Appendix C

Previous NTHS Report 2023

Natural Terrain Hazard Study Report for the Proposed Development of New Public Riding School at the Restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III)

January 2023

The Hong Kong Jockey Club
LOD Hong Kong Limited
Modern Consulting Engineers Limited

Proposed Development of New Public Riding School at the Restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III)

Natural Terrain Hazard Study Report

Revision 0

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Abbreviations

B&V	Binnie Black & Veatch Hong Kong Limited
CDV	Completely Decomposed Volcanic
EPD	Environmental Protection Department, Hong Kong SAR Government
FOS	Factor of Safety
HAB	Home Affairs Bureau, Hong Kong SAR Government
HDV	Highly Decomposed Volcanic
ha	Hectare
HKJC	The Hong Kong Jockey Club
kPa	Kilopascal
LLDPE	Linear Low Density Polyethylene
PD	Principal Datum
PRS	Public Riding School
RDA	Riding for the Disabled Association
TKO	Tseung Kwan O
Stage II/III	Tseung Kwan O Stage II/III Landfill site

Executive Summary

A new public riding school is proposed to be constructed on Restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III) by the Hong Kong Jockey Club (HKJC). A natural terrain hazard study was carried out with respect to the natural hillside located to the northeast of the proposed development site.

The natural terrain hazard assessment was carried out based on guidelines given in GEO Report No.138 2nd edition (GEO, 2016), by reviewing the topography, geomorphology, landslide susceptibility and landslide history of the NTSA. Results of the assessment showed that there is potential Open Hillslope Landslide (OHL), Debris Flow (DF) and Channelized Debris Flow (CDF) hazards from the NTSA.

Debris mobility modelling has been carried out to simulate the potential design event. The results revealed that the modelled debris will not reach the proposed facilities. Following the results from the assessment, mitigation works for the potential natural terrain hazard is considered not necessary for the proposed new public riding school. The 'No-build Zone' recommended in the previous study in 2004 was reviewed and based on the current updated landslide debris mobility modelling, no landslide debris could run beyond the lower boundary of the "No-build Zone" and therefore, as a conservative and safe approach, it is recommended to keep the "No-build Zone" for the site formation design in the later stage.

Although the results from the NTHS showed that there is no significant risk of boulder fall hazard presence within the NTSA, there are a total number of six (6) boulders with low to medium stability which were identified from the site-specific boulder survey. Having said that these 6 nos. of boulders are resting on gentle slopes ranged from 30-35°. It is not considered to have immediate danger and significant risk of boulder fall hazard. These boulders could travel further downslope in the foreseeable future if severe soil erosion occurred beneath the boulders. Among these six (6) boulders, two (2) of them are located at the "Green Belt" Zone whereas the other four (4) are located at the Clear Water Bay Country Park zone. The two (2) boulders at the "Green Belt" Zone are recommended to be removed or in-situ stabilized by rock dowels as a precautionary measures; and no mitigation for the four (4) boulders within the Clear Water Bay Country Park is proposed as they could be either caught up by the existing concrete catchwater channel at the toe of the NTSA or deposited before reaching the low density traffic access road (Group 4 facility).

1 Introduction

1.1 General

1.1.1 A public riding school is proposed to be constructed at the restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III), Tseung Kwan O, New Territories (under Government Land Allocation, GLA-TSK 500, 847019E 817245N). A natural terrain hazard study was carried out with respect to the natural hillside located to the northeast of the proposed development site. This report documented the findings of the natural terrain hazards aroused from the natural hillside and the necessary mitigation measures to be carried out.

2 Site Description

2.1 Site Location

2.1.1 The Site (the Upper Platform) which are located on a very gentle man-made fill slope (<10°) at Tseung Kwan O is defined as the area for the proposed public riding school development. The Site is overlooking by natural terrains at its north-eastern side. The natural terrain study area (NTSA) overlooking the proposed public riding school was delineated in **Figure 1, Plate 1** and **Plate 2**. According to Catchment Classification stated in GEO Report No. 138 2nd Edition (GEO, 2016), the NTSA has been divided into sixteen hillside catchments based on their topographic characteristics, for simplicity these have been labelled as OH1 to OH5, TD1 to TD8, CD1 to CD3 in this report (**Figure 1**).

2.1.2 The NTSA is a natural open hillside consist of five main drainage lines and five sub-ordinate drainage lines. The majority of the NTSA is covered with dense vegetation and is within the Clear Water Bay Country Park. The hillslope is generally facing southwest above Wan Po Road.

2.2 Initial Screening

2.2.1 An initial screening exercise has been carried out to assess whether the proposed development falls within the "In-principle Objection Criteria" or the "Alert Criteria" with respect to the concerned natural terrain according to the guideline given in GEO Report No. 138 2nd Edition. The potential hillside catchments that may affect the proposed development has been delineated based on the 1:1000 topographic map and is presented in **Figure 2**. The angular elevations projected from the hillside catchment to the location of the proposed public riding school were measured. The angular elevations of each catchment are summarised in **Table 2.1**. Graphical presentations of the angular elevation are presented in **Figure 2**.

Table 2.1 Summary of Angular Elevation for Initial Screening

Catchment Nos.	Profile Section Nos.	Corresponding Toe Facilities	Facility Group	Angular Elevation (°)
OH1	Section C1	Open space area Note 1	Group 4	32
TD1	Section C2	Open space area	Group 4	22
TD2	Section C3	Open space area	Group 4	27

TD3	Section C4	Grazing Area [Note 2]	Group 4	24
TD4	Section C5	Grazing Area	Group 4	24
TD5	Section C6	Paddock [Note 3]	Group 4	24
TD6	Section C7	Paddock	Group 4	20
CD1	Section C8	Paddock	Group 4	22
OH2	Section C9-1	Staff Resting Area	Group 1	18
	Section C9-2	Stable block	Group 3/4	22
CD2	Section C10	Stable block	Group 3/4	23
OH3	Section C11	Office/Changing Room	Group 1	24
CD3	Section C12	Paddock	Group 4	23
OH4	Section C13	Paddock	Group 4	28
TD7	Section C14	Road with low traffic density [Note 4]	Group 4	31
OH5	Section C15	Road with low traffic density	Group 4	30
TD8	Section C16	Road with low traffic density	Group 4	27

Remarks:

Note 1: Open Space Area refers to the general outdoor open-air space at the Upper Platform.

Note 2: Grazing Area is used for horses to get sunshine, fresh air and exercise where sufficient space shall be provided for each horse during occupation. Limited numbers of horses are expected inside the Area at each time. Therefore, in our option, Grazing Area can be considered as lightly-used open-air reactional area.

Note 3: Paddock is an open-air space fenced off for riding activities. Limited numbers of horses and riders are expected inside the Paddock for each riding session. Therefore, in our option, Paddock can be considered as lightly-used open-air reactional area.

Note 4: Traffic to the Upper Platform is restricted due to limited capacity of existing access road. All the public traffic will be stopped at the entrance area of the Site. Only emergency vehicles, small utility vehicles and shuttle buses for students are allowed to access the

Platform. Therefore, in our option, the access road within the Upper Platform can be considered as road with low traffic density.

2.2.2 The measured angular elevations of each catchment from the NTSA to the proposed public riding school are generally measured in between 20° and 32°, except section C9-1 has only 18°. Most of the hillside catchments satisfied the "Alert Criteria". Given the proposed facilities are generally belong to Group 4, except the staff resting area and office are belong to Group 1, according to the GEO Report No. 138, Group 4 facilities normally do not require natural terrain hazard study. However, for a holistic approach, a natural terrain hazard assessment is to be carried out for the entire NTSA.

2.2.3 Apart from the Upper Platform, the proposed public riding school also consists of two proposed Platforms, namely the Middle Platform and the Lower Platform at about +40 mPD and +10 mPD respectively (**Figure 2.1**). The measured angular elevations from the natural hillsides to the Middle and Lower Platforms are below 20 degrees, i.e. not satisfy the "Alert Criteria" and therefore, natural terrain hazard study is not required for these two Platforms.

2.2.4 Moreover, in view of the Middle Platform, given there is an existing concrete catchwater channel (2.5m wide) located at the toe of the natural hillsides to the southeast of the Platform. If there is landslide debris originated from the natural hillsides, the debris will likely to be caught up and diverted away from the platform by the catchwater channel towards the southwest downslope direction.

3 Desk Study

3.1 Topography

3.1.1 The general topography of the NTSA was reviewed based on the latest 1:1000 scale topographical map. The maximum altitude of the NTSA is about +343 mPD and its toe is at about +126 mPD. The elevation different between the toe and the crest of the NTSA is about 217 m. A slope angle map has been generated for the NTSA based on the 1:1000 topographic map with the aid of the software ArcGIS (**Figure 3**). As shown in the slope angle map, relative gentle slopes which lies <20° are mainly located at the ridge and spurs along the boundaries of the NTSA; whilst most of the hillslopes within the NTSA lie between 25° to 35° with locally relatively steep terrain (35-50°) near the northeast top of the NTSA.

3.2 Geological Maps

3.2.1 The geology of the NTSA is shown on the Hong Kong Geological Survey (HKGS) Map Sheet 12 (Clear Water Bay), 1:20,000-scale HGM20 series, 1989 Edition I. The local geology of the NTSA is presented in **Figure 4**.

3.2.2 Solid Geology

3.2.3 The 1:20,000 scale geological map sheet 12 shows that the NTSA is underlain by four types of solid geology. Fine ash crystal Tuff of the High Island Formation (JHI) underlain along the crest of the NTSA. The upper portion of the NTSA is underlain by fine ash Tuff of the Clear Water Bay Formation (fa). The middle portion of the NTSA is comprise of Trachydacite and Rhyolite lava of the Clear Water Bay Formation (JCB). The lower portion of the NTSA is underlain by fine ash Tuff of the Clear Water Bay Formation (fa) and Trachydacite lava of the Ta Miu Wan Member of the Clear Water Bay Formation (Jmw). All these formations are belonged to the Repulse Bay Volcanic Group formed in Upper Jurassic of Mesozoic.

3.2.4 Superficial Geology

3.2.5 Majority of the NTSA does not indicate superficial deposit on the 1:20,000 scale geological map which implies the superficial deposits within the NTSA is less than 2m thick; only a tiny area of Pleistocene to Holocene Debris flow deposits (Qd) was indicated at the northern portion of Catchment No CD3.

3.2.6 Structural Geology

3.2.7 No faults or any photo-lineament has been recorded within the NTSA. However, a

northwest trending inferred fault is present at about 80m away from the north of the NTSA.

3.3 GASP

3.3.1 The Geotechnical Area Studies Programme (GASP) comprised a systematic geotechnical information and assessment for land management and development planning of the Territory of Hong Kong. The findings were based on terrain classification techniques using aerial photographs, examination of geotechnical data collected from existing site investigation records and available literature and field reconnaissance. The study was based on the bedrock geology given on the 1:50,000 scale geological map produced by Allen & Stephens (1971) 'Report on the Geological Survey of Hong Kong', which has subsequently been superseded. The following are extracts from the relevant GASP report (GASP Report VII, Clear Water Bay, 2nd Edition, 1988).

3.3.2 Physical Constraints Map – This map has indicated the majority of the NTSA is covered by zones of general instability associated with predominantly insitu terrain. A small portion of area traversed along the top to the bottom of Catchment No. CD3 has been classified as zones of colluvium which are subject to overland flow and periodic inundation; and evidence of unusual groundwater regime. Toe of Catchment Nos. CD3 and OH4, and the crest of Catchment No. CD3 are recorded as slopes on insitu terrain which are generally steeper than 30°.

3.3.3 Engineering Geology Map – This map indicates that the majority of the NTSA is covered by mainly banded acid lavas and some welded Tuffs with general instability, whilst the upper portion of Catchment No. CD3 is underlain by acid lavas. A small portion of Catchment No. CD3 is covered by colluvium.

3.3.4 Geotechnical Land Use Map – This map indicates that the majority of the NTSA is designated as Class IV, which has extreme geotechnical limitations and has very high engineering cost for development. Toe of Catchment Nos. CD3 and OH4, and the crest of Catchment No. CD3 are classified as Class III, which has high geotechnical limitations and has high engineering cost for development. Part of Catchment No. CD3 is recorded as Class II, which has moderate geotechnical limitations and has normal engineering cost for development.

3.4 Enhanced Natural Terrain Hazard Landslide Inventory

3.4.1 In 1995, the GEO compiled the Natural Terrain Landslide Inventory (NTLI) from an interpretation of high-altitude (8,000ft and above) aerial photographs dated from 1945 to 1994 (King, 1999). In 2007, the GEO produced an Enhanced Natural Terrain

Landslide Inventory (ENTLI) using low-altitude (8,000ft and below) aerial photographs to update the NTLI.

3.4.2 In accordance with GEO Report No. 138 2nd Edition (GEO, 2016), landslides are classed as either "Relict" or "Recent", depending on their appearance in aerial photographs. "Relict" landslides are defined as those where the main scarp is well-defined but vegetation has re-established on the scar on the earliest set of available aerial photographs. "Recent" landslides are defined as having occurred within the timespan of the aerial photograph coverage. These are typically identified as having a light tone on the aerial photographs and are bare of vegetation.

3.4.3 Three ENTLI records have been recorded within the NTSA and one ENTLI has been registered at the boundary of the NTSA (**Figure 5.1**). Three relict landslide scars (12SWA0004E, 12SWA0005E and 12SWA0220E) are marked at the crest of Catchment No. CD3. ENTLI No. 12SWA0341E is recorded at the NTSA boundary at upper portion of Catchment No. CD3.

3.4.4 Four ENTLI records are indicated in the close vicinity of the NTSA. Three ENTLIs, namely 12SWA0006E, 12SWA0007E and 12SWA0339E were located approximately 9m to 37m to the east of the upper portion of Catchment No. CD3, whilst another ENTLI No. 12SWA0273E is located 21m to the south of the middle portion of Catchment No. TD8 (Figure 5.1).

3.4.5 Two relict (12SWA0198E and 12SWA0199E) and one recent (12SWA0378E) ENTLI records are registered below the NTSA (**Figure 5.1).**

3.4.6 In addition, ten relict ENTLI records are registered adjacent to Catchment No. OH1 (**Figure 5.2**); twenty-one ENTLI records (18 relict and 3 recent landslides) are recorded in the catchment adjacent to Catchment No. TD8 (**Figure 5.3**). Among these ENTLI records, 20 of them were formed as man-made fill slopes afterwards.

3.4.7 The ENTLI recorded within and in the vicinity of the NTSA were summarised below in **Table 3.1.**

Table 3.1 Summary of Natural Terrain Landslide Events Recorded in ENTLI

ENTLI No.	Location	Recent / Relict	ENTLI Relict Landslide Class	Year of Photo	Landslide Type	Source Gradient (°)	Width (m)	Source Length (m)	Head Elevation (mPD)
12SWA0004E	At crest of Catchment No.	Relict	Rounded Scarp	1963	R	31	14	21.5	302

ENTLI No.	Location	Recent / Relict	ENTLI Relict Landslide Class	Year of Photo	Landslide Type	Source Gradient (°)	Width (m)	Source Length (m)	Head Elevation (mPD)
	CD3		(50% certain)						
12SWA0005E	At crest of Catchment No. CD3	Relict	Sharp Scarp (80% certain)	1963	R	42	12	11	314
12SWA0220E	At crest of Catchment No. CD3	Relict	Depression related to drainage line (10% certain)	1963	R	34	12	10	306
12SWA0341E	At the NTSA boundary at upper portion of Catchment No. CD3	Relict	Rounded Scarp (50% certain)	1963	R	49.5	11	11.5	294
12SWA0006E	9m to the east of the upper portion of Catchment No. CD3	Relict	Rounded Scarp (50% certain)	1963	R	45.5	12	7.5	303
12SWA0007E	24m to the east of the upper portion of Catchment No. CD3	Relict	Rounded Scarp (50% certain)	1963	R	38	13.5	9.5	305
12SWA0339E	37m to the east of the upper portion of Catchment No. CD3	Relict	Rounded Scarp (50% certain)	1963	R	40.5	11	9.5	287
12SWA0273E	21m to the south of the middle portion of Catchment No. TD8	Relict	Depression related to drainage line (10% certain)	1963	R	49	12	7.5	207
12SWA0198E	52m below Catchment No. TD4	Relict	Sharp Scarp (80% certain)	1963	R	-	7	13	-
12SWA0378E	102m below Catchment No. OH1	Recent	-	1975	Open Hillslope Landslide	-	5	8	-
12SWA0199E	165m below Catchment No. OH2	Relict	Depression related to drainage line (10% certain)	1963	R	-	7	14	-
12SWA0195E	178m adjacent to Catchment No. OH1	Relict	Depression related to drainage line (10% certain)	1963	R	-	7	9	-

ENTLI No.	Location	Recent / Relict	ENTLI Relict Landslide Class	Year of Photo	Landslide Type	Source Gradient (°)	Width (m)	Source Length (m)	Head Elevation (mPD)
12SWA0196E	190m adjacent to Catchment No. OH1	Relict	Broad depression (10% certain)	1963	R	-	16	7	-
12SWA0197E	215m adjacent to Catchment No. OH1	Relict	Broad depression (10% certain)	1963	R	-	8	10	-
12SWA0272E	229m adjacent to Catchment No. OH1	Relict	Broad depression (10% certain)	1963	R	-	8	7	-
12SWA0017E	261m adjacent to Catchment No. OH1	Relict	Depression related to drainage line (10% certain)	1963	R	-	9	10.5	-
12SWA0018E	298m adjacent to Catchment No. OH1	Relict	Rounded Scarp (50% certain)	1963	R	-	14	13.5	-
12SWA0194E	307m adjacent to Catchment No. OH1	Relict	Rounded Scarp (50% certain)	1963	R	-	9	11.5	-
12SWA0019E	314m adjacent to Catchment No. OH1	Relict	Rounded Scarp (50% certain)	1963	R	-	10	10	-
12SWA0021E	343m adjacent to Catchment No. OH1	Relict	Rounded Scarp (50% certain)	1963	R	-	9.5	11.5	-
12SWA0020E	344m adjacent to Catchment No. OH1	Relict	Rounded Scarp (50% certain)	1963	R	-	6	10.5	-
12SWA0068E	188m adjacent to Catchment No. TD8	Relict	Depression related to drainage line (10% certain)	1963	R	50	14	20	195
12SWA0069E	238m adjacent to Catchment No. TD8	Relict	Depression related to drainage line (10% certain)	1963	R	32.5	15	15	196
12SWA0184E	272m adjacent to Catchment No. TD8	Relict	Depression related to drainage line (10% certain)	1963	R	39	12	13.5	195
12SWA0187E	259m adjacent to Catchment No. TD8	Relict	Broad depression (10% certain)	1963	R	-	28	13	-

ENTLI No.	Location	Recent / Relict	ENTLI Relict Landslide Class	Year of Photo	Landslide Type	Source Gradient (°)	Width (m)	Source Length (m)	Head Elevation (mPD)
12SWA0188E	262m adjacent to Catchment No. TD8	Relict	Broad depression (10% certain)	1963	R	-	18	11.5	-
12SWA0183E	408m adjacent to Catchment No. TD8	Relict	Depression related to drainage line (10% certain)	1963	R	42	10	12	186
12SWA0186E	311m adjacent to Catchment No. TD8	Relict	Sharp Scarp (80% certain)	1963	R	-	8	8.5	-
12SWA0185E	302m adjacent to Catchment No. TD8	Relict	Rounded Scarp (50% certain)	1963	R	-	14.5	11	-
12SWA0182E	399m adjacent to Catchment No. TD8	Relict	Depression related to drainage line (10% certain)	1963	R	45.5	9	7.5	121
12SWA0330E	436m adjacent to Catchment No. TD8	Relict	Depression related to drainage line (10% certain)	1963	R	37	8.5	10	141
12SWA0329E	418m adjacent to Catchment No. TD8	Relict	Depression related to drainage line (10% certain)	1963	R	43	8	8	116
12SWA0181E	457m adjacent to Catchment No. TD8	Relict	Depression related to drainage line (10% certain)	1963	R	47	9	11	137
12SWA0376E	415m adjacent to Catchment No. TD8	Recent	-	1973	Open Hillslope Landslide	-	4	6	-
12SWA0328E	378m adjacent to Catchment No. TD8	Relict	Rounded Scarp (50% certain)	1963	R	-	7	10.5	-
12SWA0180E	453m adjacent to Catchment No. TD8	Relict	Rounded Scarp with debris (80% certain)	1963	R	-	12	12	-
12SWA0380E	477m adjacent to Catchment No. TD8	Recent	-	1975	Channelised Debris Flow	29.5	8	12	97
12SWA0377E	534m adjacent to Catchment No. TD8	Recent	-	1973	Open Hillslope Landslide	39.5	8	6	106

ENTLI No.	Location	Recent / Relict	ENTLI Relict Landslide Class	Year of Photo	Landslide Type	Source Gradient (°)	Width (m)	Source Length (m)	Head Elevation (mPD)
12SWA0015E	634m adjacent to Catchment No. TD8	Relict	Depression related to drainage line (10% certain)	1963	R	34	15	21.5	141
12SWA0179E	647m adjacent to Catchment No. TD8	Relict	Depression related to drainage line (10% certain)	1963	R	38.5	18	16.5	136
12SWA0178E	647m adjacent to Catchment No. TD8	Relict	Rounded Scarp (50% certain)	1963	R	43.5	14	15.5	122
12SWA0016E	668m adjacent to Catchment No. TD8	Relict	Sharp Scarp (80% certain)	1963	R	29.5	15	19	114

3.5 Historical Landslide Catchment (HLC) Inventory

3.5.1 Historical Landslide Catchments (HLCs) have been defined by GEO based on the results of the ENTLI. No HLC is recorded within the NTSA and in the vicinity of the NTSA.

3.6 Hillside Pockets

3.6.1 Hillside pockets are form of natural hillside catchment which have been affected by human disturbance to varying degree (e.g. construction of roads or building platforms). GEO has compiled an inventory of Hillside Pockets for the whole Hong Kong (GEO Report No. 138, Second Edition).

3.6.2 Under the Hillside Pockets Inventory, there is no registered Hillside Pockets within or in the vicinity of the NTSA.

3.7 Reported Landslide Incidents

3.7.1 No landslide incidents recorded within the NTSA. Five incidents recorded below the NTSA (**Figure 5.2**). Details of the incident records are summarised below in **Table 3.2**.

Table 3.2 Summary of Reported Landslide Incidents

Incident No.	Location	Occurrence Slope No.	Failure Type	Failure Volume (m3)

NT82/226	220m below Catchment No. OH3	12SW-A/F72	Soil cut	<50
NT82/233	424m below Catchment No. OH2	12SW-A/F68	Retaining wall	<5
NT82/232	374m below Catchment No. TD2	12SW-A/F69	Retaining wall	<5
NT82/225	403m below Catchment No. TD2	12SW-A/F69	Soil cut	0
NT82/224	408m below Catchment No. TD2	12SW-A/F69	Soil cut	<50

3.8 Boulder Field Inventory

3.8.1 The Boulder Field Inventory is a boulder study of the whole territory of Hong Kong including a series of study reports and 1:20,000 maps. The study was based on the use of the 1963 low altitude aerial photographs.

3.8.2 Four main attributes (Percentage Area Covered, Boulder Type, Boulder Size and Boulder Shape) and additional attributes are defined for the boulder study. Multiple Attribute Mapping was adopted to define areas of land having a relatively uniform pattern of boulder deposits and the results were mapped on 1:20,000 topographic maps of Hong Kong.

3.8.3 The Boulder Field Inventory was compiled by MGSL. The inventory contains referenced polygons encompassing individual boulder fields. According to the inventory, the NTSA is located within polygon nos. S12_44, S12_53, S12_54, S12_55, S12_263, S12_272, S12_273 and S12_C. The distribution of each polygon is present in **Figure 6**. The data represent each boulder number are summarised below in **Table 3.3**.

Table 3.3 Summary of Boulder Field Inventory

Polygon No.	Boulder Type	% of area covered by boulders	% of boulder <1m	% of boulder 1-2m	% of boulder 2-5m	% of boulder >5m	Boulder Shape
S12_44	corestone or tor	<10%	20	20	40	20	angular
S12_48	colluvial boulder field	10-20%	50	30	20	0	angular
S12_49	colluvial boulder field	10-20%	0	0	100	0	angular
S12_53	cliff or rock	20-50%	10	30	60	0	angular

Polygon No.	Boulder Type	% of area covered by boulders	% of boulder <1m	% of boulder 1-2m	% of boulder 2-5m	% of boulder >5m	Boulder Shape
	outcrop						
S12_54	cliff or rock outcrop	20-50%	10	20	40	30	angular
S12_55	corestone or tor	<10%	0	20	80	0	angular
S12_58	corestone or tor	<10%	100	0	0	0	angular
S12_248	land surface obscured by vegetation						
S12_263	cliff or rock outcrop	>75%	0	0	0	100	angular
S12_264	colluvial boulder field	<10%	0	100	0	0	angular
S12_269	colluvial boulder field	50-75%	20	30	10	40	angular
S12_270	colluvial boulder field	<10%	0	20	30	50	angular
S12_272	corestone or tor	20-50%	40	20	20	20	angular
S12_273	corestone or tor	<10%	30	40	30	0	angular
S12_C	land surface obscured by cloud						

3.9 Previous Ground Investigation

3.9.1 Previous ground investigations include 6 boreholes, 5 trial pits and 14 slope strippings were carried out within the NTSA. The locations of these previous ground investigation stations are present in **Figure 7**, corresponding logs are given in **Appendix A**.

3.9.2 The boreholes located within the NTSA including 12880/BH17, 12880/BH18, 21370/NM7, 21370/NM8, 36093/DH6 and 36093/DH7, which are located at the toe of the NTSA. These six boreholes revealed 0.72m to 12.65m thick of saprolite layer overlying moderately to slightly decomposed Tuff or Trachydacite Lava. Five trial pits, namely 36093/TP6, 36093/TP7, 36093/TP7A, 36093/TP8 and 36093/TP12 are located at the lower portion of the NTSA. These five trail pits revealed 0.22m to 1.1m thick of colluvium layer overlying 0.85m to 2.35m thick of saprolitic soil derived from Tuff or Trachydacite Lava. Fourteen slope strippings at the toe of the NTSA also revealed the cut slope surfaces are predominately in-situ materials with locally 0.6m to 3.9m colluvium exposed on the upper portions the cut slopes.

3.10 Existing Facilities

3.10.1 No existing facility is located within the NTSA.

3.11 Registered Man-made Slopes

3.11.1 Eight man-made slopes are recorded within or in the close vicinity of the NTSA. Features formed along the toe of the NTSA, namely 12SW-A/C178, 12SW-A/C182, 12SW-A/C183, 12SW-A/C184, 12SW-A/C185, 12SW-A/C186, 12SW-A/C187 and 12SW-A/C188. In addition, four man-made features are registered below the NTSA, namely 12SW-A/C227, 12SW-A/F72, 12SW-A/F73 and 12SW-A/F74. The locations of the man-made features are provided in
Figure 8. The details of the registered man-made slopes are summarised below in **Table 3.5**. Neither Stage 2 nor Stage 3 Study has been carried out for these registered man-made slopes.

Table 3.5 Summary of the Registered Man-made Slopes

Feature No.	Location	Registered Date (dd/mm/ yy)	Average Angle (degree)	S2/S3 Study	Slope Upgrading Works	Checking Status/ Checking Certificate No.
12SW-A/C188	Along the toe of Catchment No. OH1	07/01/1998	45	Nil	Nil	Nil
12SW-A/C187	Along the toe of Catchment Nos. OH1 & TD1	07/01/1998	40	Nil	Nil	Nil
12SW-A/C186	Along the toe of Catchment Nos. TD1 & TD2 & TD3	07/01/1998	40	Nil	Nil	Nil
12SW-A/C185	Along the toe of Catchment No. TD3, TD4 & TD5	07/01/1998	45	Nil	Nil	Nil

Feature No.	Location	Registered Date (dd/mm/ yy)	Average Angle (degree)	S2/S3 Study	Slope Upgrading Works	Checking Status/ Checking Certificate No.
12SW-A/C184	Along the toe of Catchment Nos. TD5, TD6, CD1, OH2 & CD2	07/01/1998	70	Nil	Nil	Nil
12SW-A/C183	Along the toe of Catchment Nos. CD2, OH3 & CD3	07/01/1998	55	Nil	Nil	Nil
12SW-A/C182	Along the toe of Catchment Nos. CD3, OH4 & TD7	07/01/1998	50	Nil	Nil	Nil
12SW-A/C178	Along the toe of Catchment Nos. TD7, OH5 & TD8	07/01/1998	50	Nil	Nil	Nil
12SW-A/C227	Immediately below NTSA	14/02/2003	25	Nil	Nil	Nil
12SW-A/F73	Immediately below NTSA	07/01/1998	25	Nil	Nil	Nil
12SW-A/F74	Immediately below NTSA	07/01/1998	20	Nil	Nil	Nil
12SW-A/F72	200m below NTSA	07/01/1998	25	Nil	Nil	Nil

3.12 Previous Study

3.12.1 As part of a feasibility study for this project, a natural terrain hazard assessment was

carried out by Binnie Black & Veatch Hong Kong Limited (B&V) in 2004. According to the report, a "No-build Zone" was devised based on the calculated debris runout distances using the conservative design event. The "No-build Zone" was defined as one meter further away from the calculated debris runout distance boundary, outside of which no development will be affected by any potential natural terrain hazards. The lower boundary of the "no-build zone" was shown in **Figure D1**.

4 Aerial Photograph Interpretation

4.1 General

4.1.1 In order to study the landslide history, geomorphology and engineering geology of the NTSA and its adjacent area, an aerial photograph interpretation (API) has been carried out using a total of 120 relevant aerial photographs taken between 1924 and 2021. Site development and geomorphology obtained from API are summarised below and list of aerial photographs being examined is provided in **Appendix B**.

4.2 Landslides

4.2.1 Natural Terrain Landslide History.

4.2.2 The landslide history for the NTSA was obtained from a series of aerial photographs between 1924 and 2021.

4.2.3 Landslides have been classified as “relict” and “recent”, in accordance with GEO Report No. 138 2nd Edition (GEO, 2016). “Relict” landslides are defined as the landslides first observed on the earliest set of available aerial photographs where vegetation has re-established and the scarp is not well defined due to degradation. While “recent” landslides are defined as the landslides first observed on the earliest set of aerial photographs where vegetation has not re-established. The volumes of the landslides are assessed base on the observation from API and calculation using the formula 1/6πD.W.L, which assumes that the failure was “spoon-shaped”.

4.2.4 Based on the findings from API, 4 relict landslide scars (RL1 to RL4) have been identified within the NTSA. No recent landslide scars can be identified within the NTSA. In addition, 35 relict and 4 recent landslide scars can be determined in the study region of the NTSA. Among all, RL5 to RL9, RL22 to RL24 are considered to have similar geological and geomorphological setting with the NTSA. A relevant landslide inventory for the NTSA has been developed based on API are summarised in **Table 4.1** below.

Table 4.1 Landslide Inventory for the NTSA Based on API Findings

Landslide Reference No.	ENTLI No.	Location	Recent / Relict	Year of Photo	Landslide Type	Estimated Width (m)	Estimated Source Length (m)	Estimated Source Volume (m^3)
RL1	12SWA0004E	At crest of Catchment No. CD3	Relict	1963	Relict	12	11	35

Landslide Reference No.	ENTLI No.	Location	Recent / Relict	Year of Photo	Landslide Type	Estimated Width (m)	Estimated Source Length (m)	Estimated Source Volume (m^3)
RL2	12SWA0220E	At crest of Catchment No. CD3	Relict	1963	Relict	10	9	24
RL3	12SWA0005E	At crest of Catchment No. CD3	Relict	1963	Relict	7	11.5	29
RL4	-	At crest of Catchment No. CD3	Relict	1963	Relict	6	8	18
RL5	12SWA0341E	At the NTSA boundary at upper portion of Catchment No. CD3	Relict	1963	Relict	7.5	7	11
RL6	12SWA0006E	9m to the east of the upper portion of Catchment No. CD3	Relict	1963	Relict	8	7	12
RL7	12SWA0007E	24m to the east of the upper portion of Catchment No. CD3	Relict	1963	Relict	9	8	19
RL8	12SWA0339E	37m to the east of the upper portion of Catchment No. CD3	Relict	1963	Relict	11	13	37
RL9	12SWA0273E	21m to the south of the middle portion of Catchment No. TD8	Relict	1963	Relict	12	9.5	30
RL22	12SWA0068E	188m adjacent to Catchment No. TD8	Relict	1963	Relict	14	10	37
RL23	12SWA0069E	238m adjacent to Catchment No. TD8	Relict	1963	Relict	13	11	37
RL24	12SWA0184E	272m adjacent to Catchment No. TD8	Relict	1963	Relict	15	10	39
RC1	12SWA0376E	415m adjacent to Catchment No. TD8	Recent	1973	OHL	8.5	9	20
RC2	12SWA0377E	535m adjacent to Catchment No. T8	Recent	1973	OHL	10	9.5	25

Landslide Reference No.	ENTLI No.	Location	Recent / Relict	Year of Photo	Landslide Type	Estimated Width (m)	Estimated Source Length (m)	Estimated Source Volume (m^3)
RC3	12SWA0378E	102m below Catchment No. OH1	Recent	1975	OHL	5	8	10
RC4	12SWA0380E	477m adjacent to Catchment No. TD8	Recent	1975	CDF	6	16	40

4.2.5 A break of slope and an incisive concave depression is observed near the head of ephemeral sub-ordinate drainage line DL4.2, possibly instability (RL1) had taken place. The estimated landslide volume of RL1 is about $35m^3$. This location was possibly the ENTLI record no. 12SWA0004E. Another three concave depressions (RL2 to RL4) are discerned adjacent to RL1 which located at the crest of Catchment No. CD3. RL3 and RL4 are appeared as a spoon-shaped depression with distinct landslide trails whilst RL2 is a relatively subtle depression when compare with the other three landslides. RL3 and RL4 has an estimated failure volume of $29m^3$ and $18m^3$ respectively, whilst RL2 is about $24m^3$. RL2 and RL3 are possibly the locations of ENTLI record Nos. 12SWA0220E and 12SWA0005E respectively. RL4 does not recorded in the ENTLI.

4.2.6 Four broad and shallow concave depressions are observed adjacent to the upper portion of Catchment No. CD3, possibly four landslide incidents (RL5, RL6, RL7 and RL8) were occurred. RL5 is located at the NTSA boundary, whilst another three depressions (RL6, RL7 and RL8) are apparent approximately 9m to 37m to the east of the upper portion of Catchment No. CD3. These four landslide scarps are unobvious observed which indicate probably have been degraded for a long period of time. The estimated failure source volume of these four landslides is about $11m^3$ to $37m^3$. They are possibly registered as ENTLI Nos. 12SWA0341E, 12SWA0006E, 12SWA0007E and 12SWA0339E.

4.2.7 A distinct break of slope and depression is discerned on the bank of an ephemeral drainage line located outside the NTSA, which located approximately 20m to the south of the middle portion of Catchment No. TD8, probably a landslide event (RL9) was happened previously. RL9 has a failure volume of about $30m^3$ which is possibly the location of ENTLI No. 12SWA0273E.

4.2.8 Relict landslide scars, RL22, RL23 and RL24 located at about 200m to the south of TD8, are considered to have similar geological and geomorphological setting with the NTSA and their estimated failure volumes range from $37m^3$ to $39m^3$. All these

landslide events are regarded as relict landslides.

4.2.9 In aerial photos of year 1973, two high reflectance concave depressions are discerned approximately 415m and 535m adjacent to Catchment No. TD8, bare soil without any vegetation is observed, probably recent landslides (RC1 and RC2) occurred recently. RC1 is located on a topographic depression whilst RC2 located on the bank of a drainage line, both of them appears as shallow depressions. The estimated failure volumes of RC1 and RC2 are about 20m³ and 25m³ respectively. These two locations are registered as ENTLI Nos. 12SWA0376E (RC1) and 12SWA0377E (RC2).

4.2.10 In aerial photos of year 1975, a very shallow depression is evident on an open hillslope at about 102m below Catchment No. OH1. It is highly reflective bare soil surface without any vegetation, possibly recent landslide RC3. The failure area is relatively small and therefore the estimated source volume is only about 10m³. This is probably the location of ENTLI No. 12SWA0378E. Another elongated depression is apparent along a drainage line which located approximately 477m adjacent to Catchment No. TD8. It is highly reflective, bare soil is observed, probably a channelized debris flow (RC4) was occurred very recently due to no vegetation is present. The source area is narrow but long in shaped, and it is relatively incisive when compares to RC3. RC4 has an estimated source failure volume of 40m³. This recent landslide event is registered as ENTLI No. 12SWA0380E.

4.3 Geomorphological Conditions

4.3.1 The geomorphological map of the NTSA was developed based on API and cross-checked with field mapping. Details of the geomorphological features, including the morphology based on the system of Savigear (1965) and the regolith types based on the regolith guideline (TGN 22) are presented in **Figure 9.1** for a regional view and **Figure 9.2 to Figure 9.4** for a close-up view and described below:

4.3.2 Morphology

4.3.3 Morphologically, the NTSA appears as a generally slightly concave, fan-shaped southwest facing hillsides emerging from a northwest trending ridge. The eastern and western boundary of the NTSA is bounded by sub-rounded spurs.

4.3.4 A relatively sharp convex change of slope is discerned immediately below the ridgeline which bounded the upper boundary of the NTSA. The convex change of slope is discerned at about +142mPD at Catchment No. OH1 and then extend up to +234mPD at Catchment No. CD3. Another distinct convex change of slope is apparent at approximately +228mPD which located along the upper portion of Catchment Nos. TD7, OH5 and TD8. These convex changes of slope demarcate the upper and middle

slope terrain. The upper slope terrain comprises of gentle slope with gradient less than 20° whilst the transportation middle slope terrain comprises of relatively steeper slope with gradient lies in between 25° to 35°.

4.3.5 Regolith Types and Distribution

4.3.6 The smooth surface of the NTSA indicates the NTSA is probably covered by in-situ materials without significant mass wasting process, possibly a thin layer veneer (< 2m thick) of hillslope colluvium blanket the majority of the hillsides within the NTSA. Valley colluvium is confined along the drainage lines. Some boulder fields were deposited at the upper and middle portion of Catchment Nos. CD3, and also dispersed in the middle portion of Catchment Nos. OH4, TD7, OH5 and TD8. Many sub-angular to sub-rounded boulders were scattered across the NTSA.

4.3.7 Rock Outcrops

4.3.8 Minor intermittent rock outcrops are discerned at the crest of the NTSA which located at upper portion of Catchment Nos. CD3, OH5 and TD8.

4.3.9 Drainage Lines

4.3.10 No perennial drainage line can be discerned within the NTSA.

4.3.11 Ten linear hollows, possibly ephemeral drainage lines DLl, DL2, DL3, DL4 and DL5 and sub-ordinate ephemeral drainage lines DL4.1, DL4.2, DL4.3, DL4.4 and DL4.5 are observed in Catchment Nos. TD1, CD1, CD2, CD3, TD7 and TD8. Drainage lines DL1, DL2, DL3 and DL5 are present at the lower half portion of Catchment Nos. TD1, CD1, CD2 and TD8 respectively. DL4 contains five sub-ordinate drainage lines, namely DL4.1, DL4.2, DL4.3, DL4.4 and DL4.5. Main drainage line DL4 flows from the top of Catchment No. CD3 towards the bottom of Catchment No. CD3; sub-ordinates drainage line DL4.1 is discerned approximately 20m away from the top of Catchment No. CD3, whilst DL4.2, DL4.3 and DL4.4 are apparent at the upper, middle and lower portion of Catchment No. CD3 respectively. DL4.5 is located along Catchment No. TD7. These five southwest trending drainage lines are running towards the toe of the NTSA. Sub-ordinate drainage lines DL4.1, DL4.2, DL4.3 and DL4.4 are generally west trending and flowing towards DL4 which finally converge towards the toe of the NTSA. Sub-ordinates DL4.5 is apparent as an individual southwest trending drainage line flowing towards the toe of the NTSA. However, DL4.5 was converging towards DL4 below the NTSA. DL1 and DL5 appeared to be subtle depression, whilst DL2 and DL3 is relatively incisive, DL4 is the most distinctive. This probably indicates more water concentrate along DL4 and therefore the erosion of DL4 is more active than the other four drainage lines. Some boulders, probably colluvial boulders

are concentrated along the middle section of DL4.

