m below the granular backfill layer.
- A geotextile fabric shall be installed to separate the ground surface from the granular materials.
  - A minimum 8 ounce (Geotex 801 or equivalent) nonwoven geotextile shall be used.
- The bedding line shall be shaped to fit the culvert.
- Corrugated metal pipe culverts (CSP) shall be placed with the inside circumferential laps pointing downgrade and with the longitudinal laps at the sides or quarter points. The sections of the culvert shall be firmly joined with coupling bands. Joints shall be as tight as possible.
- Culverts shall be to the following minimum sizes unless larger sizes are required to meet flow requirements:
  - Approach culverts shall be a minimum of 400 mm in diameter.
  - Through grade culverts shall be a minimum of 600 mm in diameter.
- CSP culverts shall have a minimum thickness of 2.0 mm (12 gauge).
- Granular material shall be composed of sand or gravel free from undesirable quantities of soft or flaky particles, loam, and organic or other deleterious material. Granular material shall comply with the following requirements:

Sieve Designation	Percent by Weight Passing Canadian Metric Sieve Series		
	TYPE		
	115	116	10
50 mm	100	-	100
9.0 mm	-	100	-
900 µm	-	30 - 100	-
400 µm	-	15 - 75	-
160 µm	-	0 - 10	-
71 µm	0 - 15	-	0 - 20
Plasticity Index	0 - 6	0 - 6	0 - 6

- For backfilling all types of culverts and bridge abutments, Type 115 shall be used.
- For backfilling subsurface drain pipes, Type 116 shall be used as a filter Material.
- For backfilling curbs, curbs and gutters, sidewalks, driveways, storm sewers, and manholes, catch basins, and other ancillary structures, Type 10 shall be used.
- Earth backfill under the haunches of culverts, except those in approaches not to be paved shall be compacted with mechanical impact tampers.
- After the earth backfill and granular backfill has been placed and compacted around the culvert, the remainder of the embankment shall be constructed by drying the earth material to at least the optimum moisture content and compacted to an average of not less than one-hundred (100) percent of the maximum density as determined by a Saskatchewan Ministry of Highways and Infrastructure Standard Proctor test.
- The earth material above the bedding line shall be placed, simultaneously and uniformly, in lifts on each side of the culvert. In subcut sections, the lift shall extend to the limits of the sub-cut; otherwise the lifts shall extend not less than 15 m from each side of the culvert.
- No objectionable material shall be used within that portion of the embankment above or below the bedding line on culverts through the roadbed.
- The embankment, within three diameters or three span; of the culvert barrel, shall be free from rocks having a dimension of 80 mm or greater when measured in any direction.
- Random riprap shall be installed at all culvert locations where the culvert diameter is greater than 800 mm.
    - A nonwoven geotextile shall be placed prior to the placement of the riprap material.

6.4. Subgrade Embankments

- Earth embankments shall consist of acceptable earth material and rock material free from objectionable quantities of organic matter, frozen soil, stumps, trees, moss, and other unsuitable materials.
- The embankment shall be constructed by placing the material in successive layers.
- The depth of each layer shall not be more than fifteen (15) centimetres (cm) uncompacted. The full width of each segment of each layer shall be bladed with a motor grader at least twice prior to being compacted.
- The slopes and surface of the embankment shall be shaped and trimmed to a uniform smooth surface conforming to the cross-sections shown on the plans, or as staked.
- Stones having a dimension of eight (8) cm or more when measured in any direction shall be removed from the top fifteen (15) cm of the subgrade.
- The following requirements will apply for all embankments:
    - When unsuitable material is encountered below the natural ground surface in embankment areas, the material shall be excavated and removed.
    - The embankment layer (other than at culverts including the sub-cut backfill layer) from 750 mm to 600 mm below the top of the subgrade shall be dried to within 3% of the optimum moisture content.

- Each layer of the top 600 mm of the subgrade shall be dried to at least the optimum moisture content and compacted to an average of not less than one-hundred (100) percent of the maximum density as determined by the Saskatchewan Ministry of Highways and Infrastructure Standard Proctor test. The moisture and densities will be considered satisfactory when:
  - All individual moisture test results are equal to or less than the optimum moisture content.
  - Density test results average not less than one hundred (100) percent of the maximum density.
  - All individual density tests are greater than ninety-eight (98) percent of the maximum density.
- If the moisture existing in the soil is insufficient for compacting to the specified density and for finishing, the proponent may elect to add water.
- The foregoing requirements will also apply to backfill of subcuts and the embankment required to prepare the beds and backfill drainage structures.

