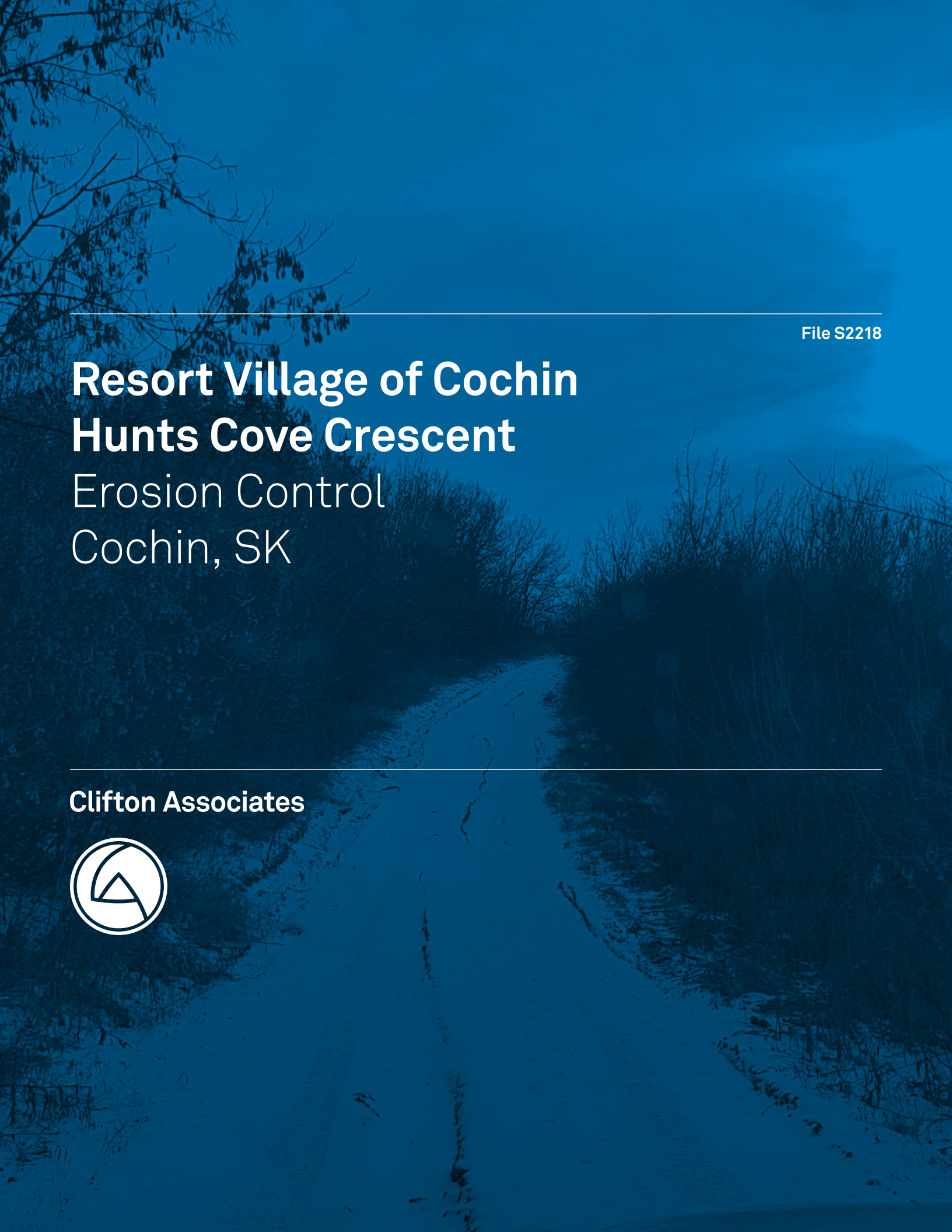

File S2218

Resort Village of Cochin
Hunts Cove Crescent
Erosion Control
Cochin, SK

Clifton Associates

Table of Contents

Appendices

List of Tables

List of Figures

1.0 Introduction

Clifton Associates Ltd. (Clifton) has been commissioned by the Resort Village of Cochin (Village) to provide a recommendation on design, materials, and construction to help implement a solution to address erosion issues at Hunts Cove Crescent in Cochin, SK (Site). According to the Village, the Site has seen erosion issues in the past two summers after no previous major issues. It is possible that alterations on surrounding properties have added to the runoff volume on the road.

