APPENDIX 'E'

REVISED STANDARD CONSTRUCTION SPECIFICATIONS

Winnipeg PUBLIC WORKS DEPARTMENT • SERVICE DES TRAVAUX PUBLICS Engineering Division • Division de l'ingénierie	**Effective Date:** Draft **DIVISION 4**
CW 3110 – R20	**SUB-GRADE, SUB-BASE AND BASE COURSE CONSTRUCTION**

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1. DESCRIPTION

1.1 General

1.1.1 This specification covers pavement removal, excavation, preparation of sub-grade, supply and placement of sub-base and base course materials, ditch grading and boulevard grading for pavements, slab renewals, curbs, miscellaneous concrete slabs, sidewalks and other related works.

1.2 Definitions

1.2.1 Sub-grade – the natural in-situ material.

1.2.2 Sub-base – the layer of material provided between the sub-grade and the base course.

1.2.3 Base course – the layer of base course material immediately underlying the pavement wearing surface.

1.2.4 Leveling course – a non-structural layer of base course material, up to 50mm in depth, placed immediately underlying the pavement wearing surface.

1.2.5 Crushed Aggregate – Crushed aggregate from glacial till pits.

1.2.6 Crushed Limestone – Crushed limestone from a limestone quarry.

1.2.7 Crushed Granite – Crushed granite from a granite quarry.

1.2.8 Crushed Recycled Concrete – Crushed Portland Cement Concrete that has been crushed into pieces that are a group of aggregate particles cemented together which may or may not include the host (dominant) particle.

1.2.9 Deleterious Material – soft material that would decay or disintegrate from weathering, porcelain, vegetation, organic material, wood, glass, plastic, metal, reinforcing steel, building rubble, brick, shale, and friable particles.

1.3 Referenced Standard Construction Specifications

1.3.1 CW 1130 – Work Site Requirements.
1.3.2 CW 3130 – Supply and Installation of Geotextile Fabrics.
1.3.3 CW 3450 – Planing of Pavement.

2. MATERIALS

2.1 Sub-Base Materials

2.1.1 Sub-base material of the type(s) shown on the Drawings or indicated in the Specifications will be supplied in accordance with the following requirements:

- Suitable site sub-base material will be of a type approved by the Contract Administrator and meet the requirements of this Specification.

- Clay borrow sub-base material will be of a type approved by the Contract Administrator.

- Crushed sub-base material will be crushed aggregate, crushed granite, crushed limestone or crushed recycled concrete.

- Crushed sub-base material shall conform to the following grading requirements:

TABLE CW 3110.1 - Sub-Base Material Grading Requirements

Canadian Metric Sieve Size	Percent Of Total Dry Weight Passing Each Sieve	
	Maximum Aggregate Size	
	50 mm	100 mm
150 000		100%
100 000		90% - 100%
50 000	100%	50% - 75%
25 000	50% - 84%	25% - 50%
10 000	25% - 60%	20% - 40%
5 000	20% - 48%	16% - 34%
2 500	15% - 40%	12% - 28%
1 250	12% - 32%	8% - 22%
315	5% - 20%	4% - 14%
80	2% - 8%	0% - 8%

- The percentage passing the designated sieve sizes for any representative sample, when plotted on a semi-log grading chart, shall show a free flowing concave curve without sharp breaks, and shall be free from abrupt changes from one side of the grading envelope to the other to avoid gap grading.

- When crushed concrete is used, crushed concrete shall not contain loose reinforcing materials and shall have the following classifications based on weight percentages:
  - minimum of 85% Crushed Recycled Concrete
  - maximum of 8% of recycled asphaltic concrete
  - maximum of 3% clay
  - maximum of 1% deleterious material

- Crushed sub-base material shall conform to the following requirements:

TABLE CW 3110.3 - Physical Property Requirements

Tests	Testing Method	Crushed Aggregate, Granite and Limestone		Crushed Recycled Concrete	
		Maximum Aggregate Size		Maximum Aggregate Size	
		50 mm	100 mm	50 mm	100 mm
Los Angeles Abrasion, % maximum	ASTM C535 (Grading 1)	--	40	--	40
Los Angeles Abrasion, % maximum	ASTM C131 (Grading A)	35	--	35	
California Bearing Ratio (CBR)* - 4 days soaked, % minimum @ 5.08 mm	ASTM D1883	80	--	80	--
Micro-Deval Abrasion, % maximum	ASTM D6928	15	15	15	15
Percentage of Fractured Particles, minimum two or more fractured faces, % mass	ASTM D5821	--	--	80	70
Liquid Limit, % maximum	ASTM D4318	--	--	22	25
Plasticity Index, % maximum	ASTM D4318	--	--	4	6

*CBR test shall be performed at 100 % maximum dry unit weight and optimum water content.

2.2 Base Course Materials

2.2.1 Base course material will be approved by the Contract Administrator.

2.2.2 Base course material will consist of sound, hard, crushed aggregate, crushed granite, crushed limestone or crushed recycled concrete.

2.2.3 Base course material should be sound durable particles produced by crushing, screening and grading of recovered materials, free from organic and soft material that would decay or disintegrate from weathering.

2.2.4 Crushed concrete shall not contain loose reinforcing materials and shall not contain more than 1% deleterious material.

2.2.5 The base course material will be well graded and conform to the following grading requirements:

TABLE CW 3110.4 - Base Course Material Grading Requirements

Canadian Metric Sieve Size	Percent Of Total Dry Weight, Passing Each Sieve
25 000	100%
20 000	94% - 100%
10 000	60% - 80%
5 000	35% - 65%
2 500	20% - 48%
1 250	12% - 34%
630	8% - 26%
315	5% - 18%
80	2% - 8%

- The percentage passing the designated sieve sizes for any representative sample, when plotted on a semi-log grading chart, shall show a free flowing concave curve without sharp breaks, and shall be free from abrupt changes from one side of the grading envelope to the other to avoid gap grading.

- Base course material shall conform to the following requirements:

TABLE CW 3110.4 - Physical Property Requirements

Tests	Testing Method	Crushed Aggregate, Granite and Limestone	Crushed Recycled Concrete
Los Angeles Abrasion, % maximum	ASTM C131 (Grading B)	35	35
California Bearing Ratio (CBR)* - 4 days soaked, % minimum @ 5.08 mm	ASTM D1883	90	90
Micro-Deval Abrasion, % maximum	ASTM D6928	14	14
Percentage of Fractured Particles, % mass: - one or more fractured faces - two or more fractured faces	ASTM D5821	--	 90 80
Liquid Limit, % maximum	ASTM D4318	--	20
Plasticity Index, % maximum	ASTM D4318	--	Non plastic

*CBR test shall be performed at 100 % maximum dry unit weight and optimum water content.