4.3.12 Topographic Depressions

4.3.13 Seven linear hollows were observed in Catchment Nos. TD2, TD3, TD4, TD5, TD6 and OH3. They are part of the head of ephemeral drainage lines or sub-drainage lines which located below the NTSA. Since they appeared as broad and subtle depressions, this indicate no water concentration and therefore the erosion activities are limited. These seven hollows within Catchment Nos. TD2, TD3, TD4, TD5, TD6 and OH3 can be degraded as minor topographic depressions, DP1 to DP7 in the engineering geomorphological map (**Figure 9.2**).

4.3.14 Erosion and sign of distress

4.3.15 No observable sign of erosion and sign of distress can be discerned within the NTSA.

4.3.16 Anthropogenic Features

4.3.17 No significant anthropogenic features are identified within the NTSA. Minor formation of footpaths, graves were evident within the NTSA since 1963.

4.3.18 In 1989, three highly reflective white spot features are discerned at the lower portion of Catchment Nos. TD5, OH2 and OH3. Bare soil is observed. The locations within Catchment Nos. OH2 and OH3 are possibly the Borehole locations of BH17 and BH18 under GIU No. 12800. The bare soil existed in Catchment No. TD5 appeared as rounded bare soil surface and thus likely created by anthropogenic activities, possibly inspection pits for the boreholes.

4.3.19 In between year 1990 to 1992, a linear feature, probably catchwater is aligned along the toe of the NTSA. Eight man-made cut slopes were formed along the toe of the NTSA, probably in association with the alignment of the catchwater. They were registered as Feature Nos. 12SW-A/C178, 12SW-A/C182, 12SW-A/C183, 12SW-A/C184, 12SW-A/C185, 12SW-A/C186, 12SW-A/C187 and 12SW-A/C188. In additional, a cut slope was formed below Catchment Nos. TD7 and OH5, probably in association with the extension of the landfill site. This man-made slope was registered as Feature No. 12SW-A/C227. The Site area is being modified and formed as a cut slope.

4.3.20 No fill bodies can be discerned within the NTSA.

5 Fieldwork

5.1 General

5.1.1 Fieldwork included detailed geological and geomorphological mapping, which was cross checked with the API and existing geological data.

5.2 Field Mapping

5.2.1 In general, the findings from field mapping were consistent with aerial photography interpretations.

5.3 Regolith Mapping and Boulders

5.3.1 **Figure 9.2** illustrates the mapped regolith types within the NTSA which generally include saprolite, hillslope colluvium, valley colluvium, landslide debris, rock outcrops.

5.3.2 Saprolitic soil covered most of the gentle slopes along the spurs and ridges along the upper portion of catchment boundaries of Catchment Nos. OH1, TD1, TD2, TD3, TD4, TD5, TD6, CD1, CD2, OH3, CD3, TD7, OH5 and TD8. Saprolite typically consists of extremely weak, orange brown, dappled red, completely decomposed Trachydacite lava (Stiff, slightly sandy SILT with some gravel) and extremely weak, pinkish brown, slightly dappled white, completely decomposed fine ash Tuff (Firm to stiff, slightly sandy SILT with some gravel) (**Plate 3**):

5.3.3 Most of the open hillslopes within the NTSA were covered by a thin veneer of matrix supported hillslope colluvium, locally associated with colluvial boulders. The colluvium generally comprises firm, brown, dappled grey, sandy SILT with some subangular fine to coarse gravel, occasional cobbles and boulders sized rock fragments **(Plate 3)**.

5.3.4 Clast supported valley colluvium, consisting of subangular cobbles and boulders with sandy silt matrix was deposited and confined within the ephemeral drainages (**Plate 4**).

5.3.5 The extent of landslide debris was estimated from field observations based on the size of the degraded landslide scars and possible lobate features observed below the scars. Most of them were either being eroded away or covered by dense vegetation. The landslide debris identified below degraded relict landslide scars (RL1 to RL9) typically comprised firm, brown, sandy Silt with gravels and some cobbles/boulders.

5.3.6 Colluvial boulders were probably derived from exhumed corestones of fine ash Tuff, Trachydacite lava and Rhyolite lava. They are generally subangular to subrounded in shape, less than 2.0m diameter scattered across the NTSA (**Plate 5**). Many of them were

concentrated and inter-locked along the ephemeral drainage lines. Others were either embedded in ground or deposited on the gentle slopes. According to the detailed boulder survey (Chung Shun, 2023), 405 nos. of boulders were recorded within the NTSA. The majority of the boulders were recorded with a high stability rating. 6 nos. of boulders were considered with low to medium stability which could travel further downslope by active soil erosion beneath the boulder in the foreseeable future. Having said that these 6 nos. of boulders are resting on gentle slopes ranged from 30-35°. It is not considered to have immediate danger and significant risk of boulder fall hazard. Details of the boulder survey are given in the separate "Boulder Survey Report".

5.4 Rock Exposures

5.4.1 Minor intermittent rock outcrops of moderately decomposed fine ash Tuff (JHI) (RO1) was mapped near the crest of Catchment No. CD3. The rockmass contains closely to medium spaced discontinuities. No adverse joint sets were identified within this outcrop (**Plate 6**).

5.4.2 Another 11 minor rock outcrops were mapped across the NTSA. Rock outcrops of moderately decomposed Trachydacite Lava (Jmw) (RO2 & RO3) were mapped at the upper portion of Catchment No. TD1 and the lower portion of Catchment No. TD4. Rock outcrops of moderately decomposed fine ash Tuff (fa) (RO4 & RO5) were mapped at the middle portion of Catchment No. TD7. Rock outcrops of moderately decomposed Trachydacite & Rhyolite Lava (JCB) (RO6, RO7, RO8, RO9, RO10, RO11 and RO12) were discerned at the upper portion of Catchment Nos. CD3, TD7, OH5 and TD8. The rockmass of RO2 to RO12 are massive and without any discontinuity.

5.4.3 All the rock outcrops mapped within the NTSA were less than 2m high. Given, no adverse joint sets were identified within these rock outcrops, rock fall is considered very unlikely to pose hazardous to the proposed development.

5.5 Natural Terrain Landslides

5.5.1 During API stage, a total of 9 relict (RL1 to RL9) potential landslide scars were identified within and in the close vicinity of the NTSA. Key features from API were targeted during mapping for field verification and the dimensions of these features were revised during field mapping. In some locations, however, relict landslide scars were not clearly defined due to overgrown shrub. In these locations the dimension of the relict landslide scars were estimated using the discernible topographic depressions and break of slopes.

5.5.2 Four relict landslides (RL1, RL2, RL3 and RL4) were identified at the upper portion of Catchment No. CD3. RL1 has a rounded scarp and shallow (Plate 7). It has a failure

volume of 39m³. RL2 has an imperceptible scarp and the failure depth is subtle, therefore the certainty of RL2 is relatively low (Plate 8). It has an estimated failure volume of 27m³. RL3 has a distinctive sharp scarp and the failure depth is relatively incisive which has a failure volume of 32m³ (Plate 9). Location of RL4 is not registered as ENTLI and was identified during API. It has a rounded scarp, but the depression is shallow. It is a relatively small-scale landslide which failure volume is only 13m³ (**Plate 10**).

5.5.3 Another four relict landslides (RL5, RL6, RL7 and RL8) were discerned at the upper portion of the adjacent catchment of Catchment No. CD3. These four relict landslide events have distinctive rounded scarp, RL5, RL6 and RL7 are relatively incisive whilst RL8 is shallow (**Plate 11 to 14**). The estimated failure source volume of RL5, RL6, RL7 and RL8 are 27m³, 20m³, 11m³ and 36m³ respectively.

5.5.4 The slope instabilities of RL1 to RL8 are located on the over-steepened slopes immediately below the convex break of slope forming the boundary between the upper and middle slope. This failure probably part of the hillside retreat process.

5.5.5 One relict landslide (RL9) is apparent near the head of a drainage line within the incising terrain which located adjacent to Catchment No. TD8. The slope instability could relate to retrogressive stream head erosion process. The failure volume of RL9 is 14m³ (**Plate 15**).

5.6 Drainage Line Characteristics

5.6.1 Ephemeral drainage line DL1 is a relatively short, small and subtle drainage line. It is located along Catchment No. TD1. It was dry during field mapping. The width and depth of DL1 is generally less than 2.7 m and 0.3-0.5 m respectively. The channelization ratios (CRs) of the drainage line are between 5 and 9. The drainage line is inclined at only at about 18-23°. The drainage line is covered by matrix supported hillslope colluvium. DL1 has a relatively broad channelization ratio and absent of clast supported valley colluvium suggested that even if slope failure occurred, the hazard is more likely to be debris flow.

5.6.2 Ephemeral drainage line DL2 is a relatively longer drainage line compared to DL1. It is located at the middle and lower portion of Catchment No. CD1 and was also dry during field mapping. The width and depth of DL2 is generally less than 3.7m and 0.9m respectively. The channelization ratios (CRs) of the drainage line are range in between 2.5 to 4.4, the upper most section of DL2 has a CR of 7.4. The inclination of the steam bed of DL2 lies in between 15 to 35°, locally up to 40°. Clast supported valley colluvium consisting of subangular cobbles and boulders with sandy silt matrix was

accumulated along the drainage line.

5.6.3 Ephemeral drainage line DL3 has similar length as DL2. It is located at the middle and lower portion of Catchment No. CD2. It was dry during field mapping. The width and depth of DL3 is generally less than 5.2m and 0.7m respectively. The channelization ratios (CRs) of the drainage line range in between 4.8 to 6.6, the middle section of DL3 is broad and subtle which has a CR of 8.7. The inclination of the steam bed of DL3 lies in between 15 to 35°. Clast supported valley colluvium consisting of subangular cobbles and boulders with sandy silt matrix was accumulated along the drainage line.

5.6.4 Ephemeral drainage line DL4 and its sub-ordinate drainage lines DL4.1, DL4.2, DL4.3 and DL4.4 are located within Catchment No. CD3. DL4 is the longest drainage line within the NTSA. The lower half section (below +214 mPD) of DL4 was in wet condition during field mapping; the upper half section (above +214 mPD) of DL4, and the entire DL4.1, DL4.2 DL4.3 and DL4.4 were in dry condition during the field mapping. The width of DL4 is generally 2.5m to 9.2m, with depth ranging from 0.4m to 1.5m. In general, the channelization ratio (CR) of the drainage line is less than 6.6 and the channel gradients are general range of 15° to 45°, locally up to 50°, suggesting that the likelihood of channelized debris flow (CDP) is high. It was noted during fielding mapping that entrainable materials comprising a thin layer (< 0.5 m) of clast supported bouldery colluvium with sandy silt matrix were present along the drainage beds. Occasional boulders were deposited on the drainage bed, up to 2.0m diameter. Moderately decomposed fine ash Tuff was mapped at the drainage channel beds at about +157 mPD and +191 mPD; moderately decomposed Trachydacite and Rhyolite lava was discerned at the channel bed at approximately +230 mPD. Channelised debris flow is a potential hazard within Catchment No. CD3. The outlet of this natural stream course discharges into the existing concrete catchwater channel (1.5m wide and 1.1m depth) along the toe of the NTSA and therefore part of the debris may retain in the catchwater.

5.6.5 Ephemeral sub-ordinate drainage line DL4.5 within Catchment No. TD7 is not recorded as a hydro-line feature marked on 1:1000 LIC map, however, during the API stage, DL4.5 was identified as an ephemeral sub-ordinate drainage line of main stream DL4 which adjoining DL4 at approximately 80m below the NTSA. Since TKO Landfill site was in use, the adjoining point of DL4.5 to main stream DL4 was being filled up and therefore DL4.5 is no longer connected to the main stream DL4. According to field mapping, it was dry, the width and depth of DL1 is generally less than 8.3 m and 1.6 m respectively. The lower section of DL4.5 (below +176 mPD) has CR range in between 4.6 to 6.6, the CRs of the upper section (above +176 mPD) lie between 7.2 to 9.5 which imply the valley is relatively broad and subtle. The debris would likely converge and

confine by topography but with low drainage concentration, therefore the potential hazard is likely to be debris flow.

5.6.6 Ephemeral drainage line DL5 is recorded as a hydro-line feature marked on 1:1000 LIC map in the lower portion of Catchment No. TD8 (below +180 mPD). According to field mapping, it was dry, the width and depth of DL5 is generally less than 8.3 m and 1.5 m respectively. The lower section of DL5 (below +164 mPD) has CRs range in between 4.0 to 7.5, the CRs of the upper section (above +164 mPD) lie in between 8.8 to 10.0 which imply the valley is relatively broad and subtle. The debris would likely converge and confine by topography but with low drainage concentration, therefore the potential hazard is likely to be debris flow.

5.6.7 Details of the drainage line mapping is given in **Appendix C** and **Plate 16**.

5.7 Topographic Depression Characteristics

5.7.1 Seven topographic depressions are identified within the NTSA from API. Topographic depression DP1, DP2, DP3, DP4 and DP5 are located along Catchment Nos. TD2, TD3, TD4, TD5 and TD6 respectively. These five topographic depressions are short, broad, shallow and subtle. They have similar channel characteristics with channel width range in between 3.8m to 4.6m and channel depth range from 0.3m to 0.5m. The CRs of DP1 to DP5 range from 9.2 to 12.7 (**Plate 17**).

5.7.2 Another two topographic depressions DP6 and DP7 lie in the lower portion of Catchment No. OH3. DP6 and DP7 are slightly longer compare with DP1 to DP5. DP6 and DP7 has channel width of 3.6m to 4.8m and channel depth of 0.4m to 0.5m. The CRs are therefore range from 9.0 to 9.6 (**Plate 17**).

5.8 Erosion and Sign of Distress

5.8.1 No sign of erosion or distress have been identified within the NTSA.

5.9 Water Seepage

5.9.1 Minor water seepage was observed at the bedrock of the channel bed at the lower half section (below +214 mPD) of drainage line DL4. No other water seepage could be observed within the NTSA.

5.10 Soil Pipes

5.10.1 No obvious soil pipe was identified within the NTSA during the field mapping.

5.11 Vegetation

5.11.1 The NTSA is well vegetated with bamboo, ferns with some shrubs and small trees.

5.12 Anthropogenic Features

5.12.1 No major anthropogenic features were found within the NTSA during field mapping. Five footpaths (FP1 to FP5) are present within the NTSA or along the boundary of the NTSA. Footpath FP1 traversed the middle portion of the NTSA from Catchment No. CD3 downwards to Catchment No. TD8. FP2 present along the upper portion from Catchment No. OH1 to Catchment No. CD3. FP3 is discerned at the lower portion of the NTSA, it traversed from Catchment No. TD6 to TD8. FP4 located along the crest of the NTSA whist FP5 apparent along the eastern boundary of the NTSA (**Plate 18**).

5.12.2 A grave is present at the upper portion of Catchment No. CD3 (**Plate 18**).

5.12.3 A concrete catchwater channel with dimension of 1.5m width and 1.1m depth were formed and aligned the toe of the NTSA (**Plate 18**).

5.12.4 No significant fill bodies can be observed within the NTSA during field mapping.

6 Engineering Geological/Geomorphological Model

6.1 General

6.1.1 Geomorphological and engineering geological models were formulated for the NTSA based on information obtained from the desk study, API, field mapping and previous GIs. An Engineering Geological Model and Geomorphological model of the NTSA were developed and presented below:

6.2 Solid Geology

6.2.1 The solid geology within the NTSA was underlain by four types of solid geology. Fine ash crystal Tuff of the High Island Formation (JHI) underlain along the crest of the NTSA. The upper portion of the NTSA is underlain by fine ash Tuff of the Clear Water Bay Formation (fa). The middle portion of the NTSA is comprise of Trachydacite and Rhyolite lava of the Clear Water Bay Formation (JCB). The lower portion of the NTSA is underlain by fine ash Tuff of the Clear Water Bay Formation (fa) and Trachydacite lava of Ta Miu Wan Member of the Clear Water Bay Formation (Jmw). All four types of geology are belonged to Repulse Bay Volcanic Group formed in Upper Jurassic of Mesozoic.

6.3 Superficial Geology

6.3.1 Superficial deposit within the NTSA is mainly a thin layer (<2.0 m) of hillslope colluvium blanketing the middle portion of the NTSA. The colluvium typically comprises firm, brown dappled grey, sandy SILT with some gravel and cobbles sized rock fragments. Clast supported valley colluvium, consisting of subangular cobbles and boulders with sandy silt matrix was deposited and confined within the ephemeral drainages.

6.4 Hillside Catchment Classification

6.4.1 Following the guideline given in GEO Report No. 138 2nd Edition (GEO, 2016), the NTHS area can be classified into three types of catchment, including Channelised Catchment, Topographic Depression Catchment and Open Hillslope Catchment, according to the type of hazard defined by the failure mechanism and mobility of debris movement. The catchment classification of the NTSA is given below:

6.4.2 Based on the LIC 1:1000 scale topographic map, the site specific aerial photograph interpretation and site mapping, the catchment classification of the NTSA is summarized in **Table 6.1** below and present graphically in **Figure 10.**

Table 6.1 Summary of Catchment Classification Assessment

Catchment No.	Catchment Type			Justification
	OH	TD	CD	
OH1	✓			1. Hillside is generally planar. 2. Absent of drainage line or distinct depression. 3. Debris path is relatively unconfined and may involve lateral spreading of debris. 4. Potential hazard will be open hillslope landslide.
OH2	✓			1. Catchment located on a spur and therefore hillslope is convex-shaped. 2. Absent of drainage line or distinct depression. 3. Debris path very likely involve lateral spreading of debris. 4. Potential hazard will be open hillslope landslide.
OH3	✓			1. Catchment located on a rounded spur and therefore hillslope is general convex-shaped. 2. Two topographic depressions appear at the lower portion of the catchment, probably head of drainage lines which located below the NTSA. 3. Debris path is relatively unconfined and may involve lateral spreading of debris, even though two topographic depressions are present, the relatively large catchment is unlikely to confine the debris flow into the short and subtle depressions. 4. Potential hazard will be open hillslope landslide.
OH4	✓			1. Hillside is generally planar. 2. Absent of drainage line or distinct depression. 3. Debris path is relatively unconfined and may involve lateral spreading of debris. 4. Potential hazard will be open hillslope landslide.
OH5	✓			1. Hillside is generally planar. 2. Absent of drainage line or distinct depression. 3. Debris path is relatively unconfined and may involve lateral spreading of debris. 4. Potential hazard will be open hillslope landslide.
TD1		✓		1. A hydro-line feature marked on 1:1000 LIC map along the catchment, but it is a relatively short, small and subtle. 2. Debris would likely converge and confine by topography but with a low drainage concentration. 3. Potential hazard will be debris flow. 4. Potential entrainment material will be relatively small as compared to the CD Catchment.
TD2		✓		1. No hydro-line feature marked on 1:1000 LIC map, but a small topographic depression is present. 2. Debris would likely converge and confine by topography but with a low drainage concentration. 3. Potential hazard will be debris flow. 4. No potential entrainment material.
TD3		✓		1. No hydro-line feature marked on 1:1000 LIC map, but a small topographic depression is present. 2. Debris would likely converge and confine by topography but with a low drainage concentration. 3. Potential hazard will be debris flow. 4. No potential entrainment material.
TD4		✓		1. No hydro-line feature marked on 1:1000 LIC map, but a small topographic depression is present. 2. Debris would likely converge and confine by topography but with a low drainage concentration. 3. Potential hazard will be debris flow. 4. No potential entrainment material.
TD5		✓		1. No hydro-line feature marked on 1:1000 LIC map, but a small topographic depression is present. 2. Debris would likely converge and confine by topography but with a low drainage concentration. 3. Potential hazard will be debris flow. 4. No potential entrainment material.

TD6		✓		1. No hydro-line feature marked on 1:1000 LIC map, but a small topographic depression is present. 2. Debris would likely converge and confine by topography but with a low drainage concentration. 3. Potential hazard will be debris flow. 4. No potential entrainment material.
TD7		✓		1. No hydro-line feature marked on 1:1000 LIC map, but a broad and subtle sub-ordinate drainage line present along the catchment. 2. Debris would likely converge and confine by topography but with a low drainage concentration. 3. Potential hazard will be debris flow. 4. Potential entrainment material will be relatively small as compared to the CD Catchment.
TD8		✓		1. A hydro-line feature marked on 1:1000 LIC map at the lower half of the catchment. 2. Debris would likely converge and confine by topography at the lower half of the catchment with a low drainage concentration. 3. Potential hazard will be debris flow. 4. Potential entrainment material will be relatively small as compared to the CD Catchment.
CD1			✓	1. A well-defined and incised drainage line leading to a single discharge point. 2. It has a relatively high drainage concentration. 3. Potential hazard will be channalised debris flow. 4. Relatively high entrainment potential.
CD2			✓	1. A well-defined and incised drainage line leading to a single discharge point. 2. It has a relatively high drainage concentration. 3. Potential hazard will be channalised debris flow. 4. Relatively high entrainment potential.
CD3			✓	1. A very well-defined and very incisive main drainage line with three incised sub-ordinate drainage lines present with the catchment leading to a single discharge point. 2. It has very high drainage concentration. 3. Potential hazard will be channalised debris flow. 4. High entrainment potential due to present of many colluvial boulders along the drainage line.

6.5 Geomorphological Model

6.5.1 To appreciate the geomorphological process within the NTSA, it is better to look at a wider picture within the Study Region. Terrain Units within the Study Region are divided into four main units developed based on the simplified land surface model (Dalrymple, et al., 1968) according to their geomorphological characteristics. The terrain units identified within the NTSA are described below and presented in Figure 11.1 for a regional view and Figure 11.2 for a close-up view of the NTSA.

6.5.2 Upper Slope Terrain Unit

6.5.3 The upper slope terrain comprises the gentle slopes along the ridges and spurs along the upper boundary of the NTSA. The slope gradient is generally less than 20 degrees. The upper slope terrain appears to be the oldest terrain unit in the NTSA. The terrain comprises predominately saprolitic soil. The predominant geomorphic processes are likely to be pedogenic process, eluviation and soil creeping. This terrain appears

currently stable with no evidence of recent or relict slope instabilities identified.

6.5.4 Middle Slope Terrain Unit

6.5.5 The transportational Middle Slope Terrain Unit is present at about +126 mPD to +316 mPD at the middle and lower portion of the NTSA. This Terrain Unit is demarcated by the convex change of slope immediately below the Upper Slope Terrain Unit. General slope gradient within this terrain is 25-35°, locally 35-50°. The Terrain mainly comprises completely decomposed fins ash Tuff, trachydacite and rhyolite lava overlain by a very thin layer of hillslope colluvium (probably <2m thick). Given only four relict landslides (RL1 to RL4) were identified at the upper portion of the NTSA, they all very degraded and could be occurred for a long period of time (over 100 years). These landslides were probably part of the hillslope retreat process. Another 4 relict landslides (RL5 to RL8) were verified at the adjacent catchment of the NTSA within this terrain unit, they were also very broad and degraded. The mass wasting process within this terrain is relatively infrequent and therefore the terrain is considered to be low to moderately susceptible to landslides.

6.5.6 Incising Terrain Unit

6.5.7 The comparatively young and active Incising Terrain is characterized by the presence of ephemeral drainage channels DL1, DL2, DL3, DL4 and DL5 which formed relatively incised valley slopes by fluvial incision, retrogressive erosion and undercutting of the adjacent soil by surface water. The terrain units are largely covered with clast supported valley colluviums overlying saprolite or bedrocks at the stream beds. No relict or recent landslide can be identified within this terrain unit in the NTSA. However, a relict landslide (RL9) was identified at the adjacent catchment of the NTSA within this terrain unit. RL9 was possibly associated with drainage incision and erosion process.

6.5.8 Disturbed Terrain Unit

6.5.9 The disturbed terrain is located below the NTSA. The Site is sitting on the Disturbed Terrain Unit. This terrain unit was used as a landfill site in between year 1988 and 1994. Slope cutting and filling were performed in this terrain unit during the operation period of the landfill site.

7 Hazard Assessment

7.1 General

7.1.1 Design Event Approach is adopted to assess the natural hazard based on the five generic hazard models defined in GEO Report No. 138 2nd Edition (GEO, 2016) as follows: open hillslope landslide, channelized debris flow, deep-seated landslide, rockfall / slide and boulder fall.

7.1.2 Based on the findings from detailed desk study, GI and field mapping as well as the geological and geomorphological model established in section 6, hazard assessment with respect to the five generic hazard models are discussed below and the natural terrain hazard map is presented in **Figure 12**.

7.2 Hazard Identification

7.2.1 Open Hillslope Landslide

7.2.2 The NTSA comprises stable upper slope terrain and transportation middle slope terrain. The upper slope terrain and is considered to be of very low susceptible to landslide as the slope gradient generally less than 20° and has no evidence of failure. Mass wasting process within the terrain unit is observed to be inactive, with no signs of erosions or past instability. Therefore, open hillslope landslide is not envisaged.

7.2.3 The NTSA also contain a transportation middle slope terrain between +126 mPD and +316 mPD where slope gradient lies between 25-35°, locally 35-50°. The Terrain mainly comprises completely decomposed fins ash Tuff, trachydacite and rhyolite lava overlain by a very thin layer of hillslope colluvium (probably <2m thick). Given four relict landslides (RL1 to RL4) were identified within this terrain in the NTSA, and four relict landslides (RL5 to RL8) were verified at the adjacent catchment of the NTSA within this terrain unit. All these relict landslides were probably occurred over 100 years ago and belonged to part of the hillslope retreat process, the mass wasting process within this terrain is considered relatively infrequent and therefore the terrain is considered to be low to moderately susceptible to open hillslope landslides.

7.2.4 Channelised Debris Flow (CDF)/Debris Flow

7.2.5 No perennial natural drainage line is present within the NTSA, but three relatively incisive (channelization ratio less than 7.5) ephemeral drainage lines DL2, DL3 and DL4 and its sub-ordinates drainage lines DL4.1, DL4.2, DL4.3 and DL4.4 are present within the NTSA. Therefore, it is considered that CDF is a potential natural hazard which may occur within the NTSA.

7.2.6 After site verification, ephemeral drainage lines DL1, DL4.4 and DL5 are broad and subtle with low drainage concentration, according to the stream characteristics, ephemeral drainage lines DL1, DL4.4 and DL5 are classified as topographic depression. In addition, five topographic depressions DP1 to DP5 are present with the NTSA. Therefore, debris flow is considered could be a potential hazard within the NTSA.

7.2.7 Deep-seated Landslide

7.2.8 Deep-seated, intact sliding is not common in Hong Kong and in some cases the displaced material has not moved from the source area (slump) or where tension cracks and bulging are the sole surface expression of movement (Irfan, 1989; Ho & Evans, 1993). Based on the existing GI information and the field mapping results, neither tension cracks, surface bulging nor persistent thick layers of kaolin/weak seam within saprolite have been identified within the NTSA that could indicate the potential for deep-seated landslides. There is no clear evidence from historical records that suggests a deep-seated landslide could have occurred, or is likely to occur, within the NTSA. Therefore, the susceptibility for deep-seated landslide occurring within the NTSA is considered to be low.

7.2.9 Rock Fall

7.2.10 Twelve intermittent rock outcrops (RO1 to RO12) are present within the NTSA, but they are massive and less than 2m high. No adverse joint sets, which can attribute to unstable rock block failure within these rock mass, can be discerned on site. Therefore, Rock Fall is not considered a viable hazard within the NTSA.

7.2.11 Boulder Fall

7.2.12 Given, i) the proposed development are mostly belonged to Group 4 facilities, ii) no evidence of past boulder fall records within the NTSA, iii) no clear evidence of any known signs of potentially boulder falls from the site specific API and field mapping. According to the special considerations for dealing with boulder fall hazards as stipulated in Section 2.3.5 of GEO Report No. 138, it is considered that no significant risk of boulder fall hazards is presence with the NTSA.

7.2.13 According to the detailed boulder survey report (Chung Shun, 2023), 6 nos. of boulders (C120, C126, C127, C128, W068 and W075) with low to medium stability which could travel further downslope by active soil erosion beneath the boulder in the foreseeable future. Having said that these 6 nos. of boulders are resting on gentle slopes ranged from 30-35°. It is not considered to have immediate danger and significant risk of boulder fall hazard. Most of the boulders could probably be caught

by the concrete catchwater channel along the toe of the NTSA. Nevertheless, removal of these boulders is recommended as a cost-effective precautionary measure. Details of the boulder survey are given in the separate "Boulder Survey Report". The records of these 6 nos. boulders were extracted from the boulder survey report in **Appendix E** and the locations of these boulders are presented in **Figure 12.**

7.2.14 Hillside Pocket Type Setting

7.2.15 The NTSA does not fall into any hillside pocket boundary. No fill body was identified from the API and field mapping within the NTSA. Therefore, it is considered that the NTSA is not associated with landslide hazard with respect to the Hillside Pocket setting.

7.3 Design Event

7.3.1 According to GEO Report No. 138 2nd Edition (GEO, 2016), a design event should refer to the magnitude of the hazard type selected for mitigation and requires the understanding of the geological and geomorphological model and the consideration of historical landslide records.

7.3.2 Landslide Susceptibility

7.3.3 The landslide susceptibility of the NTSA has been reviewed to aid the derivation of the design event magnitude. This was based on the geological and geomorphological model as well as the landslide history of the NTSA. Details of the landslide susceptibility of each terrain unit are discussed in **Table 7.1** below:

Table 7.1 Summary of Hazard Types and Landslide Susceptibility

Hazard Type	Terrain Unit Present Within NTSA	Description of Hazard and the Landslide Susceptibility
OHL	Upper Slope Terrain	The terrain comprises mainly saprolitic soil. The predominant geomorphic processes are likely to be pedogenic process, eluviation and soil creeping. This terrain appears currently stable with no evidence of recent or relict slope instabilities identified and therefore considered to have very low susceptibility to open hillslope failure.
OHL/DF	Middle Slope Terrain	General slope gradient within this terrain is 20-35°, locally 35-50°. The Terrain mainly comprises completely decomposed fins ash Tuff, trachydacite

Hazard Type	Terrain Unit Present Within NTSA	Description of Hazard and the Landslide Susceptibility
		and rhyolite lava overlain by a very thin layer of hillslope colluvium (probably <2m thick). The predominant geomorphic process within this terrain unit is considered to be the mass wasting process in the form of shallow debris slides. Given four relict landslides (RL1 to RL4) were identified within this terrain in the NTSA, and four relict landslides (RL5 to RL8) were verified at the adjacent catchment of the NTSA within this terrain unit. They are all very degraded and probably occurred over 100 years ago. The mass wasting process within this terrain is relatively infrequent and therefore the terrain is considered to be low to moderately susceptible to open hillslope landslide and debris flow.
CDF	Incising Terrain	The comparatively young and active Incising Terrain is characterized by the presence of ephemeral drainage channels DL2, DL3, DL4, DL4.1, DL4.2, DL4.3 and DL4.4 which formed relatively steep channel incised valley slopes by fluvial incision, retrogressive erosion and undercutting of the adjacent soil by surface water. The terrain units are largely covered with clast supported valley colluviums overlying saprolite or bedrocks at the stream beds. No relict or recent landslide can be identified within this terrain unit within the NTSA. However, a relict landslide (RL9) was identified at the adjacent catchment of the NTSA within this terrain unit, and also a recent landslide (RC4) in year 1975 was identified within this terrain unit adjacent to the NTSA, RL9 and RC4 were possibly associated with drainage incision and erosion process. Failure may also be attributed to the undermining effect of fluvial action along the flanks of drainage line, given the adjacent catchment has similar geomorphological setting as

Hazard Type	Terrain Unit Present Within NTSA	Description of Hazard and the Landslide Susceptibility
		the NTSA, suggesting the terrain is moderately susceptible to landslides.

7.3.4 Design Event Requirement

7.3.5 According to the latest guideline given in GEO Report No. 138 2nd Edition (GEO, 2016), the design event principle is aimed at dealing with a realistic estimation of credible failure volume (e.g. Based on recent landslides as well as relict landslides with a high degree of certainty) that may be encountered during the design life of the affected facilities. A combination of desk study, API and detained field mapping should provide basis for developing a realistic geological/geomorphological model of the NTSA by defining the magnitude of the design event.

7.3.6 Based on the detailed review on the above factors, the NTSA belongs to Upper Slope Terrain and Middle Slope Terrain units. The landslide susceptibility of these terrain units is considered to be very low to moderately high.

7.3.7 The Design Event Requirement for the NTSA is summarized in **Table 7.2**.

Table 7.2 Design event Requirement for the NTSA

Hazard	**Terrain Unit**	**Landslide History**	**Design Event Requirement**
OHL	Upper Slope Terrain	No evidence of relict and recent landslide almost in the past 100 year	Not required
OHL, DF	Middle Slope Terrain	Relict landslides RL1 to RL4 located within Catchment No. CD3 (13-39m^3); Relict landslides RL5 to RL8 located adjacent to Catchment No. CD3 (11-36m^3)	40m^3

Hazard	Terrain Unit	Landslide History	Design Event Requirement
CDF	Incising Terrain	Relict landslide RL9 located adjacent to Catchment No. TD8 ($14m^3$); Recent landslide RC4 located below the NTSA ($40m^3$)	$40m^3$

7.3.8 Based on the assessment of the design event requirements of different terrain units within the NTSA, Adopting 40m³ as a credible design event for the Middle Slope Terrain and Incising Terrain within the NTSA is considered appropriate.

7.3.9 Debris Mobility Modelling

7.3.10 A notional landslide source volume of 40m3 is adopted as the source volume for the NTSA for the debris mobility modelling.

7.3.11 In order to estimate the run out distance for debris flow within the NTSA, dynamic debris mobility modelling has been carried out using the programme 'DAN/W'. The input parameters and results of this modelling are discussed below and presented in **Appendix D**.

7.3.12 Potential landslide events have been modelled by adopting the Voellmy Rheology Model for DF and CDF; and Friction Rheology Model for OHL. To estimate the potential entrainment volume along the debris runout path analysed, the average depth of potentially entrainable materials is assessed based on the results of the drainage line mapping and professional judgments, e.g. channel gradients, probable erosion depth according to the loose materials perched on the drainage bed and the erosional materials from channel side slopes. The average thickness of entrainable materials along the ephemeral drainage line is assessed to be from 0.1 to 0.5m. The result of the debris mobility modelling is summarized in **Table 7.3** below:

Table 7.3 Summary of Debris Mobility Modelling Results

Terrain Unit	Catchment No.	Runout Path No.	Source Volume (m^3)	Analytical Model	Final Volume	Entrainment	Travel Distance (m)	Landslide Debris Reaching the

					(m^3)	Volume (m^3)		Proposed Facilities
Middle Slope Terrain /Incising Terrain	TD3	RP1	40.24	Friction & Voellmy	40.24	-	11.58	No
	TD4	RP2	40.41	Friction & Voellmy	40.41	-	27.02	No
	TD5	RP3	40.63	Friction & Voellmy	40.63	-	53.78	No
	TD6	RP4 (Case 1)	40.55	Friction & Voellmy	40.55	-	13.92	No
		RP4 (Case 2)	40.34	Friction & Voellmy	40.34	-	35.46	No
	CD1	RP5 (Case 1)	40.84	Friction & Voellmy	40.84	-	25.16	No
		RP5 (Case 2)	40.22	Friction & Voellmy	107.11	66.89	114.16	No
	OH2	RP6 (Case 1)	40.90	Friction	40.90	-	27.63	No
		RP6 (Case 2)	40.87	Friction	40.87	-	4.75	No
	CD2	RP7 (Case 1)	40.43	Friction & Voellmy	40.43	-	5.74	No
		RP7 (Case 2)	40.50	Friction & Voellmy	143.05	102.55	117.90	No
	OH3	RP8 (Case 1)	40.65	Friction	40.65	-	2.45	No
		RP8 (Case 2)	40.26	Friction	40.26	-	46.01	No
		RP9 (Case 1)	40.27	Friction	40.27	-	75.2	No
		RP9 (Case 2)	40.18	Friction	40.18	-	34.95	No
	CD3	RP10 (Case 1)	40.58	Friction & Voellmy	106.83	66.25	95.63	No

		RP10 (Case 2)	40.14	Friction & Voellmy	43.68	-	7.07	No
		RP11 (Case 1)	40.50	Friction & Voellmy	41.00	0.5	35.35	No
		RP11 (Case 2)	40.10	Friction & Voellmy	382.83	342.73	154.81	No
		RP12 (Case 1)	40.07	Friction & Voellmy	517.11	477.04	402.06	No
		RP12 (Case 2)	40.34	Friction & Voellmy	196.99	156.65	140.64	No
		RP13 (Case 1)	40.51	Friction & Voellmy	40.51	-	104.65	No
		RP13 (Case 2)	40.81	Friction & Voellmy	96.65	55.84	67.08	No
		RP14 (Case 1)	40.88	Friction & Voellmy	41.54	-	89.85	No
		RP14 (Case 2)	40.17	Friction & Voellmy	272.87	232.70	193.52	No
	OH4	RP15	40.67	Friction	40.67	-	100.87	No
	TD7	RP16	40.28	Friction & Voellmy	321.11	280.83	129.70	No
	OH5	RP17	40.89	Friction	40.89	-	135.74	No
	TD8	RP18	40.61	Friction & Voellmy	434.97	394.36	180.95	No

7.3.13 Debris mobility analysis have been carried out for Catchment Nos. TD3, TD4, TD5, TD6, CD1, OH2, CD2, OH3, CD3, OH4, TD7, OH5 and TD8. Eighteen credible run out paths, (the steepest paths generated from ArcGIS, RP1 to RP18) have been modelled. The results indicate that the debris on different elevations along the credible run out paths RP1 to RP18 would not reach the proposed facilities of the proposed new public riding school. Volume of the Potential entrainment materials along the

biggest CD catchment CD3 is estimated in the range between 7.07m^3 and 402.06m^3. Most of the modelled landslide debris would either be deposited at the shallow hillsides or retained at the concrete catchwater channel at the toe of the NTSA.

7.3.14 Results of the debris mobility analysis also showed that no landslide debris could run beyond the lower boundary of the "No-build Zone" which was defined in the previous feasibility study in 2004.

8 Hazard Mitigation Strategy

8.1 General

8.1.1 Following the review of the landslide hazards on the NTSA, debris mobility model for Catchment Nos. TD3, TD4, TD5, TD6, CD1, OH2, CD2, OH3, CD3, OH4, TD7, OH5 and TD8 have been simulated to assess whether a failure volume of 40m³ from the NTSA could pose hazard to the proposed new public riding school. The results revealed that the debris on all credible flow paths (RP1 to RP18) will not reach the proposed facilities. Given most of the proposed development are belonged to Group 4 facilities, therefore natural terrain hazard mitigation measures is considered not necessary.