- Approaches to be constructed as per Municipalities Approach Construction policy.

6.5. Traffic Gravel

- Traffic gravel shall comply with Type 106.

Sieve Designation	Percent by Weight Passing Canadian Metric Sieve Series
	TYPE
	106
40.0 mm	-
31.5 mm	-
22.4 mm	100
18.0 mm	63 – 92
5.0 mm	0 – 50
2.0 mm	0 – 35
400 µm	
Fractured Faces	40% Minimum

- A tolerance of 3% in the percent by weight passing the maximum size sieve shall be permitted.

6.6. Traffic Gravel Behind Construction

- Type 106 Traffic Gravel shall be placed and spread on a newly constructed subgrade surface.
- Traffic gravel Type 106 shall not be deposited until the subgrade surface has been compacted (to the required density) and trimmed.
- Traffic gravel shall be dumped and spread uniformly on the subgrade surface as required.
- Traffic gravel shall be applied to the finished surface of all approaches.

6.7. Sub-Base Course

- Sub-base aggregate shall be composed of sound, hard, and durable particles of sand, gravel and rock free from injurious quantities of soft or flaky particles, shale, loam, clay balls and organic or other deleterious material.
- Sub-base course shall comply with the requirements listed in following table:

Sieve Designation	Percent by Weight Passing Canadian Metric Sieve Series
50 mm	100
2.0 mm	0 – 80.0
400 µm	0 – 45.0
160 µm	0 – 20.0
71 µm	0 – 8.0
Plasticity Index	0 – 6

A tolerance of 3% in the percent by weight passing the maximum size sieve shall be permitted providing 100% of the oversize passes the 63.0 mm sieve.

- The thickness of any one compacted lift of sub-base course shall not exceed 120 mm.
- Sub-base courses shall be compacted until no further settlement is apparent and the particles are well keyed into place.
- The finished surface of the sub-base course shall be true to grade and cross section and free of any surface defects, rutting or deformations the placement of the next course.

6.8. Granular Base Course

- Base aggregate shall be composed of sound, hard and durable particles of sand, gravel and rock free from injurious quantities of elongated, soft or flaky particles, shale, loam, clay balls and organic or other deleterious material.
- Base Course Mix (Type 33) shall comply with the requirements listed in following table:

Sieve Designation	Percent by Weight Passing Canadian Metric Sieve Series
18.0 mm	100
12.5 mm	75.0 – 100.0
5.0 mm	50.0 – 75.0
2.0 mm	32.0 – 52.0
900 µm	20.0 – 35.0
400 µm	15.0 – 25.0
160 µm	8.0 – 15.0
71 µm	6.0 – 11.0
Plasticity Index	0 – 6
Fractured Faces (%)	50.0% Minimum
Lightweight Pieces	5.0% Maximum

- A tolerance of 3% in the percent by weight passing the maximum size sieve shall be permitted providing 100% of the oversize passes the 22.4 mm sieve.
- Granular Base Mix shall be spread on dry and unfrozen surfaces and shall not be compacted if the atmospheric temperature is less than 2° Celsius.
- The finished surface of the Granular Base Course shall be true to grade and cross section and free of any surface defects.
- The Granular Base Course shall be considered satisfactory when:
  - It contains no surface defects.
  - The average density meets or exceeds 100% of maximum density.
  - All individual test results are greater than 98% of maximum density.
  - The moisture content is less than or equal to the optimum moisture content.
- A prime coat shall be placed on the finished final lift of Granular Base Course
  - Prime coat shall be placed within 24 hours, weather permitting.

6.9. Asphalt Prime and Tack Coat

- The proponent may elect to use MC-30, an emulsified asphalt primer, road-mixed SS-1, road-mixed SS-1H for the prime coat.
  - If using SS-1 or SS-1H, the SS-1 must be incorporated into the top 25 mm to 50 mm of the Granular Base Course.
- SS-1 or SS-1H emulsified asphalt shall be used as a tack coat.
- The tack coat shall be applied in accordance with the application rates outlined in the following table:

Surface Type	Application Rate (L/m^2)		
	Residual	Undiluted	Diluted (one part water to one part emulsified asphalt)
New Asphalt Concrete	0.14 – 0.18	0.23 – 0.32	0.45 – 0.60

- Potable water shall be used to dilute the emulsified asphalt.
- The tack coat shall be applied in a single application and uniformly across the prepared surface.
- Asphalt for prime coat and tack coat shall not be applied to a prepared surface when:
  - The surface temperature is less than 2° C.
  - The weather is misty, rainy, or if rain is impending.
- Traffic will not be permitted to travel on prime coat until 6 hours after application. After 6 hours, excess asphalt remaining on the surface shall be blotted by sand before traffic is permitted to travel on the surface.