2.3 Lime or Portland Cement

2.3.1 Use either Lime or General Use Cement for drying the sub-grade.

2.3.2 Supply Lime in accordance with CSA A82.43.

2.3.3 Supply Portland Cement in accordance with CSA - Section 4.

2.4 Imported Fill Material

2.4.1 Imported fill material will consist of low to medium plastic clays or mixtures of sand and clay, uniform in texture.

2.4.2 The fill material shall be free of wood, vegetation, concrete rubble or stones larger than 25 millimetres in diameter.

3. CONSTRUCTION METHODS

3.1 Pavement Removal

3.1.1 Remove existing concrete pavement, including curbs and asphalt overlays at locations as shown on the Drawings or as directed by the Contract Administrator. Remove all pavements to a combined thickness of 300 millimetres, unless otherwise indicated in the Specifications.

3.1.2 Remove existing asphalt pavement including asphalt curbs at locations as shown on the Drawings or as directed by the Contract Administrator. Remove pavement to a maximum thickness of 150 millimetres, unless otherwise indicated in the Specifications.

3.1.3 Saw-cut the existing pavement full-depth along the limits designated for removal.

3.1.4 Utilize backhoe type equipment unless approved otherwise by the Contract Administrator.

3.1.5 Dispose of material in accordance with Section 3.4 of CW 1130.

3.2 Excavation

3.2.1 Excavate in-situ material to the depth to accommodate the pavement structure as shown on the Drawings or as directed by the Contract Administrator.

3.2.2 Stockpile suitable in-situ material and suitable site sub-base material at locations on site as directed by the Contract Administrator.

3.2.3 Dispose of surplus suitable site material and unsuitable material such as frost heaving clays, silts, rocks and rubble in accordance with Section 3.4 of CW 1130.

3.2.4 Strip and stockpile topsoil from the site in a manner which will prevent contamination of topsoil with underlying soil materials. Stockpile the stripped topsoil at locations on site for later use.

3.2.5 The limits of excavation will be taken as a vertical plane 450 millimetres beyond the limits of the proposed pavement except when slip form paving equipment is specified for placement of the concrete pavement, the limits of excavation will be increased to a vertical plane 750 millimetres beyond the limits of the proposed pavement.

3.2.6 During excavation, the Contractor will be advised by the Contract Administrator as to which areas have an unsuitable sub-grade.

3.2.7 Remove wooden poles, concrete bases, or tree stumps encountered under pavements to the top of subgrade or 1 metre below the bottom of the pavement surface, whichever depth is greater.

3.2.8 Backfill and compact over-excavated areas with sub-base material approved by the Contract Administrator.

3.2.9 Excavate additional material beyond the boulevard grading and ditch grading limits as directed by the Contract Administrator.

3.3 Preparation of Sub-grade and Placement of Sub-Base Material

3.3.1 Compact the sub-grade after the bottom of the excavation has been approved by the Contract Administrator.

3.3.2 Compact areas of suitable sub-grade material, the full width of the excavation, to a minimum of 95% Standard Proctor Density.

3.3.3 If the sub-grade material cannot be compacted to the required density, the Contractor shall proceed as directed by the Contract Administrator and approved by the City of Winnipeg.

3.3.4 Sub-base material shall not be placed over frozen sub-grade.

3.3.5 Place and compact suitable site sub-base material before placing any new sub-base material.

3.3.6 Place and compact crushed sub-base material with or without geogrid as directed by the Contract Administrator in accordance with CW 3135.

3.3.7 Place and compact sub-base materials in layers to a depth of 3 times the maximum aggregate size. Compact to a minimum of 100% Standard Proctor Density, for the full width of the excavation, and each layer must be levelled and approved by the Contract Administrator before the succeeding layer may be placed.

3.3.8 Layering, mixing or blending of crushed concrete with crushed aggregate or crushed limestone sub-base materials is not allowed.

3.3.9 Recompact or replace any layer which has been rejected.

3.3.10 When excess water has been applied, either by sprinkling operations or by precipitation, to cause local or continuous pondage, soil compaction will not be permitted until sufficient soil drying has occurred, creating a condition lending itself favourably to compacting operations. Exercise necessary precautions to protect compacted areas against excess wetting from any natural or artificial sources of water application.

3.3.11 Should excess moisture from continuous or heavy precipitation threaten to unduly delay the completion of the Contract, apply in writing to the Contract Administrator requesting permission to use Lime or Portland Cement to dry out the clay sub-grade or sub-base material at specific location(s).

3.4 Placement of Sub-Base Material With Geotextile Fabric

3.4.1 Install separation or separation/reinforcement geotextile fabric in accordance with CW 3130.

3.4.2 For sub-grades with CBR ≥ 3.0%, place and compact sub-base material to a minimum of 150 mm over the geotextile fabric prior to allowing construction traffic to travel on the sub-base.

3.4.3 For subgrades with CBR < 3.0%, place and compact sub-base material to a minimum of 300 mm over the geotextile fabric prior to allowing construction traffic to travel on the sub-base.

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3.4.4 The minimum lift thickness may need to be increased for very weak subgrades to prevent spreading equipment from damaging the geosynthetic as directed by the Contract Administrator.

3.4.5 Place sub-base material by end-dumping methods and level with front-end loader type of equipment as approved by the Contract Administrator to avoid damage to the geotextile fabric and minimize sub-grade failures.

3.4.6 Layering, mixing or blending of crushed concrete with crushed aggregate or crushed limestone sub-base materials is not allowed.

3.4.7 Avoid sudden stops or sharp turns by construction equipment during placement of sub-base materials.

3.4.8 Construction traffic will not be allowed to travel on the placed sub-base material until approved by the Contract Administrator.

3.5 Placement of Crushed Sub-base Material with Geotextile Fabric and Geogrid For Unstable Sub-grades

3.5.1 Prepare the subgrade in accordance with Section 3.3 of this Specification.

3.5.2 Supply and install geotextile fabric over the subgrade in accordance with CW 3130 and Section 3.4 of this Specification.