8.1.2 Although there is no significant risk of boulder fall hazard presence within the NTSA, in view of the fact that 6 nos. of boulders with low to medium stability (without immediate and obvious danger conditions) were identified from the site-specific boulder survey. Among these 6 boulders, only four of them fall within the Clear Water Bay Country Park zone. The 2 boulders (W068 and W075) outside the Clear Water Bay Country Park are recommended to be removed or in-situ stabilized by rock dowels as a precautionary measures as they may likely travel further downslope towards the proposed development under the condition of heavily erosion underneath the boulders; and no mitigation for the 4 boulders (C120, C126, C127 and C128) within the Clear Water Bay Country Park is proposed as they could be either caught up by the existing concrete catchwater channel at the toe of the NTSA or deposited before reaching the low density traffic access road (Group 4 facility) which is about 50m away from the NTSA. The justification of these 4 boulders will not reach the facilities is further supplemented by the boulder fall modelling presented in Appendix F.

9 Conclusions & Recommendations

9.1 General

9.1.1 A natural terrain hazard assessment was carried out based on guidelines given in GEO Report No.138 2nd edition (GEO, 2016), by reviewing the topography, geomorphology, landslide susceptibility and landslide history of the NTSA. Results of the assessment showed that there is potential OHL, DF, CDF and BF hazard from the NTSA.

9.1.2 Debris mobility modelling has been carried out to simulate the potential design event of 40m³. The results revealed that the debris will not reach the proposed facilities. Following the result from the assessment, mitigation works for the potential natural terrain hazard is considered not necessary for the proposed new public riding school.

9.1.3 The 'No-build Zone' recommended in the previous feasibility study in 2004 was reviewed. The "No-build Zone" was calculated based on the debris runout distances using the conservative design event. The "No-build Zone" was defined as one meter further away from the calculated debris runout distance boundary, outside of which no development will be affected by any potential natural terrain hazards. Based on the updated current landslide debris mobility modelling, no landslide debris could run beyond the lower boundary of the "No-build Zone" and therefore, as a conservative and safe approach, it is recommended to keep the "No-build Zone" for the site formation design in the later stage.

9.1.4 A total 6 numbers of boulders with low to medium stability (C120, C126, C127, C128, W068 and W075) are identified. Only four boulders C120. C126, C127 and C128 are within the Clear Water Bay Country Park zone.

9.1.5 Boulders Nos. W068 and W075 which are outside the Clear Water Bay Country Park are recommended to be removed or in-situ stabilized by rock dowels as a cost-effective precautionary measures as they may likely travel further downslope towards the proposed development under the condition of heavily erosion underneath the boulders.

9.1.6 No mitigation for Boulder Nos. C120, C126, C127 and C128 within the Clear Water Bay Country Park is proposed as they could be either caught up by the existing concrete catchwater channel at the toe of the NTSA or deposited before reaching the low density traffic access road (Group 4 facility) which is about 50m away from the NTSA.

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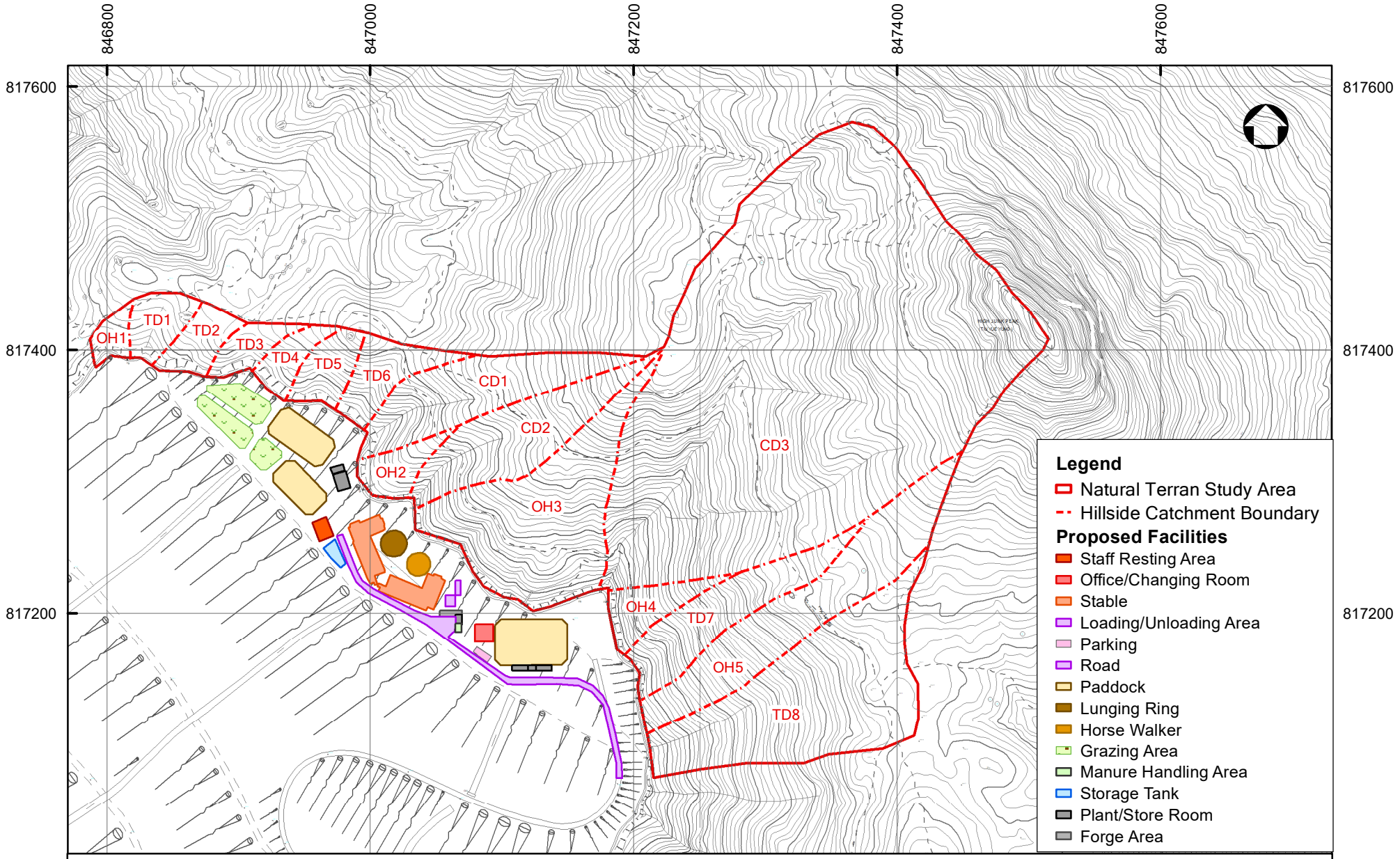
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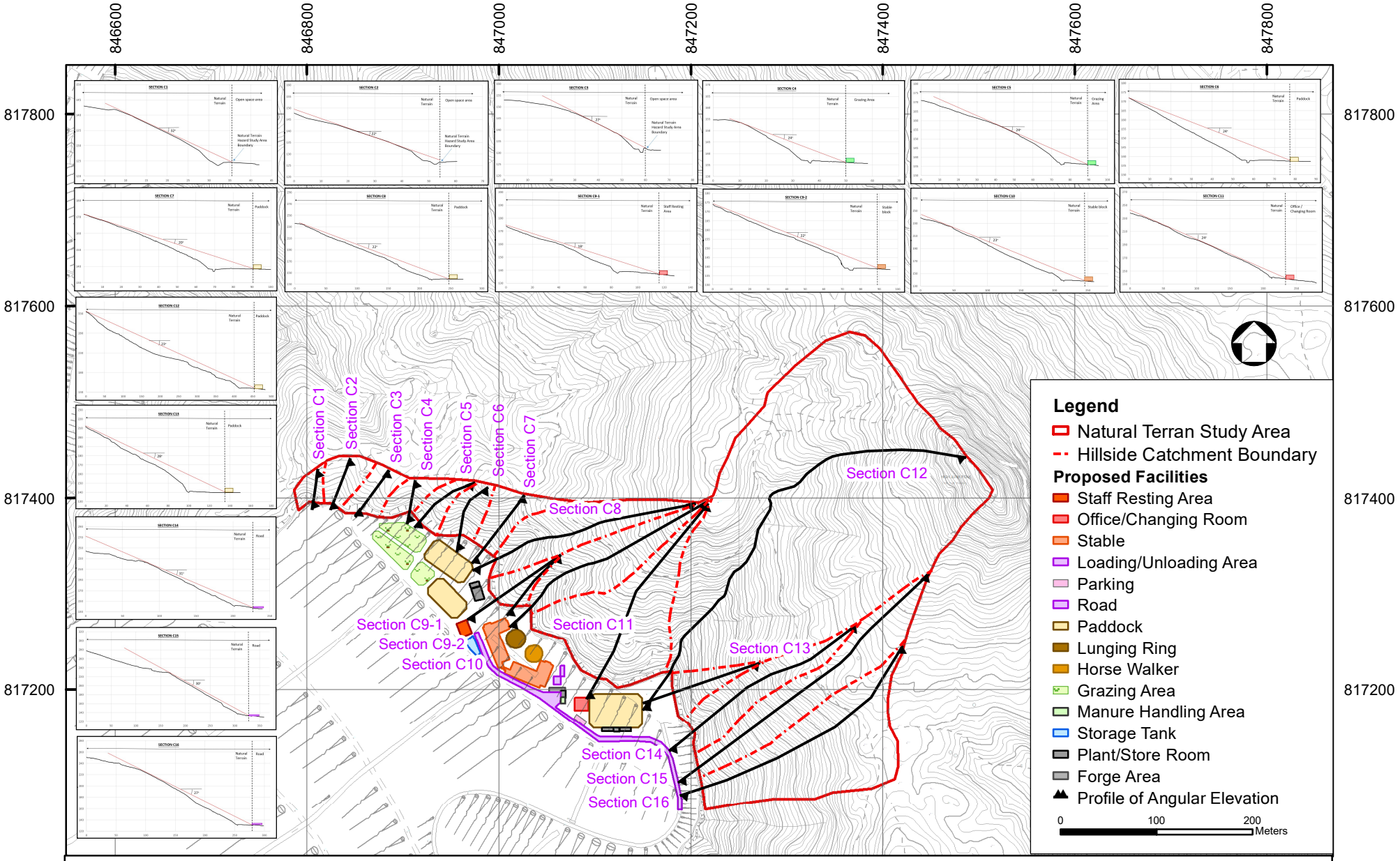
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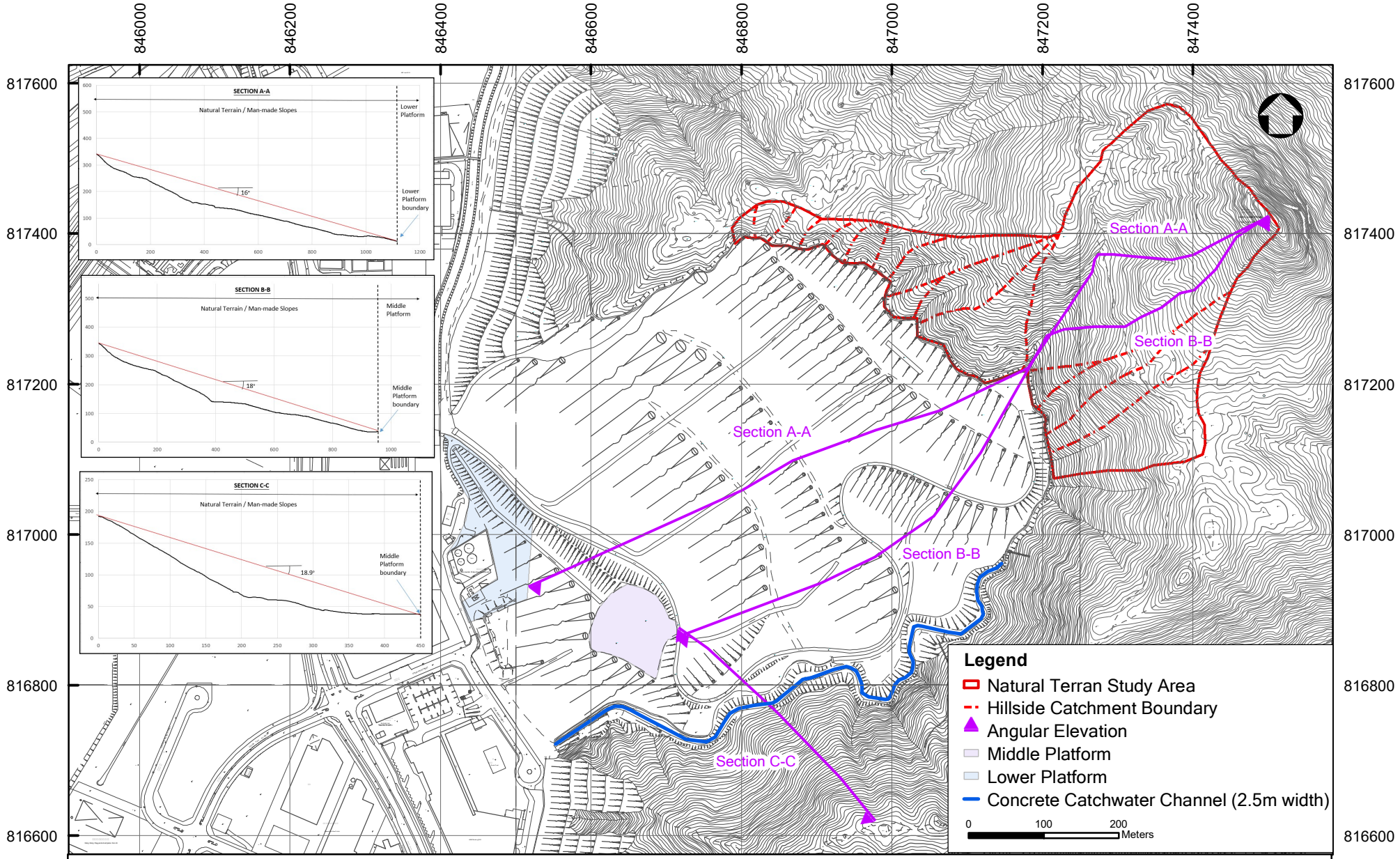
PROJECT: Natural Terrain Hazard Study for the Proposed Development of New Public Riding School at the Restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III)

TITLE: Location Plan of NTSA	SCALE: 1 :4000	Modern Consulting Engineers Limited In association with Calvint Geo-Services Limited	FIGURE NO : FIGURE 1



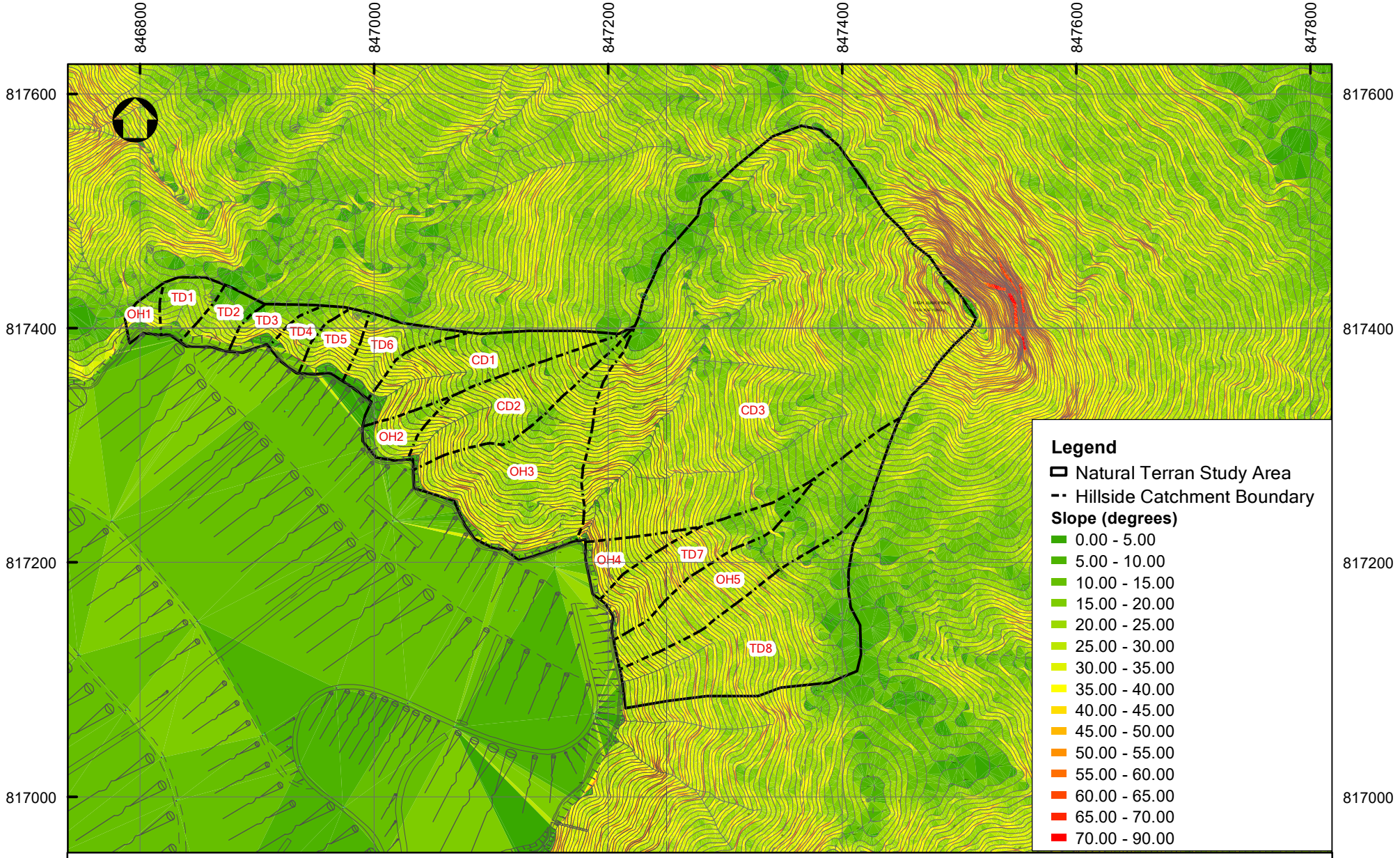
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TITLE: Angular Elevation	SCALE: 1 :5500	Modern Consulting Engineers Limited In association with Calvint Geo-Services Limited	FIGURE NO : FIGURE 2



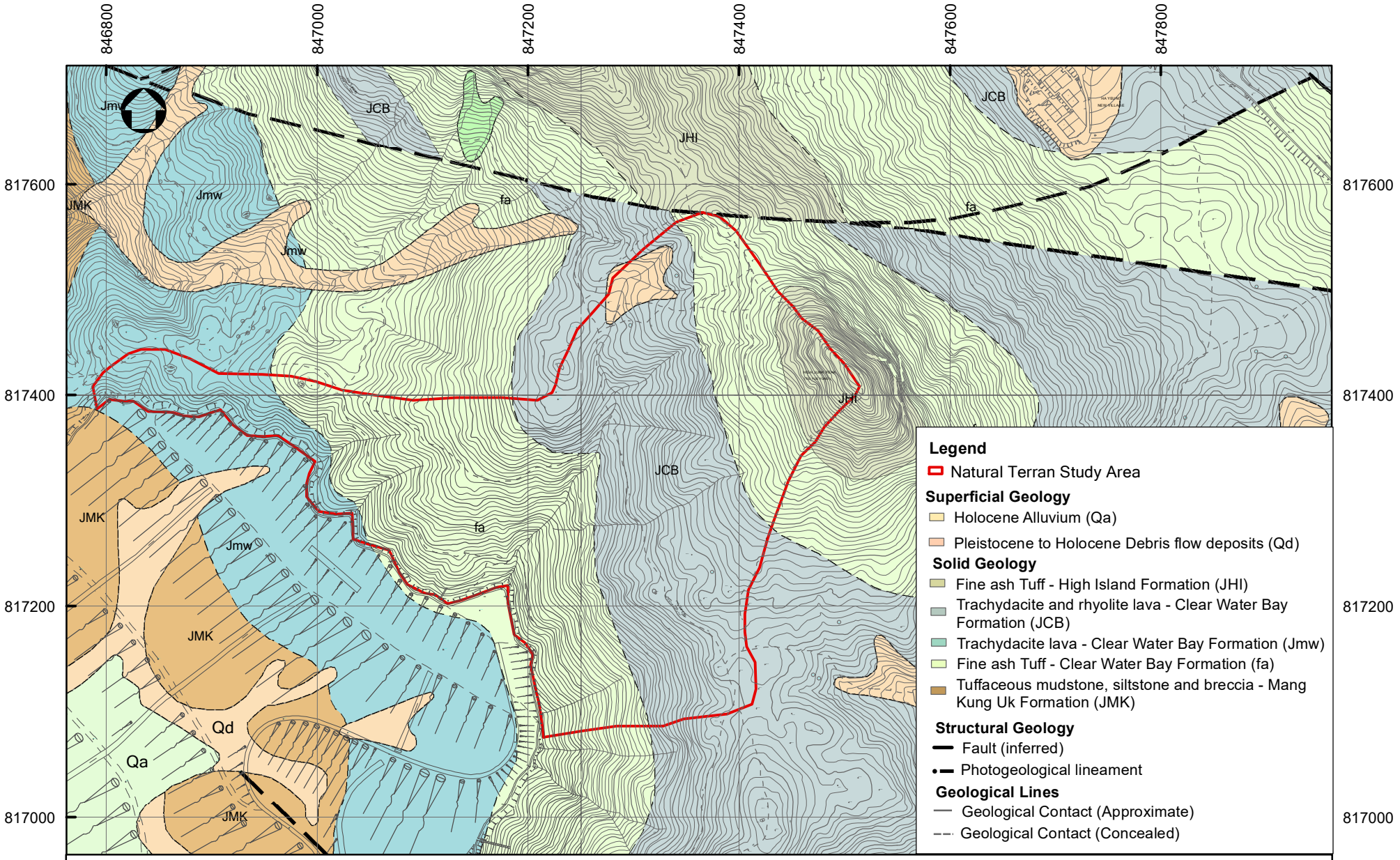
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TITLE: Angular Elevation (Middle & Lower Platforms)	**SCALE:** 1 :7000	**Modern Consulting Engineers Limited** In association with CALVINT GEO-SERVICES LIMITED	**FIGURE NO :** FIGURE 2.1



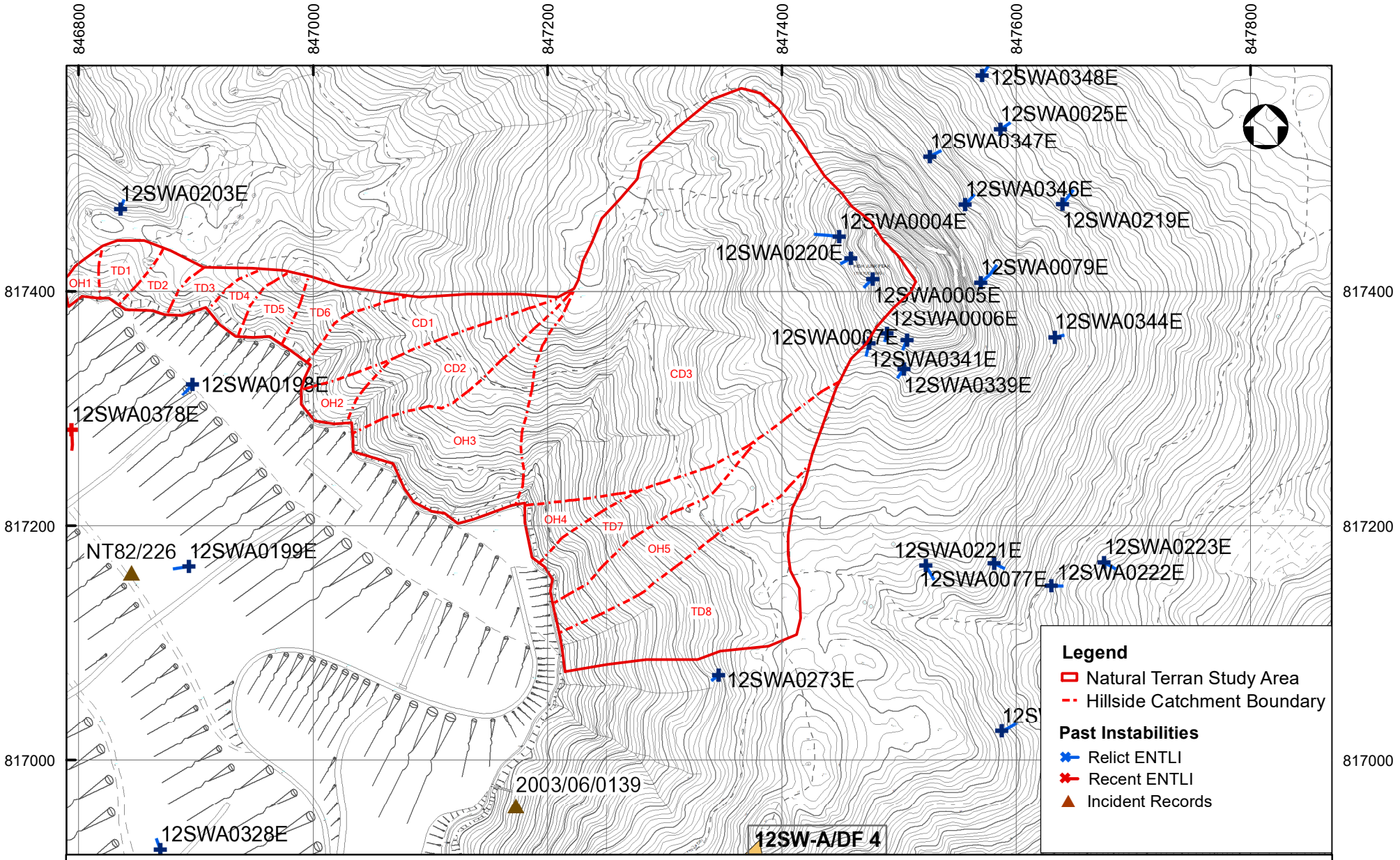
PROJECT: Natural Terrain Hazard Study for the Proposed Development of New Public Riding School at the Restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III)

TITLE: Slope Angle Map	SCALE: 1 :4500	Modern Consulting Engineers Limited In association with CALVINT GEO-SERVICES LIMITED	FIGURE NO : FIGURE 3



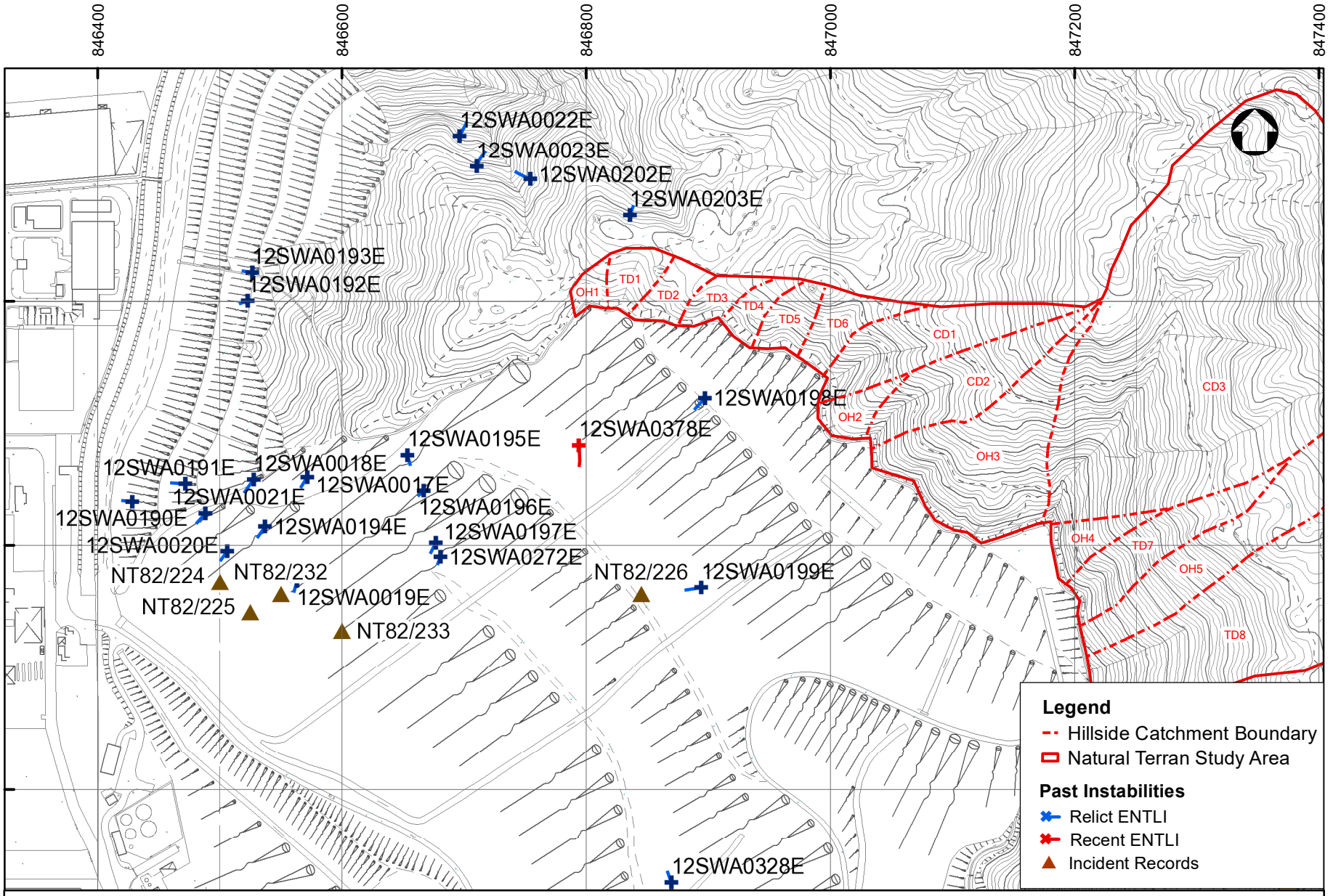
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TITLE: Geological Map	SCALE: 1 :5000	Modern Consulting Engineers Limited In association with CALVINT GEO-SERVICES LIMITED	FIGURE NO : FIGURE 4



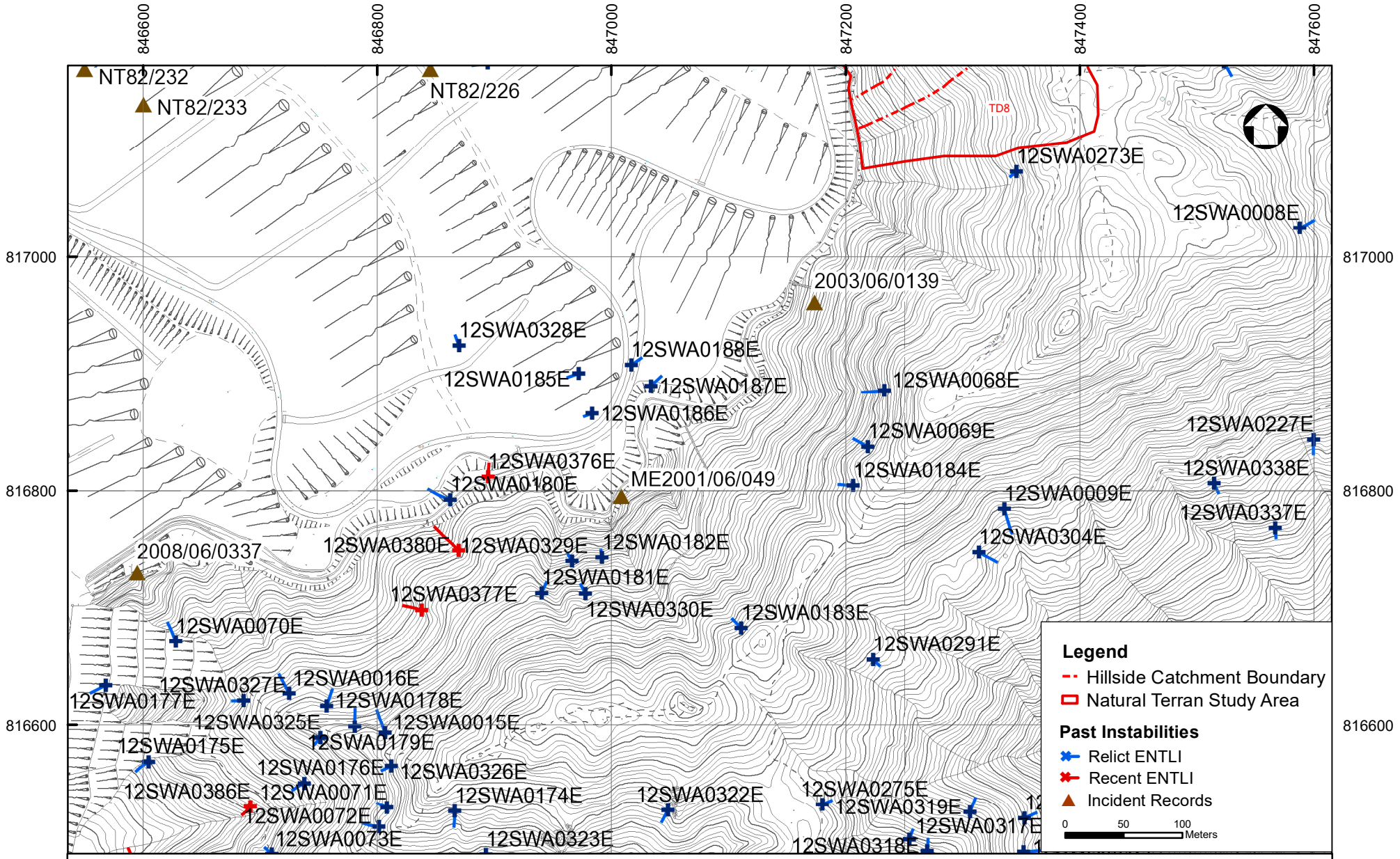
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TITLE: Recorded Past Instabilities (Natural Terrain Study Area)	SCALE: 1 :4500	Modern Consulting Engineers Limited In association with Calvint Geo-Services Limited	FIGURE NO : FIGURE 5.1



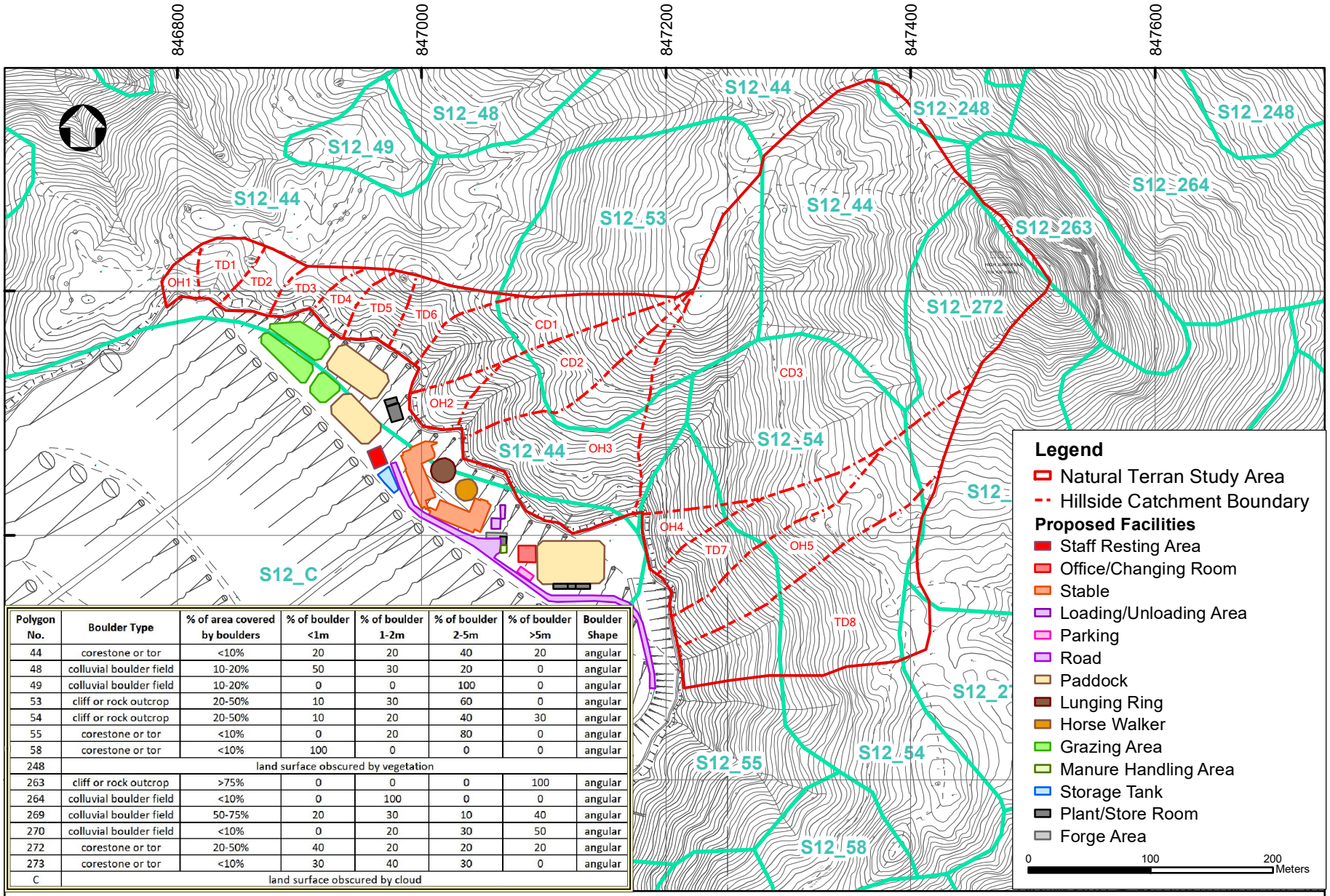
PROJECT: Natural Terrain Hazard Study for the Proposed Development of New Public Riding School at the Restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III)

TITLE: Recorded Past Instabilities (Below Study Area - Northern Portion)	**SCALE:** 1 :4500	**Modern Consulting Engineers Limited** In association with CALVINT GEO-SERVICES LIMITED	**FIGURE NO :** FIGURE 5.2



PROJECT: Natural Terrain Hazard Study for the Proposed Development of New Public Riding School at the Restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III)

TITLE: Recorded Past Instabilities (Below Study Area - Southern Portion)	**SCALE:** 1 :4500	**Modern Consulting Engineers Limited** In association with CALVINT GEO-SERVICES LIMITED	**FIGURE NO :** FIGURE 5.3



Polygon No.	Boulder Type	% of area covered by boulders	% of boulder <1m	% of boulder 1-2m	% of boulder 2-5m	% of boulder >5m	Boulder Shape
44	corestone or tor	<10%	20	20	40	20	angular
48	colluvial boulder field	10-20%	50	30	20	0	angular
49	colluvial boulder field	10-20%	0	0	100	0	angular
53	cliff or rock outcrop	20-50%	10	30	60	0	angular
54	cliff or rock outcrop	20-50%	10	20	40	30	angular
55	corestone or tor	<10%	0	20	80	0	angular
58	corestone or tor	<10%	100	0	0	0	angular
248	land surface obscured by vegetation						
263	cliff or rock outcrop	>75%	0	0	0	100	angular
264	colluvial boulder field	<10%	0	100	0	0	angular
269	colluvial boulder field	50-75%	20	30	10	40	angular
270	colluvial boulder field	<10%	0	20	30	50	angular
272	corestone or tor	20-50%	40	20	20	20	angular
273	corestone or tor	<10%	30	40	30	0	angular
C	land surface obscured by cloud						

PROJECT: Natural Terrain Hazard Study for the Proposed Development of New Public Riding School at the Restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III)