6.10. Asphalt Concrete

- Virgin aggregate used for Asphalt Concrete shall be composed of sound, hard and durable particles of sand, gravel and rock, free from injurious quantities of elongated, soft or flaky particles, shale, clay, loam, ironstone, coal and organic or other deleterious materials.

- Type 150 – 200A asphalt shall be used as bituminous binder.
  - This material shall meet the requirements of Saskatchewan Ministry of Highways and Infrastructure's Specifications for Manufactured Materials (SMM) For Asphalt Cements.
- Hydrated-lime or liquid anti-strip shall be used as an anti-stripping agent.
  - The stripping potential shall not exceed 5% as determined by SMHI Standard Test Procedure (STP 204-15).
  - Liquid anti-stripping agent shall be added at a rate of approximately 1.0% of the weight of liquid asphalt added.
  - The amount of hydrated lime added shall be approximately 1% of the total dry aggregate by weight.
  - The Contractor shall ensure the procedures and equipment used for the addition of hydrated lime anti-stripping agent are adequate to ensure that the hydrated lime is added at a uniform consistent rate.
- Only the following Mix Design Type will be permitted:

Sieve Designation	Percent By Weight Passing Canadian Metric Sieve Series
12.5 mm	100
9.0 mm	76-89
5.0 mm	50-60
2.0 mm	30-48
900 um	19-38
400 um	10-26
160 um	3-10
71 um	2-5
Fracture Minimum %	70 (1 face)
Sand Equivalent Minimum %	45
Los Angeles Abrasion (% loss)	35 (max)
Organic Content (% passing 5 mm)	1.0
Marshal Blows	50
Marshal Stability (kN) at 60ºC min	8
Retained Stability (min %)	75
Marshal Flow Index (mm)	2-4
Air Voids in Mixture	3-5
Voids Filled With Asphalt %	70-80
Min Film Thickness	8.0

- A tack coat shall be applied and allowed to fully cure prior to the placement of the asphalt mix (paving operations).
- Asphalt concrete shall be spread on dry, clean, and unfrozen surfaces.
- Asphalt concrete shall be placed in accordance with the following temperature limitations:

  - Paving may begin, for other than the final lift, when the temperature is 0° C provided the temperature is forecast, by Environment Canada, for the closest location to the project, to reach at least 5° C that day.
  - The final lift of asphalt concrete shall not be placed if:
    - The atmospheric temperature is less than 5° C;
    - The surface temperature is less than 7° C.
- The asphalt concrete mat shall be constructed to a field density range of 97% to 98% of the Marshall Density based on readings from a correlated Nuclear Densometer gauge.
  - The proponent will develop a correlation between the results of the nuclear gauge and the results of the asphalt concrete cores obtained from the compacted lift of asphalt concrete. The density results obtained from the cores will be used to correct the Field Density results obtained from the nuclear gauge.
- The asphalt mat shall be constructed so that:
  - There are no pavement depressions.
  - Longitudinal construction joints from one lift to the next shall be separated by at least 100 mm.
- The minimum and maximum thickness of a compacted lift of asphalt concrete shall meet the following requirements:
  - Minimum asphalt mat thickness shall be 30 mm.
  - Maximum asphalt mat thickness shall be 50 mm.
- The asphalt mix temperature in the paver shall not be less than 110° C.
- Contact faces of curbs, gutters, manholes, and sidewalks shall be coated with asphalt using a hand applicator before placing the asphalt mix.
- When paving is discontinued on the roadway, the asphalt concrete shall be temporarily feathered to a slope of 10 horizontal to 1 vertical. When paving is resumed, the transverse joint shall be straight and have a vertical face when the taper is removed.
- Asphalt mix shall not be placed or allowed to fall on previously laid top lift asphalt concrete or the existing asphalt concrete.
- Transverse construction joints from one lift to the next shall be separated by at least 2.0 m.
- The proponent shall construct the asphalt mat so that there are no areas of:
  - Segregation.
  - Surface defects which may consist of:
    - Roller marks.
    - Open texture.
    - Improper matching of longitudinal and/or transverse joints.
    - Cracking or tearing.
    - Contamination by diesel, hydraulic fluids, detergent or other harmful products.
    - Foreign objects or materials that are detrimental to the asphalt concrete.
    - Clay balls or oversized materials.
  - Any repairs required shall be to the satisfaction and approval by the Municipality.