3.5.3 Supply and install geogrid in accordance with CW 3135.

3.5.4 Supply crushed sub-base material in accordance with Section 2.1 of CW 3110.

3.5.5 Place crushed sub-base material by end dumping down the centre of the excavation. The sub-base shall be pushed forward and levelled using a track type dozer where possible, to build a thickened section to support the hauling operations and avoid damage to the subgrade, geotextile fabric or geogrid. This procedure shall continue until all sub-base material has been placed down the centre of the excavation.

3.5.6 Spread the crushed sub-base material to facilitate final grades utilizing a track type dozer.

3.5.7 Initial compaction of the crushed sub-base material shall consist of two complete passes utilizing vibratory type equipment capable of compacting the material. Each pass shall be over lapped by half the width of the roller. All additional compaction shall be completed utilizing static type equipment. No trucks, rubber tire loaders or graders will be allowed to travel on the sub-base material until the Contract Administrator has approved the compaction of the sub-base.

3.6 Placement of Base Course Material

3.6.1 Place and compact base course material to a minimum 75 millimetres thickness for pavement and approaches to a minimum of 100% Standard Proctor Density for the full width of the excavation unless otherwise shown on the Drawings or as directed by the Contract

Administrator.

3.6.2 Level the compacted base course to the finished base course elevation.

3.6.3 Maintain the finished base course until the pavement is placed.

3.6.4 Spread base course material uniformly to avoid segregation, free of pockets of fine and coarse material.

3.6.5 Place and compact leveling course to a maximum thickness of 50 millimetres for sidewalks, renewal of existing curbs and miscellaneous concrete slabs, to 95% Standard Proctor Density.

3.6.6 Place and compact base course material immediately beneath pavement and forms to provide firm support.

3.7 Placement of Imported Fill

3.7.1 Place fill materials to satisfy the grading requirements of boulevard and ditches.

3.7.2 Supply material in accordance with Section 2.5 of this specification.

3.7.3 Compact to a minimum of 95% Standard Proctor Density.

3.7.4 Imported fill shall be free of frozen lumps and shall be placed and compacted in an unfrozen state. Imported fill shall not be placed over frozen subsoil.

3.8 Grading of Boulevards

3.8.1 Grading of the boulevards and medians to receive sod will be understood to mean the required excavation or backfilling to a depth up to 150 millimetres so that the boulevards and medians, after compaction, are at a uniform depth of 100 millimetres below finished boulevard grade, as shown on the Drawings.

3.8.2 Remove all debris, stones and concrete rubble from the boulevards and medians before commencing grading.

3.8.3 Grade the boulevards and medians to receive sod, unless otherwise shown on the Drawings or as directed by the Contractor Administrator.

3.8.4 Remove all debris, stones and concrete rubble from the boulevards and medians before commencing grading.

3.8.5 Excavate to a depth of up to 150 millimetres to meet the final grade 100 millimetres below finished boulevard grade.

3.8.6 Place and compact suitable backfill material as approved by the Contract Administrator to a depth of up to 150 millimetres to meet the final grade 100 millimetres below finished boulevard grade.

3.8.7 Supply backfill material in accordance with Section 2.5 of this specification.

3.8.8 Compact backfill materials to a minimum of 95% Standard Proctor Density.

3.9 Grading of Ditches

3.9.1 Grading of ditches will be understood to mean the required excavation or backfilling to a depth up to 300 millimetres so that the ditches, after compaction are at finished grade where no sodding is required or at a uniform depth of 100 millimetres below finished grade where sodding is required.

3.9.2 Grade ditches as shown on the Drawings or as directed by the Contract Administrator.

3.9.3 Excavate to a depth of up to 300 millimetres to meet the final ditch grade requirements.

3.9.4 Place and compact suitable backfill material as approved by the Contract Administrator to a depth of up to 300 millimetres to meet the final ditch grade requirements.

3.9.5 Supply backfill material in accordance with Section 2.5 of this specification.

3.9.6 Compact backfill materials to a minimum of 95% Standard Proctor Density.

3.10 Quality of Sub-grade, Sub-base and Base Course Layers

3.10.1 Utilize quality control tests to determine the acceptability of the sub-grade, sub-base and base course layers, as placed and compacted before the succeeding layer may be applied.

3.10.2 Promptly fill holes made by sampling with appropriate material and thoroughly compact to conform with the adjoining material.

3.10.3 Where Field Density Tests cannot be performed, the Contractor shall proof roll to verify the stability and uniformity of compaction. Proof rolling procedures shall comply with the following requirements:

- The test roller equipment shall be either a tandem-axle rear dump truck or a tri-axle rear dump truck (with raised third axle) loaded to a minimum gross weight of 30 tonnes. The Contractor may, with the approval of the Contract Administrator, use alternate equipment that produces similar results;

- Tire pressure shall be no less than 90 percent of the manufacturer's recommended maximum inflation;

- Operate the equipment between 4.0 and 8.0 km/hr;

- Proof rolling must be carried out the same calendar day that compaction is completed, otherwise the surface must be watered and given a minimum of three passes with the roller prior to the commencement of proof rolling;

- Rutting in excess of 25 mm but not more than 150 mm shall not be accepted and the layer will be reworked and compacted to the required density. No substantial surface cracking or lateral movement of the layer shall be allowed; and

- Where the rutting exceeds 150 mm, proceed as directed by the Contract Administrator.

3.10.4 The frequency and number of tests will be as directed by the Contract Administrator.

3.11 Removal of Existing Concrete Bases

3.11.1 Remove existing concrete bases as shown on the Drawings or as directed by the Contract Administrator.

3.11.2 Remove to a depth of 1.0 metre below finished grade.

3.11.3 Dispose of material in accordance with Section 3.4 of CW 1130.

3.11.4 Backfill holes remaining with base course material and compact to the satisfaction of the Contract Administrator.

4. QUALITY ASSURANCE TESTING

4.1 The Contract Administrator shall ensure that a minimum of one sample of base course and sub-base materials are tested prior to starting construction in accordance with Sections 2.1 and 2.2. The Contract Administrator shall ensure that the materials are sampled in accordance with ASTM D75 Standard Practice for Sampling Aggregates. Copies of the test results shall be sent to the City of Winnipeg, Research and Standards Engineer.

4.2 The Contractor shall not deliver materials to site prior to approval of the Contract Administrator.

4.3 If one test fails to meet the requirements of this Specification, the material shall be re-tested. If the material fails a second test, the Contractor shall designate a new source for supply of the material. The Contractor shall reimburse the City for any additional costs the City incurs as a result of failed tests.