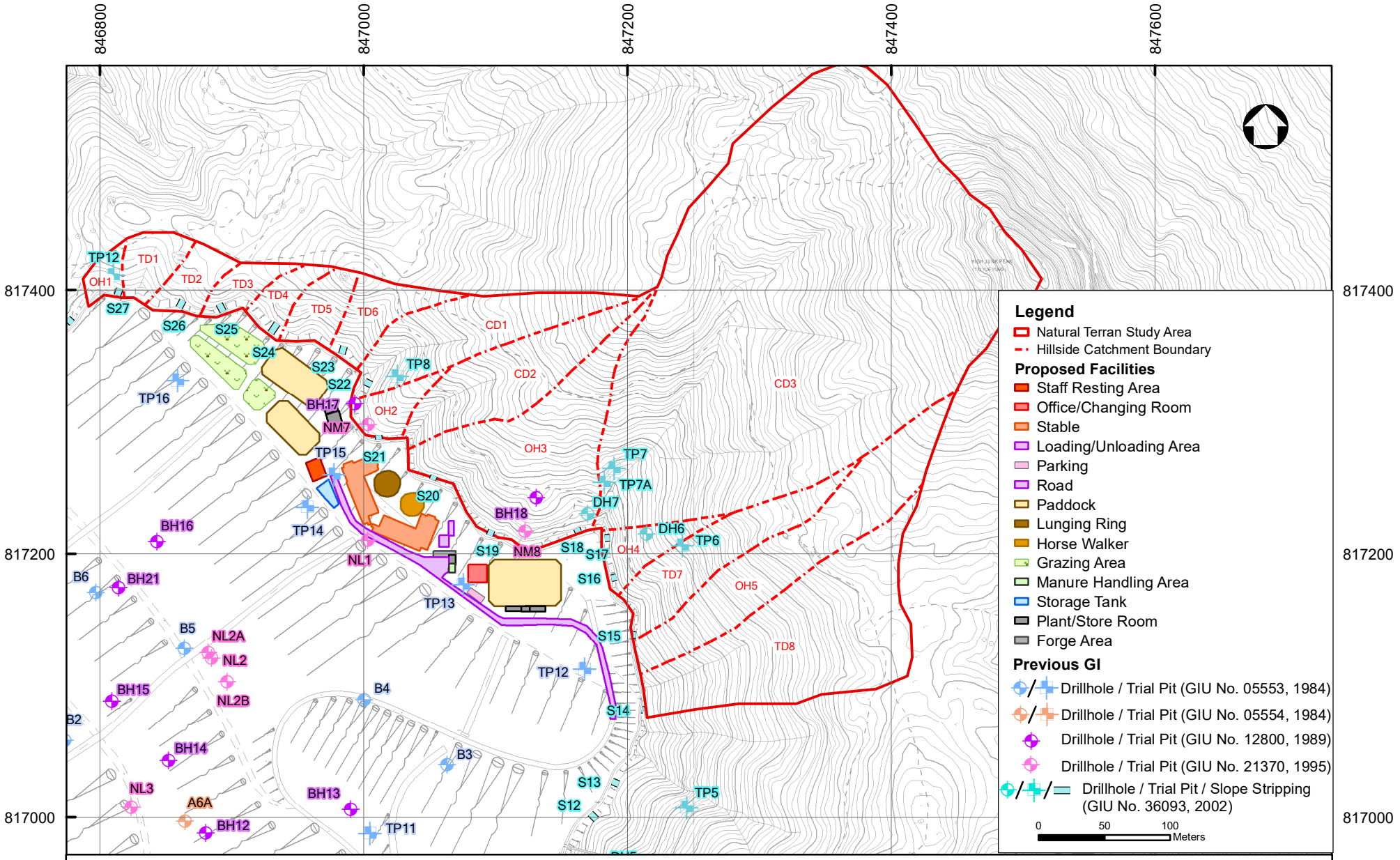
TITLE: Boulder Inventory

SCALE: 1 :4500

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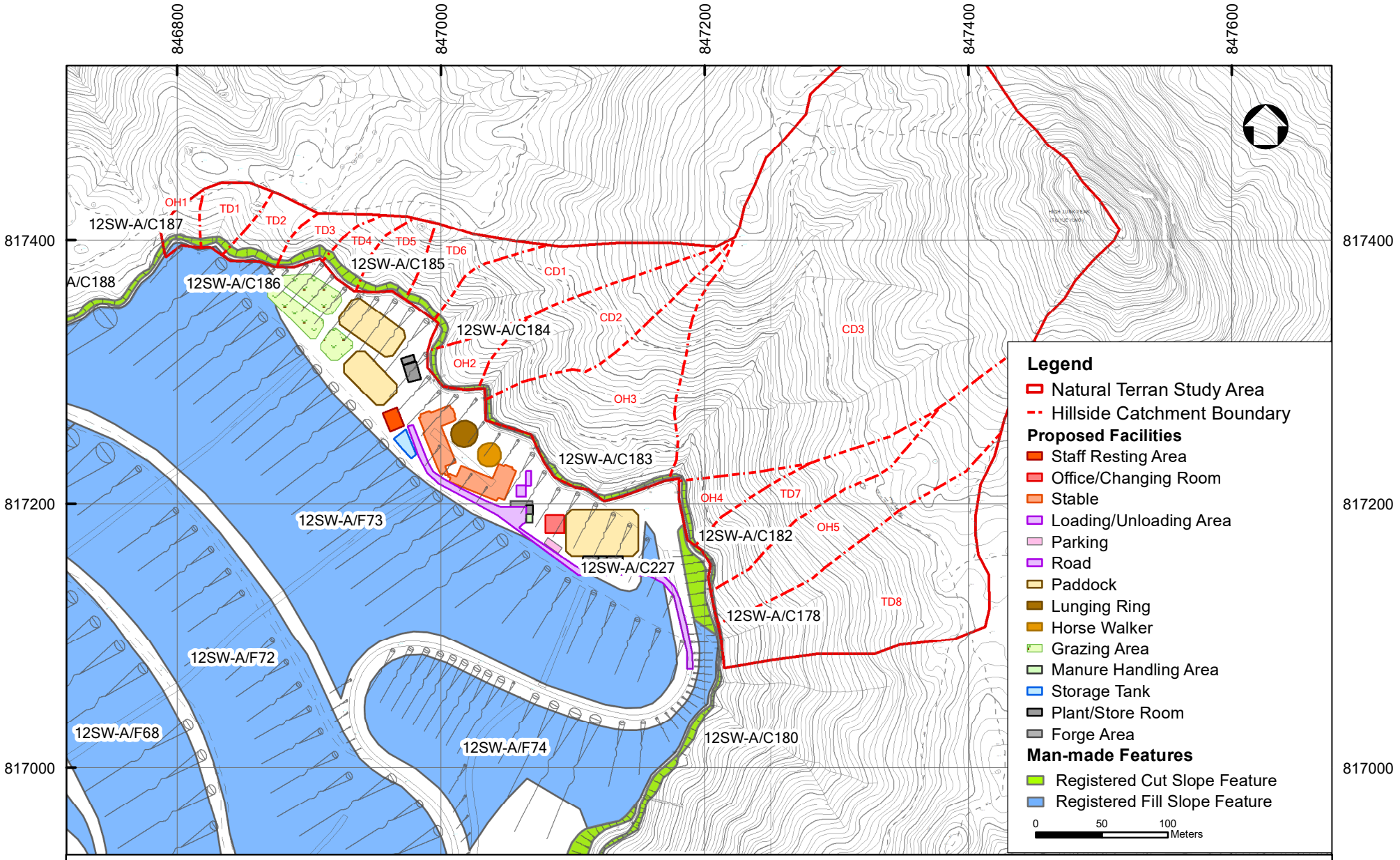
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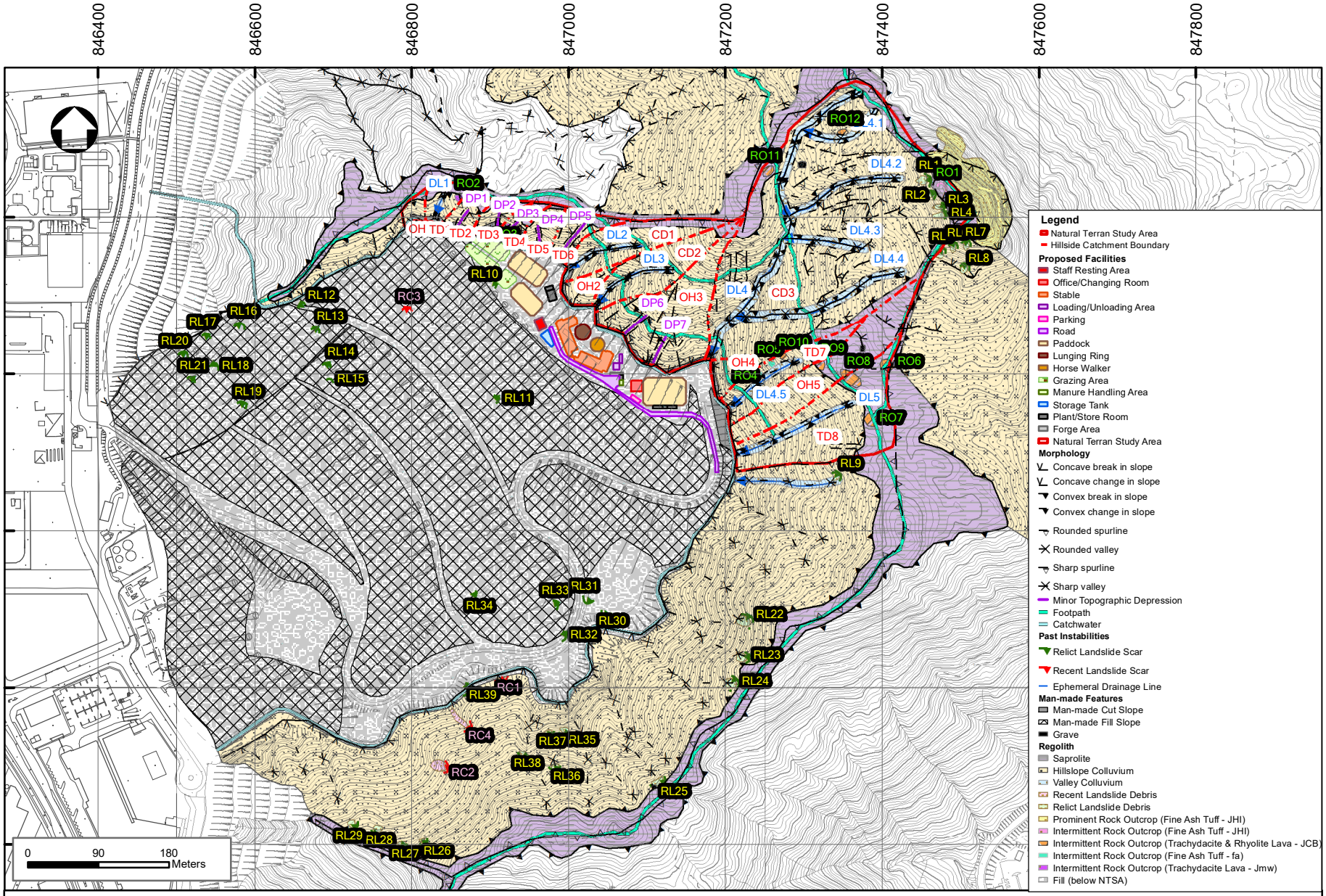
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TITLE: Location Plan of Ground Investigations (Natural Terrain Study Area)	**SCALE:** 1 :4000	Modern Consulting Engineers Limited In association with Calvint Geo-Services Limited	**FIGURE NO :** FIGURE 7



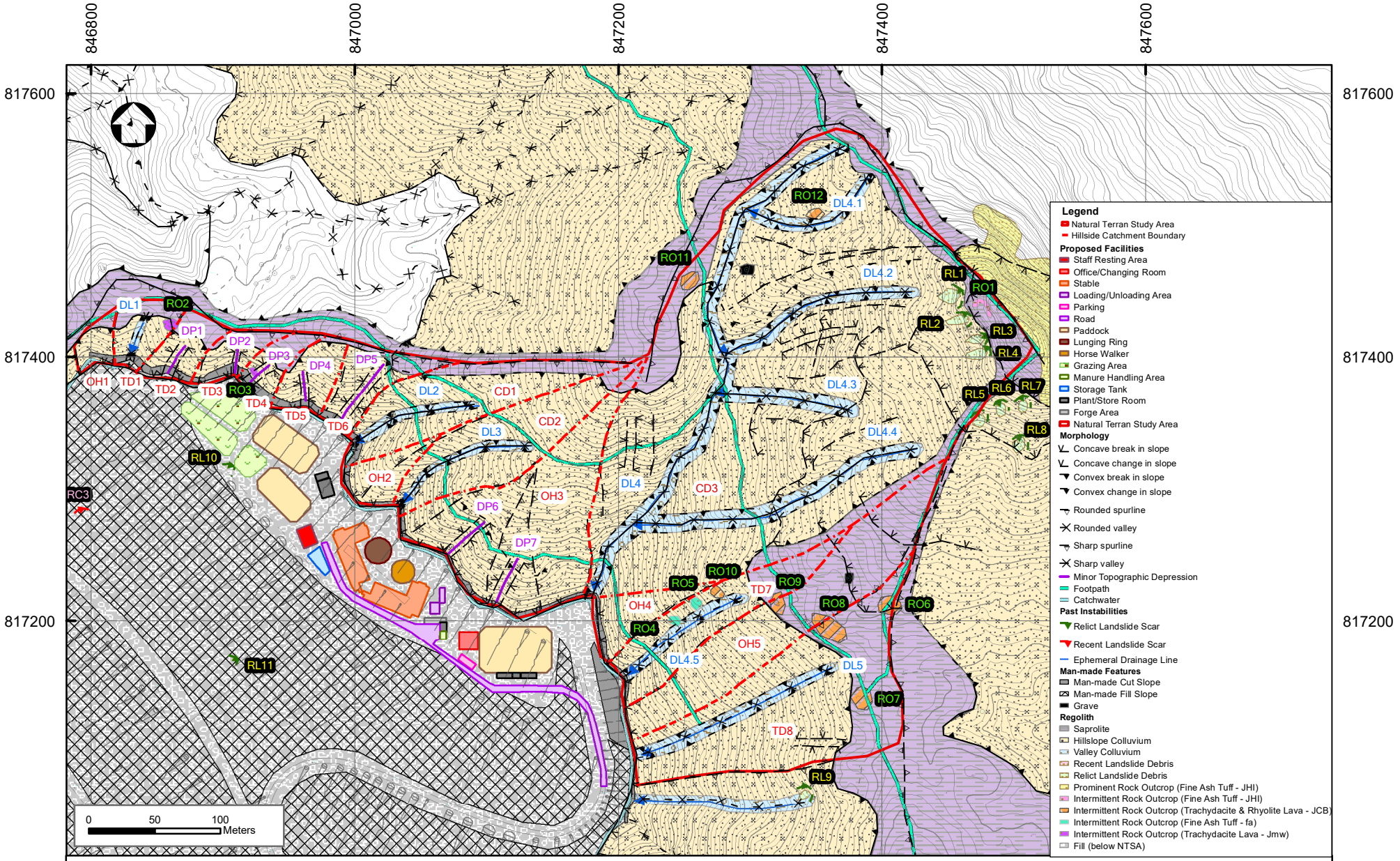
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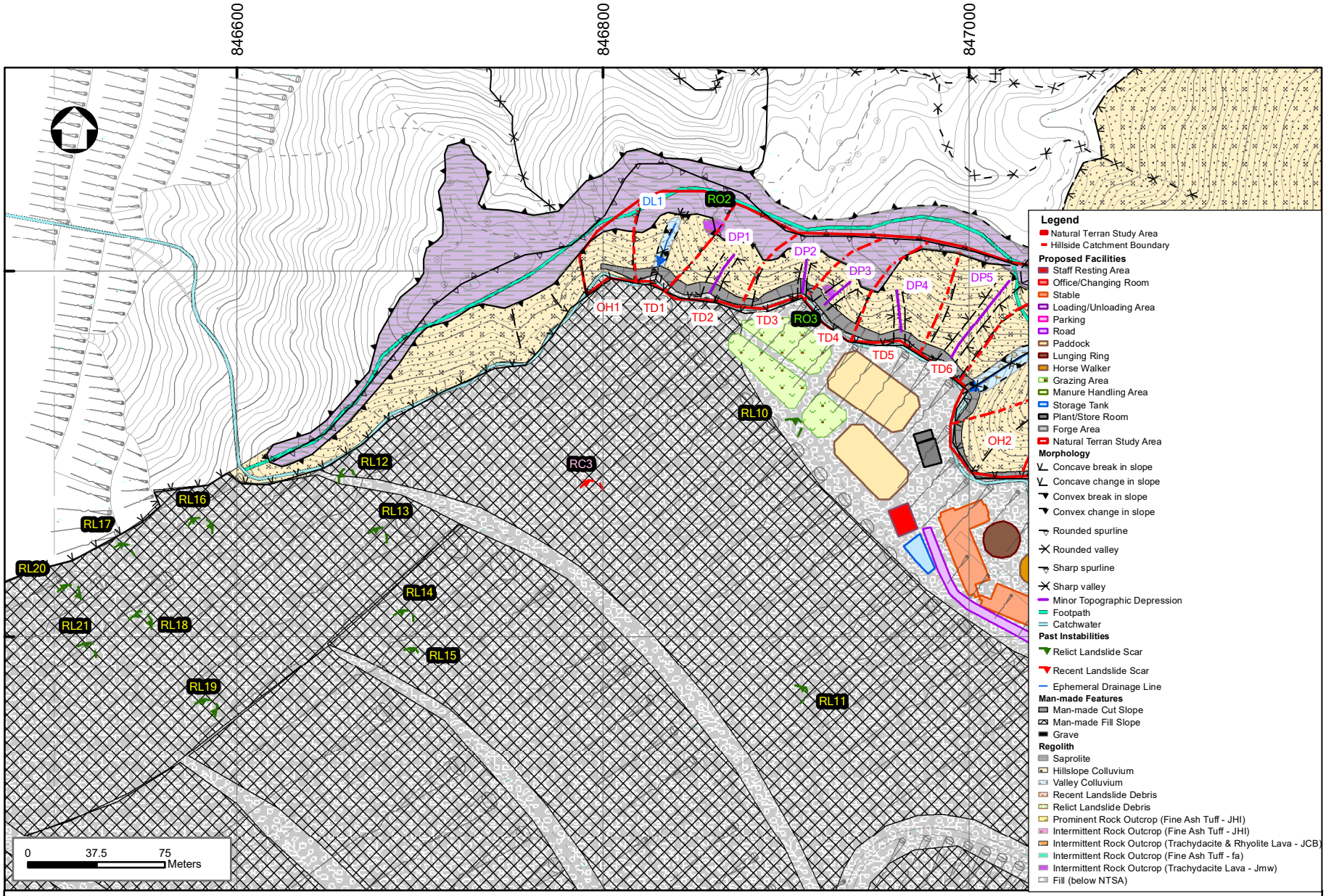
PROJECT: Natural Terrain Hazard Study for the Proposed Development of New Public Riding School at the Restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III)

TITLE: Engineering Geomorphological Map (Regional View)	SCALE: 1 :7000	Modern Consulting Engineers Limited In association with Calvint Geo-Services Limited	FIGURE NO : FIGURE 9.1



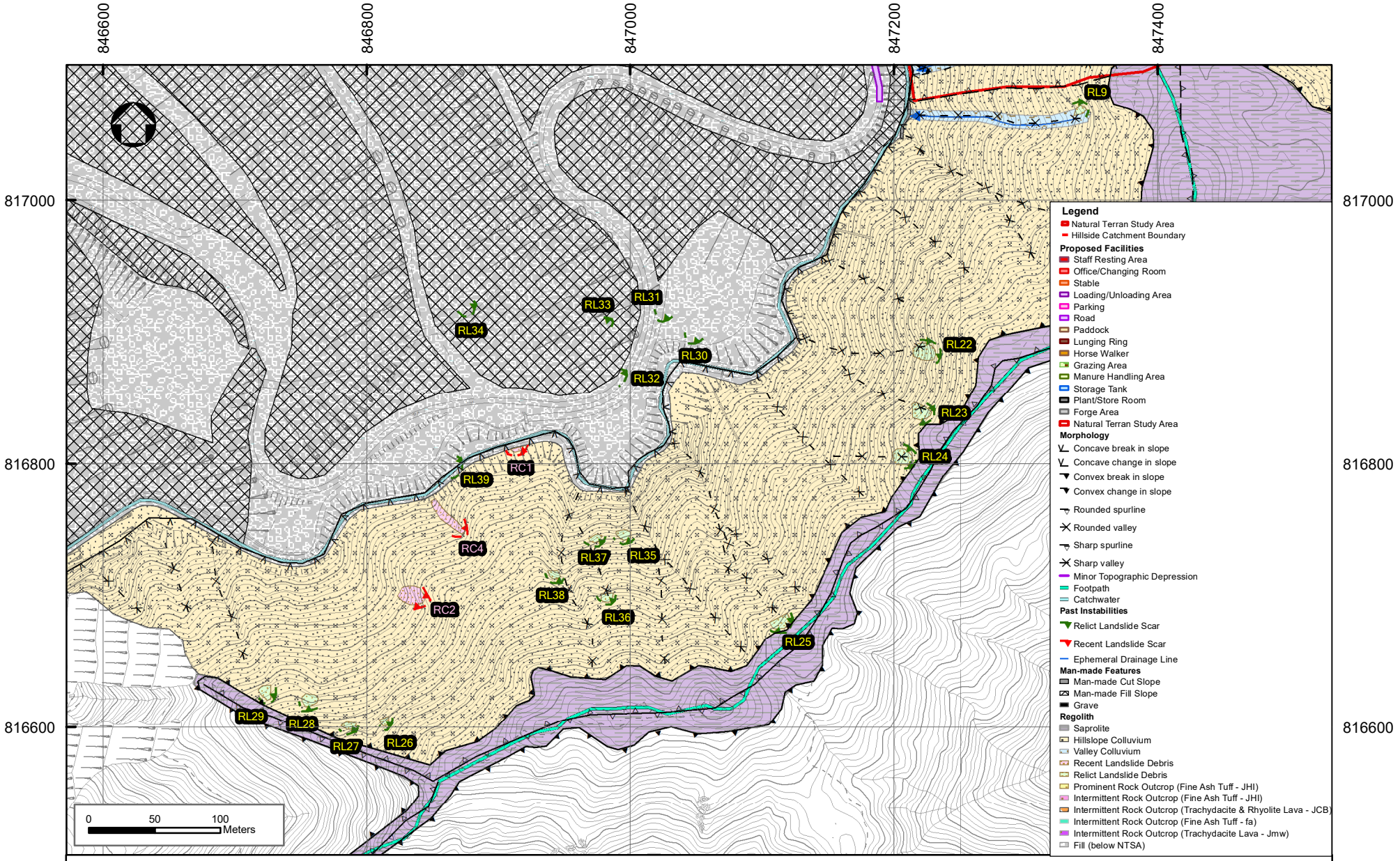
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TITLE: Engineering Geomorphological Map (Natural Terrain Study Area)	SCALE: 1 :4000	Modern Consulting Engineers Limited In association with Calvint Geo-Services Limited	FIGURE NO : FIGURE 9.2



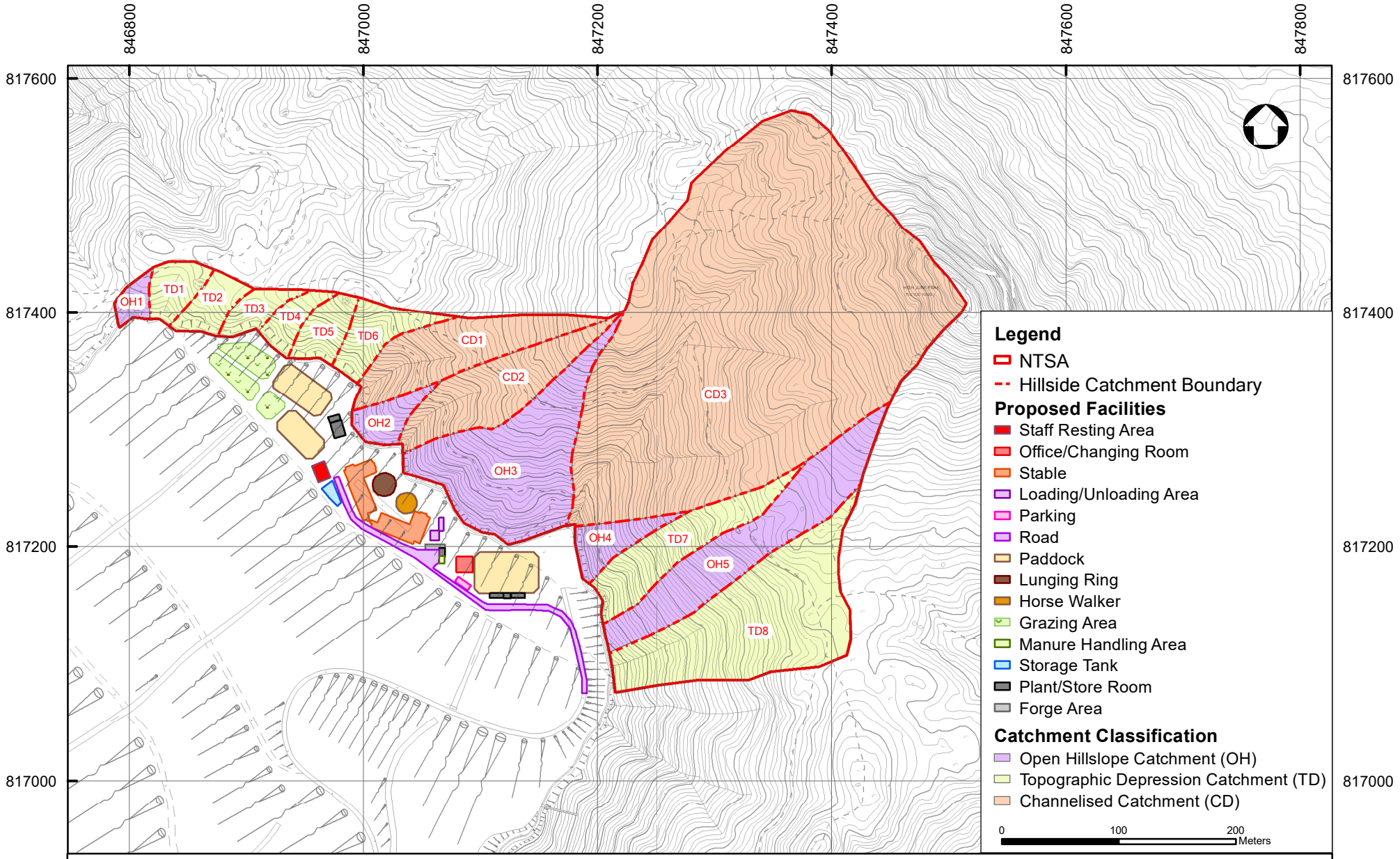
PROJECT: Natural Terrain Hazard Study for the Proposed Development of New Public Riding School at the Restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III)

TITLE:	SCALE:		FIGURE NO :
Engineering Geomorphological Map (Below Study Area - Northern Portion)	1 :4000	Modern Consulting Engineers Limited In association with Calvint Geo-Services Limited	FIGURE 9.3



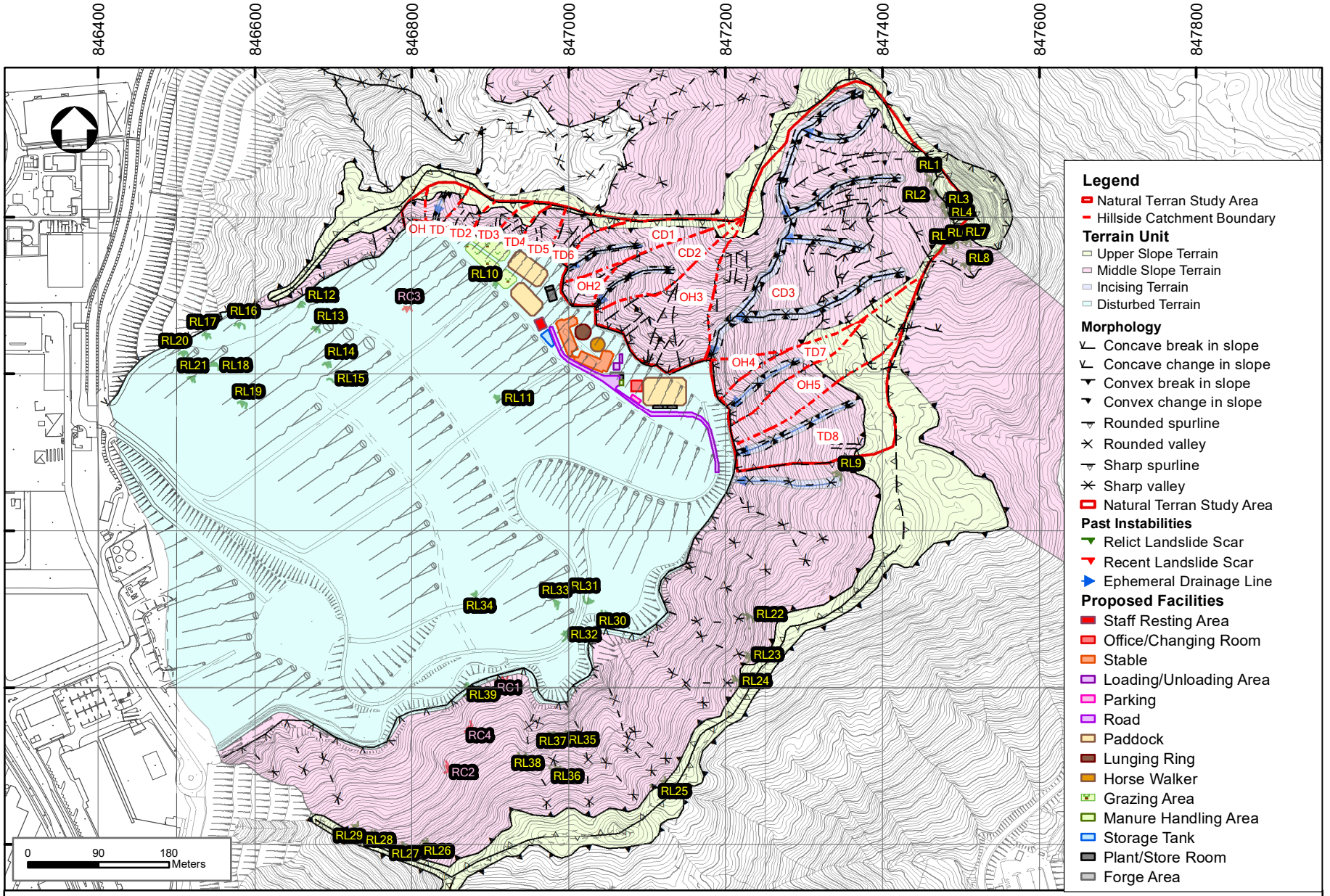
PROJECT: Natural Terrain Hazard Study for the Proposed Development of New Public Riding School at the Restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III)

TITLE:	SCALE:		FIGURE NO :
Engineering Geomorphological Map (Below Study Area - Southern Portion)	1 :4000	Modern Consulting Engineers Limited In association with CALVINT GEO-SERVICES LIMITED	FIGURE 9.4



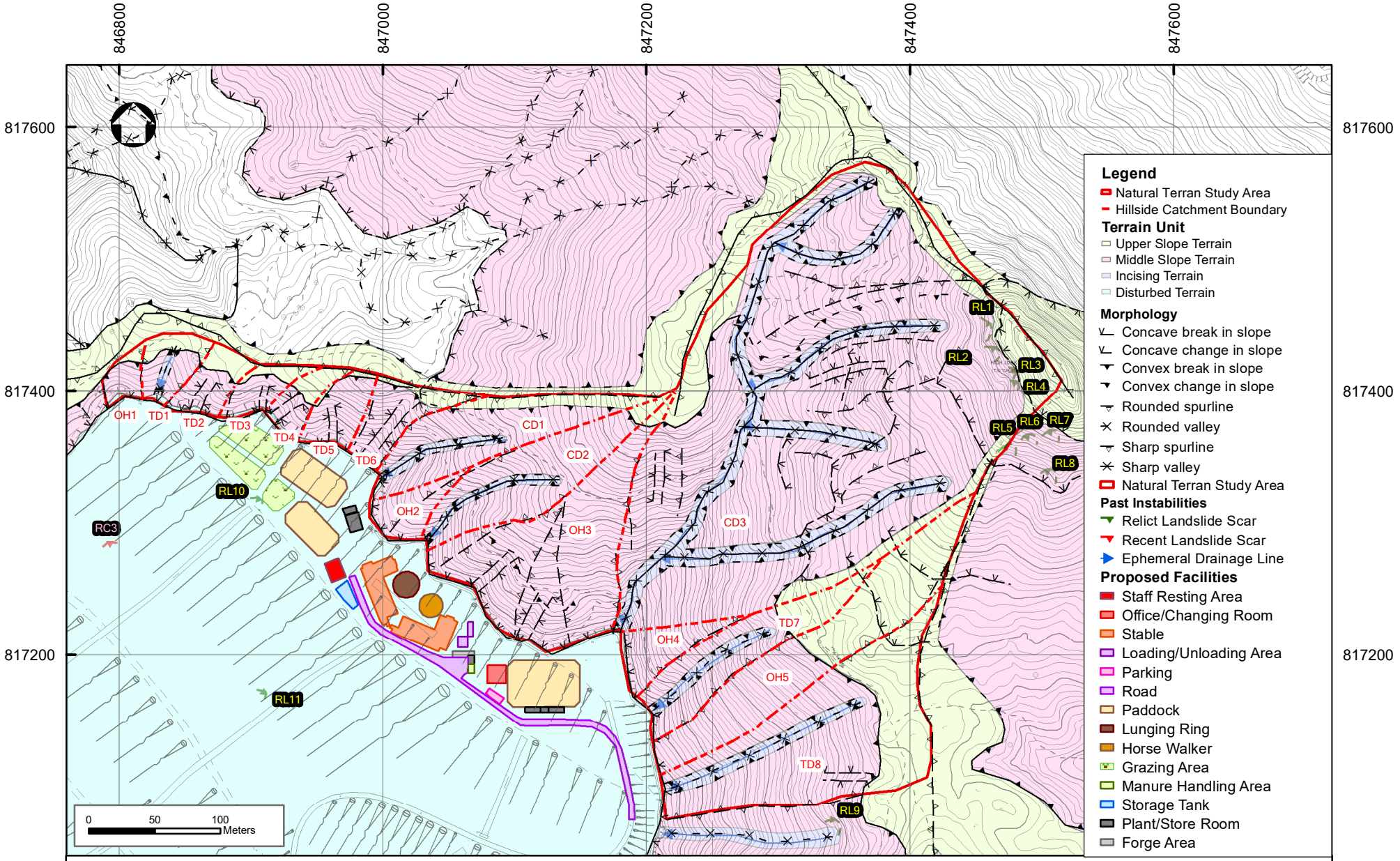
PROJECT: Natural Terrain Hazard Study for the Proposed Development of New Public Riding School at the Restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III)

TITLE: Catchment Classification Map	SCALE: 1 :4500	Modern Consulting Engineers Limited In association with Calvint Geo-Services Limited	FIGURE NO : FIGURE 10



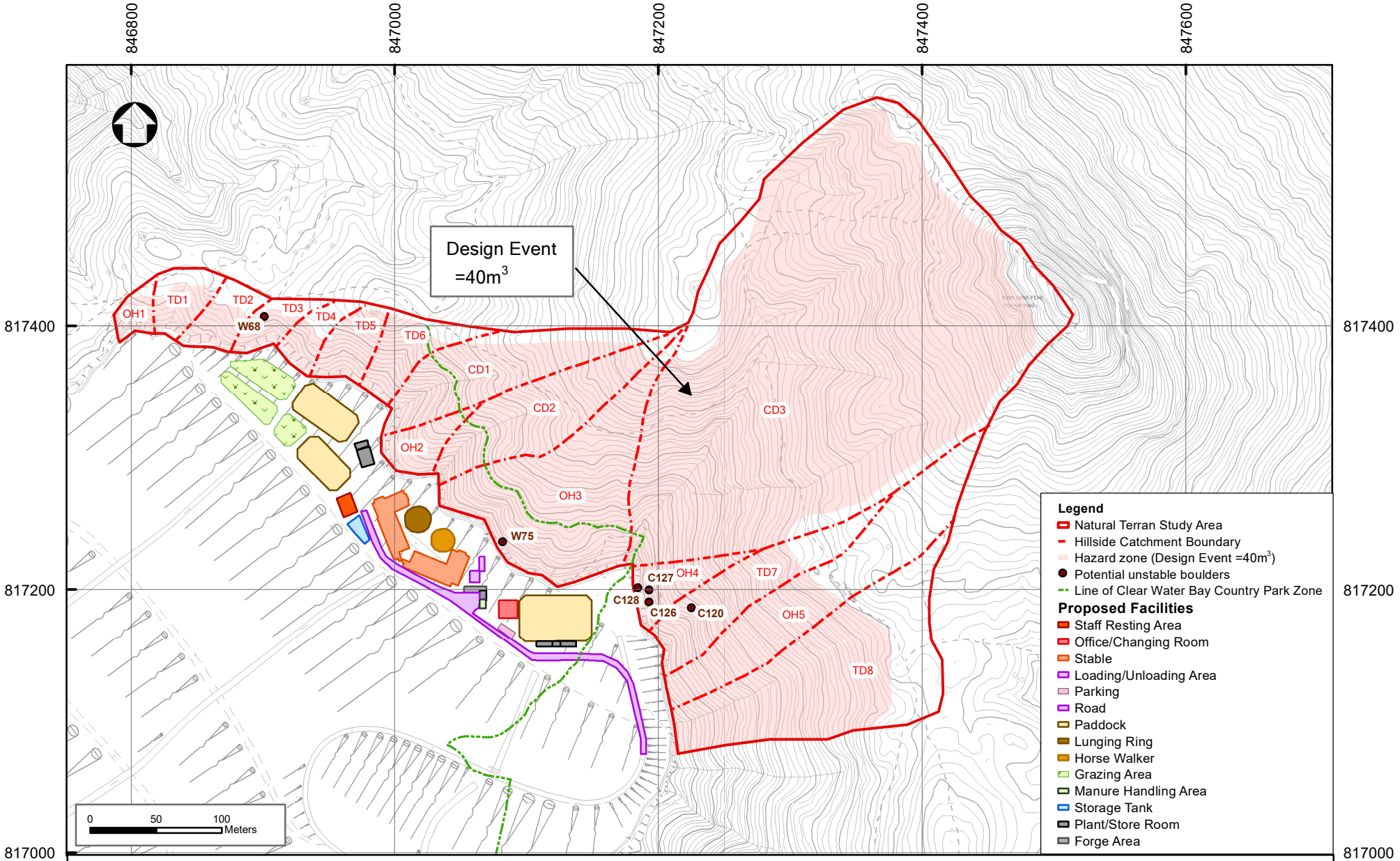
PROJECT: Natural Terrain Hazard Study for the Proposed Development of New Public Riding School at the Restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III)

TITLE: Terrain Unit Map (Regional View)	**SCALE:** 1 :7000	**Modern Consulting Engineers Limited** In association with Calvint Geo-Services Limited	**FIGURE NO :** FIGURE 11.1