6.11. Seeding

- Prior to seeding, the area to be seeded shall be true to grade and cross section and free from irregularities.
- The proponent shall harrow the seeded areas immediately after the seeding is completed.
- The seed material shall contain the following blend of seeds:

Seed Mix Common Name	% of Mix
Sheep's Fescue	15
Canada Blue Grass	15
Blue Fescue	15
Hard Fescue	15
Chewings Fescue	15
Creeping Red Fescue	15
Perennial Rye Grass	10

- The seed application rate shall be 14 kg per hectare (31 lbs per acre).
- The Municipality may approve other grass seed mixtures having similar grass seeds or slight changes in mixture percentages.

7. Design and Construction Certification

- The Municipality reserves the right to request any and/or all test result(s) or other associated documentation at any stage of the project.
- Upon completion of the project and prior to the start of the warranty period, the proponent's Engineer and/or engineering firm shall complete and submit a signed and sealed Statutory Declaration stating that all design and construction criteria/specifications in accordance with the parameters aforementioned have been met.
    - The Engineer of Record shall be a Professional Engineer registered with the Association Of Professional Engineers and Geoscientists of Saskatchewan (APEGS) and licensed to practice (Permission to Consult) within the Province of Saskatchewan.
    - The Engineer(s) of Record shall have reviewed and/or been involved with the design and/or construction of the project and shall have firsthand knowledge of the work completed.

P.MACHIBRODA
ENGINEERING LTD.

CONSULTING GEOTECHNICAL AND GEOENVIRONMENTAL ENGINEERS AND GEOSCIENTISTS

806-48th STREET EAST
SASKATOON, SK
S7K 3Y4
P: 306.665.8444
F: 306.652.2092
E: pmel.sk@machibroda.com

www.machibroda.com

- Geotechnical Engineering
- Foundation Design Recommendations
- Inspection Services
- Earthwork Structures
- Slope Stability
- Pavement Design
- Hydrogeological Studies
- Environmental Site Assessments
- Site Decommissioning and Clean-up
- Test Drilling Services
- Piezocone (CPTu) Testing
- Soils Testing
- Concrete Testing
- Asphalt Testing
- Pile Driver Analyzer (PDA Testing)

May 20, 2020

Associated Engineering (Sask.) Ltd.
1 – 2225 Northridge Drive
Saskatoon, SK S7L 6X6

Attention: Mr. Bill Delainey, Group Manager – Urban Planning

RE: GEOTECHNICAL ADDENDUM TO SNC-LAVALIN REPORT 163596 SUBDIVISION ROADS PROPOSED RESIDENTIAL SUBDIVISION W½-11-37-04-W3M EAST OF SASKATOON, SASKATCHEWAN PMEL PROJECT NO. 16265

1 INTRODUCTION

While employed by SNC-Lavalin, I (Cory Zubrowski) prepared a geotechnical report for the above-mentioned site (refer to SNC-Lavalin Project No. 613596, dated August 2013). It is understood that a geotechnical addendum is now required to address some questions posed by the RM of Corman Park. Specifically, additional information is required with respect to roadway design and basement construction as relevant to flooding.

This letter addresses the subdivision roads; an additional letter will be provided for the basement construction as relevant to flooding. The information presented in this letter supercedes the recommendations presented in the 613596 geotechnical report.

2 SUBDIVISION ROADS

At the time of preparation of the 613596 geotechnical report, the intent was to use gravel-surfaced roads. It is now understood that paved roads are required as per the RM of Corman Park Country Residential Paved Roads standard. Based on the RM standards, the following road structure recommendations have been provided.

2.1 DESIGN CBR

The near-surface subgrade soils consisted of silt/clay. The group index and correlated soaked California Bearing Ratio (CBR) values have been summarized in Table I.

TABLE I - SOAKED CBR VALUES (GI CORRELATED).

Test Hole No.	Depth (metres)	Soil Type	Group Index	Correlated Soaked CBR	Corrected Soaked CBR[1]
613596-1	1.0	Silt	6.6	6.8	4.8
613596-12	1.0	Silt/Clay	9.2	5.3	4.3
613596-17	1.0	Silt	6.4	7	5.0
613596-31	1.0	Sandy Silt	2.5	11.3	10.3
				Average (All Samples)	**6.1**
				Average (Sandy Silt Removed)	**4.7**

[1] The MHI Surfacing Design Manual recommends reducing the soaked CBR of silt soil by 1 to 2.