2.0 Study Area

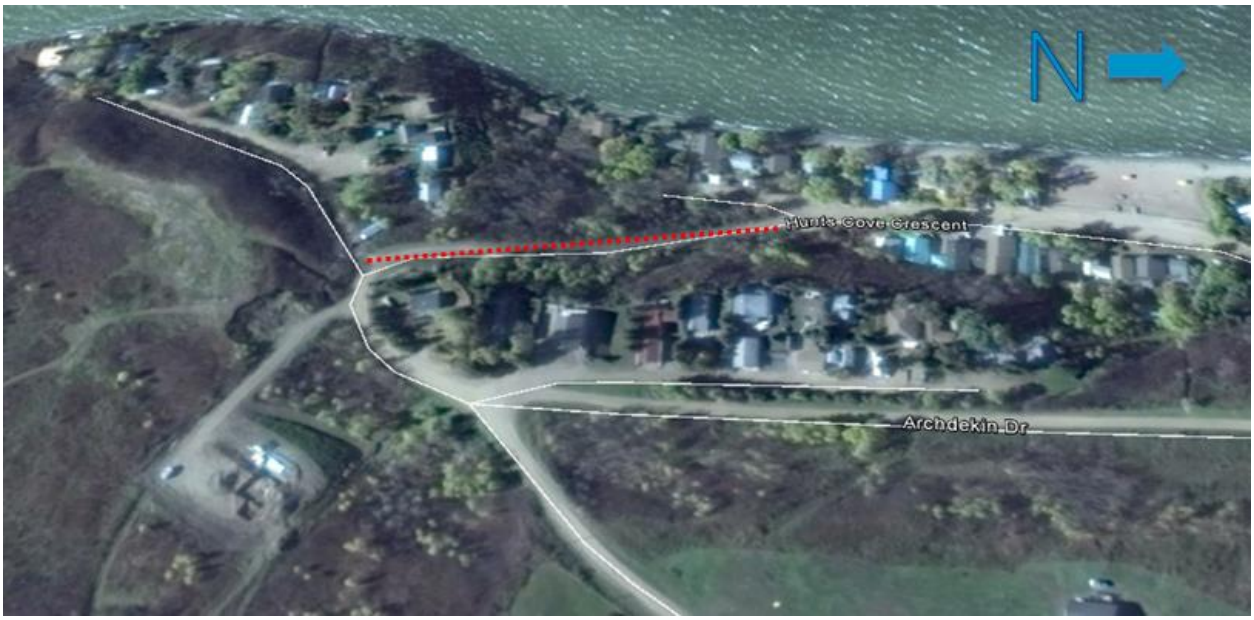

Figure 2.1: Area of Study (Google Earth Pro, 2014)

Area of Study (Google Earth Pro, 2014)

The area of study is shown above in Figure 2.1. The dashed line marks the hillside where the erosion issues on Hunts Cove Crescent are situated. The top of the hill is approximately 560 meters above sea level (masl) down to 544 masl (11% slope) at the at the bottom of the hill and 538 masl where the road meets the beach area. The road is sloped to the east, going down the hillside.

Erosion is the process where natural forces such as water, wind, and gravity wear away soil. At the Site, this is likely occurring due to spring melt and major rainfall event runoff. It is possible that alterations to the terrain on surrounding properties have contributed to the recent issues noted by the Village by re-routing overland flow and adding to the runoff volume.

3.0 Site Visit

Frank Skilnick and Anthony Brockbank of Clifton visited the Site on 21 December 2016. Rutting of up to 15 cm deep was noted in the road and the east ditch. The road top was not completely visible as the ground was snow-covered at the time.

4.0 Road Reconstruction

The gradient of the hillside on Hunts Cove Crescent is relatively steep, therefore it will be important to restore the road to a smooth condition to ensure that erosion rills do not develop. Water on or under the roadway is the single most significant cause of damage to the roadway. Problems related to water include rutting, cracking, potholes, erosion, washouts, heaving, flooding, and premature failure of the roadway. To prevent these problems and help ensure a roadway achieves it's designed service life, three things need to be established; get water off the road, out of the road, and away from the road. The solution is an efficient drainage system.

A road drainage system is dependent on its "weakest link". This means that if any of its elements is out of order, the whole system will not operate as planned and the road can be damaged. A well built and maintained road drainage system can be a very sustainable investment, depending on the stakeholders. The main advantages of a good drainage system are: effective removal of rainwater out of the road surface and its surroundings, road structures that stay dry, good bearing capacity, and a road that is nice and safe to drive.