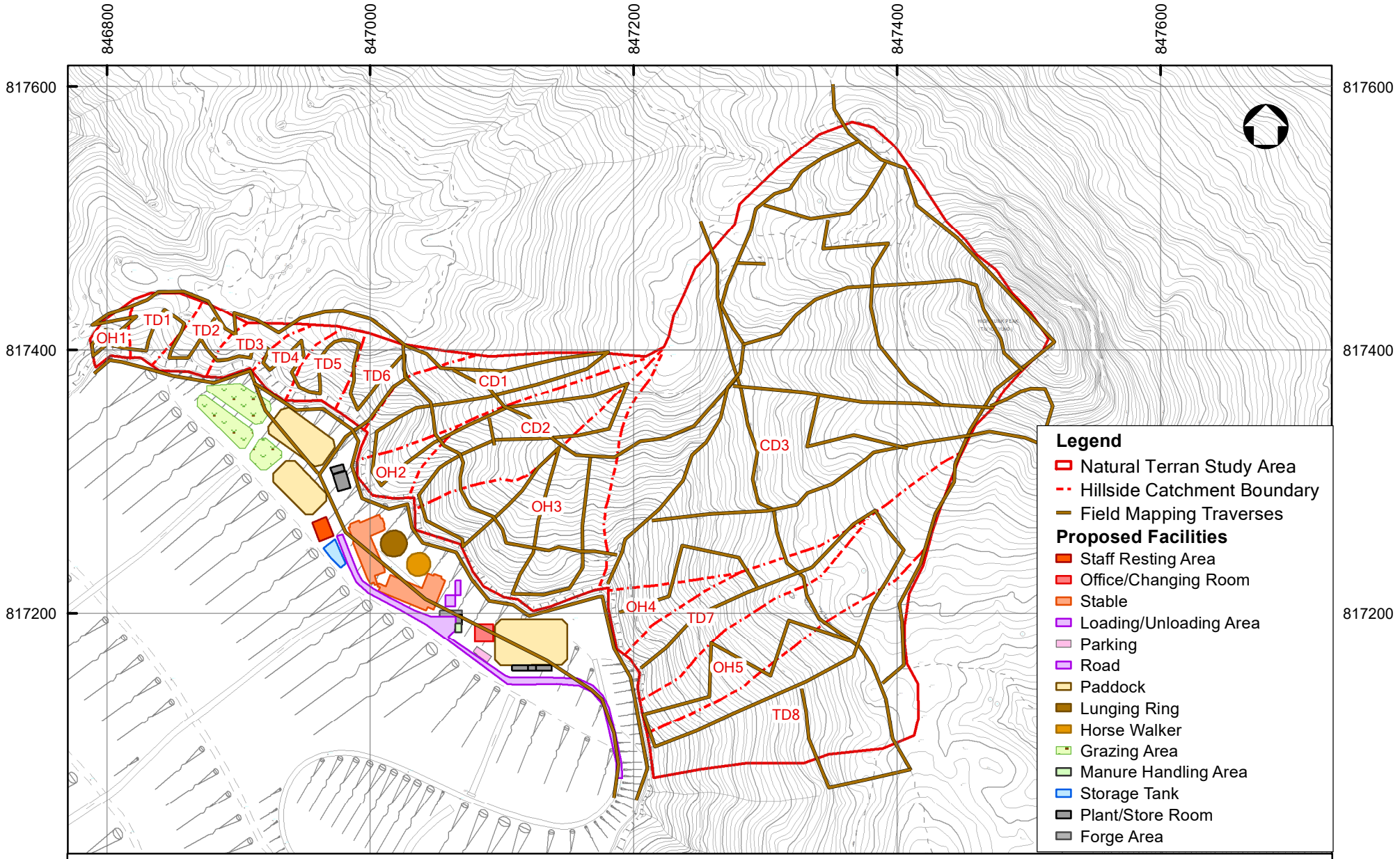
PROJECT: Natural Terrain Hazard Study for the Proposed Development of New Public Riding School at the Restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III)

TITLE: Terrain Unit Map (Natural Terrain Study Area)	**SCALE:** 1 :7000	Modern Consulting Engineers Limited In association with Calvint Geo-Services Limited	**FIGURE NO :** FIGURE 11.2



PROJECT: Natural Terrain Hazard Study for the Proposed Development of New Public Riding School at the Restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III)

TITLE: Natural Terrain Hazard Map	**SCALE:** 1 :4000	Modern Consulting Engineers Limited In association with Calvint Geo-Services Limited	**FIGURE NO :** FIGURE 12



PROJECT: Natural Terrain Hazard Study for the Proposed Development of New Public Riding School at the Restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III)

TITLE: Field Mapping Traverses	**SCALE:** 1 :4000	Modern Consulting Engineers Limited In association with Calvint Geo-Services Limited	**FIGURE NO :** FIGURE 13

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Plate 17 General View of Topographic Depressions within NTSA

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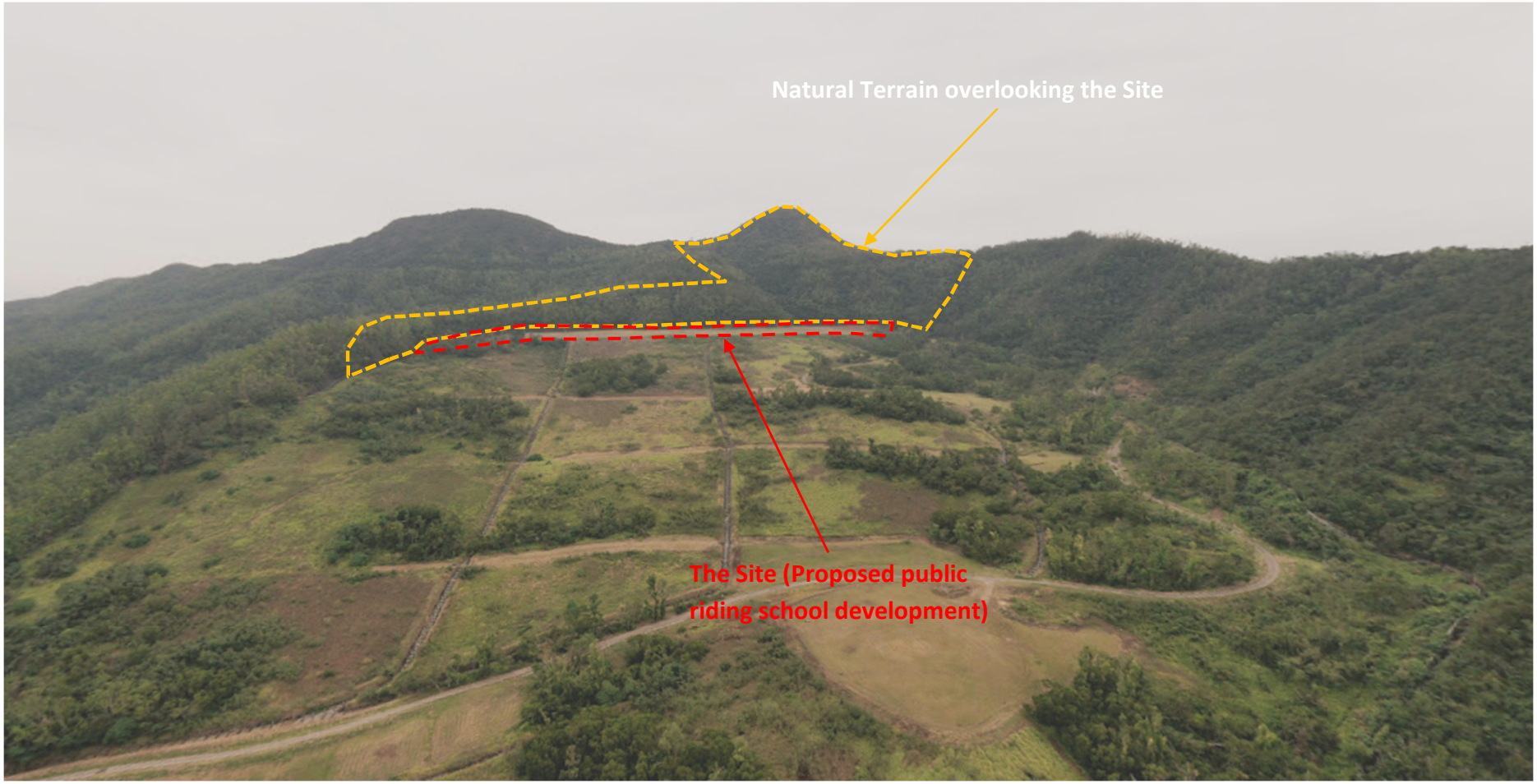


Plate 1 General View of the Natural Terrain Hazard Study Area (NTSA) overlooking the Site

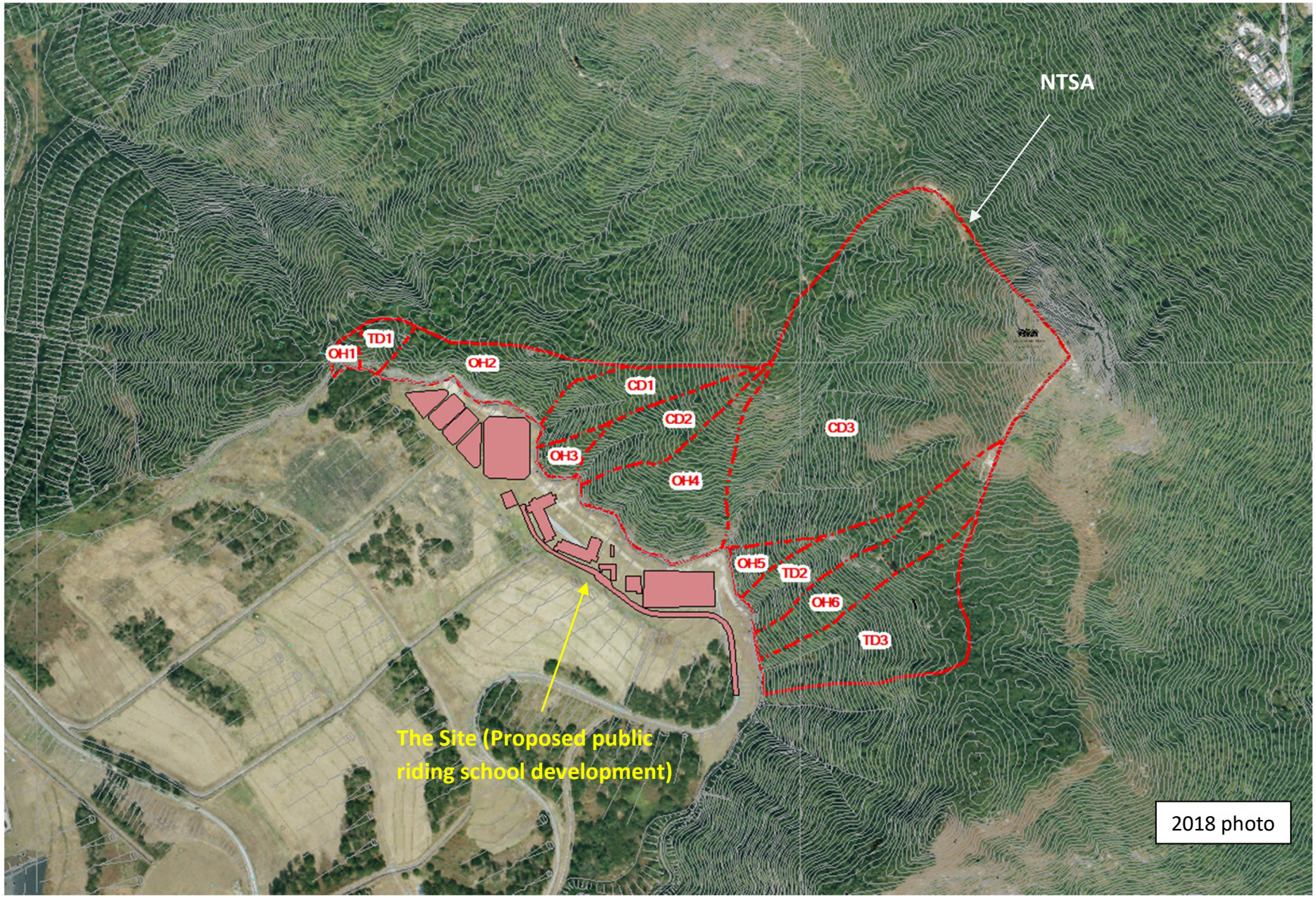
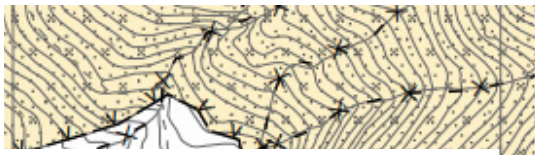


Plate 2 Aerial view of the NTSA and the Site



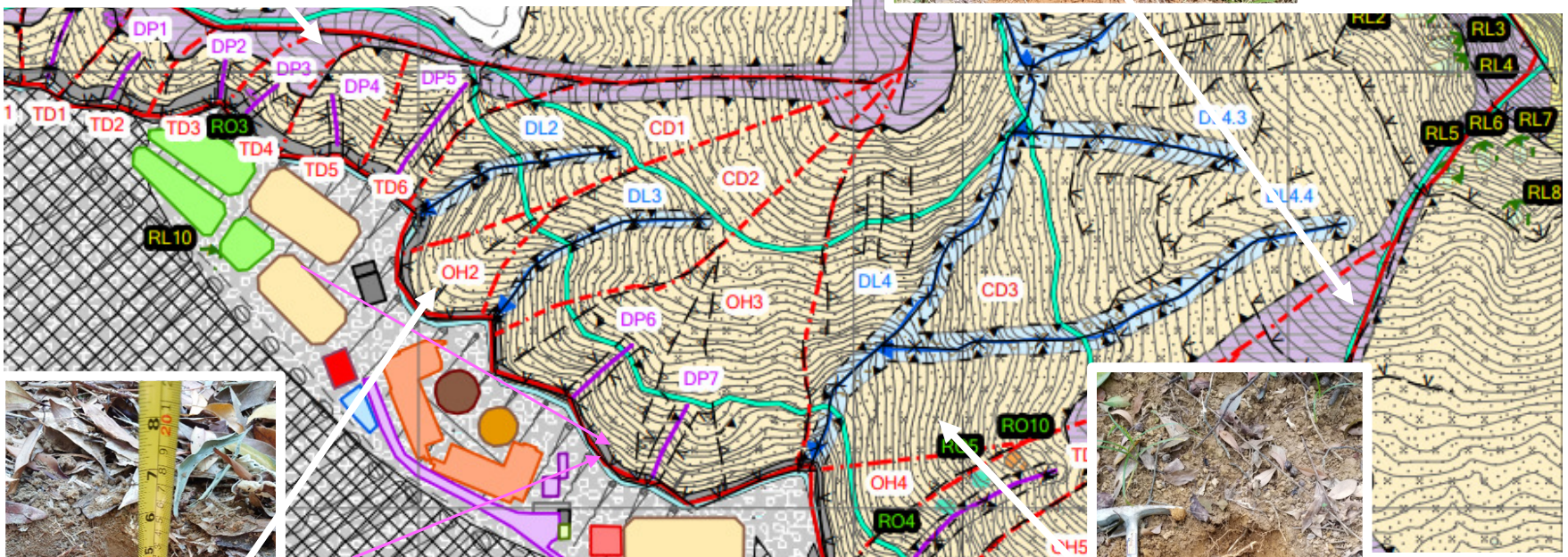


Saprolite: Extremely weak, orange brown, dappled red, completely decomposed Trachydacite lava. (Stiff, slightly sandy SILT with some gravel)





Saprolite: Extremely weak, pinkish brown, slightly dappled white, completely decomposed fine ash Tuff. (Firm to stiff, slightly sandy SILT with some gravel)





Hillslope colluvium: Firm, brown, dappled grey, sandy SILT with some subangular fine to coarse gravel, occasional cobbles and boulders sized rock fragments.



Hillslope colluvium: Firm, yellowish brown, dappled grey, sandy SILT with some subangular fine to coarse gravel occasional cobbles and boulders sized rock fragments.

Plate 3 Saprolitic soil and Hillslope Colluvium within the NTSA



Plate 4 Valley Colluvium along the ephemeral drainage lines within the NTSA






Plate 5 Boulders Scattered across the NTSA

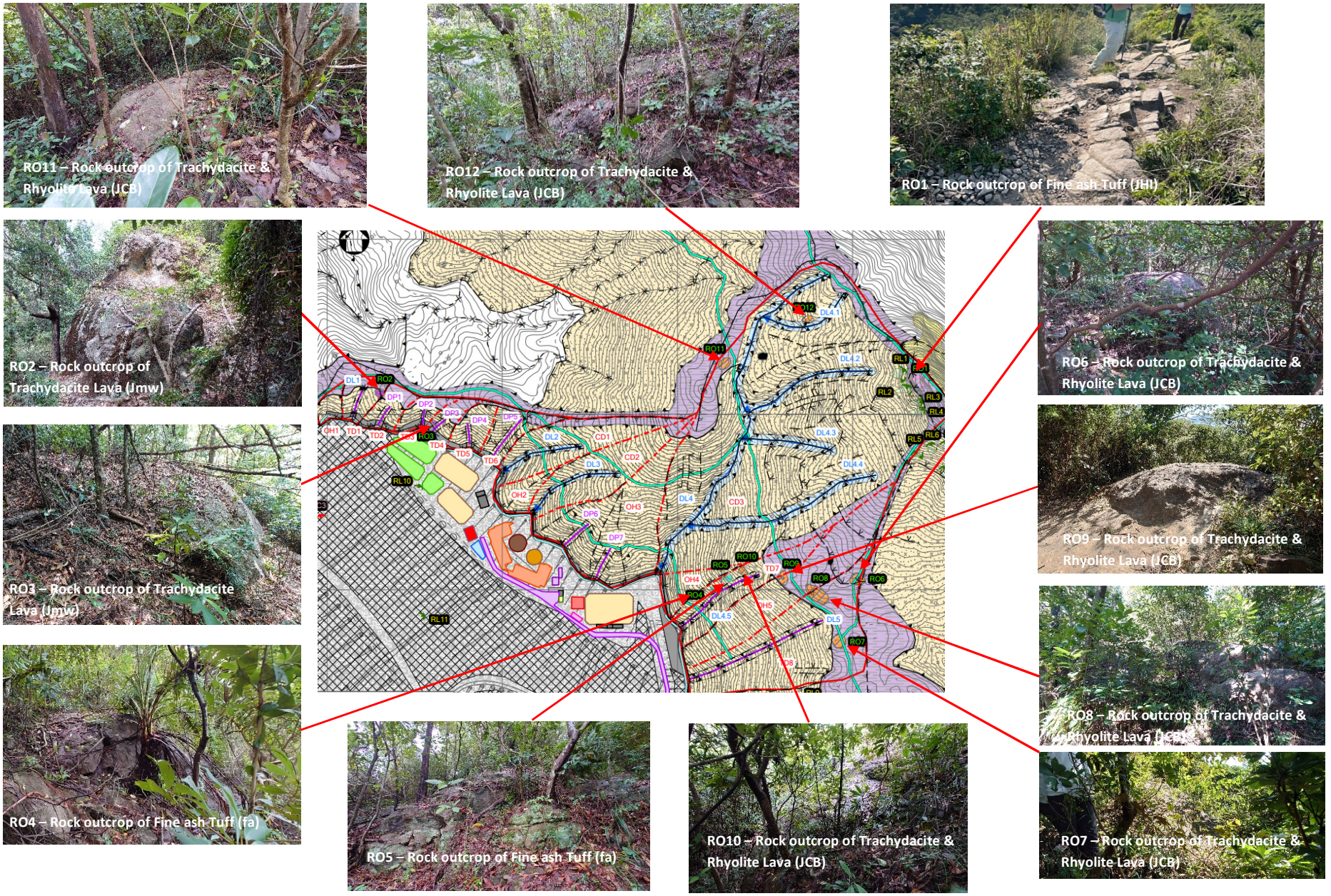


Plate 6 Rock Outcrops Discerned within the NTSA

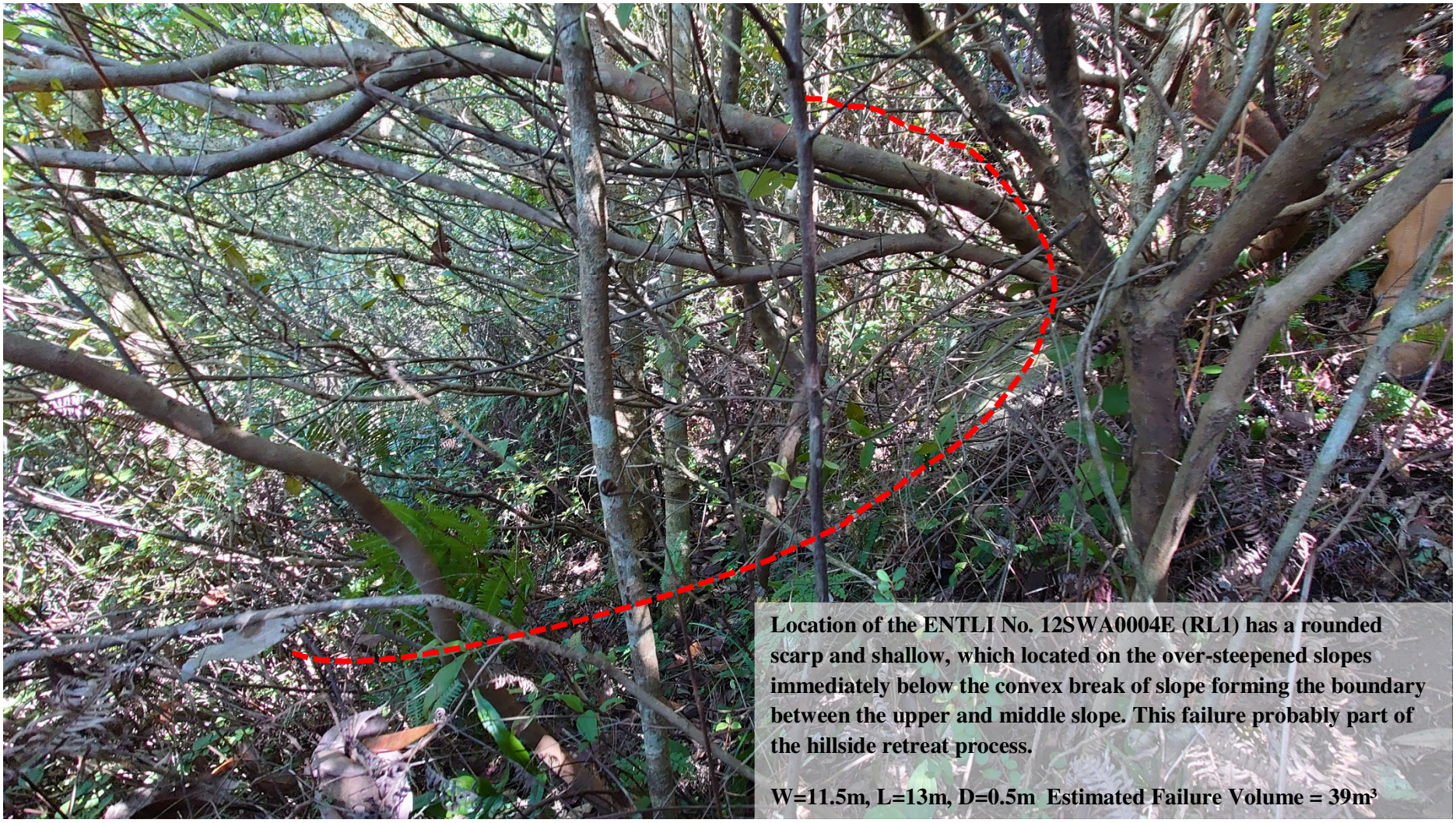


Plate 7 Relict landslide scar RL1 (ENTLI No. 12SWA0004E) located at the Crest of Catchment No. CD3



Plate 8 Relict landslide scar RL2 (ENTLI No. 12SWA0220E) located at the Crest of Catchment No. CD3



Plate 9 Relict landslide scar RL3 (ENTLI No. 12SWA0005E) located at the Crest of Catchment No. CD3



Plate 10 Relict landslide scar RL4 (Not Registered as ENTLI) located at the Crest of Catchment No. CD3



Plate 11 Relict landslide scar RL5 (ENTLI No. 12SWA0341E) located at the Crest of the Catchment Adjacent to Catchment No. CD3



Plate 12 Relict landslide scar RL6 (ENTLI No. 12SWA0006E) located at the Crest of the Catchment Adjacent to Catchment No. CD3



Plate 13 Relict landslide scar RL7 (ENTLI No. 12SWA0007E) located at the Crest of the Catchment Adjacent to Catchment No. CD3



Plate 14 Relict landslide scar RL8 (ENTLI No. 12SWA0339E) located at the Crest of the Catchment Adjacent to Catchment No. CD3



Plate 15 Relict landslide scar RL9 (ENTLI No. 12SWA0273E) located Near Head of Drainage Line Adjacent to Catchment No. TD3

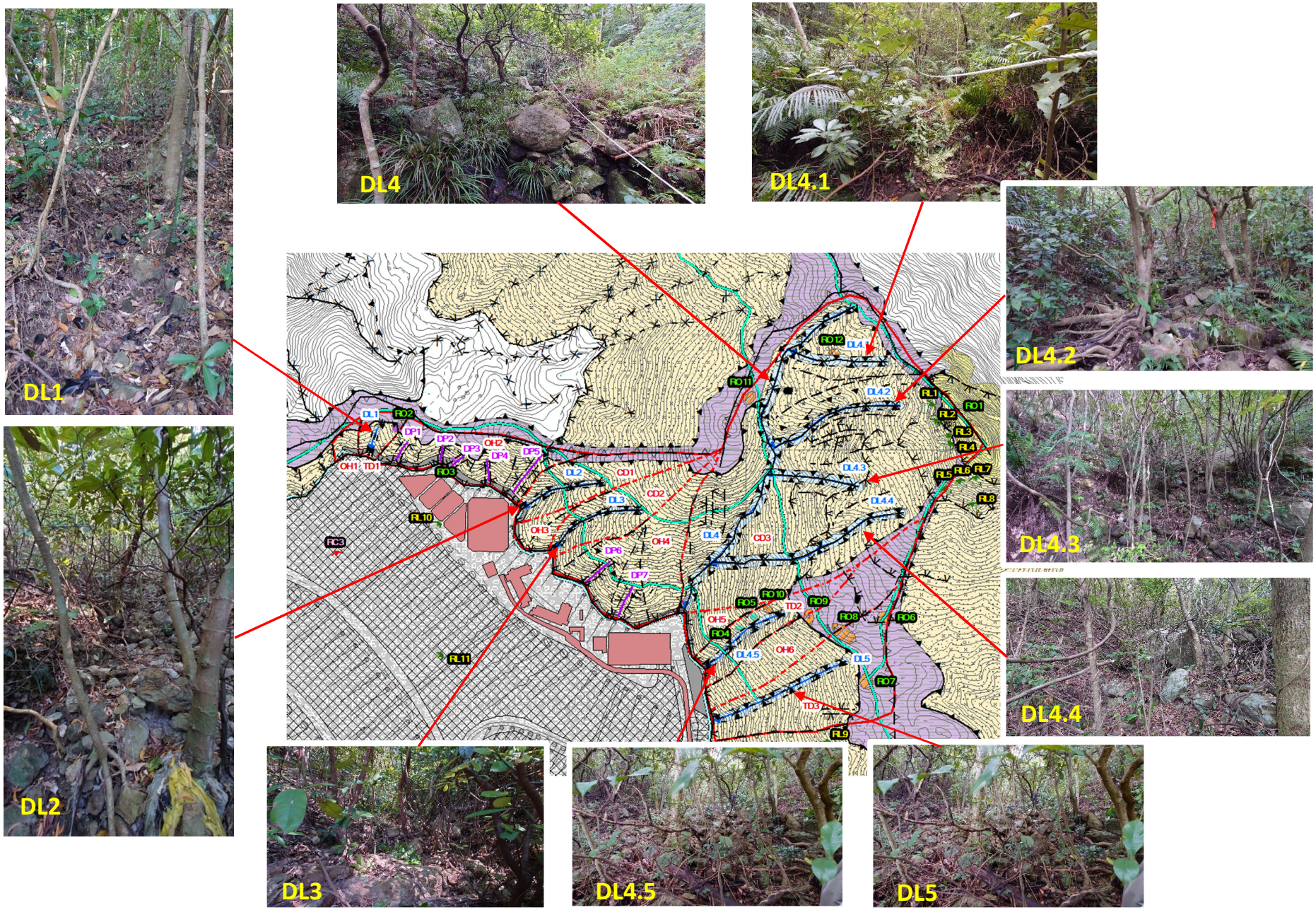


Plate 16 General View of the Ephemeral Drainage Lines within NTSA

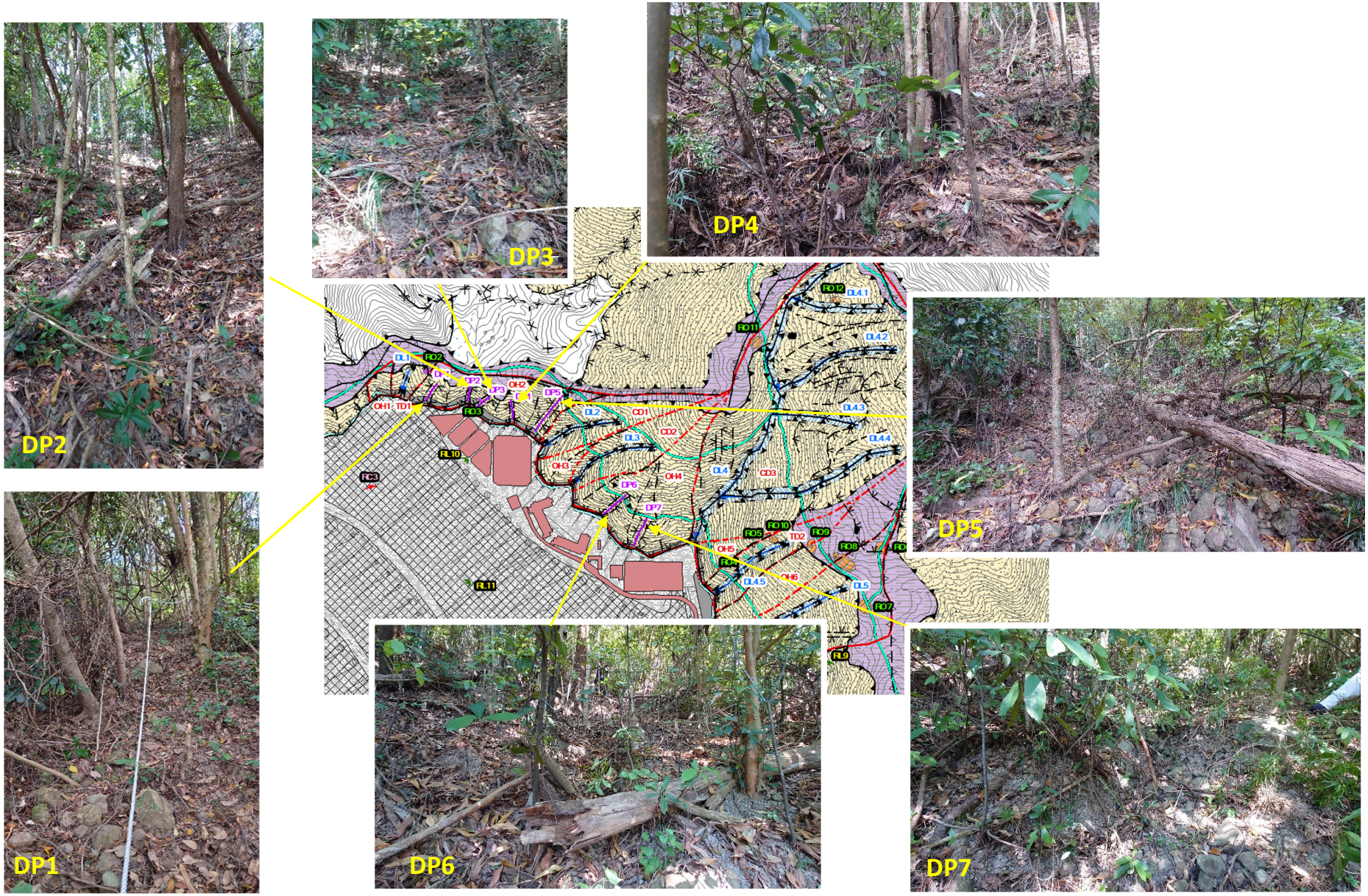


Plate 17 General View of Topographic Depressions within NTSA



Plate 18 Anthropogenic Features within and below the NTSA

Appendix A

Ground Investigation Records

DRILLHOLE RECORD

W. O. PW7/2/22.99
HOLE NO. BH17
SHEET 1 of 2
DATE from 30.11.88 to 1.12.88

PROJECT Junk Bay Landfill Stage II & III		
METHOD Rotary	CO-ORDINATES	ROCK COREBIT T6
MACHINE & No. Diamont Boart D51	E 846993 N 817314	HOLE DIA. S 168mm
FLUSHING MEDIUM Water	ORIENTATION VERTICAL	GROUND-LEVEL 140.07 mPD

Drilling Progress	Casing depth/size	Water level/ time/ date	Water Recovery %	Total core Recovery %	Solid core Recovery %	R. Q. D.	Fracture Index	Tests	Samples	Reduced Level	Depth (m)	Legend	Grade	Zone	Description
30/11	S		80								1.00				Soil
	4.90 S									+135.17	4.90				
				97	38	0	*				6.00				
											6.35				
				100	94	54	7		T6		7.00		III		Moderately strong, grey fine grained moderately decomposed VOLCANIC closely spaced joints dip 5° to 60° sub-vertical joints at 5.30m to 6.45m, 8.25m to 8.90m, rock fractured between 4.90m to 6.45m
											7.75				
				100	92	36	7				8.00				
30/11		4.76m at 18:00									9.00				
1/12		8.18m at 8:00									9.25				
1/12			0	100	79	41	4			+130.07	10.00				

- Small disturbed sample
- Large disturbed sample
- SPT liner sample
- U76 undisturbed sample
- U100 undisturbed sample
- Mazier sample
- P/S Piston sample
- Water sample
- Water level
- Standard penetration test
- Permeability test
- Piezometer tip
- In-situ vane shear test

LOGGED W.G.Lau
DATE 2.12.88
CHECKED S.P.Su
DATE 8.12.88

REMARKS
1. * : Cannot be determined
2. Installed a slotted P.V.C. pipe ϕ100mm at depth 10.40m

Lam Geotechnics Limited

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- Laboratory: G/F., 218 Wan Chai Rd., Hong Kong.
- Telex: 61840 LGEOL HX
- Fax: 5-8932274
- Tels: 5-8910563, 5-734365

DRILLHOLE RECORD

W. O. PW7/2/22.99
HOLE NO. BH17
SHEET 2 of 2
DATE from 30.11.88 to 1.12.88

PROJECT Junk Bay Landfill Stage II & III		
METHOD Rotary	CO-ORDINATES	ROCK COREBIT T6
MACHINE & No. Diamont Boart D51	E 846993 N 817314	HOLE DIA. S 168mm
FLUSHING MEDIUM Water	ORIENTATION VERTICAL	GROUND-LEVEL 140.07 mPD

Drilling Progress	Casing depth/size	Water level/ time/ date	Water Recovery %	Total core Recovery %	Solid core Recovery %	R. Q. D.	Fracture Index	Tests	Samples	Reduced Level	Depth (m)	Legend	Grade	Zone	Description
1/12 1/12		9.40m at 18:00	0	100	79	41	4		T6	+129.37	10.70		III		See sheet 1 of 2 End of investigation hole at 10.70m

11.00
12.00
13.00
14.00
15.00
16.00
17.00
18.00
19.00
20.00

- Small disturbed sample
- Large disturbed sample
- SPT liner sample
- U76 undisturbed sample
- U100 undisturbed sample
- Mazier sample
- P/S Piston sample
- Water sample
- Water level
- Standard penetration test
- Permeability test
- Piezometer tip
- In-situ vane shear test

LOGGED W.G.Lau
DATE 2.12.88
CHECKED S.P.Su
DATE 8.12.88

REMARKS

Lam Geotechnics Limited

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DRILLHOLE RECORD

W. O. PW7/2/22.99
HOLE NO. BH18
SHEET 1 of 1
DATE from 6.12.88 to 6.12.88

PROJECT Junk Bay Landfill Stage II & III		
METHOD Rotary	CO-ORDINATES	ROCK COREBIT T6
MACHINE & No. Diamont Boart D51	E 847131 N 817242	HOLE DIA. S 168mm
FLUSHING MEDIUM Water	ORIENTATION VERTICAL	GROUND-LEVEL 164.69 mPD

Drilling Progress	Casing depth/size	Water level/ time/ date	Water Recovery %	Total core Recovery %	Solid core Recovery %	R. Q. D.	Fracture Index	Tests	Samples	Reduced Level	Depth (m)	Legend	Grade	Zone	Description
6/12	S		80								1.00				Soil
	2.33 S									+162.36	2.00 2.33				
				100	55	34	>8				3.00				Moderately strong to strong in part, moderately strong to moderately weak below 4.82m, grey to greyish brown fine grained moderately to slightly decomposed VOLCANIC, highly to moderately decomposed VOLCANIC below 4.82m, closely to moderately spaced joints at upper part, very closely to closely spaced joints below 4.82m, sub-vertical joints at depth 7.05m to 8.15m, dip 5° to 20° and 50° to 60°
				92	42	42	>16				3.33				
				96	64	58	7				3.95 5.00				
									T6		5.30		III to II		
				96	67	14	>7				6.00				
											6.80				
		3.50m at 18:00		94	38	8	*				7.00 8.00				
6/12			80							+156.39	8.30				End of investigation hole at 8.30m
											9.00 10.00				

- Small disturbed sample
- Large disturbed sample
- SPT liner sample
- U76 undisturbed sample
- U100 undisturbed sample
- Mazier sample
- P/S Piston sample
- Water sample
- Water level
- Standard penetration test
- Permeability test
- Piezometer tip
- In-situ vane shear test

LOGGED W.G.Lau
DATE 7.12.88
CHECKED S.P.Su
DATE 14.12.88

REMARKS
1 * : Cannot be determined
2. Installed a slotted P.V.C. pipe ϕ100mm at depth 8.00m

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TEL.: 2365 9123-6, 2333 6482 FAX NO.: 852-2765 8034

DRILLHOLE RECORD

HOLE NO. NM 7

CONTRACT GE/93/09

SHEET 1 of 4

PROJECT Restoration of Tseung Kwan O Landfills Additional Site Investigation

METHOD Rotary

MACHINE & No. DR73

FLUSHING MEDIUM Water

CO-ORDINATES
E 847003.25
N 817297.78

ORIENTATION Vertical

W.O. No GE/93/09.110

DATE from 14/11/95 to 16/11/95

GROUND LEVEL 145.85 mPD

Drilling Progress	Casing size	Water level (m) Shift start/ end	Total core Recovery %	Solid core Recovery %	R.Q.D.	Fracture Index	Tests	Samples	Reduced Level	Depth (m)	Legend	Grade	Description
14/11/95	200mm dia.							0.00				V	Extremely weak, brownish grey, completely decomposed, medium grained TRACHYDACITE LAVA. (Silty fine to medium SAND with occasional subangular fine quartz gravel)
1							1,2, 2,2, 3,7 N=14	1 1.15					
								2 1.45					
2								2.25	143.60	2.25			
			50					3				IV	Weak, greyish brown, highly decomposed, medium grained TRACHYDACITE LAVA. (Sandy angular medium to coarse GRAVEL sized rock fragments)
								2.75	143.10	2.75			
3			100	41	0	13.3		NMLC				IV/III	Weak to moderately strong, yellowish brown and brownish grey, highly to moderately decomposed, medium grained TRACHYDACITE LAVA. Joints very closely to closely spaced, iron-manganese stained, rough stepped and undulating, dipping at 10-20°, 30-40° and 50-60°. Generally fractured from 3.35m to 3.85m and 4.35m to 5.20m.
						NI		3.35					
								3.75					
4			100	67	67	10.0		3.85					
						NI		4.35					
			93	6	0			4.50					
5								5.20	140.65	5.20			
			100	66	12	17.5						III	Moderately strong, brownish grey, moderately decomposed, medium grained TRACHYDACITE LAVA. Joints are very closely to closely spaced, iron-manganese stained, rough stepped and undulating, dipping at 20-30°, 40-50° and 50-60°.
6		5.50m at 18:00						6.23	139.62	6.23			
								6.53				IV	Very weak to weak, brown and greyish brown, highly decomposed, medium grained TRACHYDACITE LAVA. (Silty fine to coarse SAND with much angular medium to coarse gravel sized rock fragments) Core loss from 6.89m to 7.21m, inferred completely to highly decomposed, Trachydacite Lava.
15/11/95		Dry at 08:00	75	23	23	NI		6.89	138.96	6.89			
7						NA						V/IV	
						NR		7.21	138.64	7.21			
						9.3		7.50				III/II	
	Px		100	90	77	0		7.64					
8								8.24					
						>20		8.67					
						4.1		9.00					
9			100	82	55			9.40	136.45	9.40			
						>20		9.55				III	Moderately strong to strong, greenish grey and brownish grey, moderately to slightly decomposed, medium grained TRACHYDACITE LAVA. Joints are closely to medium, locally very closely and widely spaced, iron-manganese stained, rough planar and stepped, dipping at 10-20° and 40-50°.
						7.5		9.95	135.85	10.00			
10													See sheet 2 of 4 for details.