Upon review of Table I, the average group index correlated soaked CBR value was 6.1 for all samples assessed and 4.7 with the sandy silt sample removed. Based on a review of the test hole drill logs, the majority of the roadways within the development will likely be constructed on silt. As such, the pavement design has been based on a soaked CBR value of 4 to 5 for silt subgrade soil.

2.2 DESIGN TRAFFIC LOADING

It is understood that the subdivision will be divided into approximately 83 lots with an assumed average of 680 vehicle trips per day at full build out (i.e., 20 years). It is assumed that each trip will consist of 2 vehicle passes (i.e., 1,360 vehicle passes per day at year 20). The traffic loading assumptions have been summarized in Table II. Based on the assumed traffic loading, a design N_{15} of 325,021 ESALs was calculated for the proposed roadways. A detailed breakdown of the design traffic loading (ESALs) has been attached for reference.

TABLE II - TRAFFIC INFORMATION

Item	Value	Note
Design Life	15 years	As per the RM of Corman Park Country Residential Paved Roads specification.
Design AADT (Year 20)	1,360	680 trips/day as provided by Associated Engineering (Sask.) Ltd. 680 trips/day x 2 traffic passes/trip = 1,360 AADT.
Percent Growth Rate	5% - Year 0 to 20	Year 20 build out of the development as provided by Associated Engineering.
Design AADT (Year 1)	513	Based on assumed and provided parameters (back calculated using 5% growth rate and AADT at 20 year).
Number of Lanes per Direction	1	Assumed (2-way traffic - 1 lane per direction).
Directional Split	50%	Assumed (traffic will travel equally in each direction).
Percent Commercial Truck Traffic	4%	Assumed (construction trucks, garbage/recycling trucks and septic trucks anticipated).

TABLE III - TRAFFIC INFORMATION (CONTINUED)...

Item	Value	Note
Truck Traffic Distribution	90%/10%	Assumed (single unit trucks/tractor semi-trailer combinations).
Bus Passes/Design Life	6,000	Assumed (1 bus trip per day x 2 passes per trip x 5 days/school week x 40 school weeks/year x 15 years).
ESALs per Unit (Trucks)	3.0/6.3	Single unit trucks/tractor semi-trailer combinations.
ESALs per Unit (Buses)	5	

2.3 RECOMMENDED PAVEMENT STRUCTURE

The R.M. of Corman Park Country Residential Paved Road Construction Standard requires the roadway to be designed in accordance with the Saskatchewan Ministry of Highways and Infrastructure's Shell curve method.

As discussed in Section 2.1, a soaked CBR in the order of 4 to 5 was utilized for the design of the proposed Roadways. As such, the CBR 4.0 and 5.0 shell curves were utilized for the design (curves have been attached for reference).

Based on the CBR rating and design traffic loading (as summarized in Sections 2.1 and 2.2, respectively), the recommended asphalt concrete pavement structure has been presented in Table IV.

TABLE IV - THICKNESS DESIGN FOR PAVEMENT STRUCTURES.

Pavement Structure	Thickness (mm)
Asphalt Concrete (150-200A) [1]	75
Granular Base (Min CBR = 65)	175
Granular Sub-Base (Min CBR = 20)	235
Geotextile / Geogrid [2]	As Required
Prepared Subgrade	(600)
Total Thickness (mm)	**485**

[1] Asphalt Concrete type as per the R.M. of Corman Park Residential Paved Road Construction Standard.
[2] Geogrid/geotextile may be required where soft/wet/loose subgrade soil conditions are encountered.

2.4 PAVEMENT CONSTRUCTION RECOMMENDATIONS

It should be noted that the R.M. of Corman Park has roadway construction standards. Detailed construction specifications (subgrade preparation, material type and compaction specifications, etc.) have been outlined in the R.M. of Corman Park Country Residential Paved Road Construction Standard (https://www.rmcormanpark.ca/DocumentCenter/View/1812/Country-Residential-Paved-Road?bidId=). The pavement should be designed/constructed in accordance with the construction specifications provided in the R.M. Paved Road Construction Standard.

3 CLOSURE

We trust that this meets your requirements at this time. If you have any questions or require additional information, please contact our office.