4.4 The Contract Administrator shall confirm that materials delivered to site are equal to or better than the materials tested prior to construction by sampling from site and testing in accordance with Section 4.7. The Contract Administrator shall be present to witness that the sampling is in accordance with ASTM D75 Standard Practice for Sampling Aggregates. Where required, the Contractor shall provide all necessary equipment or personnel to aid in the sampling.

4.5 If circumstances make it necessary to collect samples from the quarry rather than the site, the Contractor shall provide a written explanation to the Contract Administrator and the City of Winnipeg, Research and Standards Engineer for approval.

4.6 The Contractor shall provide a weekly estimate of the material supplied to the Contract Administrator.

4.7 The Contract Administrator shall ensure the frequency of quality assurance tests during construction is as follows:

Gradation and Micro-Deval Abrasion tests for crushed aggregate, crushed granite, and crushed limestone:

For subbase: <2000 tonnes per project – The minimum testing frequency for each size shall be one sample, then sample every 3000 tonnes for 50 mm aggregate and 5000 tonnes for 100 aggregate.

For base: <500 m^3 per project – The minimum testing frequency shall be one sample, then sample every 750 m^3.

Gradation, Los Angeles Abrasion, Micro-Deval Abrasion, CBR, Percentage of Fractured Particles, Liquid Limit and Plasticity Index for crushed recycled concrete:

For subbase: <1200 tonnes per project – The minimum testing frequency for each size shall be one sample, then sample every 2000 tonnes for 50 mm aggregate and 3000 tonnes for 100 mm aggregate.

For base: <300 m^3 per project – The minimum testing frequency shall be one sample, then sample every 500 m^3.

4.8 When a change in the properties of the materials occurs or when the performance of materials is found to be unsatisfactory, the use of the materials shall be discontinued until the Contractor, with the approval of the Contract Administrator, proves the source to be satisfactory. Copies of the new test results shall be sent to the City of Winnipeg, Research and Standards Engineer.

4.9 The Contractor shall cease using the non-complying materials and at the discretion of the Contract Administrator, remove the unacceptable materials, including those that have already been placed and compacted. No payment shall be made for unacceptable materials.

4.10 The Contract Administrator shall be allowed access to all sampling locations and reserves the right to take a sample at any time.

4.11 When more than one source is used for supplying materials, test data from each source and material shall be managed independently.

4.12 The Contractor shall provide written notification to the Contract Administrator and the City of Winnipeg, Research and Standards Engineer prior to changing the aggregate source. The Contractor shall reimburse the City for any additional costs the City incurs as a result of the change.

4.13 Determine the Standard Proctor Density for the sub-grade, sub-base and base course materials at the optimum moisture content in accordance with ASTM Standard D698. The field density of each sub-grade, sub-base and base course layers will be a percentage of the Standard Proctor Density, in Sections 3.3, 3.4, 3.5 and 3.6 of this specification.

4.14 Verify the field density of the compacted layers by Field Density Tests in accordance with ASTM Standard D1556, Test for Density of Soil in Place by the Sand-Cone Method, or ASTM Standard D6938, Standard Test Methods for In-Place Density and Water Content of Soil and Soil Aggregate by Nuclear Methods (Shallow Depth). The Contractor shall reimburse the City for any additional costs the City incurs as a result of failed tests.

4.15 Testing in addition to the requirements of this Specification shall be as directed by the Contract Administrator.

4.16 There shall be no charge for any materials taken for testing purposes.

5. MEASUREMENT AND PAYMENT

5.1 Pavement Removal

5.1.1 Pavement removal will be measured on an area basis and paid for at the Contract Unit Price per square meter for the "Items of Work" listed here below. The area to be paid for will be the total number of square metres of existing pavement removed in accordance with this specification, accepted and measured by the Contract Administrator.

Items of Work:

Pavement Removal
i.) Concrete Pavement
ii.) Asphalt Pavement

5.1.2 Disposal of material will be included in the payment for the "Items of Works" listed for pavement removal.

5.1.3 Curb and asphalt overlay will be included in the payment for the Item of Work if both are removed in one operation with the pavement.

5.1.4 Payment for pavement over 300mm in thickness will be paid in ratio to the thickness over 300mm.

5.2 Stripping and Stockpiling Topsoil

5.2.1 Stripping and stockpiling topsoil will be measured on a volume basis and paid for at the Contract Unit Price per cubic metre for "Stripping and Stockpiling Topsoil". The volume to be paid for will be the total number of cubic metres of existing topsoil stripped and stockpiled in accordance with this specification, accepted and measured by the Contract Administrator.

5.3 Excavation

5.3.1 Excavation will be measured on a volume basis and paid for at the Contract Unit Price per cubic metre for "Excavation". The volume to be paid for will be the total number of cubic metres excavated in accordance with this specification, accepted and measured by the Contract Administrator.

5.3.2 The volume of excavation will be measured by cross-sections in its original position and computed by the method of Average End Areas.

5.3.3 Only material excavated within the limits of excavation will be included in the payment for "Excavation".

5.3.4 Disposal of material, removal of miscellaneous trees, shrub and concrete bases unless otherwise indicated in the Specifications, will be included in payment for "Excavation".

5.3.5 Excavation of solid bedrock, glacial till, boulders, loose rock, concrete rubble and foundations which are located within the limits of excavation and which require the use of additional or unconventional excavation equipment will be measured and paid for in addition to the unit price for excavation.

5.4 Sub-grade Compaction

5.4.1. Sub-grade compaction will be measured on an area basis and paid for at the Contract Unit Price per square metre for "Sub-Grade Compaction". The area to be paid for will be the total number of square metres of sub-grade compacted in accordance with this specification, accepted and measured by the Contract Administrator.

5.5 Sub-base Material

5.5.1 Suitable Site Sub-base Material

5.5.1.1 The reloading, hauling, placing and compaction of suitable site sub-base material will be measured on a volume basis and paid for at the Contract Unit Price per cubic metre for "Placing Suitable Site Sub-base Material". The volume to be paid for will be the total number of cubic metres of suitable site sub-base material placed in accordance with this specification, accepted and measured by the Contract Administrator.

5.5.1.2 The volume of suitable sub-base material will be measured by cross-sections and computed by the method of Average End Areas.