- SMALL DISTURBED SAMPLE
- LARGE DISTURBED SAMPLE
- SPT LINER SAMPLE
- U76 UNDISTURBED SAMPLE
- U100 UNDISTURBED SAMPLE
- MAZIER SAMPLE
- PISTON SAMPLE
- WATER SAMPLE
- PIEZOMETER TIP
- STANDPIPE
- STANDARD PENETRATION TEST
- PERMEABILITY TEST
- IN-SITU VANE SHEAR TEST

LOGGED K.M.To

DATE 21/11/95

CHECKED Eric Loke

DATE 22/11/95

REMARKS
Carried out water absorption test at depth 8.50m to 13.00m and 20.50m to 25.00m.
Installed 75mm dia. uPVC tube from 0.00m to 26.50m.
Installed three piezometers at depth 11.00m, 18.50m and 30.00m.

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DRILLHOLE RECORD

HOLE NO. **NM 7**

CONTRACT GE/93/09

SHEET 2 of 4

PROJECT **Restoration of Tseung Kwan O Landfills Additional Site Investigation**

METHOD **Rotary**

MACHINE & No. **DR73**

FLUSHING MEDIUM **Water**

CO-ORDINATES
E 847003.25
N 817297.78

ORIENTATION **Vertical**

W.O. No **GE/93/09.110**

DATE from **14/11/95** to **16/11/95**

GROUND LEVEL **145.85** mPD

Drilling Progress	Casing size	Water level (m) Shift start/ end	Total core Recovery %	Solid core Recovery %	R.Q.D.	Fracture Index	Tests	Samples	Reduced Level	Depth (m)	Legend	Grade	Description
15/11/95	Px					>20		NMLC 10.00				III	Moderately weak to moderately strong, brownish grey, moderately decomposed, medium grained TRACHYDACITE LAVA. Joints are very closely to closely spaced, iron-manganese stained, rough stepped and undulating, dipping at 10-20°, 30-40° and 50-60°.
			100	70	0			10.40					
11													
								11.34	134.51	11.34			
			100	100	74	6.6						III/II	Moderately strong to strong, greenish grey and brownish grey, moderately to slightly decomposed, medium grained TRACHYDACITE LAVA. Joints are closely to medium, locally very closely spaced, iron-manganese stained, rough stepped and planar, occasionally undulating, dipping at 10-20°, 40-50° and 60-70°.
12						11.5	L=21.67	11.95					
			100	98	60			12.30					
								12.82					
13						3.9							
								13.30					
			100	100	100			13.59	132.26	13.59			
						0						II	Strong, greenish grey, spotted white, mottled and dappled dark greenish grey, slightly decomposed, medium grained TRACHYDACITE LAVA. Joints are very widely spaced, chlorite infilled, rough planar, dipping at 10-20°.
14													
								14.83					
15			100	100	93								
16								16.05	129.80	16.05			
						>20		16.33				III	Moderately strong to strong, greenish grey, locally brownish grey, moderately decomposed, medium grained TRACHYDACITE LAVA. Joints are closely to medium, locally very closely spaced, iron manganese stained, rough planar and stepped, occasionally undulating, dipping at 10-20°, 30-40° and 50-60°, occasionally 70-80°. Weak and highly decomposed along 10° dipping joint from 17.43m to 17.45m.
			100	95	78	1.3		16.40					
17													
		17.03m at 18:00				11.4		17.20					
								17.81					
18								18.08					
16/11/95		Dry at 08:00	100	91	57	14.5							
								18.70	127.15	18.70			
19						0						II	Strong, greenish grey, slightly decomposed, medium grained TRACHYDACITE LAVA. Joints are very widely spaced, chlorite infilled rough planar, dipping at 30-40°.
								19.31					
			100	100	100			TNW 20.00	125.85	20.00			
20													

- SMALL DISTURBED SAMPLE
- LARGE DISTURBED SAMPLE
- SPT LINER SAMPLE
- U76 UNDISTURBED SAMPLE
- U100 UNDISTURBED SAMPLE
- MAZIER SAMPLE
- PISTON SAMPLE
- WATER SAMPLE
- PIEZOMETER TIP
- STANDPIPE
- STANDARD PENETRATION TEST
- PERMEABILITY TEST
- IN-SITU VANE SHEAR TEST

LOGGED **K.M.To**

DATE **21/11/95**

CHECKED **Eric Loke**

DATE **22/11/95**

REMARKS
See sheet 1 of 4 for details.

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DRILLHOLE RECORD

HOLE NO. NM 7

CONTRACT GE/93/09

SHEET 3 of 4

PROJECT Restoration of Tseung Kwan O Landfills Additional Site Investigation

METHOD Rotary

MACHINE & No. DR73

FLUSHING MEDIUM Water

CO-ORDINATES
E 847003.25
N 817297.78

ORIENTATION Vertical

W.O. No GE/93/09.110

DATE from 14/11/95 to 16/11/95

GROUND LEVEL 145.85 mPD

Drilling Progress	Casing size	Water level (m) Shift start/ end	Total core Recovery %	Solid core Recovery %	R.Q.D.	Fracture Index	Tests	Samples	Reduced Level	Depth (m)	Legend	Grade	Description
16/11/95	Px		100	100	91			TNW				II	See sheet 2 of 4 for details.
								20.87	124.98	20.87			
21			100	87	68	17.2		20.96				III/II	Moderately strong to strong, greenish grey, locally brownish grey, moderately to slightly decomposed, medium grained TRACHYDACITE LAVA. Joints are closely to medium, locally very closely spaced, iron-manganese stained, rough planar and stepped, occasionally undulating, dipping at 20-30°, 40-50° and 60-70°. Weak and highly decomposed from 21.16m to 21.20m. Moderately strong and moderately decomposed from 24.51m to 24.61m.
						1.5		21.51					
22			100	100	84	6.8		21.90					
								22.17					
23			100	99	83		L=21.22	22.86					
24													
			100	96	89			24.31					
						>20		24.51	121.34	24.51		III	
						7.4		24.61	121.24	24.61		III/II	
25						0		24.88	120.97	24.88		II	Strong, greenish grey, spotted white, mottled and dappled dark greenish grey, slightly decomposed, medium grained TRACHYDACITE LAVA. Joints are widely to very widely, locally very closely to closely spaced, chlorite and calcite infilled, rough planar, dipping at 20-30°. Moderately strong and moderately decomposed from 29.21m to 29.34m.
26			100	100	100			25.81					
27													
			100	100	100			27.31					
28													
								28.71					
29			100	97	93			29.21	116.64	29.21		III	
						>20		29.34	116.51	29.34		II	
						1.6							
30								30.00	115.85	30.00			

- SMALL DISTURBED SAMPLE
- LARGE DISTURBED SAMPLE
- SPT LINER SAMPLE
- U76 UNDISTURBED SAMPLE
- U100 UNDISTURBED SAMPLE
- MAZIER SAMPLE
- PISTON SAMPLE
- WATER SAMPLE
- PIEZOMETER TIP
- STANDPIPE
- STANDARD PENETRATION TEST
- PERMEABILITY TEST
- IN-SITU VANE SHEAR TEST

LOGGED K.M.To

DATE 21/11/95

CHECKED Eric Loke

DATE 22/11/95

REMARKS
See sheet 1 of 4 for details.

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GEOTECHNICS & CONCRETE ENGINEERING (H.K.) LTD.
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DRILLHOLE RECORD

HOLE NO. NM 7

CONTRACT GE/93/09

SHEET 4 of 4

PROJECT Restoration of Tseung Kwan O Landfills Additional Site Investigation

METHOD Rotary

MACHINE & No. DR73

FLUSHING MEDIUM Water

CO-ORDINATES
E 847003.25
N 817297.78

ORIENTATION Vertical

W.O. No GE/93/09.110

DATE from 14/11/95 to 16/11/95

GROUND LEVEL 145.85 mPD

Drilling Progress	Casing size	Water level (m) Shift start/ end	Total core Recovery %	Solid core Recovery %	R.Q.D.	Fracture Index	Tests	Samples	Reduced Level	Depth (m)	Legend	Grade	Description
16/11/95	Px	19.35m at 18:00						TNW 30.59	115.26	30.59		II	See sheet 3 of 4 for details.
													End of investigation hole at 30.59m.

31
32
33
34
35
36
37
38
39
40

- SMALL DISTURBED SAMPLE
- LARGE DISTURBED SAMPLE
- SPT LINER SAMPLE
- U76 UNDISTURBED SAMPLE
- U100 UNDISTURBED SAMPLE
- MAZIER SAMPLE
- PISTON SAMPLE
- WATER SAMPLE
- PIEZOMETER TIP
- STANDPIPE
- STANDARD PENETRATION TEST
- PERMEABILITY TEST
- IN-SITU VANE SHEAR TEST

LOGGED K.M.To

DATE 21/11/95

CHECKED Eric Loke

DATE 22/11/95

REMARKS
See sheet 1 of 4 for details.

JCRIC

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TEL.: 2365 9123–6, 2333 6482 FAX NO.: 852-2765 8034

DRILLHOLE RECORD

HOLE NO. NM 8

CONTRACT GE/93/09

SHEET 1 of 3

PROJECT Restoration of Tseung Kwan O Landfills Additional Site Investigation

METHOD Rotary

MACHINE & No. DR73

FLUSHING MEDIUM Water

CO-ORDINATES
E 847122.52
N 817217.09

ORIENTATION Vertical

W.O. No GE/93/09.110

DATE from 23/11/95 to 27/11/95

GROUND LEVEL 152.76 mPD

Drilling Progress	Casing size	Water level (m) Shift start/ end	Total core Recovery %	Solid core Recovery %	R.Q.D.	Fracture Index	Tests	Samples	Reduced Level	Depth (m)	Legend	Grade	Description
23/11/95	200mm dia.							0.00				V	Extremely weak, yellowish brown, completely decomposed, medium grained TRACHYDACITE LAVA. (Silty fine to medium SAND with occasional angular fine gravel sized rock fragments)
								0.60	152.16	0.60			
			100	28	28	7.1		T6131 0.88	151.88	0.88		II	
1						NI		1.60				IV/III	Weak to moderately strong, yellowish brown, light brownish grey and locally greenish grey, highly to moderately decomposed, medium grained TRACHYDACITE LAVA. Joints are very closely to closely spaced, iron-manganese stained, rough stepped, dipping at 10-20°, 30-40° and 50-60°. Strong and slightly decomposed from 0.60m to 0.88m Moderately strong and moderately decomposed from 2.50m to 3.25m and 5.26m to 5.60m. Core losses from 4.10m to 4.50m and 5.90m to 6.20m, inferred completely to highly decomposed Trachydacite Lava. Highly fractured from 0.88m to 2.00m, 2.30m to 2.50m, 3.50m to 4.10m, 5.00m to 5.90m and 6.20m to 6.40m.
			100	43	20			NMLC 2.00					
2						13.3		2.30					
			100	71	40	NI		2.50	150.26	2.50		III	
						13.3							
3								3.25	149.51	3.25			
						>20		3.50				IV/III	
			60	0	0	NI							
4								4.10	148.66	4.10			
						NR						V/IV	
		3.80m at 18:00						4.50	148.26	4.50			
			84	30	20	>20						IV/III	
5								5.00					
		4.70m at 08:00	75	30	19			5.26	147.50	5.26			
24/11/95						14.7						III	
								5.60	147.16	5.60			
						NI		5.90	146.86	5.90		IV/III	
6						NR		6.20	146.56	6.20		V/IV	
			100	76	63	NI		6.40	146.36	6.40		IV/III	
						12.7						III	Moderately strong, locally moderately weak, yellowish brown and light brownish grey, moderately decomposed, medium grained TRACHYDACITE LAVA. Joints are very closely to closely spaced, iron-manganese stained, rough stepped and undulating, dipping at 20-30° and 60-70°.
7								7.10					
			100	96	86			7.60					
			100	91	68								
8								8.37	144.39	8.37			
						6.9						III/II	See sheet 2 of 3 for details.
9								9.00					
			100	92	92								
10								9.97	142.76	10.00			

- SMALL DISTURBED SAMPLE
- LARGE DISTURBED SAMPLE
- SPT LINER SAMPLE
- U76 UNDISTURBED SAMPLE
- U100 UNDISTURBED SAMPLE
- MAZIER SAMPLE
- PISTON SAMPLE
- WATER SAMPLE
- PIEZOMETER TIP
- STANDPIPE
- STANDARD PENETRATION TEST
- PERMEABILITY TEST
- IN-SITU VANE SHEAR TEST

LOGGED K.M.To

DATE 30/11/95

CHECKED Eric Loke

DATE 01/12/95

REMARKS
Carried out water absorption test at depth 20.00m to 24.00m (Double type) and 25.00m to 29.27m (Single type).
Installed 75mm dia. uPVC tube to depth 25.77m.
Installed three piezometers at depth 15.00m, 20.77m and 28.77m.

JCRIC

GEOTECHNICS & CONCRETE ENGINEERING (H.K.) LTD.
6 KO SHAN RD., GROUND FL., HUNG HOM, KOWLOON, HONG KONG.
TEL.: 2365 9123-6, 2333 6482 FAX NO.: 852-2765 8034

DRILLHOLE RECORD

HOLE NO. NM 8

CONTRACT GE/93/09

SHEET 2 of 3

PROJECT Restoration of Tseung Kwan O Landfills Additional Site Investigation

METHOD Rotary

MACHINE & No. DR73

FLUSHING MEDIUM Water

CO-ORDINATES
E 847122.52
N 817217.09

ORIENTATION Vertical

W.O. No GE/93/09.110

DATE from 23/11/95 to 27/11/95

GROUND LEVEL 152.76 mPD

Drilling Progress	Casing size	Water level (m) Shift start/ end	Total core Recovery %	Solid core Recovery %	R.Q.D.	Fracture Index	Tests	Samples	Reduced Level	Depth (m)	Legend	Grade	Description
24/11/95	200mm dia.	7.65m at 18:00	100	93	53	13.3		NMLC 10.00				III/II	Moderately strong to strong, brownish grey, locally greenish grey, spotted white, mottled green, moderately to slightly decomposed, medium grained TRACHYDACITE LAVA. Joints are closely to medium, locally very closely spaced, iron-manganese stained, rough stepped, occasionally undulating, dipping at 20-30°, 40-50° and 50-60°, occasionally 70-80°. Moderately strong and moderately decomposed from 17.24m to 17.35m.
	Px							10.57					
25/11/95		10.00m at 08:00	100	70	0	17.0		10.90					
11			100	87	63			11.10					
						9.8							
12								12.40					
			100	100	63								
						6.5							
13													
								13.95					
14			100	100	90								
								14.58					
			100	98	52	13.5							
15													
								15.54					
			100	97	87	6.7							
16													
						15.4		16.59					
								16.99					
17			100	83	51			17.24	135.52	17.24			
						>20		17.35	135.41	17.35		III	
						5.4						III/II	
18		13.50m at 18:00											
						18.5		18.27					
								18.45					
		15.27m at 08:00	100	100	83			18.81	133.95	18.81			
27/11/95						6.6						II	Strong, greenish grey, spotted white, slightly decomposed, medium grained TRACHYDACITE LAVA. Joints are closely to medium spaced, iron-manganese stained, rough stepped and undulating, dipping at 10-20°, 40-50° and
19								19.25					
			100	93	69								
20								20.00	132.76	20.00			

- SMALL DISTURBED SAMPLE
- LARGE DISTURBED SAMPLE
- SPT LINER SAMPLE
- U76 UNDISTURBED SAMPLE
- U100 UNDISTURBED SAMPLE
- MAZIER SAMPLE
- PISTON SAMPLE
- WATER SAMPLE
- PIEZOMETER TIP
- STANDPIPE
- STANDARD PENETRATION TEST
- PERMEABILITY TEST
- IN-SITU VANE SHEAR TEST

LOGGED K.M.To

DATE 30/11/95

CHECKED Eric Loke

DATE 01/12/95

REMARKS
See sheet 1 of 3 for details.

JCRIC

GEOTECHNICS & CONCRETE ENGINEERING (H.K.) LTD.
6 KO SHAN RD., GROUND FL., HUNG HOM, KOWLOON, HONG KONG.
TEL.: 2365 9123-6, 2333 6482 FAX NO.: 852-2765 8034

DRILLHOLE RECORD

HOLE NO. NM 8

CONTRACT GE/93/09

SHEET 3 of 3

PROJECT Restoration of Tseung Kwan O Landfills Additional Site Investigation

METHOD Rotary

MACHINE & No. DR73

FLUSHING MEDIUM Water

CO-ORDINATES
E 847122.52
N 817217.09

ORIENTATION Vertical

W.O. No GE/93/09.110

DATE from 23/11/95 to 27/11/95

GROUND LEVEL 152.76 mPD

Drilling Progress	Casing size	Water level (m) Shift start/ end	Total core Recovery %	Solid core Recovery %	R.Q.D.	Fracture Index	Tests	Samples	Reduced Level	Depth (m)	Legend	Grade	Description
27/11/95	Px		100	96	65			NMLC 20.32	132.44	20.32		II	60-70°.
						15.6						III/II	Moderately strong to strong, brownish grey and greenish grey, spotted white, moderately to slightly decomposed, medium grained TRACHYDACITE LAVA. Joints are very closely to closely, locally medium spaced, iron-manganese stained, rough stepped and planar, occasionally undulating, dipping at 10-20°, 30-40° and 50-60°, occasionally 70-80°. Weak to moderately weak and highly to moderately decomposed from 22.24m to 22.31m.
						2.7		20.96					
21						15.9		21.33					
			100	85	30			21.57					
22							L=24.57						
						7.1		22.46					
23								23.10					
			100	66	57			23.45					
						14.9		23.80					
24			100	100	76			24.12					
						9.2							
25								25.08					
			100	95	60								
								25.97	126.79	25.97			
26						6.8		26.13				II	Strong, greenish grey, locally light brown, spotted white, dappled green, slightly decomposed, medium grained TRACHYDACITE LAVA. Joints are closely to medium, locally very closely spaced, iron stained, occasionally chlorite infilled, rough stepped and planar, dipping at 10-20°, 40-50°, occasionally 60-70°. Moderately strong to strong and moderately to slightly decomposed from 27.68m to 27.86m.
			100	100	87								
27							L=11.18	27.30					
						10.8		27.68	125.08	27.68			
			100	95	70				124.90	27.86		III/II	
28								28.23				II	
						1.0		28.65					
		18.50m at 18:00	100	100	100								
29								29.27	123.49	29.27			
													End of investigation hole at 29.27m.
30													

- SMALL DISTURBED SAMPLE
- LARGE DISTURBED SAMPLE
- SPT LINER SAMPLE
- U76 UNDISTURBED SAMPLE
- U100 UNDISTURBED SAMPLE
- MAZIER SAMPLE
- PISTON SAMPLE
- WATER SAMPLE
- PIEZOMETER TIP
- STANDPIPE
- STANDARD PENETRATION TEST
- PERMEABILITY TEST
- IN-SITU VANE SHEAR TEST

LOGGED K.M.To

DATE 30/11/95

CHECKED Eric Loke

DATE 01/12/95

REMARKS
See sheet 1 of 3 for details.

JCRIC

GEOTECHNICS & CONCRETE ENGG. (H.K.) LTD.

GROUND INVESTIGATION DEPARTMENT

HOLE NO. **DH6**

SHEET 1 of 2

DRILLHOLE RECORD

CONTRACT NO. GE/2001/13

PROJECT Agreement No. FD 01-052 Geotechnical Review and Site Investigation Works for Tseung Kwan O Landfill Stage II/III Afteruse Development Ground Investigation

METHOD	Rotary Cored	CO-ORDINATES E 847214.42 N 817215.18	Works Order No. GE/2001/13.10
MACHINE & No.	DR86		DATE from 04/06/2002 to 07/06/2002
FLUSHING MEDIUM	Air-Foam	ORIENTATION Vertical	GROUND LEVEL 170.73 mPD

Drilling Progress	Casing size	Water level (m) & Time	Total core Recovery %	Solid core Recovery %	R.Q.D.	Fracture Index	Tests	Samples	Reduced Level	Depth (m)	Legend	Grade	Description
04/06/2002	PX							1	170.73	0.00		VI	Firm, yellowish brown (10YR 5/8), slightly sandy SILT. (RESIDUAL SOIL)
								2	169.73	1.00		V	Extremely weak, light yellowish brown (2.5Y 6/4) dappled white, completely decomposed, fine ash crystal TUFF. (Firm to stiff, sandy SILT)
04/06/2002	PX 1.50	1.20m at 18:00						3		1.50			
05/06/2002	HX	Dry at 08:00	90					4					
								5	168.13	2.60		V	Extremely weak, pale brown (10YR 6/3) dappled yellow and white, completely decomposed, fine ash crystal TUFF. (Silty fine to coarse SAND)
							1,3 5,3,4,5 N=17	6					
								7		3.05			
			100					8		3.50			
								9	166.13	4.60		V	Extremely weak, light brownish grey (10YR 6/2), completely decomposed, fine ash crystal TUFF. (Silty fine to coarse SAND)
							3,6 6,7,7,8 N=28	10					
								11		5.05			
			100					12	165.23	5.50		V	Extremely weak, yellowish brown (10YR 5/8), completely decomposed, fine ash crystal TUFF. (Silty fine to coarse SAND with occasional subangular fine to medium gravel sized rock fragments)
								13		6.60			
							4,6 10,13,13,15 N=51	14					
								15		7.05			
			100					16	163.23	7.50		V/IV	Extremely weak to very weak, grey (7.5YR 6/1) dappled brown, completely to highly decomposed, fine ash crystal TUFF. (Subangular fine to coarse GRAVEL with silty sand)
05/06/2002	HX 8.60	5.50m at 18:00						17	162.13	8.60		III/IV	Moderately weak, brownish grey spotted white, moderately to highly decomposed, fine ash crystal TUFF. Joints are closely to very closely spaced, rough undulating and rough stepped, narrow, iron and manganese oxide stained, dipping at 10° to 20°, 40° to 50° and 70° to 80°. From 8.90m to 9.08m : A subvertical joint
06/06/2002		Dry at 08:00	100	44	11	11.8 NI		T2101				IV	
												III/IV	
			100	41	0	20.0 NI		T2101		9.51		IV	
												III/IV	

- SMALL DISTURBED SAMPLE
- LARGE DISTURBED SAMPLE
- SPT LINER SAMPLE
- U76 UNDISTURBED SAMPLE
- U100 UNDISTURBED SAMPLE
- MAZIER SAMPLE
- PISTON SAMPLE
- WATER SAMPLE
- PIEZOMETER TIP
- STANDPIPE
- STANDARD PENETRATION TEST
- PERMEABILITY TEST
- IMPRESSION PACKER TEST
- IN-SITU VANE SHEAR TEST
- PACKER TEST

LOGGED K.L. Lo

DATE 08/06/2002

CHECKED Tom Lo

DATE 10/06/2002

REMARKS
1. Standpipe was installed at 16.53m depth.

GEOTECHNICS & CONCRETE ENGG. (H.K.) LTD.

GROUND INVESTIGATION DEPARTMENT

HOLE NO. **DH6**

SHEET **2** of **2**

DRILLHOLE RECORD

CONTRACT NO. GE/2001/13

PROJECT Agreement No. FD 01-052 Geotechnical Review and Site Investigation Works for Tseung Kwan O Landfill Stage II/III Afteruse Development Ground Investigation

METHOD	**Rotary Cored**	CO-ORDINATES **E 847214.42** **N 817215.18**	Works Order No. **GE/2001/13.10**
MACHINE & No.	**DR86**		DATE from **04/06/2002** to **07/06/2002**
FLUSHING MEDIUM	**Air-Foam**	ORIENTATION **Vertical**	GROUND LEVEL **170.73** mPD

Drilling Progress	Casing size	Water level (m) & Time	Total core Recovery %	Solid core Recovery %	R.Q.D.	Fracture Index	Tests	Samples	Reduced Level	Depth (m)	Legend	Grade	Description
10						15.0			160.53	10.00 10.20		IV	dipping at 80° to 90°. From 9.08m to 9.20m : Weak and highly decomposed. From 9.44m to 9.53m : Weak and highly decomposed. From 9.95m to 10.10m : Weak and highly decomposed.
			100	66	46	NI		T2101				III/IV III	
11						10.0						III/IV	
						4.4				11.60		III	Moderately strong, brown grey spotted white, moderately decomposed, fine ash TUFF. Joints are closely spaced, rough undulating and rough stepped, very narrow, iron and manganese oxide stained, dipping at 20° to 30°, 40° to 50° and 70° to 80°. From 10.55m to 11.00m : Moderately weak and moderately to highly decomposed. From 11.50m to 12.12m : A subvertical joint dipping at 80° to 90°. From 11.80m to 12.40m : Moderately weak and moderately to highly decomposed. From 12.45m to 13.05m : A subvertical joint dipping at 80° to 90°.
			100	84	44								
12						4.0		T2101				III/IV	
												III	
13			100	74	40	11.1				13.08		III/IV	
									157.08	13.65		III	From 13.08m to 13.65m : Moderately weak and moderately to highly decomposed.
14		Dry at 18:00				NI		T2101					Moderately strong, brown grey spotted white, moderately decomposed, fine ash crystal TUFF. Joints are closely spaced, locally medium and very closely spaced, rough undulating and rough stepped, very narrow, iron and manganese oxide stained, dipping at 20° to 30°, 40° to 50° and 60° to 70°.
	06/06/2002 07/06/2002					13.5				14.52			
15		Dry at 08:00	100	80	48								
						>20		T2101	155.27	15.46		II	Moderately strong, brownish grey spotted white, moderately decomposed, coarse ash crystal TUFF. Joints are closely spaced, locally medium and very closely spaced, rough undulating and rough stepped, very narrow, iron and manganese oxide stained, dipping at 20° to 30°, 40° to 50° and 60° to 70°. From 15.46m to 15.68m : Strong and slightly decomposed. From 16.43m to 16.53m : A subvertical joint dipping at 80° to 90°.
16						2.9				15.95		III	
			100	90	86	>20 11.8							
	07/06/2002	Dry at 18:00							154.20	16.53			
17													Hole completed at 16.53m.
18													
19													
20													

- SMALL DISTURBED SAMPLE
- LARGE DISTURBED SAMPLE
- SPT LINER SAMPLE
- U76 UNDISTURBED SAMPLE
- U100 UNDISTURBED SAMPLE
- MAZIER SAMPLE
- PISTON SAMPLE
- WATER SAMPLE
- PIEZOMETER TIP
- STANDPIPE
- STANDARD PENETRATION TEST
- PERMEABILITY TEST
- IMPRESSION PACKER TEST
- IN-SITU VANE SHEAR TEST
- PACKER TEST

LOGGED **K.L. Lo**

DATE **08/06/2002**

CHECKED **Tom Lo**

DATE **10/06/2002**

REMARKS

GEOTECHNICS & CONCRETE ENGG. (H.K.) LTD.

GROUND INVESTIGATION DEPARTMENT

HOLE NO. **DH7**

SHEET 1 of 1

DRILLHOLE RECORD

CONTRACT NO. GE/2001/13

PROJECT Agreement No. FD 01-052 Geotechnical Review and Site Investigation Works for Tseung Kwan O Landfill Stage II/III Afteruse Development Ground Investigation

METHOD	Rotary Cored	CO-ORDINATES E 847169.93 N 817230.31	Works Order No. GE/2001/13.10
MACHINE & No.	DR86		DATE from 30/05/2002 to 31/05/2002
FLUSHING MEDIUM	Air-Foam	ORIENTATION Vertical	GROUND LEVEL 153.18 mPD

Drilling Progress	Casing size	Water level (m) & Time	Total core Recovery %	Solid core Recovery %	R.Q.D.	Fracture Index	Tests	Samples	Reduced Level	Depth (m)	Legend	Grade	Description
0 30/05/2002	HX								153.18	0.00			
								1 INSPECTION PIT	152.68	0.50		V	Dark greyish brown (10YR 4/2) dappled yellowish brown and locally white, slightly silty fine to coarse SAND with much angular to subangular fine to coarse gravel sized rock fragments and occasional rootlets. (FILL)
1	HX 1.22							2	152.18	1.00		IV/V	Extremely weak, yellowish brown (10YR 5/8) mottled white, locally dappled dark brown, completely decomposed, fine ash TUFF. (Silty fine to coarse SAND with some subangular fine to medium gravel sized quartz fragments)
								3	151.96	1.22		III	
2 30/05/2002		0.80m at 18:00	100	50	23	NI		T2IO1					Very weak to weak, grey (7.5YR 6/1) dappled brown, highly to completely decomposed, fine ash TUFF. (Angular to subangular fine to coarse GRAVEL with some cobble sized rock fragments)
31/05/2002		Dry at 08:00	95	83	68	12.3				1.96			
3								T2IO1					Strong to moderately strong, greenish grey spotted white and dappled yellowish brown and dark brown, slightly to moderately decomposed, fine ash TUFF.
			100	86	86			T2IO1		3.26			Joints are closely to medium spaced, locally widely and very closely spaced, smooth planar and smooth undulating, extremely narrow to very narrow, iron and manganese oxide stained, dipping at 5° to 15°, 20° to 30°, 55° to 65° and 70° to 80°.
4						3.7						II/III	From 1.22m to 1.27m : Moderately weak and moderately decomposed.
			100	100	100			T2IO1		4.09			From 1.27m to 3.74m : Moderately strong and moderately decomposed.
5						1.0							From 3.26m to 3.59m : An 80° to 90° joint.
						6.1		T2IO1		5.56			
6			100	99	89								
7 31/05/2002		Dry at 18:00					A	T2IO1	146.16	7.02			
													Hole completed at 7.02m.
8													
9													
10													

- SMALL DISTURBED SAMPLE
- LARGE DISTURBED SAMPLE
- SPT LINER SAMPLE
- U76 UNDISTURBED SAMPLE
- U100 UNDISTURBED SAMPLE
- MAZIER SAMPLE
- PISTON SAMPLE
- WATER SAMPLE
- PIEZOMETER TIP
- STANDPIPE
- STANDARD PENETRATION TEST
- PERMEABILITY TEST
- IMPRESSION PACKER TEST
- IN-SITU VANE SHEAR TEST
- PACKER TEST

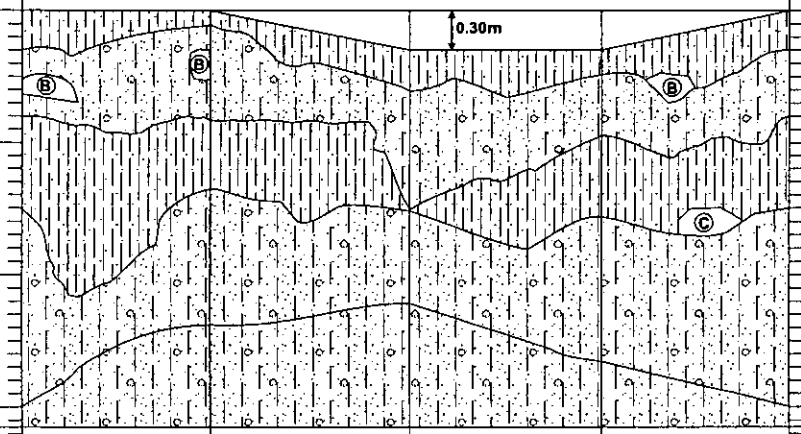
LOGGED K.L. Lo

DATE 01/06/2002

CHECKED Tom Lo

DATE 03/06/2002

REMARKS
1. Standpipe was installed at 7.02m depth.

Samples & Test	Depth (m)	Sketch	Depth (m)	Legend	Description	Grade
1, 2, 3, 4, 5, 6, 7, 8, 9	0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0		0.30 0.80 3.15		Soft, dry, very dark greyish brown (10YR 3/2), sandy SILT with some subangular fine to coarse gravel and occasional boulder sized rock fragments and with some rootlets. (COLLUVIUM) Loose, moist, yellowish brown (10YR 5/4) mottled light yellowish brown and white, very silty fine to coarse SAND with some subangular fine to coarse gravel and occasional boulder sized rock fragments and with occasional rootlets. (COLLUVIUM) Stiff, moist, yellowish brown (10YR 5/6) mottled pink and light yellowish brown, sandy SILT with occasional subangular fine gravel sized rock fragments and with some subrounded to rounded pocket of completely decomposed fine ash tuff of maximum size 0.50m x 0.40m. (RESIDUAL SOIL) Extremely weak, yellowish brown (10YR 5/6) mottled pink and white, completely decomposed, fine ash TUFF. (Silty fine to coarse SAND with occasional fine gravel sized rock fragments) Extremely weak to very weak, light grey (5Y 7/2) mottled yellowish brown and pink, completely to highly decomposed, fine ash TUFF. (Silty fine to coarse SAND with some angular fine gravel sized rock fragments) Trial pit terminated at maximum depth 3.15m.	VI V V/IV

Notes:
1. Small disturbed samples were taken at 0.50m, 1.00m, 1.50m, 2.00m, 2.50m and 3.00m depths.
2. Undisturbed vertical samples (U100) were taken at 1.00m, 2.00m and 3.00m (0% recovery) depths.

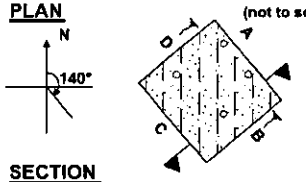
SYMBOLS

- Small Disturbed Sample
- Large Disturbed Sample
- Undisturbed Vertical Sample
- Undisturbed Horizontal Sample
- Block Sample
- Insitu Density Test
- Water Sample
- Water Seepage

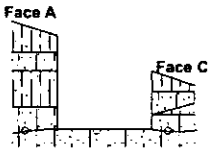
REMARKS

Ground Water
No Groundwater
Plant Used
Hand dug
Shoring
Timber shoring over full height
Stability
Stable
Depth at pit centre
3.00m
Others
Nil

PLAN (not to scale)



SECTION



Contract No.	:	GE/2001/13
Works Order No.	:	GE/2001/13.10
Co-ordinates	:	
E 847241.54		N 817206.07
Ground Level	:	182.69 mPD
Logged by	:	K.L. Lo
Date logged	:	13/06/2002
Checked by	:	Tom Lo
Date Checked	:	14/06/2002

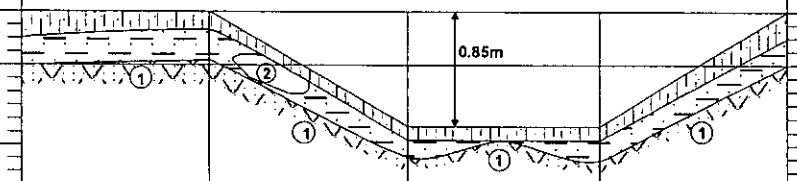
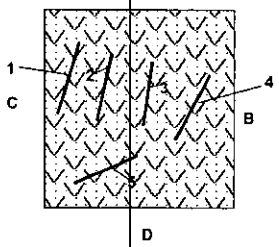
PROJECT

Agreement No. FD 01-052 Geotechnical Review and Site Investigation Works for Tseung Kwan O Landfill Stage II/III Afteruse Development Ground Investigation

Sheet	1	of	1	
Date excavated	10/06/2002	to	12/06/2002	
Date Reinstated	05/07/2002	to	05/07/2002	

TRIAL PIT NO.
TP6

GEOTECHNICS & CONCRETE ENGG. (HONG KONG) LIMITED
GROUND INVESTIGATION DEPARTMENT

Samples & Test	Depth (m)	Sketch	Depth (m)	Legend	Description	Grade
1	0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0	 ① Moderately strong, light brownish grey mottled yellowish brown and black, moderately decomposed lapilli bearing, fine ash TUFF. ② Boulder sized moderately decomposed tuff. Top View  Joint number / Dip Direction/ Dip Angle 1 248°/076° 2 248°/078° 3 250°/080° 4 302°/068° 5 295°/076° FACE A: 1.50 m FACE B: 1.50 m FACE C: 1.50 m FACE D: 1.50 m	0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0	0.20 0.40	Firm, dry, dark grey (2.5Y 4/1), sandy SILT with some subangular fine to coarse gravel and occasional cobble sized rock fragments and some rootlets. (COLLUVIUM) Stiff, moist, light brown (10YR 5/3) spotted white, slightly sandy CLAY with much subangular fine to coarse gravel and occasional cobble and boulder of maximum size 400mm sized rock fragments and with occasional rootlets. (COLLUVIUM) Trial pit terminated at 0.40m depth. Note: 1. Large disturbed sample was taken at 0.30m depth.	

SYMBOLS

- Small Disturbed Sample
- Large Disturbed Sample
- Undisturbed Vertical Sample
- Undisturbed Horizontal Sample
- Block Sample
- Insitu Density Test
- Water Sample
- Water Seepage

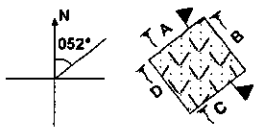
REMARKS

Ground Water
No Groundwater
Plant Used
Hand dug
Shoring
No shoring

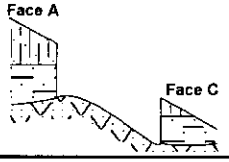
Stability
Stable

Depth at pit centre
0.40m
Others
Nil

PLAN (not to scale)



SECTION



Contract No. :	GE/2001/13	
Works Order No. :	GE/2001/13.10	
Co-ordinates :		
E 847182.48	N 817253.88	
Ground Level :	164.99 mPD	
Logged by :	K.L. Lo	
Date logged :	07/06/2002	
Checked by :	Tom Lo	
Date Checked :	08/06/2002	

PROJECT

Agreement No. FD 01-052 Geotechnical Review and Site Investigation Works for Tseung Kwan O Landfill Stage II/III Afteruse Development Ground Investigation

Sheet 1	of 1		TRIAL PIT NO. TP7
Date excavated	06/06/2002	to 06/06/2002	
Date Reinstated	03/07/2002	to 03/07/2002	

GEOTECHNICS & CONCRETE ENGG. (HONG KONG) LIMITED
GROUND INVESTIGATION DEPARTMENT

Samples & Test	Depth (m)	Sketch	Depth (m)	Legend	Description	Grade
1, 2, 3, 4, 5, 6	0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0	0.90m	0.15, 0.5, 1.00, 1.0, 1.5, 1.85, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0		Firm, dry, dark grey (2.5Y 4/1), slightly sandy CLAY with some subangular fine to coarse gravel and occasional cobble sized rock fragments and with some rootlets. (COLLUVIUM) Firm, moist, light brown (10YR 5/3) spotted white, slightly sandy CLAY with much subangular fine to coarse gravel and cobble sized rock fragments and with occasional rootlets. (COLLUVIUM) Weak to very weak, yellowish brown (10YR 5/4) mottled light grey, highly to completely decomposed, fine ash TUFF. (Stiff, sandy SILT with much subangular fine to coarse gravel sized rock fragments) Trial pit terminated at 1.85m depth.	IV/V

① Moderately strong to moderately weak, yellowish brown mottled light grey, moderately to highly decomposed, fine ash TUFF.
② Moderately strong and moderately decomposed, fine ash TUFF.
③ Weak and highly decomposed, fine ash TUFF.