To repair the damage from the erosion, the road top on the hillside should be re-graded and covered with approximately 100 mm of a pit run type material. The road should be sloped towards the east at a grade of no more than 2%. Slanting the road towards the east will drain water away and prevent erosion on the steep west side slope, reducing the potential for slope instability. Yearly maintenance on this area, maintaining the 2% slope, will be beneficial to the long term performance of the road. The east ditch should be approximately 1 m wide, lined with 75 mm of Class 1A riprap followed by 150 mm of Class 1 riprap. Figure 4.1, also shown as Drawing S2218-04 in Appendix A, illustrates the cross section of the reconstructed road and ditch.

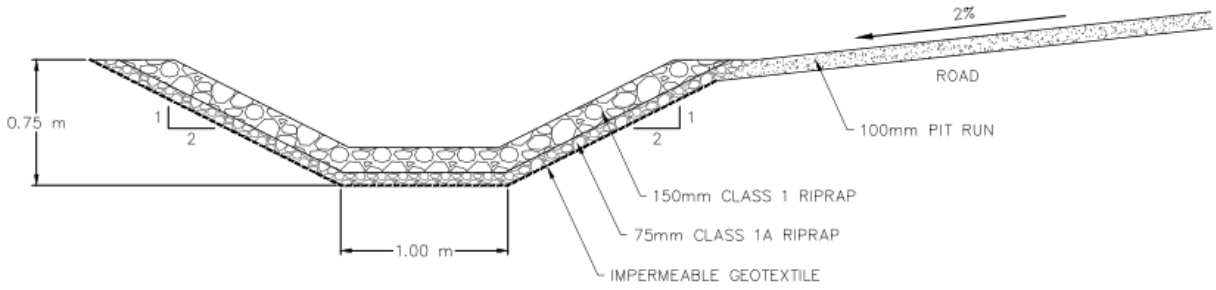

Figure 4.1: Roadway Reconstruction Cross Section

Where the slope flattens out at the bottom of the hill, an energy dissipating system should be implemented. The design should be similar to Drawing 5 shown in Appendix A, with an impermeable geotextile lining the ditch subgrade.

Table 4.1 outlines the Specifications for Class 1A and 1 riprap.

Table 4.1: Rock Class

NOMINAL RIPRAP CLASS BY MEDIAN PARTICLE DIAMETER		D15		D50		D85		D100
Class	**Size (mm)**	**Min (mm)**	**Max (mm)**	**Min (mm)**	**Max (mm)**	**Min (mm)**	**Max (mm)**	**Max (mm)**
1A	75	47	65	72	86	98	116	150
1	150	93	130	143	173	196	231	300

5.0 Proposed Design Alternatives

Clifton has outlined two approaches to deal with the runoff water from the hillside of Hunts Cove Crescent and its associated drainage area. All of the proposed designs use an energy dissipater at the base of the hillside. An energy dissipater is a structure designed to control erosion at the outlet of area passing water. It prevents erosion by decreasing the velocity of flowing water and dissipating the energy on non-erodible materials.

5.1 Catch Basin

The first option is to install a catch basin at the bottom of the hill, shown below in Figure 5.1 and Figure 5.2. The basin would collect excess water and would be routed between the cabins west of the intersection at the bottom of the hill via drainage swale or a steel or high density polyethylene culvert. The immediate area surrounding the catch basin would need to be sloped inwards. Also, this option would necessitate and easement from the applicable property owners.

Figure 5.1: Catch Basin Option

Figure 5.2: Location of proposed drainage culvert between address numbers 8452 and 8462 on Hunts Cove Crescent

Maintenance activities for catch basins include:

- Removing debris and silt from inlets so that water can freely enter;
- Ensuring the area around inlets and catch basins are sound and have water-tight joints, which prevents deterioration of the structure; and,
- Springtime freeze/thaw cycles may cause ice to form over the catch basin, so monitoring may be required.

5.2 Drainage Ditch - Swale/Culvert Road Crossing

Another solution to handle runoff from the hillside would be to create a drainage ditch from the bottom of the hill, north to the beach. This would involve approximately 100 m of ditch in the east side of Hunts Cove Crescent. Because of development, the ditch may need to be modified in areas along the distance to the swale.

The ditches should be approximately 1 m wide with 2H:1V side slopes, with Class 1 riprap or similar with 450 mm culverts at the driveways. Grass or other vegetation should be applied to the ditch floor as erosion protection, through sodding or a seeding, then applying a biodegradable rolled erosion control product (S150BN or similar). The location where the drainage ditch crosses the road should be a 450 mm culvert, sloped down towards the lake or a swale. A swale is a shallow tract of land sloped to convey surface drainage. Should the swale be utilized, coarse rock is recommended to fill in the shallow area in order to maintain the road surface and proper channel flow. Two locations for the road crossing location are

outlined in Figure 5.3 and Figure 5.4, as well as in Appendix A. At the beach discharge point, erosion protection measure such as grass or energy dissipating rocks should be implemented. The Location for the proposed discharge point is shown in Figure 5.5.