5.5.1.3 Only material placed within the limits of excavation will be included in the payment for "Placing Suitable Site Sub-base Material".

5.5.1.4 No measurement or payment will be made for materials rejected by the Contract Administrator.

5.5.2 Clay Borrow Sub-base Material

5.5.2.1 The supplying, placing and compaction of clay borrow sub-base material will be measured on a volume basis and paid for at the Contract Unit Price per cubic metre for "Supplying and Placing Clay Borrow Sub-base Material". The volume to be paid for will be the total number of cubic metres of material compacted in place in accordance with this specification, accepted and measured by the Contract Administrator.

5.5.2.2 The volume of clay borrow sub-base material will be measured by cross-sections and computed by the method of Average End Areas.

5.5.2.3 Only material placed within the limits of excavation will be included in the payment for "Supplying and Placing Clay Borrow Sub-base Material".

5.5.2.4 No measurement or payment will be made for materials rejected by the Contract Administrator.

5.5.3 Crushed Sub-base Material

5.5.3.1 The supplying, placing and compaction of crushed sub-base material will be measured on

a weight basis and paid for at the Contract Unit Price per tonne for the "Items of Work" listed here below. The weight to be paid for will be the total number of tonnes of crushed sub-base material supplied and placed in accordance with this specification, accepted and measured by the Contract Administrator.

Items of Work:

Crushed Sub-Base Material
i.) 50 mm*
ii.) 100mm*

*Limestone, Granular or Crushed Concrete Material may be specified.

5.5.3.2 The weight to be paid for will be the total number of tonnes of crushed sub-base material as measured on a certified weigh scale.

5.5.3.3 Only material placed within the limits of excavation will be included in the payment for the "Items of Work" listed for crushed sub-base material.

5.5.3.4 No measurement or payment will be made for materials rejected by the Contract Administrator.

5.6 Base Course Material

5.6.1 The supplying, placing and compaction of base course material will be measured on a volume basis and paid for at the Contract Unit Price per cubic metre for the "Supplying and Placing Base Course Material *". The volume to be paid for will be the total number of cubic metres of base course material supplied and placed in accordance with this specification, accepted and measured by the Contract Administrator.

* Limestone, Granular or Crushed Concrete Material may be specified.

5.6.2 The volume of base course material will be measured by cross-sections and computed by the method of Average End Areas.

5.6.3 Only material placed within the limits of excavation will be included in payment for "Supplying and Placing Base Course Material" or "Asphalt Cuttings Base Course Material".

5.6.4 No measurement or payment will be made for materials rejected by the Contract Administrator.

5.7 Leveling Course

5.7.1 No payment will be made for leveling course.

5.8 Grading of Boulevards

5.8.1 The grading of boulevards will be measured on an area basis and paid for at the Contract Unit Price per square metre for "Grading of Boulevards". The area to be paid for will be the total number of square metres of boulevards graded in accordance with this specification, accepted and measured by the Contract Administrator.

5.8.2 Additional excavation over 150 millimetres in depth required to complete boulevard grading will be paid for as "Boulevard Excavation".

5.8.3 Additional placement of backfill material over 150 millimetres in depth required to complete boulevard grading will be paid as "Imported Fill Material".

5.9 Ditch Grading

5.9.1 Ditch grading will be measured on an area basis and paid for at the Contract Unit Price per square metre for "Ditch Grading". The area to be paid for will be the total number of square metres of ditch graded in accordance with this specification, accepted and measured by the Contract Administrator.

5.9.2 Additional excavation over 300 millimetres in depth required to complete the ditch grading will be paid for as "Ditch Excavation".

5.9.3 Additional placement of backfill material over 300 millimetres in depth required to complete the ditch grading will be paid as "Imported Fill Material".

5.10 Boulevard Excavation

5.10.1 Boulevard excavation will be measured on a volume basis and paid for at the Contract Unit Price per cubic metre for "Boulevard Excavation". The volume to be paid for will be the total number of cubic metres of boulevard excavated in accordance with this specification, accepted and measured by the Contract Administrator.

5.10.2 The volume of excavation will be as measured by cross-sections in its original position and computed by the method of Average End Areas.

5.11 Ditch Excavation

5.11.1 Ditch excavation will be measured on a volume basis and paid for at the Contract Unit Price per cubic metre for "Ditch Excavation". The volume to be paid for will be the total number of cubic metres of ditches excavated in accordance with this specification, accepted and measured by the Contract Administrator.

5.11.2 The volume of excavation will be as measured by cross-sections in its original position and computed by the method of Average End Areas.

5.12 Removal of Existing Concrete Bases

5.12.1 Removal of existing concrete bases will be measured on a unit basis and paid for at the Contract Unit Price per unit for the "Items of Work" listed here below. The number of units to be paid for will be the total number of existing concrete bases removed in accordance with this specification, accepted and measured by the Contract Administrator.

Items of Work:

Removal of Existing Concrete Bases
i.) 600 mm Diameter or Less

ii.) Greater than 600 mm Diameter

5.12.2 No measurement or payment will be made for concrete bases removed for parking metres and precast concrete bases for traffic signs.

5.13 Imported Fill Material

5.13.1 Imported material fill will be measured on a volume basis and paid for at the Contract Unit Price per cubic metre for "Imported Fill Material". The volume to be paid for will be the total number of cubic metres of imported fill material supplied and placed in accordance with this specification, accepted and measured by the Contract Administrator.

5.13.2 The volume of imported fill material will be computed from cross-sections by the method of Average End Areas.

5.14 Lime or Portland Cement

5.14.1 Lime for drying the sub-grade will be measured on a weight basis and paid for at the Contract Unit Price per tonne for "Supplying and Placing Lime". The weight to be paid for will be the total number of tonnes of Lime supplied and placed in accordance with this specification, accepted and measured by the Contract Administrator.

5.14.2 Portland Cement for drying the sub-grade will be measured on a weight basis and paid for at the Contract Unit Price per tonne for "Supplying and Placing Portland Cement". The weight to be paid for will be the total number of tonnes of Portland Cement supplied and placed in accordance with this specification, accepted and measured by the Contract Administrator.

5.14.3 The weight to be paid for will be the total number of tonnes of Lime or Portland Cement as measured on a certified weigh scale.