FACE A: 1.50 m FACE B: 1.50 m FACE C: 1.50 m FACE D: 1.50 m

Notes:
1. Small disturbed samples were taken at 0.50m, 1.00m and 1.50m depths.
2. Undisturbed vertical sample (U100) samples were taken at 1.00m depth.
3. Large disturbed sample was taken at 1.80m depths.

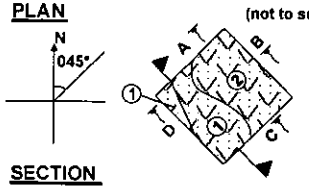
SYMBOLS

- Small Disturbed Sample
- Large Disturbed Sample
- Undisturbed Vertical Sample
- Undisturbed Horizontal Sample
- Block Sample
- Insitu Density Test
- Water Sample
- Water Seepage

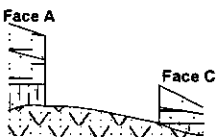
REMARKS

Ground Water
No Groundwater
Plant Used
Hand dug
Shoring
Timber shoring over full height
Stability
Stable
Depth at pit centre
1.30m
Others
Nil

PLAN (not to scale)



SECTION



Contract No.	:	GE/2001/13
Works Order No.	:	GE/2001/13.10
Co-ordinates	:	
E 847189.84	N	817265.01
Ground Level	:	166.88 mPD
Logged by	:	K.L. Lo
Date logged	:	11/06/2002
Checked by	:	Tom Lo
Date Checked	:	12/06/2002

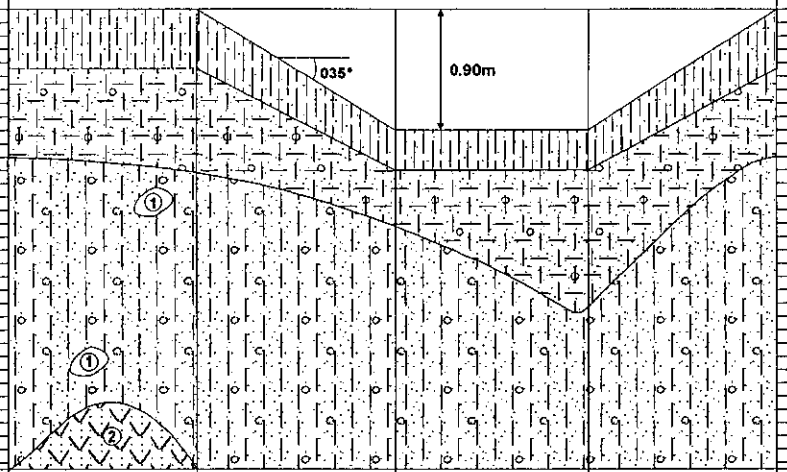
PROJECT

Agreement No. FD 01-052 Geotechnical Review and Site Investigation Works for Tseung Kwan O Landfill Stage II/III Afteruse Development Ground Investigation

Sheet	1	of	1	
Date excavated	10/06/2002	to	10/06/2002	
Date Reinstated	03/07/2002	to	03/07/2002	

TRIAL PIT NO.
TP7A

GEOTECHNICS & CONCRETE ENGG. (HONG KONG) LIMITED
GROUND INVESTIGATION DEPARTMENT

Samples & Test	Depth (m)	Sketch	Depth (m)	Legend	Description	Grade
			0.45		Stiff, dry, dark grey (2.5Y 4/1) sandy SILT with some subangular fine to coarse gravel and occasional cobble sized rock fragment and some rootlets. (COLLUVIUM)	
			1.10		Firm, moist, dark greyish brown (10YR 4/2) sandy SILT/CLAY with some subangular fine to coarse gravel and cobble sized rock fragments and some rootlets. (COLLUVIUM)	
					Weak to extremely weak, dry, olive grey (5Y 5/2) mottled yellowish brown and brown, highly to completely decomposed, lapilli bearing fine ash TUFF. (Silty fine to medium SAND with occasional subangular fine gravel and occasional boulder of maximum size 300mm sized rock fragment.	IV/V
			3.45		Trial pit terminated at 3.45m depth.	

Notes:
1. Small disturbed samples were taken at 0.50m, 1.00m, 1.50m, 2.00m, 2.50m and 3.00m depths.
2. Undisturbed vertical samples (U100) were taken at 1.00m and 2.00m depths.
3. Large disturbed samples was taken at 3.00m depth.

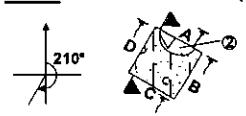
SYMBOLS

- Small Disturbed Sample
- Large Disturbed Sample
- Undisturbed Vertical Sample
- Undisturbed Horizontal Sample
- Block Sample
- Insitu Density Test
- Water Sample
- Water Seepage

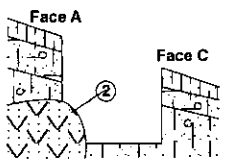
REMARKS

Ground Water
No Groundwater
Plant Used
Hand dug
Shoring
Timber shoring over full height
Stability
Stable
Depth at pit centre
3.00m
Others
Nil

PLAN (not to scale)



SECTION



Contract No.	:	GE/2001/13
Works Order No.	:	GE/2001/13.10
Co-ordinates	:	
E 847025.18	N 817334.69	
Ground Level	:	155.42 mPD
Logged by	:	K.L. Lo
Date logged	:	06/06/2002
Checked by	:	Tom Lo
Date Checked	:	07/06/2002

PROJECT

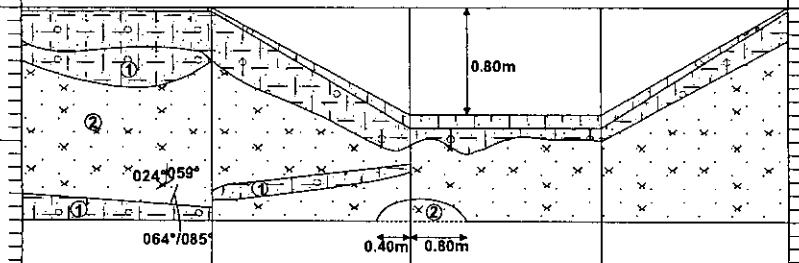
Agreement No. FD 01-052 Geotechnical Review and Site Investigation Works for Tseung Kwan O Landfill Stage II/III Afteruse Development Ground Investigation

Sheet	1	of	1	
Date excavated	03/06/2002	to	05/06/2002	
Date Reinstated	04/07/2002	to	04/07/2002	

TRIAL PIT NO.
TP8

GEOTECHNICS & CONCRETE ENGG. (HONG KONG) LIMITED
GROUND INVESTIGATION DEPARTMENT

Samples & Test	Depth (m)	Sketch	Depth (m)	Legend	Description	Grade
1	0.5		0.03		Loose, dry, dark grey (2.5Y 4/1), silty fine to coarse SAND with occasional fine to medium gravel sized rock fragments and some rootlets. (TOP SOIL)	
			0.25			IV
2	1.0		0.5		Loose, dry, dark brownish grey (2.5Y 3/2) dappled white and red, silty fine to coarse SAND with some subrounded to subangular fine to coarse gravel sized rock fragments, occasional cobble sized rock fragments. (COLLUVIUM)	
	1.5		1.0			
			1.5		Weak to moderately weak, dry, yellowish brown dappled white, red and black, highly decomposed, highly fractured, TRACHYDACITE LAVA.	
	2.0		1.60		Trial pit terminated at 1.60m.	
	2.5		2.0			
	3.0		2.5			
	3.5		3.0			
	4.0		3.5			
	4.5		4.0			
	5.0		4.5			
	5.5		5.0			
	6.0		5.5			
			6.0			



① Extremely weak to very weak, moist, yellow brown (10YR 5/8), completely to highly decomposed, TRACHYDACITE LAVA. (Silty fine to coarse SAND with some subangular fine to coarse gravel and cobble sized rock fragments)
② Moderately weak, yellowish brown dappled white and streaked black, moderately to highly decomposed, TRACHYDACITE LAVA.

FACE A: 1.50 m | FACE B: 1.50 m | FACE C: 1.50 m | FACE D: 1.50 m

Note:
1. Small disturbed samples were taken at 0.50m and 1.00m depths.

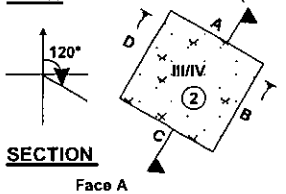
SYMBOLS

- Small Disturbed Sample
- Large Disturbed Sample
- Undisturbed Vertical Sample
- Undisturbed Horizontal Sample
- Block Sample
- Insitu Density Test
- Water Sample
- Water Seepage

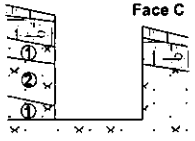
REMARKS

Ground Water
No Groundwater
Plant Used
Hand dug
Shoring
No shoring
Stability
Stable
Depth at pit centre
1.20m
Others
Nil

PLAN (not to scale)



SECTION



Contract No.	:	GE/2001/13
Works Order No.	:	GE/2001/13.10
Co-ordinates	:	
E 846809.76		N 817411.30
Ground Level	:	135.44 mPD
Logged by	:	K.L. Lo
Date logged	:	07/06/2002
Checked by	:	Tom Lo
Date Checked	:	08/06/2002

PROJECT

Agreement No. FD 01-052 Geotechnical Review and Site Investigation Works for Tseung Kwan O Landfill Stage II/III Afteruse Development Ground Investigation

Sheet	1	of	1	
Date excavated	04/06/2002	to	06/06/2002	
Date Reinstated	02/07/2002	to	02/07/2002	

TRIAL PIT NO.
TP12

GEOTECHNICS & CONCRETE ENGG. (HONG KONG) LIMITED
GROUND INVESTIGATION DEPARTMENT

GEOTECHNICS & CONCRETE ENGG.(HK) LTD.
GROUND INVESTIGATION DEPARTMENT

Stripping No.: S14

Sheet 1 of 1

SLOPE STRIPPING LOG

Slope No.: NIL

Contract No.: GE/2001/13

Project: Agreement No. FD 01-052 Geotechnical Review and Site Investigation Works for Tseung Kwan O Landfill Stage II/III Afteruse Development Ground Investigation

Datum (toe) Co-ordinates: E 847211.04 N 817081.50 Level 129.91 mPD

Datum (crest) Co-ordinates: E 847211.87 N 817081.29 Level 131.35 mPD

Works Order No.: GE/2001/13.10

Excavated by: T.O. Yuen

Supervised by: T.M. Chow

Date Started / Excavation : 27/06/2002

Date Completed : 04/07/2002

Date Reinstated :

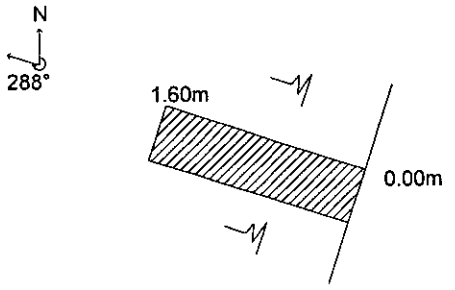
Sample or test	Distance from Datum (m)	Reduced Level (mPD)	Slope Angle	Description and Sample Data	Legend	Grade	Discontinuities: Dip/ Dip Direction	Discontinuities: Nature & Infilling
	0	131.35						
	0.80	130.63	64°	Stiff, dry, brownish grey (10YR 6/2) dappled yellowish brown, sandy SILT with some subangular fine to coarse gravel and cobble sized rock fragments and occasional rootlets. (COLLUVIUM)		III		
	1.60	129.91		Moderately strong, brown dappled grey, moderately decomposed, lapilli bearing, fine ash TUFF. (Massive)				
				End of stripping at 1.60m.				

Remarks: 1. 70mm shotcrete surface.

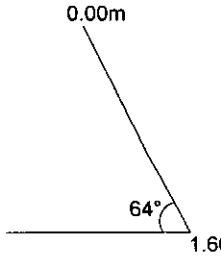
Symbol for Sample / Test:

- Small disturbed sample
- Large disturbed sample
- Block sample
- Insitu-density test
- m Moisture content test
- Water sample
- Seepage
- [ ] Photograph

Sketch Plan:



Sketch Section:



Logged by : K.L. Lo

Date Logged : 05/07/2002

Checked by : Tom Lo

Date Checked : 06/07/2002

GEOTECHNICS & CONCRETE ENGG.(HK) LTD.
GROUND INVESTIGATION DEPARTMENT

SLOPE STRIPPING LOG

Stripping No.: S15
Sheet 1 of 1
Slope No.: NIL

Contract No.: GE/2001/13

Project:
Agreement No. FD 01-052 Geotechnical Review and Site Investigation Works for Tseung Kwan O Landfill Stage II/III Afteruse Development Ground Investigation

Datum (toe) Co-ordinates:
E 847204.42
N 817138.20
Level 142.69 mPD

Datum (crest) Co-ordinates:
E 847206.27
N 817138.03
Level 145.26 mPD

Works Order No.: GE/2001/13.10
Excavated by: T.O. Yuen
Supervised by: T.M. Chow

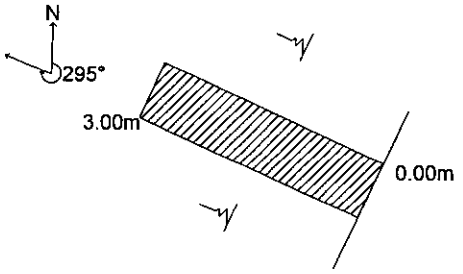
Date Started / Excavation : 13/06/2002
Date Completed : 24/06/2002
Date Reinstated :

Sample or test	Distance from Datum (m)	Reduced Level (mPD)	Slope Angle	Description and Sample Data	Legend	Grade	Discontinuities: Dip/ Dip Direction	Discontinuities: Nature & Infilling
	0	145.26						
	1		59°	Very weak, dry, light yellowish brown (2.5Y 6/4) dappled white and dark brown, highly to completely decomposed, TRACHYDACITE LAVA. (Stiff, sandy SILT with much angular to subangular fine to coarse gravel and some cobble sized rock fragments)		IV/V		
	1.90	143.63		Extremely weak, dry, yellowish brown (10YR 5/8) dappled white and light grey, completely decomposed, TRACHYDACITE LAVA. (Stiff, sandy SILT with some angular to subangular fine to coarse gravel and occasional cobble sized rock fragments)		V		
	3.00	142.69		End of stripping at 3.00m.				
	4							
	5							
	6							
	7							
	8							
	9							
	10							
	11							
	12							
	13							
	14							
	15							
	16							

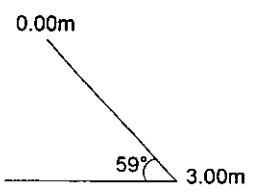
Remarks: 1. 100mm chunam surface.

Symbol for Sample / Test:
- Small disturbed sample
- Large disturbed sample
- Block sample
- Insitu-density test
- m Moisture content test
- Water sample
- Seepage
- [ ] Photograph

Sketch Plan:



Sketch Section:



Logged by : K.L. Lo
Date Logged : 25/06/2002
Checked by : Tom Lo
Date Checked : 26/06/2002

GEOTECHNICS & CONCRETE ENGG.(HK) LTD.
GROUND INVESTIGATION DEPARTMENT

SLOPE STRIPPING LOG

Stripping No.: S16
Sheet 1 of 1
Slope No.: NIL

Contract No.: GE/2001/13

Project: Agreement No. FD 01-052 Geotechnical Review and Site Investigation Works for Tseung Kwan O Landfill Stage II/III Afteruse Development Ground Investigation

Datum (toe) Co-ordinates: E 847188.07 N 817181.19 Level 141.77 mPD

Datum (crest) Co-ordinates: E 847191.33 N 817181.97 Level 148.44 mPD

Works Order No.: GE/2001/13.10
Excavated by: T.O. Yuen
Supervised by: T.M. Chow

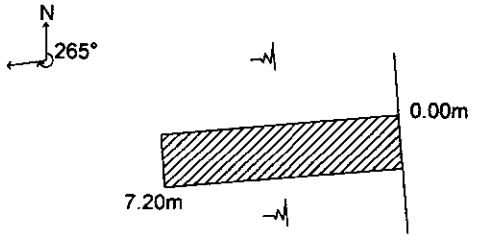
Date Started / Excavation : 13/06/2002
Date Completed : 24/06/2002
Date Reinstated :

Sample or test	Distance from Datum (m)	Reduced Level (mPD)	Slope Angle	Description and Sample Data	Legend	Grade	Discontinuities: Dip/ Dip Direction	Discontinuities: Nature & Infilling
	0	148.44						
	1		60°	Firm, dry, brownish grey (10YR 6/2), sandy SILT with some angular to subangular fine to coarse gravel and cobble sized rock fragments. (COLLUVIUM)				
	2							
	3							
	3.90	145.66						
	5.00	143.91	77°	Very weak, dry, light yellowish brown (2.5Y 6/4) dappled white, highly to completely decomposed, TUFF. (Stiff, sandy SILT with much angular to subangular fine to coarse gravel and some cobble sized rock fragments)		IV/V		
	6			Extremely weak, dry, yellowish brown (10YR 5/8) dappled light grey and white, completely decomposed, TUFF. (Silty fine to coarse SAND with occasional angular fine gravel sized quartz fragments)		V		
	6.90	142.06						
	7.20	141.77		Very weak, dry, light yellowish brown (2.5Y 6/4) dappled white, highly to completely decomposed, TUFF. (Silty fine to coarse SAND with some angular to subangular fine to coarse gravel sized rock fragments)		IV/V		
	8			End of stripping at 7.20m.				
	9							
	10							
	11							
	12							
	13							
	14							
	15							
	16							

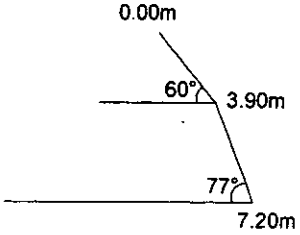
Remarks: 1. 40mm chunam surface.

Symbol for Sample / Test:
- Small disturbed sample
- Large disturbed sample
- Block sample
- Insitu-density test
- m Moisture content test
- Water sample
- Seepage
- [ ] Photograph

Sketch Plan:



Sketch Section:



Logged by : K.L. Lo
Date Logged : 25/06/2002
Checked by : Tom Lo
Date Checked : 26/06/2002

GEOTECHNICS & CONCRETE ENGG.(HK) LTD.
GROUND INVESTIGATION DEPARTMENT

Stripping No.: S17

Sheet 1 of 1

SLOPE STRIPPING LOG

Slope No.: NIL

Contract No.: GE/2001/13	Datum (toe) Co-ordinates: E 847183.09 N 817211.83 Level 141.98 mPD	Datum (crest) Co-ordinates: E 817186.31 N 817212.15 Level 147.22 mPD	Works Order No.: GE/2001/13.10
Project: Agreement No. FD 01-052 Geotechnical Review and Site Investigation Works for Tseung Kwan O Landfill Stage II/III Afteruse Development Ground Investigation			Excavated by: T.O. Yuen
			Supervised by: T.M. Chow
Date Started / Excavation : 13/06/2002	Date Completed : 24/06/2002		Date Reinstated :

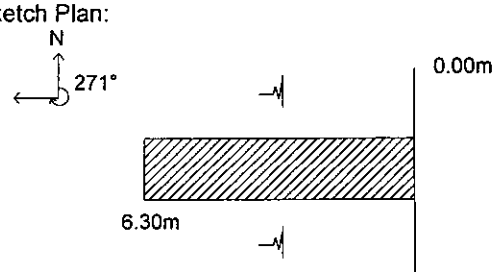
Sample or test	Distance from Datum (m)	Reduced Level (mPD)	Slope Angle	Description and Sample Data	Legend	Grade	Discontinuities: Dip/ Dip Direction	Discontinuities: Nature & Infilling
	0	147.22						
	1			Loose, dry, brown (7.5YR 5/4), slightly sandy SILT with much angular to subangular fine to coarse gravel and some cobble sized rock fragment. (COLLUVIUM)				
	2 2.00	145.56						
	3		56°	Moderately strong, light grey dappled dark brown, moderately decomposed, TRACHYDACITE LAVA. Joints are closely to medium spaced, smooth planar and rough planar, iron and manganese oxide stained, dipping at 70° to 80°. From 3.00m to 3.20m : An 80° to 90° joint. From 3.70m to 4.00m : An 80° to 90° joint. From 3.80m to 3.90m : An 80° to 90° joint.		III	068°/86° 074°/82° 176°/88° 068°/80° 065°/79° 017°/69° 066°/75°	
	4							
	5							
	6 6.30	141.98						
	7			End of stripping at 6.30m.				
	8							
	9							
	10							
	11							
	12							
	13							
	14							
	15							
	16							

Remarks: 1. 50mm chunam surface.

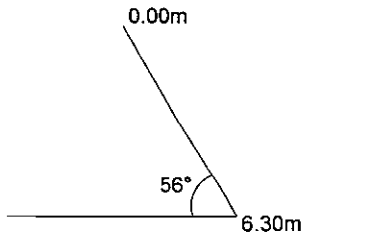
Symbol for Sample / Test:

- Small disturbed sample
- Large disturbed sample
- Block sample
- Insitu-density test
- m Moisture content test
- Water sample
- Seepage
- [ ] Photograph

Sketch Plan:



Sketch Section:



Logged by : K.L. Lo

Date Logged : 25/06/2002

Checked by : Tom Lo

Date Checked : 26/06/2002

GEOTECHNICS & CONCRETE ENGG.(HK) LTD.
GROUND INVESTIGATION DEPARTMENT

Stripping No.: S18

Sheet 1 of 1

SLOPE STRIPPING LOG

Slope No.: NIL

Contract No.: GE/2001/13	Datum (toe) Co-ordinates: E 847162.66 N 817216.63 Level 141.53 mPD	Datum (crest) Co-ordinates: E 847161.74 N 817218.94 Level 146.16 mPD	Works Order No.: GE/2001/13.10
Project: Agreement No. FD 01-052 Geotechnical Review and Site Investigation Works for Tseung Kwan O Landfill Stage II/III Afteruse Development Ground Investigation			Excavated by: T.O. Yuen
			Supervised by: T.M. Chow
Date Started / Excavation : 14/06/2002	Date Completed : 24/06/2002		Date Reinstated :

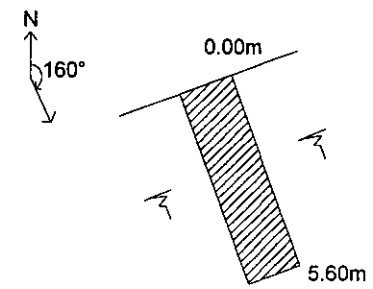
Sample or test	Distance from Datum (m)	Reduced Level (mPD)	Slope Angle	Description and Sample Data	Legend	Grade	Discontinuities: Dip/ Dip Direction	Discontinuities: Nature & Infilling
	0	146.16						
	1			Moderately strong, brown dappled grey, moderately decomposed, TRACHYDACITE LAVA. Joints are closely spaced, rough undulating and rough planar, extremely narrow, iron and manganese oxide stained, dipping at 35° to 45° and 65° to 75°.		III		
	2			From 1.30m to 1.40m : An 80° to 90° joint.			175°/84° 194°/56° 172°/39°	
	3		56°				356°/74° 355°/73° 356°/75°	
	4			From 4.10m to 4.40m : An 80° to 90° joint.			008°/84°	
	5						135°/64°	
	5.60	141.53						
	6			End of stripping at 5.60m. Chunam is wet. ① Seepage at 4.10m. ② PVC pipe of diameter 30mm.				
	7							
	8							
	9							
	10							
	11							
	12							
	13							
	14							
	15							
	16							

Remarks: 1. 30mm chunam surface.

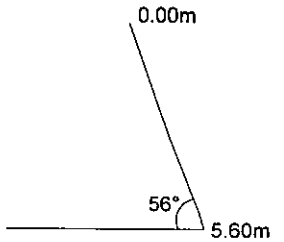
Symbol for Sample / Test:

- Small disturbed sample
- Large disturbed sample
- Block sample
- Insitu-density test
- m Moisture content test
- Water sample
- Seepage
- [ ] Photograph

Sketch Plan:



Sketch Section:



Logged by : K.L. Lo

Date Logged : 25/06/2002

Checked by : Tom Lo

Date Checked : 26/06/2002

GEOTECHNICS & CONCRETE ENGG.(HK) LTD.
GROUND INVESTIGATION DEPARTMENT

Stripping No.: S19

Sheet 1 of 1

SLOPE STRIPPING LOG

Slope No.: NIL

Contract No.: GE/2001/13

Project: Agreement No. FD 01-052 Geotechnical Review and Site Investigation Works for Tseung Kwan O Landfill Stage II/III Afteruse Development Ground Investigation

Datum (toe) Co-ordinates: E 847095.71 N 817214.28 Level 140.83 mPD

Datum (crest) Co-ordinates: E 847096.79 N 817217.11 Level 144.51 mPD

Works Order No.: GE/2001/13.10

Excavated by: T.O. Yuen

Supervised by: T.M. Chow

Date Started / Excavation : 14/06/2002

Date Completed : 24/06/2002

Date Reinstated :

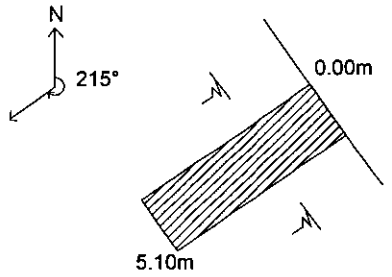
Sample or test	Distance from Datum (m)	Reduced Level (mPD)	Slope Angle	Description and Sample Data	Legend	Grade	Discontinuities: Dip/ Dip Direction	Discontinuities: Nature & Infilling
	0	144.51						
	1			Extremely weak to very weak, dry, brown (7.5YR 5/4) dappled grey and white, completely to highly decomposed, TRACHYDACITE LAVA. (Silty fine SAND with some angular to subangular fine to medium gravel sized rock fragments)		V/IV		
	2	2.00 143.07						
	3	3.20 142.21	46°	Moderately weak, light grey dappled dark brown, moderately to highly decomposed, TRACHYDACITE LAVA. Joints are closely spaced, rough planar, iron and manganese oxide stained, dipping at 84°. From 2.20m to 2.50m : An 80° to 90° joint.		III/IV	226°/84°	
		3.80 141.78		Very weak, dry, brown (7.5YR 5/4) dappled grey and white, highly to completely decomposed, TRACHYDACITE LAVA. (Very silty fine to coarse SAND with some angular to subangular fine to coarse gravel sized rock fragments)		IV/V		
	4					III/IV	076°/83° 140°/68° 250°/78°	
	5	5.10 140.83		Moderately weak, light grey dappled light yellowish brown, moderately to highly decomposed, TRACHYDACITE LAVA. Joints are closely spaced, rough planar, iron and manganese oxide stained, dipping at 65° to 75°. From 3.90m to 4.00m : An 80° to 90° joint. End of stripping at 5.10m.				
	6							
	7							
	8							
	9							
	10							
	11							
	12							
	13							
	14							
	15							
	16							

Remarks: 1. 40mm chunam surface.

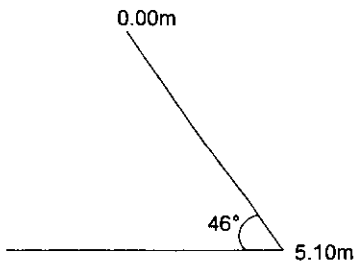
Symbol for Sample / Test:

- Small disturbed sample
- Large disturbed sample
- Block sample
- Insitu-density test
- m Moisture content test
- Water sample
- Seepage
- [ ] Photograph

Sketch Plan:



Sketch Section:



Logged by : K.L. Lo

Date Logged : 25/06/2002

Checked by : Tom Lo

Date Checked : 26/06/2002

GEOTECHNICS & CONCRETE ENGG.(HK) LTD.
GROUND INVESTIGATION DEPARTMENT

Stripping No.: S20

Sheet 1 of 1

SLOPE STRIPPING LOG

Slope No.: NIL

Contract No.: GE/2001/13	Datum (toe) Co-ordinates: E 847052.67 N 817256.30 Level 140.08 mPD	Datum (crest) Co-ordinates: E 847053.31 N 817258.87 Level 146.16 mPD	Works Order No.: GE/2001/13.10
Project: Agreement No. FD 01-052 Geotechnical Review and Site Investigation Works for Tseung Kwan O Landfill Stage II/III Afteruse Development Ground Investigation			Excavated by: T.O. Yuen
			Supervised by: T.M. Chow
Date Started / Excavation : 14/06/2002	Date Completed : 24/06/2002		Date Reinstated :

Sample or test	Distance from Datum (m)	Reduced Level (mPD)	Slope Angle	Description and Sample Data	Legend	Grade	Discontinuities: Dip/ Dip Direction	Discontinuities: Nature & Infilling
	0	146.16						
	1.70	144.80	53°	Firm, dry, dark brown (7.5YR 3/2), slightly sandy SILT with some angular to subangular fine to coarse gravel and occasional cobble sized rock fragments. (COLLUVIUM)				
	1.90	144.64		Weak to moderately weak, light grey dappled brown and yellowish brown, highly to moderately decomposed, TRACHYDACITE LAVA. (MASSIVE)		IV/III		
	2.20	144.37				IV/V		
	3.70	143.00		Very weak, dry, yellowish brown (10YR 5/8) dappled white and grey, highly to completely decomposed, TRACHYDACITE LAVA. (Stiff, slightly sandy SILT)				
	6.90	140.08	66°	Moderately strong, light grey dappled dark brown, moderately decomposed, TRACHYDACITE LAVA. Joints are closely to medium spaced, rough planar, iron oxide stained, dipping at 70° to 80°.		III	043°/82° 144°/76° 153°/78°	
				From 6.50m to 6.90m : Weak to moderately weak and highly to moderately decomposed.		IV/III		
				End of stripping at 6.90m.				

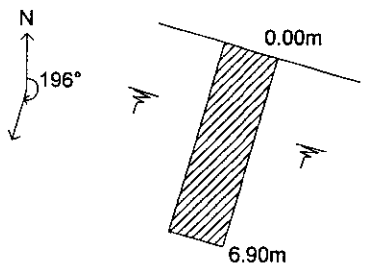
① root of diameter 12mm.
② PVC weephole of diameter 50mm.

Remarks: 1. 50mm chunam surface from 0.00m to 4.10m.
2. 150mm chunam surface with iron mesh from 4.10m to 6.90m.

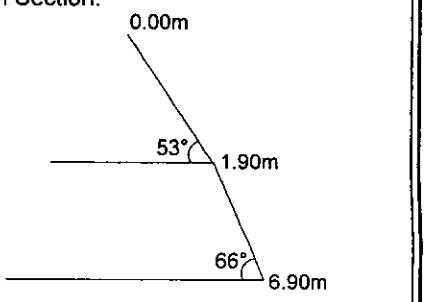
Symbol for Sample / Test:

- Small disturbed sample
- Large disturbed sample
- Block sample
- Insitu-density test
- m Moisture content test
- Water sample
- Seepage
- [ ] Photograph

Sketch Plan:



Sketch Section:



Logged by : K.L. Lo — Date Logged : 25/06/2002 — Checked by : Tom Lo — Date Checked : 26/06/2002

GEOTECHNICS & CONCRETE ENGG.(HK) LTD.
GROUND INVESTIGATION DEPARTMENT

SLOPE STRIPPING LOG

Stripping No.: S21
Sheet 1 of 1
Slope No.: NIL

Contract No.: GE/2001/13

Project:
Agreement No. FD 01-052 Geotechnical Review and Site Investigation Works for Tseung Kwan O Landfill Stage II/III Afteruse Development Ground Investigation

Datum (toe) Co-ordinates:
E 847011.28
N 817286.79
Level 139.49 mPD

Datum (crest) Co-ordinates:
E 847010.96
N 817289.65
Level 144.18 mPD

Works Order No.: GE/2001/13.10
Excavated by: T.O. Yuen
Supervised by: T.M. Chow

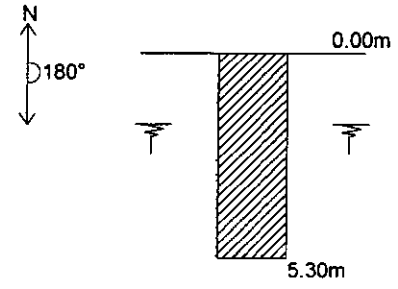
Date Started / Excavation : 14/06/2002
Date Completed : 24/06/2002
Date Reinstated :

Sample or test	Distance from Datum (m)	Reduced Level (mPD)	Slope Angle	Description and Sample Data	Legend	Grade	Discontinuities: Dip/ Dip Direction	Discontinuities: Nature & Infilling
	0	144.18						
	1.10	143.21	62°	Weak, brown dappled white, highly decomposed, TRACHYDACITE LAVA. Joints are very closely spaced, rough planar, extremely narrow to very narrow, iron oxide stained, dipping at 30° to 40°.		IV	190°/38° 191°/38° 190°/37° 190°/35°	
	2.50	141.97		Moderately strong, brown dappled white and grey, moderately decomposed, TRACHYDACITE LAVA. Joints are very closely to closely spaced, smooth planar, extremely narrow, iron and manganese oxide stained, dipping at 70°.		III	253°/70° 256°/70°	
				From 2.10m to 2.50m : Weak and highly decomposed.		IV	255°/70° 256°/70°	
				Weak, brown dappled dark brown and light grey, highly decomposed, TRACHYDACITE LAVA. (MASSIVE) From 2.50m to 3.80m : Weak to very weak, highly to completely decomposed trachydacite lava. (Stiff, sandy silt)		IV/V		
	5.30	139.49				IV		
				End of stripping at 5.30m.				

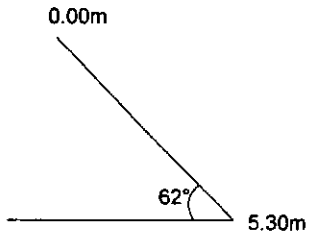
Remarks: 1. 50mm chunam surface with iron mesh.

Symbol for Sample / Test:
- Small disturbed sample
- Large disturbed sample
- Block sample
- Insitu-density test
- m Moisture content test
- Water sample
- Seepage
- [ ] Photograph

Sketch Plan:



Sketch Section:



Logged by : K.L. Lo
Date Logged : 25/06/2002
Checked by : Tom Lo
Date Checked : 26/06/2002

GEOTECHNICS & CONCRETE ENGG.(HK) LTD.
GROUND INVESTIGATION DEPARTMENT

Stripping No.: S22

Sheet 1 of 1

SLOPE STRIPPING LOG

Slope No.: NIL

Contract No.: GE/2001/13

Project: Agreement No. FD 01-052 Geotechnical Review and Site Investigation Works for Tseung Kwan O Landfill Stage II/III Afteruse Development Ground Investigation

Datum (toe) Co-ordinates: E 847001.31 N 817330.13 Level 138.83 mPD

Datum (crest) Co-ordinates: E 847004.89 N 817328.54 Level 143.80 mPD

Works Order No.: GE/2001/13.10

Excavated by: T.O. Yuen

Supervised by: T.M. Chow

Date Started / Excavation : 19/06/2002

Date Completed : 24/06/2002

Date Reinstated :

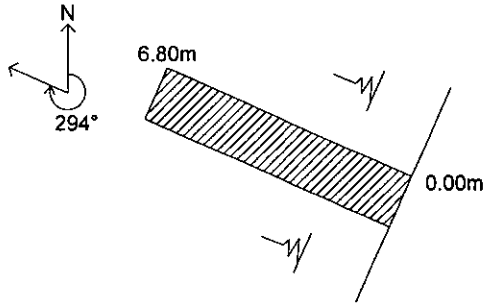
Sample or test	Distance from Datum (m)	Reduced Level (mPD)	Slope Angle	Description and Sample Data	Legend	Grade	Discontinuities: Dip/ Dip Direction	Discontinuities: Nature & Infilling
	0	143.80						
1 2 3 4 5 6 7	1 2 3		47°	Extremely weak, dry, light yellowish brown (2.5Y 6/4) dappled white and dark brown, completely decomposed, TRACHYDACITE LAVA. (Stiff, sandy SILT with some angular to subangular fine to coarse gravel sized rock and quartz fragments) From 0.50m to 0.70m : Extremely weak to very weak and completely to highly decomposed. From 1.80m to 1.90m : Extremely weak to very weak and completely to highly decomposed. From 2.20m to 2.40m : Extremely weak to very weak and completely to highly decomposed. From 2.80m to 3.00m : Extremely weak to very weak and completely to highly decomposed.		V V/IV V V/IV V/IV V V/IV V		
	4.00	140.87						
8 9 10 11 12	5 6			Extremely weak, dry, yellowish brown (10YR 5/8) dappled light grey and light yellow, completely decomposed, TRACHYDACITE LAVA. (Silty fine to coarse SAND with occasional angular to subangular fine to coarse gravel sized rock fragments) From 4.90m to 5.20m : Extremely weak to very weak and completely to highly decomposed. From 5.40m to 5.60m : Very weak and highly to completely decomposed.		V IV/V V		
	6.80	138.83						
	7 8 9 10 11 12 13 14 15 16			End of stripping at 6.80m. Note: 1. Small disturbed samples were taken from 0.00m to 6.00m for interval 0.50m.				

Remarks: 1. 50mm chunam surface with iron mesh.