Issues regarding the drainage ditch option are that it will take up additional space, with some areas of conflict near trees, driveways and power poles. The width of the ditch would also narrow the existing roadway. Damaged culvert ends and corrosion can become a concern. Maintenance items with culverts include inspection for clogging from sediment as well as debris.

Figure 5.3: Drainage Ditch Option, crossing at beach

Figure 5.4: Drainage Ditch Option, crossing at 8502 Hunts Cove Crescent

Figure 5.5: Location of proposed discharge point of drainage swale, north of address number 8512 on Hunts Cove Crescent

6.0 Closure

Because of the restrictions due to development and private property, options are limited. Both a swale and a buried culvert will minimize the impact on the private property. We trust that this report meets your requirements. If you have any questions, please contact us at (306) 975-0401.

Clifton Associates Ltd.

Anthony Brockbank EIT
Environmental Engineer

Frank Skilnick PEng
Senior Transportation Engineer

Association of Professional
Engineers and Geoscientists of Saskatchewan
Certificate of Authorization No. C0238

Appendix A

Clifton Associates
Drawings

Clifton Associates

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SITE PLAN
SCALE: 1:25,000

NOTES:

1. SITE PLAN IMAGERY FROM GOOGLE EARTH PRO© 2016 AND IMAGE © DIGITALGLOBE DATED 2 OCT. 2014.
2. LEGAL DESCRIPTION: NE 24-47-17 W3M, RM OF MEOTA #468, SASKATCHEWAN.

DRAWING REVISIONS

REV	DESCRIPTION	BY	DATE

ENGINEER
Clifton Associates

CLIENT
RESORT VILLAGE OF COCHIN

PROJECT
HUNTS COVE CRESCENT EROSION CONTROL
COCHIN, SK

TITLE
OPTION 1

DESIGNED	SCALE: AS SHOWN	DATE: 2017-05-01
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CHECKED	FILE NO.: S2218-01	SHEET NO.

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RESORT VILLAGE OF COCHIN

PROJECT
HUNTS COVE CRESCENT EROSION CONTROL
COCHIN, SK

TITLE
OPTION 2

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PROJECT
HUNTS COVE CRESCENT EROSION CONTROL
COCHIN, SK

TITLE
OPTION 3

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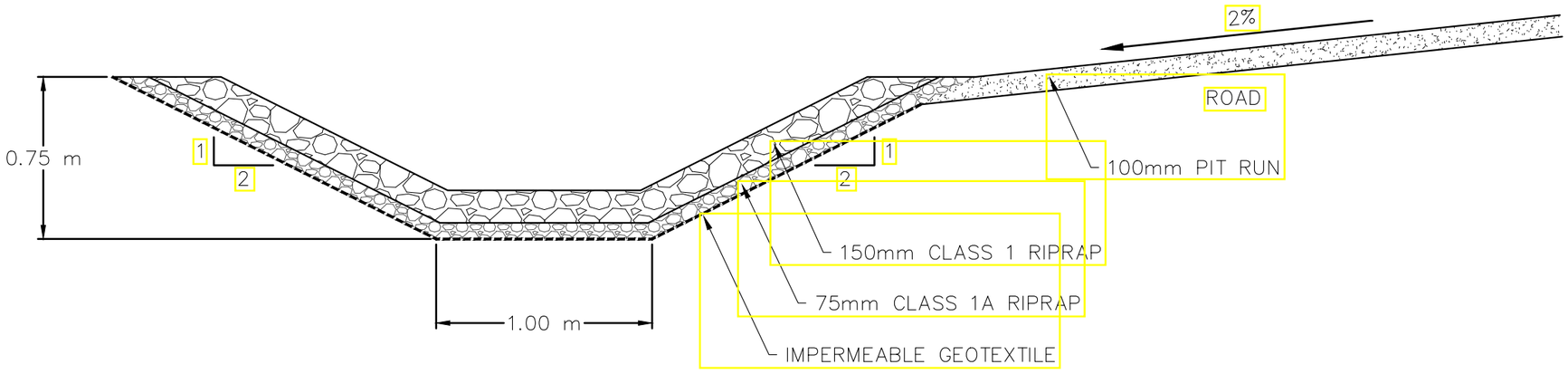