P. MACHIBRODA ENGINEERING LTD.

Association of Professional Engineers & Geoscientists of Saskatchewan
CERTIFICATE OF AUTHORIZATION
P. MACHIBRODA ENGINEERING LTD.
Number 172
Permission to Consult held by:

Discipline	Sk. Reg. No.	Signature
Geotechnical	12138	

2020-05-20

Eric Antymniuk, P.Eng.

PROFESSIONAL ENGINEER
C.C. ZUBROWSKI
MEMBER 12138
2020 05 20
YR. MO. DAY
SASKATCHEWAN

Cory Zubrowski, P. Eng.

Enclosures:
Detailed Breakdown of Design Traffic Loading, Shell Curves

APPENDIX A

DETAILED BREAKDOWN OF
DESIGN TRAFFIC LOADING, AND,
SHELL CURVES

DETAILED BREAKDOWN OF DESIGN TRAFFIC LOADING

1) Design Traffic Loading (ESALs)

Associated Engineering (Sask.) Ltd. has reported that the subdivision will be divided into approximately 83 lots and it can be assumed that there will be an average of 680 vehicle trips per day at full build out (i.e., 20 years). It is assumed that each trip will consist of 2 vehicle passes (i.e., 1,360 vehicle passes per day).

The roadway design has been based off the following design traffic loading assumptions.

TABLE A1 Traffic Volume

Item	Value	Note
Design Life	15 years	As per the RM of Corman Park Country Residential Paved Roads specification.
Design AADT - Year 20	1,360	680 trips/day as provided by Associated Engineering (Sask.) Ltd. (680 trips/day*2 traffic passes/trip = 1,360 AADT).
Percent Growth Rate	5% - Year 0 to 20	Year 20 build out of the development was provided by Associated Engineering (Sask.) Ltd.
Design AADT - Year 1	513	Based on assumed and provided parameters (back calculated using 5% growth rate and AADT at 20 year).
Number of Lanes per direction	1	Assumed (2 way traffic - 1 lane per direction).
Directional Split	50%	Assumed (traffic will travel equally in each direction).
Percent Commercial Truck Traffic	4%	Assumed (construction trucks, garbage/recycling and septic trucks anticipated).
Truck Traffic Distribution	90%/10%	Assumed (single unit trucks/tractor semi-trailer combinations).
Bus Passes/Design Life	6,000	Assumed (1 bus trip per day x 2 passes per trip x 5 days/school week x 40 school weeks/year x 15 years).
ESALs per Unit – Trucks	3.0/6.3	Single unit trucks/tractor semi-trailer combinations.
ESALs per Unit – Buses	5	

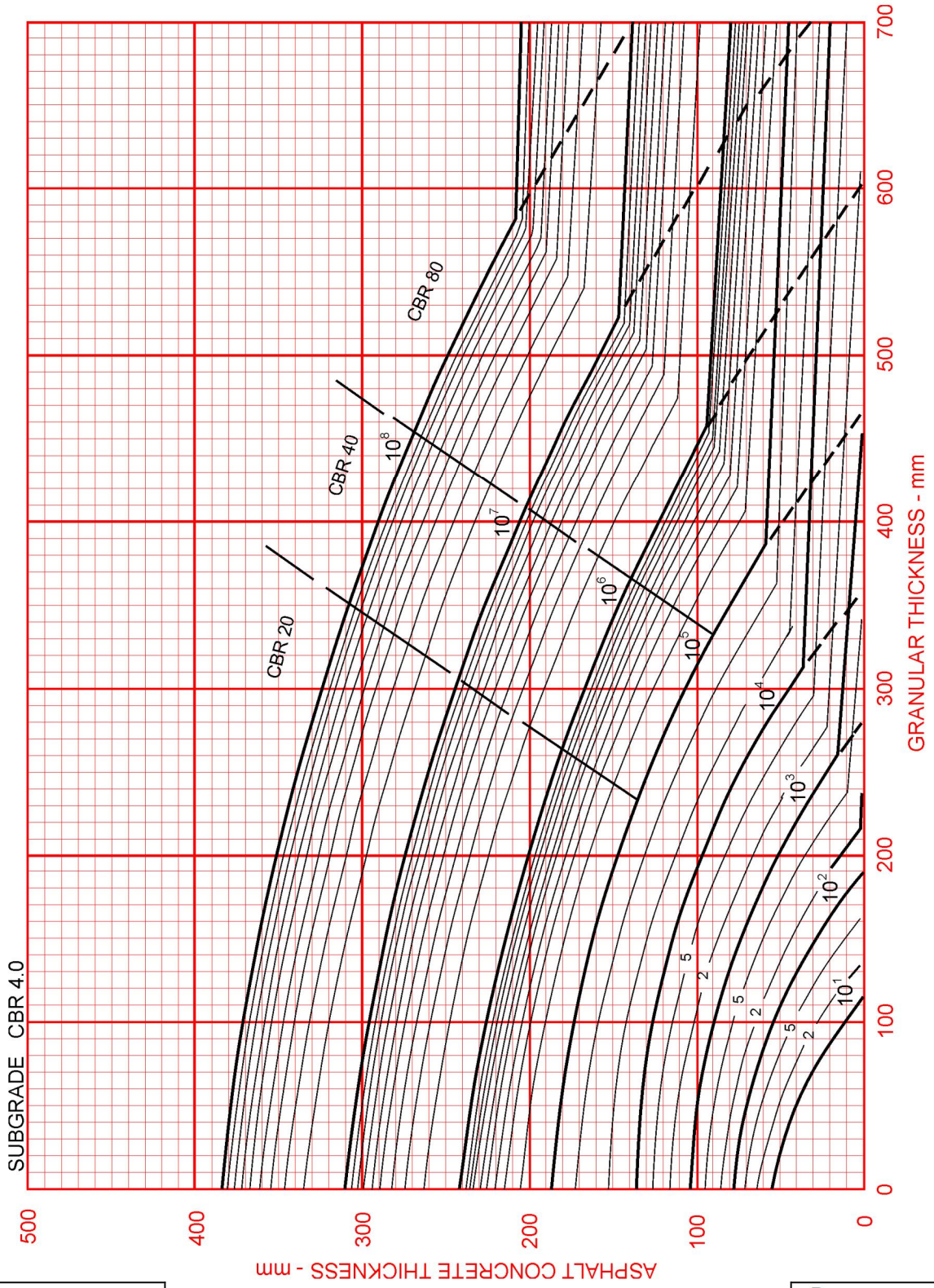
Based on the above assumption, the following truck traffic volume is assumed to use the roadway over the design life:

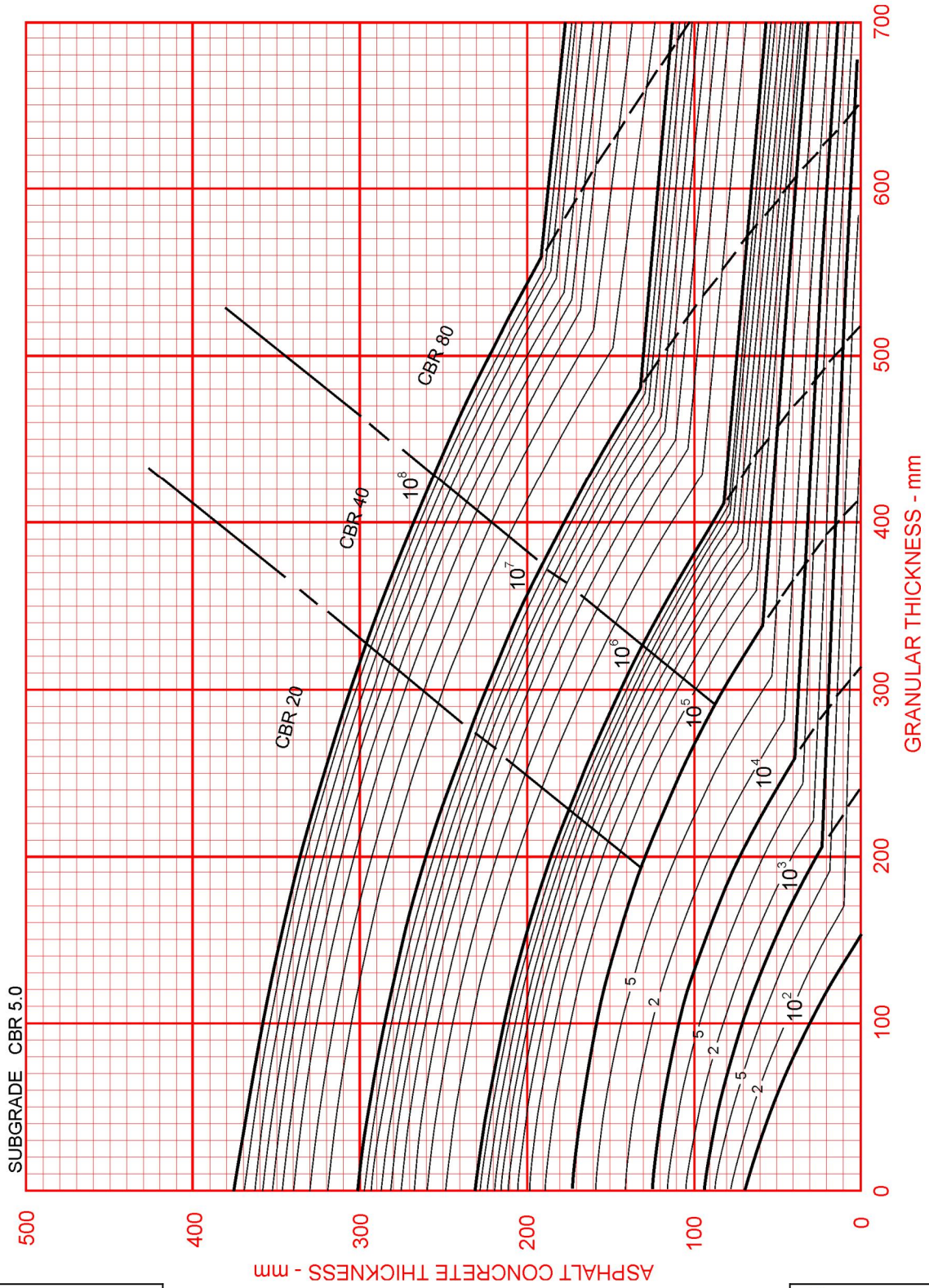
TABLE A2 Cumulative Truck Traffic

Year	Growth Rate (per year)	AADT	AADT - Design Lane[2]	Percent Commercial Traffic	Total Trucks - Design Lane (per day)[3]	Total Trucks - Design Lane (per year)[4]	Cumulative Truck Traffic
0	5%	513.0	256.5	4%	10.3	3,744.9	3,744.9
1	5%	538.7	269.3	4%	10.8	3,932.1	7,677.0
2	5%	565.6	282.8	4%	11.3	4,128.8	11,805.8
3	5%	593.9	296.9	4%	11.9	4,335.2	16,141.0
4	5%	623.6	311.8	4%	12.5	4,551.9	20,692.9
5	5%	654.7	327.4	4%	13.1	4,779.5	25,472.5
6	5%	687.5	343.7	4%	13.7	5,018.5	30,491.0
7	5%	721.8	360.9	4%	14.4	5,269.5	35,760.5
8	5%	757.9	379.0	4%	15.2	5,532.9	41,293.4
9	5%	795.8	397.9	4%	15.9	5,809.6	47,102.9
10	5%	835.6	417.8	4%	16.7	6,100.0	53,203.0
11	5%	877.4	438.7	4%	17.5	6,405.0	59,608.0
12	5%	921.3	460.6	4%	18.4	6,725.3	66,333.3
13	5%	967.3	483.7	4%	19.3	7,061.6	73,394.9
14	5%	1,015.7	507.9	4%	20.3	7,414.6	80,809.6
15	5%	1,066.5	533.2	4%	21.3	7,785.4	88,594.9