Winnipeg PUBLIC WORKS DEPARTMENT • SERVICE DES TRAVAUX PUBLICS Engineering Division • Division de l'ingénierie	**Effective Date:** Draft **DIVISION 4**
CW 3130 – R5	**SUPPLY AND INSTALLATION OF GEOTEXTILE FABRICS**

TABLE OF CONTENTS

1. DESCRIPTION

1.1 General

1. This specification covers the supply and installation of Separation (slit-tape or slit-film woven), Separation/Filtration (nonwoven), and Subgrade Stabilization fabrics relating to Surface Works construction.

2. All property values, with the exception of apparent opening size, represent minimum average roll values (MARV) in the weakest principle direction. Values for apparent opening size represent maximum roll values.

1.2 Definitions

Nonwoven Geotextile:	A planar geosynthetic made of randomly orientated yarns produced by bonding fibres, or interlocking fibres, or both bonding and interlocking fibres by mechanical, chemical, or thermal means.
Slit-Tape / Slit-Film Woven Geotextile:	A planar geosynthetic made from flat, tape-like yarns that are produced by slitting and extruded film. Unsuitable for applications in which high groundwater or moderate to high moisture contents are present.
Multi-Filament Fibrillated Yarn High Strength Woven Geotextile:	A planar woven geotextile made from high-tenacity long-chain synthetic polymers composed of at least 95 percent by weight polyolefins. They shall form a stable network such that the filaments or yarns retain their dimensional stability relative to each other, including selvages.
Minimum Average Roll Value (MARV):	Property value calculated as typical minus two standard deviations. It shall yield a 97.7 percent degree of confidence that any sample taken during quality assurance testing will exceed value reported.
Typical Value (TV):	The mean value calculated from documented manufacturing quality control test results for a defined population obtained from one test method associated with one specific property.
Minimum Value (MV):	The lowest sample value from documented manufacturing quality control test results for a defined population from one test method associated with one specific property.
Separation:	A geosynthetic function in which a geotextile is used to prevent mixing of two dissimilar materials to maintain their engineering properties such as a subgrade soil and an aggregate cover.
Filtration:	A geosynthetic function in which a geotextile is placed between two dissimilar soils to allow for long-term passage of water into a subsurface drainage system and retain the in-situ soil.

Reinforcement:	A geosynthetic function in which a geotextile acts as a tensile member in the surface structure of a pavement.
Confinement:	A geosynthetic function in which a geosynthetic prevents the lateral movement (rutting) of aggregate.
Stabilization:	The use of a geosynthetic or combination of geosynthetics and geogrid on weak to very weak subgrade conditions (CBR ≤ 3.0%) to provide the coincident functions of separation, filtration, reinforcement, and confinement.
California bearing ratio (CBR)	Standard test method for evaluation of the mechanical strength of materials in accordance with ASTM Standard D1883.

1.3 Referenced Standard Construction Specifications

1. CW 3110 – Sub-Grade, Sub-Base and Base Course Construction.
2. CW 3120 – Installation of Subdrains
3. CW 3135 – Supply and Installation of Geogrid.
4. Approved Products for Surface Works.

2. MATERIALS

2.1 Approved Products

1. Use only those materials listed as Approved Products for Surface Works. The Approved Products are available in Adobe Acrobat (.pdf) format at the City of Winnipeg, Corporate Finance, Material Management Internet site at: https://www.winnipeg.ca/finance/findata/matmgt/std_const_spec/current/Docs/Approved_Products_Surface_Works.pdf

2.2 Material Identification

1. Geotextile fabric is to be labelled in accordance with ASTM D4873/D4873M, and must clearly show the manufacturer name, product style number and roll number.

2. Products without proper identification or labelling, mislabelling, or misrepresentation of materials shall be rejected.

2.3 Shipment, Storage and Handling

1. Geotextile rolls shall be wrapped with a material that will protect the geosynthetic, including the ends of the roll, from damage due to shipment, water, sunlight, and contaminants.

2. Protective wrapping shall be maintained during shipment and storage and shall remain on the geotextile fabric until installation.

3. During storage, geotextile rolls shall be elevated off the ground and adequately covered to protect them from site construction damage, precipitation, contamination of dirt or dust, extended ultraviolet radiation, and any other environmental condition that may damage the physical property values of the geosynthetic.

2.4 Certification

1. The Contractor shall provide Mill Certificate and MARV Roll Data to the Contract Administrator prior to installation. The Certification shall state that the furnished geotextile meets MARV requirements of the specification as evaluated under the Manufacturer's quality control program. The Certification shall be attested to by a person having legal authority to bind the Manufacturer.

2. The Contractor shall provide a letter to the Contract Administrator stating the product name, manufacturer, style number, chemical composition of the filaments or yarns and other pertinent information to fully describe the geotextile.

3. All testing and data to be in accordance with approved ASTM standards. Data reported in accordance with other standards will not be accepted.

2.5 Geotextile Property Requirements for Separation, Filtration, and Stabilization

2.5.1. Separation Geotextile Fabric

1. Separation geotextile fabric will be a slit-tape or slit-film woven fabric and will be used for unsaturated subgrade soils containing low fines (less than 15% passing the 0.075 mm sieve) with CBR ≥ 3.0% and not subject to seasonal increases in moisture content or fluctuating water table.

2. Separation geotextile fabric shall meet or exceed the following requirements:

Table CW 3130.1 – Separation Fabric Requirements

Physical Property	Statistical Reporting	Standard	Test Method
Grab Tensile Strength, minimum	MARV	1400 N	ASTM D4632
Elongation, maximum	MARV	50%	ASTM D4632
CBR Puncture, minimum	MARV	4000 N	ASTM D 6241
Trapezoid Tear, minimum	MARV	500 N	ASTM D4533
Apparent Opening Size, maximum	TV	0.43 mm	ASTM D4751
Permittivity, minimum	MV	0.05 sec^{-1}	ASTM D4491
Flow Rate, minimum	MV	160 $l/min/m^2$	ASTM D4491
U.V. Resistance, minimum	MV	70% after 500 hrs	ASTM D4355

All physical property requirements shall be provided using the appropriate statistical reporting method in Table CW 3130.1 and as defined by ASTM D4759.

2.5.2. Separation/Filtration Geotextile Fabric

1. Separation/Filtration geotextile fabric will be nonwoven and will be used for unsaturated subgrade soils containing high fines (more than 15% passing the 0.075 mm sieve) with CBR ≥ 3.0% and subject to seasonal increases in moisture content or fluctuating water table.