NOTES:

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DRAWING REVISIONS

REV	DESCRIPTION	BY	DATE

ENGINEER

Clifton Associates

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RESORT VILLAGE OF COCHIN

PROJECT

HUNTS COVE CRESCENT EROSION CONTROL
COCHIN, SK

TITLE

ROAD CROSS SECTION

DESIGNED	SCALE: NTS	DATE: 2017-05-01
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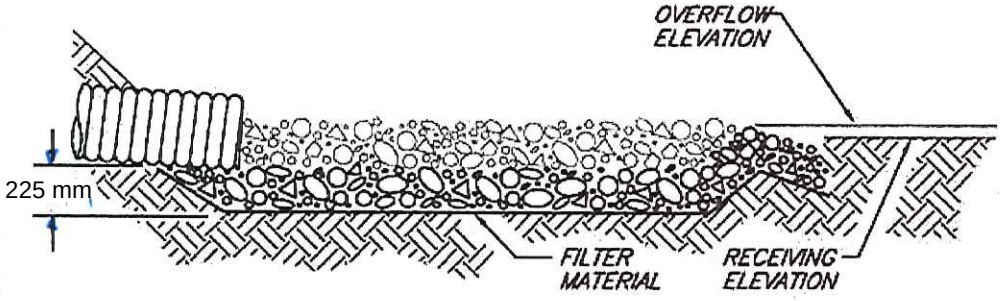

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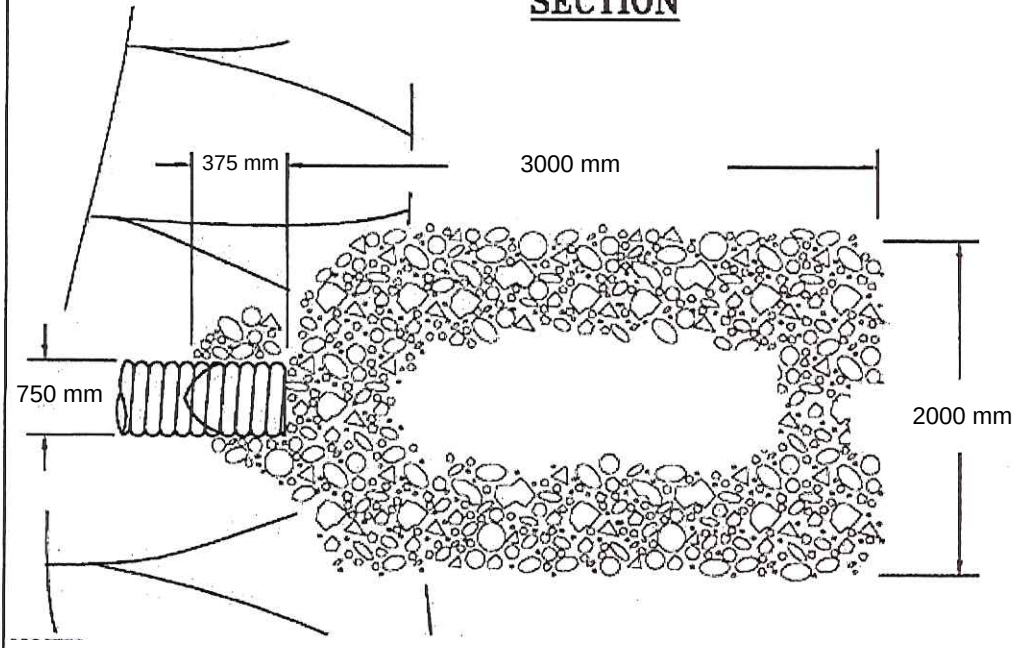

FILTER AND ROCK LAYER MUST BE CONTINUOUS AND MAINTAIN INTIMATE CONTACT WITH THE BASE SOIL OR FILTER LAYER. GRANULAR FILTER DETERMINED BY QUALIFIED PROFESSIONAL. MIN. THICKNESS 150 MM. WOVEN OR NON-WOVEN GEOTEXTILE MUST MEET SPECIFIED MATERIAL PROPERTIES.
ROCK NOMINAL CLASS SIZE AND GRADATION TO BE DETERMINED BY QUALIFIED PROFESSIONAL.
PLACE ROCK LAYER USING METHOD THAT MINIMIZES FILTER LAYER DISPLACEMENT AND/OR DAMAGE.
DISSIPATER SHALL BE SET AT 0% GRADE AND BE IN ALIGNMENT WITH CONDUIT.

ENERGY DISSIPATER

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