16	5%	1,119.8	559.9	4%	22.4	8,174.6	96,769.6
17	5%	1,175.8	587.9	4%	23.5	8,583.4	105,353.0
18	5%	1,234.6	617.3	4%	24.7	9,012.5	114,365.5
19	5%	1,296.3	648.2	4%	25.9	9,463.2	123,828.7
20	5%	1,361.1	680.6	4%	27.2	9,936.3	133,765.0

Where:

[1] AADT = AADT(20XX) x (1+Growth Rate)
[2] AADT-Design Lane = AADT x Directional Split x Load Distribution Factor (Truck)
[3] Total Trucks - Design Lane (per day) = AADT - Design Lane x Percent Commercial Traffic
[4] Total Trucks - Design Lane (per year) = Total Trucks - Design Lane x 365


SUBGRADE CBR 4.0
CBR 20
CBR 40
CBR 80
10^8
10^7
10^6
10^5
10^4
10^3
10^2
10^1
5
2
5
2
5
2
0
100
200
300
400
500
600
700
GRANULAR THICKNESS - mm
500
400
300
200
100
0
ASPHALT CONCRETE THICKNESS - mm


SUBGRADE CBR 5.0
CBR 20
CBR 40
CBR 80
10^8
10^7
10^6
10^5
10^4
10^3
10^2
5
2
5
2
5
2
0
100
200
300
400
500
600
700
GRANULAR THICKNESS - mm
0
100
200
300
400
500
ASPHALT CONCRETE THICKNESS - mm