2. Separation/Filtration geotextile fabric shall meet or exceed the following requirements:

Table CW 3130.2 – Separation/Filtration Fabric Requirements

Physical Property	Statistical Reporting	Standard	Test Method
Grab Tensile Strength, minimum	MARV	900 N	ASTM D4632
Elongation, minimum	MARV	50%	ASTM D4632
CBR Puncture, minimum	MARV	2200 N	ASTM D 6241
Trapezoid Tear, minimum	MARV	350 N	ASTM D4533
Apparent Opening Size, maximum	TV	0.18 mm	ASTM D4751
Permittivity, minimum	MV	1.4 sec^{-1}	ASTM D4491
Flow Rate, minimum	MV	3870 $l/min/m^2$	ASTM D4491
U.V. Resistance, minimum	MV	70% after 500 hrs	ASTM D4355

All physical property requirements shall be provided using the appropriate statistical reporting method in Table CW 3130.2 and as defined by ASTM D4759.

2.5.3. Stabilization Geotextile Fabric

1. Stabilization fabric will be either a multi-filament fibrillated yarn high strength woven geotextile or separation/filtration geotextile fabric (non-woven) and geogrid, and will be used for saturated fine-grained subgrade (more than 15% passing the 0.075 mm sieve) with CBR less than 3.0% and/or subject to thaw weakening, or erodible silt subgrades to provide the coincident functions of separation, filtration, and reinforcement.

2. The multi-filament fibrillated yarn high strength woven geotextile shall meet or exceed the following requirements:

Table CW 3130.3 – Subgrade Stabilization Geotextile Fabric Requirements

Physical Property	Statistical Reporting	Machine Direction	Cross-Machine Direction	Test Method
Ultimate Tensile Strength, minimum	MARV	70.0 kN/m	70.0 kN/m	ASTM D4595
Tensile Strength (at 5% Strain), minimum	MARV	35.0 kN/m	43.8 kN/m	ASTM D4595
Flow Rate, minimum	MV	1222 l/min/m^2		ASTM D4491
Apparent Opening Size, maximum	TV	0.60 mm – maximum		ASTM D4751
Permittivity, minimum	MV	0.5 sec^{-1}		ASTM D4491
U.V. Resistance, minimum	MV	>70% after 500 hrs		ASTM D4355

All physical property requirements shall be provided using the appropriate statistical reporting method in Table CW 3130.3 and as defined by ASTM D4759.

3. Separation/filtration geotextile fabric (non-woven) and geogrid must meet the requirements of both CW 3130 Section 2.5.2 and CW 3135 Section 2.5.

3. CONSTRUCTION METHODS

1. Commence installation of geotextile fabric after material has been approved by the Contract Administrator and the preparation of the sub-grade has been completed and accepted in accordance with CW 3110.

2. The surface of the subgrade should be relatively smooth and level. Depressions or humps greater than 50 mm should be removed.

3. The geotextile fabric shall be laid smooth without wrinkles or folds on the prepared sub-grade in the direction of the construction traffic. The geotextile fabric shall be free from any tension or stress.

4. Adjacent geotextile rolls should be overlapped along their sides and ends as a function of subgrade strength as follows:

CBR > 3%:	450 mm overlap
3% ≥ CBR > 2%:	750 mm overlap
2% ≥ CBR > 0.5%:	900 mm overlap or sewn
CBR ≤ 0.5%:	Sewn
All roll ends	1000 mm or sewn

For every 500 metres, the average CBR value shall be used to determine the overlap.

5. On curves, the geotextile may be cut or folded to conform to the curves.

6. Install pins or place piles of sub-base material as required in order to hold geotextile fabric in place.

7. Install geotextile fabric to the complete limits of the roadway sub-grade including intersections and turning lanes or as directed by the Contract Administrator.

8. Prior to covering, the geotextile shall be inspected by the Contract Administrator for damage (e.g. holes, tears, rips) during installation.

9. Cover the damaged area with a geotextile patch that extends an amount equal to the required overlap beyond the damaged area.

10. Remove and replace geotextile fabric that is improperly installed or damaged as directed by the Contract Administrator.

11. Construction vehicles are not permitted directly on the geosynthetic. Turning of vehicles shall not be permitted on the first lift above the geotextile.

12. Install geotextile fabric in accordance with this specification and procedures recommended by the manufacturer.

13. Place and compact the sub-base over the geotextile fabric in accordance with CW3110.

4. MEASUREMENT AND PAYMENT

1. Supply and installation of "Geotextile Fabric" will be measured on an area basis and paid for at the Contract Unit Price per square metre for "Geotextile Fabric". The area to be paid for will be the total number of square metres of "Geotextile Fabric" (*), supplied and installed in accordance with this specification, accepted and measured by the Contract Administrator.

   (*) - Specify Separation, Separation/Filtration, or Stabilization.

2. Only material placed within the designated sub-grade limits will be included in the payment for "Geotextile Fabric".

3. No measurement or payment will be made for geotextile fabric removed and replaced due to improper installation or damaged materials.

4. No measurement or payment will be made for overlapped material described in this Specification.

PUBLIC WORKS DEPARTMENT • SERVICE DES TRAVAUX PUBLICS Engineering Division • Division de l'ingénierie	**Effective Date:** Draft **DIVISION 4**
CW 3135 – R2	**SUPPLY AND INSTALLATION OF GEOGRID**

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1. DESCRIPTION

1.1 General

1. This specification covers the supply and installation of geogrid for use as reinforcement of base or subbase layers for pavement structures.

2. This specification also covers the supply and installation of geogrid in conjunction with a separation/filtration (nonwoven) geotextile fabric for use in subgrade stabilization applications.

1.2 Definitions

Geogrids:	A synthetic planar structure formed by a regular network of tensile strength elements with apertures of sufficiently large size to allow for interlocking with the surrounding soil to perform the primary function of reinforcement.
Minimum Average Roll Value (MARV):	Property value calculated as typical minus two standard deviations. It shall yield a 97.7 percent degree of confidence that any sample taken during quality assurance testing will exceed value reported.
Apertures:	The open spaces formed between the interconnected network of longitudinal and transverse ribs of a geogrid.
Separation:	A geosynthetic function in which a geotextile is used to prevent mixing of two dissimilar materials to maintain their engineering properties such as a subgrade soil and an aggregate cover.
Filtration:	A geosynthetic function in which a geotextile is placed between two dissimilar soils to allow for long-term passage of water into a subsurface drainage system and retain the in-situ soil.
Reinforcement:	A geosynthetic function in which a geotextile acts as a tensile member in the surface structure of a pavement.
Confinement:	A geosynthetic function in which a geosynthetic prevents the lateral movement (rutting) of aggregate.
Stabilization:	The use of a geosynthetic or combination of geosynthetics and geogrid on weak to very weak subgrade conditions (CBR ≤ 3.0%) to provide the coincident functions of separation, filtration, reinforcement, and confinement.
California bearing ratio (CBR)	Standard test method for evaluation of the mechanical strength of materials in accordance with ASTM Standard D1883.

D50	Value of the particle diameter at 50% in the cumulative particle size distribution for the aggregate above the geogrid.
D85	Value of the particle diameter at 85% in the cumulative particle size distribution for the aggregate above the geogrid.

1.3 Referenced Standard Construction Specifications

1. CW 3110 – Sub-grade, Sub-base and Base Course Construction.
2. CW 3130 – Supply and Installation of Geotextile Fabrics.
3. Approved Products for Surface Works.

2. MATERIALS

2.1 Approved Products

1. Use only those materials listed as Approved Products for Surface Works. The Approved Products are available in Adobe Acrobat (.pdf) format at the City of Winnipeg, Corporate Finance, Material Management Internet site at: https://www.winnipeg.ca/finance/findata/matmgt/std_const_spec/current/Docs/Approved_Products_Surface_Works.pdf

2.2 Material Identification

1. Geogrid is to be labelled in accordance with ASTM D4873/D4873M, and must clearly show the manufacturer name, product style number and roll number.

2. Products without proper identification or labelling, mislabelling, or misrepresentation of materials shall be rejected.

2.3 Storage and Handling

1. Geogrid rolls shall be elevated off the ground and adequately covered to protect them from site construction damage, precipitation, any contamination of dirt, dust any other deleterious materials.

2. Geogrid rolls shall be protected from extended ultraviolet radiation including sunlight, chemicals that are strong acids or strong bases, flames including welding sparks, excess temperatures, and any other environmental conditions that may damage the physical properties of the geotextile.

3. Store and handle the geogrid in accordance with the manufacturer's recommendations.

2.4 Certification

1. The Contractor shall provide Mill Certificate and MARV Roll Data to the Contract Administrator prior to installation. The Certification shall state that the geogrid meets MARV requirements of the specification as evaluated under the Manufacturer's quality control program. The Certification shall be attested to by a person having legal authority to bind the Manufacturer.

2. The Contractor shall provide a letter to the Contract Administrator stating the product name, manufacturer, style number, and other pertinent information to fully describe the geogrid.

3. All testing and data to be in accordance with approved ASTM standards. Data reported in accordance with other standards will not be accepted.

2.5 Geogrid Properties for Reinforcement of Base Course or Sub-base Layers

1. Geogrid will be extruded polypropylene, bi-axial, single layer with opening configuration either square or rectangular in shape.

2. The axis with the least strength will be taken as the ultimate strength of the geogrid for any given property.

Table CW 3135.1 – Geogrid Property Requirements

Physical Property	Machine Direction	Cross-Machine Direction	Test Method
Ultimate Tensile Strength	19.2 kN/m^2	28.8 kN/m^2	ASTM D 6637
Tensile Strength @ 2% Strain	6.0 kN/m	9.0 kN/m	ASTM D 6637
Tensile Strength @ 5% Strain	11.8 kN/m	19.6 kN/m	ASTM D 6637
Junction Efficiency	90%		ASTM D 6637
Aperture Size	25 – 75 mm		Direct Measure
U.V. Resistance	70% after 500 hrs		ASTM D4355

3. All physical property requirements are Minimum Average Roll Values (MARV) determined in accordance with ASTM 4759. Values not labelled as MARV will not be accepted.

2.6 Separation/Filtration Geotextile Fabric (non-woven) and Geogrid for Separation, Filtration, and Reinforcement

1. Separation/filtration geotextile fabric (non-woven) and geogrid must meet the requirements of both CW 3130 Section 2.5.2 and CW 3135.

2. Geotextile/Geogrid composite products must meet the requirements of both CW 3135 and CW 3130.

3. CONSTRUCTION METHODS

3.1 Geogrid

1. The Aperture Size shall be as follows:

   Aperture Size ≥ D50 of aggregate immediately above geogrid
   Aperture Size ≤ 2 x D85 of aggregate immediately above geogrid

2. The geogrid shall be laid smooth without wrinkles or folds on the Separation/Filtration geotextile fabric or prepared sub-grade in the direction of construction traffic. The geogrid shall be free from any tension or stress.

3. Adjacent geogrid rolls should be overlapped along their sides and ends as a function of subgrade strength as follows:

CBR > 3%:	450 mm overlap
3% ≥ CBR > 2%:	750 mm overlap
2% ≥ CBR > 0.5%:	900 mm overlap or sewn
CBR ≤ 0.5%:	A multi-filament fibrillated yarn high strength woven geotextile in accordance with CW 3130 shall be used

4. Cut geogrid to conform to curves.

5. Place piles of base or sub-base material as required to hold geogrid in place. Pins and washers are not permitted.

6. Install geogrid to the limits of the roadway sub-grade including intersections and turning lanes or as directed by the Contract Administrator.

7. Prior to covering, the geogrid shall be inspected by the Contract Administrator for damage during installation.

8. Cover the damaged area with a geogrid patch that extends an amount equal to the required overlap beyond the damaged area.

9. Remove and replace geogrid that is improperly installed or damaged as directed by the Contract Administrator.

10. Construction vehicles are not permitted directly on the geogrid. Turning of vehicles shall not be permitted on the first lift above the geogrid.

11. Avoid sudden stops or sharp turns by construction equipment during placement of sub-base materials.

12. Install geogrid in accordance with this specification and the manufacturer's recommendations.

4. MEASUREMENT AND PAYMENT

4.1 Geogrid

1. Supply and installation of geogrid will be measured on an area basis and paid for at the Contract Unit Price per square metre for "Supply and Install Geogrid". The area to be paid for will be the total number of square metres of geogrid, supplied and installed in accordance with this specification, accepted and measured by the Contract Administrator.

2. Only material placed within the designated sub-grade limits will be included in the payment for "Supply and Install Geogrid".

3. No measurement or payment will be made for geogrid removed and replaced due to improper installation or damaged materials.

4. No measurement or payment will be made for the overlap described in this Specification.