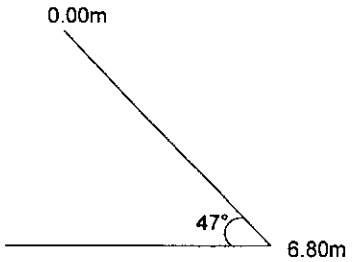
Symbol for Sample / Test:

- Small disturbed sample
- Large disturbed sample
- Block sample
- Insitu-density test
- m Moisture content test
- Water sample
- Seepage
- [ ] Photograph

Sketch Plan:



Sketch Section:



Logged by : K.L. Lo

Date Logged : 25/06/2002

Checked by : Tom Lo

Date Checked : 26/06/2002

GEOTECHNICS & CONCRETE ENGG.(HK) LTD.
GROUND INVESTIGATION DEPARTMENT

Stripping No.: S23

Sheet 1 of 1

SLOPE STRIPPING LOG

Slope No.: NIL

Contract No.: GE/2001/13	Datum (toe) Co-ordinates: E 846983.30 N 817351.63 Level 138.32 mPD	Datum (crest) Co-ordinates: E 846984.81 N 817356.87 Level 143.71 mPD	Works Order No.: GE/2001/13.10
Project: Agreement No. FD 01-052 Geotechnical Review and Site Investigation Works for Tseung Kwan O Landfill Stage II/III Afteruse Development Ground Investigation			Excavated by: T.O. Yuen
			Supervised by: T.M. Chow
Date Started / Excavation : 24/06/2002	Date Completed : 04/07/2002		Date Reinstated :

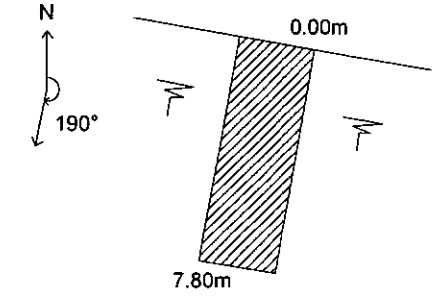
Sample or test	Distance from Datum (m)	Reduced Level (mPD)	Slope Angle	Description and Sample Data	Legend	Grade	Discontinuities: Dip/ Dip Direction	Discontinuities: Nature & Infilling
	0	143.71						
1 2 3 4	1 2			Extremely weak to very weak, dry, light grey (7.5YR 7/1) dappled white and yellowish brown and occasional dark grey, completely to highly decomposed TRACHYDACITE LAVA. (Very stiff, sandy SILT with some angular to subangular fine to coarse gravel and occasional cobble sized rock fragments) From 1.60m to 1.70m : Weak and highly decomposed.		V/IV		
	2.40	142.04				①		
5	2.90	141.69		Weak to moderately weak, light grey dappled brown, highly to moderately decomposed, TRACHYDACITE LAVA. (Massive)		IV/III		
6 7 8	3 4		44°	Very weak, dry, yellowish brown (10YR 5/8) dappled light grey and dark brown, highly to completely decomposed, TRACHYDACITE LAVA. (Very stiff, sandy SILT with some angular fine to coarse gravel and occasional cobble sized rock fragments)		IV/V		
	4.50	140.58						
9 10	5			Weak to moderately weak, light grey dappled brown, highly to moderately decomposed, TRACHYDACITE LAVA. (Massive)		IV/III		
	5.20	140.09						
11				Extremely weak, dry, brown (7.5YR 5/4) mottled light grey dappled yellow, completely decomposed, TRACHYDACITE LAVA. (Silty fine to coarse SAND)		V		
	6.00	139.53						
12 13 14	7			Moderately weak, light yellowish brown mottled brown and light grey, moderately to highly decomposed, TRACHYDACITE LAVA. Joints are medium spaced, rough planar, extremely narrow, iron oxide stained, dipping at 70° to 80° and 80° to 90°.		III/IV	220°/83° 195°/70° 220°/75°	
	7.80	138.32						
	8 9 10 11 12 13 14 15 16			End of stripping at 7.80m. ① Highly decomposed TRACHYDACITE LAVA. (Core Stone) Note: 1. Small disturbed samples were taken from 0.00m to 7.00m for interval 0.50m.				

Remarks: 1. 150mm shotcrete with iron mesh from 0.00m to 6.00m.

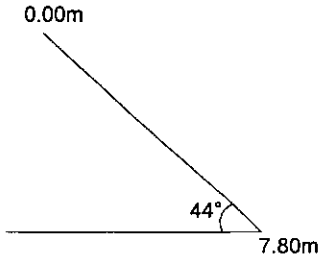
Symbol for Sample / Test:

- Small disturbed sample
- Large disturbed sample
- Block sample
- Insitu-density test
- m Moisture content test
- Water sample
- Seepage
- [ ] Photograph

Sketch Plan:



Sketch Section:



Logged by : K.L. Lo

Date Logged : 05/07/2002

Checked by : Tom Lo

Date Checked : 06/07/2002

GEOTECHNICS & CONCRETE ENGG.(HK) LTD.
GROUND INVESTIGATION DEPARTMENT

Stripping No.: S24

Sheet 1 of 1

SLOPE STRIPPING LOG

Slope No.: NIL

Contract No.: GE/2001/13	Datum (toe) Co-ordinates: E 846929.67 N 817367.78 Level 137.70 mPD	Datum (crest) Co-ordinates: E 846933.79 N 817373.89 Level 146.27 mPD	Works Order No.: GE/2001/13.10
Project: Agreement No. FD 01-052 Geotechnical Review and Site Investigation Works for Tseung Kwan O Landfill Stage II/III Afteruse Development Ground Investigation			Excavated by: T.O. Yuen
			Supervised by: T.M. Chow
Date Started / Excavation : 25/06/2002	Date Completed : 04/07/2002		Date Reinstated :

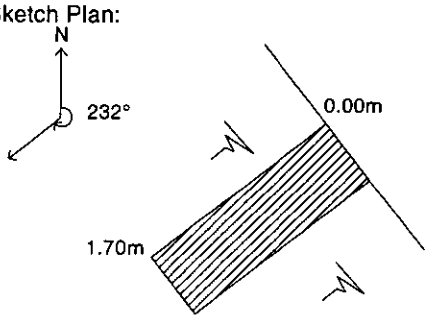
Sample or test	Distance from Datum (m)	Reduced Level (mPD)	Slope Angle	Description and Sample Data	Legend	Grade	Discontinuities: Dip/ Dip Direction	Discontinuities: Nature & Infilling
	0	146.27						
1 2 3 4 5	1 2 3	2.90	144.14	Firm, moist, yellowish brown (10YR 5/8) dappled greyish brown and mottled white, sandy SILT with much angular to subangular fine to coarse gravel and some cobble sized rock fragments. (COLLUVIUM)				
6 7 8 9 10 11	4 5	5.80	142.02	Extremely weak, dry, yellowish brown (10YR 5/8) mottled white, completely decomposed, fine ash TUFF. (Very stiff, sandy SILT with occasional subangular fine gravel sized quartz fragments)		V		
12	6		47°	Extremely weak, dry, yellowish brown (10YR 5/8) mottled light grey and dappled dark brown, completely decomposed fine ash TUFF. (Stiff, slightly sandy SILT)		V		
13		6.70	141.36					
14	7	7.40	140.85	Very weak, dry, light yellowish brown (2.5Y 6/4) mottled white, highly to completely decomposed, fine ash TUFF. (Silty fine to medium SAND with some angular fine to coarse gravel sized rock fragments)		IV/V		
15						V		
16	8	8.20	140.26	Extremely weak, yellowish brown (10YR 5/8) mottled light grey, completely decomposed, fine ash TUFF. (Stiff, sandy SILT with some subangular fine to medium gravel sized quartz and rock fragments)		IV/V		
17						IV/III		
18	9	9.20	139.53			IV/V		
19		9.70	139.16	Very weak, yellowish brown (10YR 5/8) mottled white, highly to completely decomposed, fine ash TUFF. (Slightly silty fine to medium SAND)		III/IV		
20	10			From 8.25m to 8.50m : Weak, yellowish brown dappled dark brown and mottled light grey, highly decomposed.		IV/V		
21				From 8.60m to 8.85m : Weak to moderately weak, light grey dappled dark brown, highly to moderately decomposed.		III		
22	11					IV/V		
23		11.70	137.70	Moderately weak, dark brown dappled light yellowish brown and light grey, moderately to highly decomposed, fine ash TUFF.				
	12			Very weak, dry, yellowish brown (10YR 5/8) dappled dark brown and mottled light grey, highly to completely decomposed, fine ash TUFF. (Silty fine to coarse SAND with some angular to subangular fine to medium gravel sized rock fragments)				
	13			From 10.50m to 10.65m : Moderately strong, light grey spotted black and mottled pink moderately decomposed fine ash TUFF. (CORESTONE)				
	14			End of stripping at 11.70m.				
	15			Note: 1. Small disturbed samples were taken from 0.00m to 11.50m at interval 0.50m.				
	16							

Remarks: 50mm shotcrete with iron mesh.

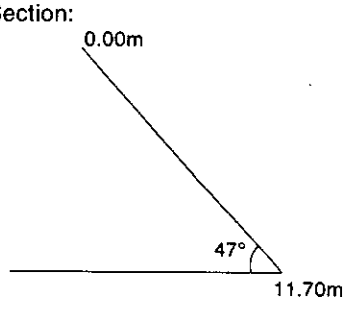
Symbol for Sample / Test:

- Small disturbed sample
- Large disturbed sample
- Block sample
- Insitu-density test
- m Moisture content test
- Water sample
- Seepage
- [ ] Photograph

Sketch Plan:



Sketch Section:



Logged by : K.L. Lo

Date Logged : 05/07/2002

Checked by : Tom Lo

Date Checked : 06/07/2002

GEOTECHNICS & CONCRETE ENGG.(HK) LTD.
GROUND INVESTIGATION DEPARTMENT

SLOPE STRIPPING LOG

Stripping No.: S25
Sheet 1 of 1
Slope No.: NIL

Contract No.: GE/2001/13

Project: Agreement No. FD 01-052 Geotechnical Review and Site Investigation Works for Tseung Kwan O Landfill Stage II/III Afteruse Development Ground Investigation

Datum (toe) Co-ordinates: E 846892.96 N 817383.80 Level 136.90 mPD

Datum (crest) Co-ordinates: E 846890.46 N 817389.25 Level 144.18 mPD

Works Order No.: GE/2001/13.10
Excavated by: T.O. Yuen
Supervised by: T.M. Chow

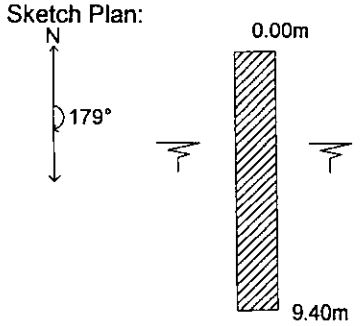
Date Started / Excavation : 25/06/2002
Date Completed : 04/07/2002
Date Reinstated :

Sample or test	Distance from Datum (m)	Reduced Level (mPD)	Slope Angle	Description and Sample Data	Legend	Grade	Discontinuities: Dip/ Dip Direction	Discontinuities: Nature & Infilling
	0	144.18						
1 2	1.30	143.17		Very stiff, dry, brown (7.5YR 5/4) dappled light yellow and white, sandy SILT with some subangular to subrounded fine to coarse gravel sized rock fragments and rootlets. (COLLUVIUM)				
3 4 5 6 7 8 9	4.60	140.61		Extremely weak, dry, yellowish brown (10YR 5/8) dappled white, completely decomposed, TRACHYDACITE LAVA. (Silty fine to coarse SAND)		V		
10	4.90	140.38	51°	Extremely weak to very weak, moist, reddish brown (5YR 5/4), completely to highly decomposed, TRACHYDACITE LAVA. (Silty fine to coarse SAND with some subangular fine to coarse gravel sized rock fragments)		V/IV V		
11 12	6.00	139.53		Extremely weak, dry, yellowish brown (10YR 5/8), completely decomposed, TRACHYDACITE LAVA. (Silty fine to coarse SAND)		V/IV		
13	6.60	139.06		Extremely weak to very weak, dry, brown (7.5YR 5/4) dappled white and yellow, completely to highly decomposed, fine grained GRANITE. (Silty fine to coarse SAND with some subangualr fine to coarse gravel sized rock fragments)				
14 15 16 17 18	9.40	136.90		Stiff, moist, brown (7.5YR 5/4) dappled red, white and light yellow, sandy SILT with some subangular fine to coarse gravel and cobble sized rock fragments. (FILL)				
	10 11 12 13 14 15 16			End of stripping at 9.40m. ① Root of 5mm diameter Note : 1. Small disturbed samples were taken from 0.00m to 9.00m at interval 0.50m.				

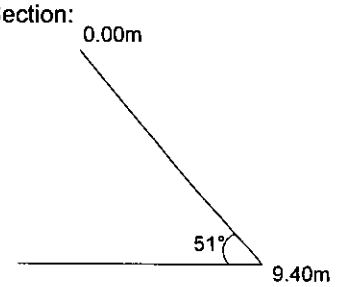
Remarks: 1. From 0.00m to 6.10m : 80mm thickness of concrete surface. 2. From 6.10m to 8.00m : 450mm thickness of concrete surface. 3. From 8.00m to 9.40m : 80mm thickness of concrete surface. 4. From 0.60m to 5.60m : Concrete surface with wire mesh.

Symbol for Sample / Test:
- Small disturbed sample
- Large disturbed sample
- Block sample
- Insitu-density test
- m Moisture content test
- Water sample
- Seepage
- [ ] Photograph

Sketch Plan:



Sketch Section:



Logged by : K.L. Lo
Date Logged : 05/07/2002
Checked by : Tom Lo
Date Checked : 06/07/2002

GEOTECHNICS & CONCRETE ENGG.(HK) LTD.
GROUND INVESTIGATION DEPARTMENT

SLOPE STRIPPING LOG

Stripping No.: S26
Sheet 1 of 1
Slope No.: NIL

Contract No.: GE/2001/13

Project:
Agreement No. FD 01-052 Geotechnical Review and Site Investigation Works for Tseung Kwan O Landfill Stage II/III Afteruse Development Ground Investigation

Datum (toe) Co-ordinates:
E 846860.02
N 817386.98
Level 132.47 mPD

Datum (crest) Co-ordinates:
E 846862.56
N 817391.84
Level 138.86 mPD

Works Order No.: GE/2001/13.10
Excavated by: T.O. Yuen
Supervised by: T.M. Chow

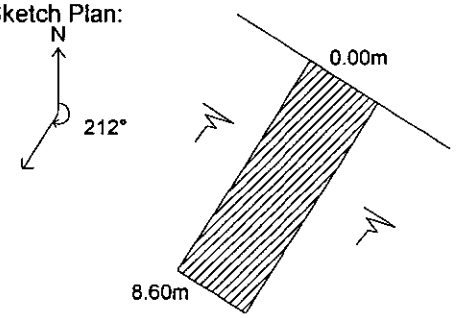
Date Started / Excavation : 26/06/2002
Date Completed : 04/07/2002
Date Reinstated :

Sample or test	Distance from Datum (m)	Reduced Level (mPD)	Slope Angle	Description and Sample Data	Legend	Grade	Discontinuities: Dip/ Dip Direction	Discontinuities: Nature & Infilling
	0	138.86						
	0.60	138.41		Very stiff, dry, brown (10YR 4/3) dappled yellow and white, sandy SILT with some subrounded fine to coarse gravel and occasional cobble sized rock fragments. (COLLUVIUM)				
	1			Extremely weak, moist, light yellowish brown (10YR 6/4) dappled red and white completely decomposed, TRACHYDACITE LAVA. (Silty fine to coarse SAND)		V		
	2							
	3 3.00	136.63						
	3.40	136.33		Extremely weak to very weak, moist, light yellowish brown (10YR 6/4) dappled red and white, completely to highly decomposed, TRACHYDACITE LAVA. (Silty fine to coarse SAND with some subangular fine to coarse gravel sized rock fragments)		V/IV		
	4					IV	257°/74°	
	4.60	135.44	48°	Weak, brown dappled black, highly decomposed, TRACHYDACITE LAVA. Joints are extremely narrow, iron and manganese oxide stained.		V/IV		
	5							
	6			Extremely weak to very weak, dry, yellowish brown (10YR 5/6) dappled white and grey and mottled pink, completely to highly decomposed, TRACHYDACITE LAVA. (Silty fine to coarse SAND with some angular fine to coarse gravel sized rock fragments)				
	7							
	8							
	8.60	132.47						
	9			End of stripping at 8.60m.				
	10							
	11							
	12							
	13							
	14							
	15							
	16							

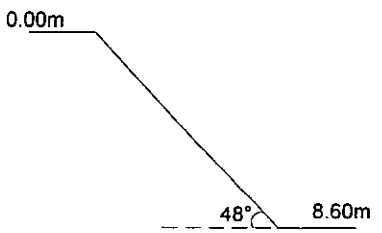
Remarks: 70mm shotcrete surface.

Symbol for Sample / Test:
- Small disturbed sample
- Large disturbed sample
- Block sample
- Insitu-density test
- m Moisture content test
- Water sample
- Seepage
- [ ] Photograph

Sketch Plan:



Sketch Section:



Logged by : K.L. Lo
Date Logged : 05/07/2002
Checked by : Tom Lo
Date Checked : 06/07/2002

GEOTECHNICS & CONCRETE ENGG.(HK) LTD.
GROUND INVESTIGATION DEPARTMENT

Stripping No.: S27

Sheet 1 of 1

SLOPE STRIPPING LOG

Slope No.: NIL

Contract No.: GE/2001/13

Project: Agreement No. FD 01-052 Geotechnical Review and Site Investigation Works for Tseung Kwan O Landfill Stage II/III Afteruse Development Ground Investigation

Datum (toe) Co-ordinates: E 846813.08 N 817396.12 Level 125.94 mPD

Datum (crest) Co-ordinates: E 846814.66 N 817400.43 Level 131.37 mPD

Works Order No.: GE/2001/13.10

Excavated by: T.O. Yuen

Supervised by: T.M. Chow

Date Started / Excavation : 26/06/2002

Date Completed : 04/07/2002

Date Reinstated :

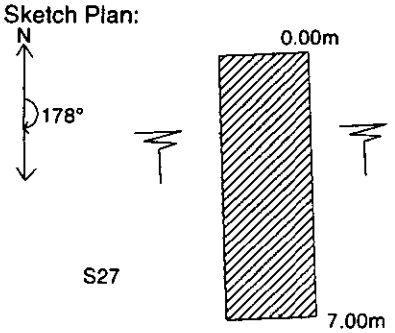
Sample or test	Distance from Datum (m)	Reduced Level (mPD)	Slope Angle	Description and Sample Data	Legend	Grade	Discontinuities: Dip/ Dip Direction	Discontinuities: Nature & Infilling
	0	131.37						
	0.80	130.75		Firm, dry, yellowish brown (10YR 5/8), sandy SILT with some angular to subangular cobble sized rock fragments. (COLLUVIUM)				
	1			Extremely weak to weak, dry, light grey (10Y 7/2) dappled brown, completely to highly decomposed, TRACHYDACITE LAVA. (Very stiff, slightly sandy SILT with some angular to subangular fine to coarse gravel and occasional cobble sized rock fragments)		V/IV		
	2							
	3							
	3.70	128.50	51°					
	4			Weak, dry, light grey dappled yellowish brown and grey, highly decomposed, TRACHYDACITE LAVA. Joints are closely spaced, rough planar and rough undulating, extremely narrow, iron and manganese oxide stained, sandy silt (<2mm) infilled.		IV	①075°/80° ②030°/60° ③108°/79° ④315°/86° ⑤038°/79° ⑥035°/72°	iron and manganese oxide
	5							
	5.60	127.02						
	6			Weak to extremely weak, dry, light grey (10Y 7/2) dappled yellowish brown, highly to completely decomposed, TRACHYDACITE LAVA. (Slightly sandy, silty angular fine to coarse GRAVEL and some cobble sized rock fragments)		IV/V	⑦248°/70° ⑧304°/60° ⑨060°/82° ⑩227°/68°	
	7 7.00	125.94		End of stripping at 7.00m.				
	8							
	9							
	10							
	11							
	12							
	13							
	14							
	15							
	16							

Remarks: Slope was covered by an average 65mm thick shotcrete with iron mesh at the base.

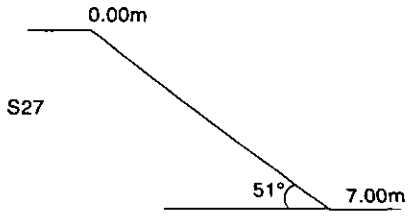
Symbol for Sample / Test:

- Small disturbed sample
- Large disturbed sample
- Block sample
- Insitu-density test
- m Moisture content test
- Water sample
- Seepage
- [ ] Photograph

Sketch Plan:



Sketch Section:



Logged by : K.L. Lo

Date Logged : 05/07/2002

Checked by : Tom Lo

Date Checked : 06/07/2002

Appendix B

Detailed Aerial Photograph Interpretations

B.1 DETAILED AERIAL PHOTOGRAPH INTERPRETATION

The following report comprises the detailed observations made from the examination of aerial photographs taken between 1924 and 2021. A list of aerial photographs examined in this study is presented in Table B1. The interpretations on geomorphology and man-made features are shown in Figure B1 to B21.

YEAR	**OBSERVATIONS**
1924 (Figure B1)	High altitude and poor resolution stereo pairs. The NTSA appears as southwest facing natural hillsides emerging from a northwest trending ridgeline below High Junk Peak. Due to the poor resolution of aerial photographs, the entire NTSA and the Site (proposed public riding school development area) appears as high reflectance, no detail observation can be examined.
1945 (Figure B2)	High altitude and fair resolution stereo pairs. The eastern and western boundary of the NTSA is bounded by indistinct rounded spurs. Several linear hollows, possibly ephemeral drainage lines DL1, DL2, DL3, DL4 and DL5 and their sub-ordinate drainage lines can be discerned within the NTSA. No perennial drainage line can be discerned within the NTSA. The area below the NTSA and the Site is extensively cultivated.
1956	Low altitude and fair resolution stereo pairs. No substantial change to the NTSA since 1945.
1963 (Figure B3, B4 & B5)	Low altitude and high resolution stereo pairs. The smooth surface of the NTSA indicates the NTSA is probably covered by in-situ materials without significant mass wasting process, possibly a thin layer veneer (< 2m thick) of hillslope colluvium blanket the majority of the hillsides within the NTSA. Valley colluvium is confined along the drainage lines. Small portion of intermittent rock outcrops can be discerned at the crest of the NTSA which located along the ridgeline at upper portion of Catchment Nos. CD3, OH5 and TD8. Rock cliff is present at the hillside behind the crest of the NTSA which facing northeast. <u>Ephemeral drainage lines:</u> Ten linear hollows, possibly ephemeral drainage lines DLl, DL2, DL3, DL4 and DL5 and sub-ordinate ephemeral drainage lines DL4.1, DL4.2, DL4.3,

YEAR	OBSERVATIONS

DL4.4 and DL4.5 are observed in Catchment Nos. TD1, CD1, CD2, CD3, TD7 and TD8. Drainage lines DL1, DL2, DL3 and DL5 are present at the lower half portion of Catchment Nos. TD1, CD1, CD2 and TD8 respectively. DL4 contains five sub-ordinate drainage lines, namely DL4.1, DL4.2, DL4.3, DL4.4 and DL4.5. Main drainage line DL4 flows from the top of Catchment No. CD3 towards the bottom of Catchment No. CD3; sub-ordinates drainage line DL4.1 is discerned approximately 20m away from the top of Catchment No. CD3, whilst DL4.2, DL4.3 and DL4.4 are apparent at the upper, middle and lower portion of Catchment No. CD3 respectively. DL4.5 is located along Catchment No. TD7. These five southwest trending drainage lines are running towards the toe of the NTSA. Sub-ordinate drainage lines DL4.1, DL4.2, DL4.3 and DL4.4 are generally west trending and flowing towards DL4 which finally converge towards the toe of the NTSA. Sub-ordinates DL4.5 is apparent as an individual southwest trending drainage line flowing towards the toe of the NTSA. However, DL4.5 was converging towards DL4 below the NTSA. DL1 and DL5 appeared to be subtle depression, whilst DL2 and DL3 is relatively incisive, DL4 is the most distinctive. This probably indicates more water concentrate along DL4 and therefore the erosion of DL4 is more active than the other four drainage lines. Some boulders, probably colluvial boulders are concentrated along DL4.

Topographic depressions:

Seven linear hollows were observed in Catchment Nos. TD2, TD3, TD4, TD5, TD6 and OH3. They are part of the head of ephemeral drainage lines or sub-drainage lines which located below the NTSA. Since they appeared as broad and subtle depressions, this indicate no significant water concentration and therefore the erosion activities are relatively small. These seven hollows within Catchment Nos. TD2, TD3, TD4, TD5, TD6 and OH3 can be regarded as minor topographic depressions.

Relict landslide scars within NTSA:

A break of slope and a concave depression is observed near the head of ephemeral sub-ordinate drainage line DL4.2, possibly instability (RL1) had taken place. The estimated landslide volume of RL1 is about $35m^3$. This location was possibly the ENTLI record no. 12SWA0004E. Another three concave depressions (RL2 to RL4) are discerned adjacent to RL1 which located at the crest of Catchment No. CD3. RL3 and RL4 are appeared as a spoon-shaped depression with distinct landslide trails whilst RL2 is a relatively subtle depression when compare with the other three landslides. RL3 and RL4 has an estimated failure volume of $29m^3$ and $18m^3$ respectively, whilst RL2 is about $24m^3$. However, RL2 may not be regarded as genuine landslide scar, further verification on site is required. RL2 and RL3 are possibly the locations of ENTLI record Nos. 12SWA0220E and 12SWA0005E respectively. RL4 does not recorded in the ENTLI.

Relict landslide scars to the east of NTSA:

Four broad and shallow concave depressions are observed adjacent to the upper portion of Catchment No. CD3, possibly four landslide incidents (RL5, RL6, RL7 and RL8) were occurred. RL5 is located at the NTSA boundary,

YEAR **OBSERVATIONS**

whilst another three depressions (RL6, RL7 and RL8) are apparent approximately 9m to 37m to the east of the upper portion of Catchment No. CD3. These four landslide scarps are very degraded which indicate probably were occurred for a long period of time. The estimated failure source volume of these four landslides is about 11m^3 to 37m^3. They are possibly registered as ENTLI Nos. 12SWA0341E, 12SWA0006E, 12SWA0007E and 12SWA0339E.

A distinct break of slope and depression is discerned on the bank of an ephemeral drainage line located outside the NTSA, which located approximately 20m to the south of the middle portion of Catchment No. TD8, probably represent a relict landslide scar, RL9. RL9 has a failure volume of about 30m^3 which is possibly the location of ENTLI No. 12SWA0273E.

Relict landslide scars below the NTSA:

Two concave depressions were apparent below the NTSA, probably two landslide events (RL10 and RL11) were occurred previously. RL10 is located approximately 52m below Catchment No. TD4 whilst RL11 is discerned 165m below Catchment No. OH2. RL10 apparent as a sharp break of slope, therefore the landslide scarp was distinct which indicated it has a relatively higher certainly and this relict landslide possibly happened in a more recently period of time. The depression of RL10 is relatively shallow and small in size, the failure volume estimated to be 16m^3. RL11 is observed at the head of a sub-ordinate drainage line. Its landslide source area appears more incisive than RL10. The estimated failure volume of RL11 is about 39m^3. RL10 and RL11 are possibly the locations of ENTLI Nos. 12SWA0198E and 12SWA0199E respectively.

Landslide scars adjacent to the Catchment OH1:

Ten concave depressions are evident in the adjacent catchment of Catchment No. OH1, which located approximately 170 to 345m to the west of the NTSA. They are probably relict landslides scars (RL12 to RL21). RL12 to RL15 are located on the bank of a drainage line which located outside the NTSA. They are hardly observed since broad and shallow depressions without obvious break of slope, therefore possibly have been degraded for a long period of time and the certainty of these landslide features are relatively low. The estimated failure volume is relatively small, about 10 m^3 to 30m^3. RL12 to RL15 are recorded as ENTLI Nos. 12SWA0195E, 12SWA0196E, 12SWA0197E and 12SWA0272E respectively. RL16 to RL21 are discerned on an open hillslope. They apparent as rounded scarps with very distinct linear-shaped landslide trails, therefore these six landslide features have a relatively higher certainty. Their failure source areas are relatively bigger and more incisive than RL12 to RL15, therefore RL16 to RL21 has a larger failure volume range between 30m^3 to 60m^3. The locations of RL16 to RL21 are registered as ENTLI Nos. 12SWA0017E, 12SWA0018E, 12SWA0194E, 12SWA0019E, 12SWA0021E and 12SWA0020E respectively.

Landslide scars adjacent to the Catchment TD8:

Eighteen concave depressions are apparent on the adjacent catchment of

YEAR **OBSERVATIONS**

Catchment No. TD8, which located approximately 190 to 670m to the south of the NTSA. They are probably relict landslides scars (RL22 to RL39). RL22 to RL29 are discerned immediately below the ridgeline. Their depression sizes are relatively broad, but most of them are located at the head of drainage lines, the suspected landslide scars are mostly rounded which is hardly to distinguish whether the depressions are related to the shape of the drainage lines or landslide failures, therefore the certainties are not too high. Geomorphologically, since these eight landslides were occurred on the over-steepened slopes immediately below the convex break of slope forming the boundary between the upper and lower landforms. These failures may be possibly part of the hillside retreat process. The estimated failure volumes of RL22 to RL29 are range in between $37m^3$ to $57m^3$. RL22 to RL29 are registered as ENTLI Nos. 12SWA0068E, 12SWA0069E, 12SWA0184E, 12SWA0183E, 12SWA0015E, 12SWA0179E, 12SWA0178E and 12SWA0016E respectively. Another ten landslides are evident in the lower portion of the catchment, namely RL30 to RL39. They have a smaller scale of depressions when compares to RL22 to RL29. Most of them are located on the bank of drainage lines or open hillslope which also apparent as sharper scars, therefore the certainty of RL30 to RL39 are relatively higher. The failure volumes of RL30 to RL39 are about $24m^3$ to $38m^3$. Locations of RL30 to RL39 are probably the location of ENTLI Nos. 12SWA0187E, 12SWA0188E, 12SWA0186E, 12SWA0185E, 12SWA0328E, 12SWA0182E, 12SWA0330E, 12SWA0329E, 12SWA0181E and 12SWA0180E respectively.

RL1 to RL39 are discerned in dark grey tone, therefore they may have been happened long period ago. Among these relict landslide scars, RL22, RL23 and RL24 are considered to have similar geological and geomorphological setting with the NTSA and their estimated failure volumes range from $37m^3$ to $39m^3$. All these landslide events are regarded as relict landslides. No recent landslide is present within or in the close vicinity of the NTSA.

A spot of high reflectance feature was existed at the upper portion of Catchment No. OH5, possibly grave.

Four high reflectance linear features were traversed within the NTSA, probably footpaths (FP1 to FP4). FP1 were present along the middle portion of Catchment No. CD3 downwards to the upper portion of Catchment Nos. TD7, OH5 and TD8. FP2 were discerned from the top of Catchment No. OH1 which run along the ridgeline across Catchment Nos. TD1, TD2, TD3, TD4, TD5, TD6, CD1, CD2, OH3 and finally CD3 adjoining FP1. FP3 was relatively less reflective, possibly lightly in use when compares to FP1 and FP2. It apparent at the top of Catchment No. TD6 then passed through Catchment Nos. CD1, OH2, CD2 and along the toe of Catchment Nos. OH3, CD3, OH4, TD7, OH5 and TD8. FP4 existed along the ridgeline which located at the crest of the NTSA.

The agricultural terraces and farmlands observed below the NTSA in year 1945 were still actively in use. Many cottages were constructed around the agricultural terraces and farmlands.

YEAR	OBSERVATIONS
	Morphologically, a convex change of slope is discerned immediately below the ridgeline which bounded the upper boundary of the NTSA. The convex change of slope is discerned at about +142mPD at Catchment No. OH1 and then extend up to about +234mPD at Catchment No. CD3. Another distinct convex change of slope is apparent at approximately +228mPD which located along the upper portion of Catchment Nos. TD7, OH5 and TD8. These convex changes of slope demarcate the upper and middle slope terrain. The upper slope terrain comprises of gentle slope with gradient less than 20° whilst the transportation middle slope terrain comprises of relatively steeper slope with gradient lies in between 25° to 35°.
1964	High altitude and high resolution stereo pairs. No observable significant change to the NTSA since 1963.
1967	High altitude and high resolution stereo pairs. Most of the NTSA was obscured by cloud. No observable significant change to the visible portion of the NTSA since 1963.
1973 (Figure B6)	High altitude and high resolution stereo pairs. No observable significant change to the NTSA since 1967. Two high reflectance concave depressions are discerned approximately 415m and 535m adjacent to Catchment No. TD8, bare soil without any vegetation is observed, probably recent landslides (RC1 and RC2) occurred recently. RC1 is located on a topographic depression whilst RC2 located on the bank of a drainage line, both of them appears as shallow depressions. The estimated failure volumes of RC1 and RC2 are about $20m^3$ and $25m^3$ respectively. These two locations are registered as ENTLI Nos. 12SWA0376E (RC1) and 12SWA0377E (RC2). A new footpath (FP5) is formed along the eastern boundary of the NTSA which traversed along the spurline from the top of Catchment No. CD3 downslope to the top of Catchment No. TD8 which adjoining FP1.
1974	Low altitude and high resolution stereo pairs. No significant changes could be observed since 1973.
1975 (Figure B7)	High altitude and high resolution stereo pairs.

YEAR	OBSERVATIONS
	No observable significant change to the NTSA since 1967.
	A very shallow depression is evident on an open hillslope at about 102m below Catchment No. OH1. It is highly reflective bare soil surface without any vegetation, possibly recent landslide RC3. The failure area is relatively small and therefore the estimated source volume is only about $10m^3$. This is probably the location of ENTLI No. 12SWA0378E.
	An elongated depression is apparent along a drainage line which located approximately 477m adjacent to Catchment No. TD8. It is highly reflective, bare soil is observed, probably a channelized debris flow (RC4) was occurred very recently due to no vegetation is present. The source area is narrow but long in shaped, and it is relatively incisive when compares to RC3. RC4 has an estimated failure volume of $40m^3$. This recent landslide event is registered as ENTLI No. 12SWA0380E.
1976	High altitude and high resolution stereo pairs.
	No significant changes could be observed since 1975.
1978	High altitude and high resolution stereo pairs.
	No significant changes could be observed since 1976.
1979	High altitude and high resolution stereo pairs.
	No significant changes could be observed since 1978.
1980	Low altitude and high resolution stereo pairs.
	No significant changes could be observed since 1979.
1981	High altitude and high resolution stereo pairs.
	No significant changes could be observed since 1980.
1982	High altitude and high resolution stereo pairs.
	No significant changes could be observed since 1981.
1983	Low altitude and high resolution stereo pairs.
	No significant changes could be observed since 1982.

YEAR	OBSERVATIONS
1984	High altitude and high resolution stereo pairs. No significant changes could be observed since 1983.
1985 (Figure B8 & B9)	Low altitude and high resolution stereo pairs. Part of the NTSA does not cover by these stereo pairs. Several tiny high reflectance features are present below Catchment Nos. TD2, OH2, OH3 and TD7. Bare soil is observed, sharp break of slopes are discerned within the bare soil features. This is possibly due to minor excavation by anthropogenic activities, the excavated soil were then dumped and pushed downslope which formed the soil trails. The boundary in between the excavated areas and the soil trails formed the convex break of slopes. These locations are possibly the trial pit locations of TP12, TP13, TP14, TP15 and TP16 under GIU No. 05553. The upper portion of Catchment Nos. TD7, OH5 and TD8 were appeared as lighter tone, bare soil is observed, possibly due to hill fire.
1986	Low altitude and high resolution stereo pairs. No observable significant change to the NTSA since 1985.
1987	Low altitude and high resolution stereo pairs. No observable significant change to the NTSA since 1986.
1988 (Figure B10)	Low altitude and high resolution stereo pairs. No observable significant change to the NTSA since 1987 except some vegetation grew on the slope surface. The agricultural terraces and cottages located below the NTSA were demolished. Site formation and reclamation works were commenced below the NTSA, probably the area was begun to use as landfill site.
1989 (Figure B11)	Low altitude and high resolution stereo pairs. Three highly reflective white spot features are discerned at the lower portion of Catchment Nos. TD5, OH2 and OH3. Bare soil is observed. The locations within Catchment Nos. OH2 and OH3 are possibly the Borehole locations of BH17 and BH18 under GIU No. 12800. The bare soil existed in Catchment No. TD5 appeared as rounded bare soil surface and thus likely created by anthropogenic activities, possibly this was an inspection pit for the proposed

YEAR	OBSERVATIONS
	ground investigation, but no ground investigation record could be found at that location, possible the proposed GI station has been deleted. The site formation works below the NTSA was ongoing, the area was continued to serve as landfill site.
1990 (Figure B12)	High altitude and high resolution single photograph. No observable significant change to the NTSA since 1989. A linear feature, probably catchwater is aligned along the toe of the NTSA. Formation of eight man-made cut slopes were commenced along the toe of the NTSA, probably in association with the alignment of the catchwater. They were registered as Feature Nos. 12SW-A/C178, 12SW-A/C182, 12SW-A/C183, 12SW-A/C184, 12SW-A/C185, 12SW-A/C186, 12SW-A/C187 and 12SW-A/C188. A cross-shaped features are apparent in the middle portion of Catchment No. OH3. It was located at the intersection of two footpaths, possibly a resting place or sign indicator for hikers.
1991	Low altitude and high resolution stereo pairs. Formation of feature Nos. 12SW-A/C178, 12SW-A/C182, 12SW-A/C183, 12SW-A/C184, 12SW-A/C185, 12SW-A/C186, 12SW-A/C187 and 12SW-A/C188 were ongoing. The area below the NTSA was continued to serve as landfill site.
1992 (Figure B13)	Low altitude and high resolution stereo pairs. A small patch of high reflectance bare soil is observed at the upper portion of Catchment No. CD3, possible a grave was constructed. Formation of feature Nos. 12SW-A/C178, 12SW-A/C182, 12SW-A/C183, 12SW-A/C184, 12SW-A/C185, 12SW-A/C186, 12SW-A/C187 and 12SW-A/C188 were completed. A cut slope was formed below Catchment Nos. TD7 and OH5, probably in association with the extension of the landfill site. This man-made slope was registered as Feature No. 12SW-A/C227. The area below the NTSA was continued to serve as landfill site.

YEAR	OBSERVATIONS
1993	Low altitude and high resolution stereo pairs. No observable significant change to the NTSA since 1992 except footpath FP1 was partially widened. The area below the NTSA was continued to serve as landfill site.
1994 (Figure B14)	Low altitude and high resolution stereo pairs. Entire footpath FP1 was being widened. The landfill site located below the NTSA is apparent as being filled up and the surface was smoothened. It was probably closed and no longer in use. The Site area is filled up as a platform.
1995 (Figure B15)	Low altitude and high resolution colour stereo pairs. No observable significant change to the NTSA since 1994. Eight man-made fill slopes were formed at the former landfill site which located below the NTSA. Man-made drainage channels are formed on the slope surfaces. They are registered as Feature Nos. 12SW-A/F67, 12SW-A/F68, 12SW-A/F69, 12SW-A/F70, 12SW-A/F72, 12SW-A/F73, 12SW-A/F74 and 12SW-A/F96.
1996 (Figure B16)	Low altitude and high resolution stereo pairs. Many linear features are apparent parallel to the contour lines in Catchment Nos. TD6, CD1, OH2, CD2, OH3 and CD3. A very thin layer of surface soil may be disturbed along these linear features by anthropogenic activities, possibly plantation.
1997 (Figure B17)	Low altitude and high resolution colour photograph. No observable significant change to the NTSA since 1996. The linear features observed in year 1996 were no longer observable.
1998	Low altitude and fair resolution colour photograph. Part of the NTSA was obscured by cloud. No observable significant change to the NTSA since 1997.
1999	Low altitude and high resolution colour stereo pairs.

YEAR	OBSERVATIONS
	No observable significant change to the NTSA since 1998.
2000	Low altitude and high resolution colour stereo pairs.
	No observable significant change to the NTSA since 1999.
2001	Low altitude and high resolution colour stereo pairs.
	No observable significant change to the NTSA since 2000 except some vegetation grew on the slope surface.
2002	Low altitude and high resolution colour stereo pairs.
	No observable significant change to the NTSA since 2001.
2003	Low altitude and fair resolution colour stereo pairs.
	No observable significant change to the NTSA since 2002.
2004 (Figure B18)	Low altitude and high resolution colour stereo photo.
	The upper portion of Catchment Nos. CD3, TD7, OH5 and TD8 are apparent as grey tone, possibly hill fire was occurred.
	A linear feature is discerned at the Site area, probably it is used as model aeroplane training field.
2005	Low altitude and high resolution colour stereo photo.
	No observable significant change to the NTSA since 2004.
2006	Low altitude and high resolution colour stereo pairs.
	No observable significant change to the NTSA since 2005 except denser vegetation grew on the slope surface.
2007	Low altitude and high resolution stereo pairs.
	No observable significant change to the NTSA since 2006 except denser vegetation grew on the slope surface.
2008	Low altitude and high resolution colour stereo pairs.
	No observable significant change to the NTSA since 2007 except denser

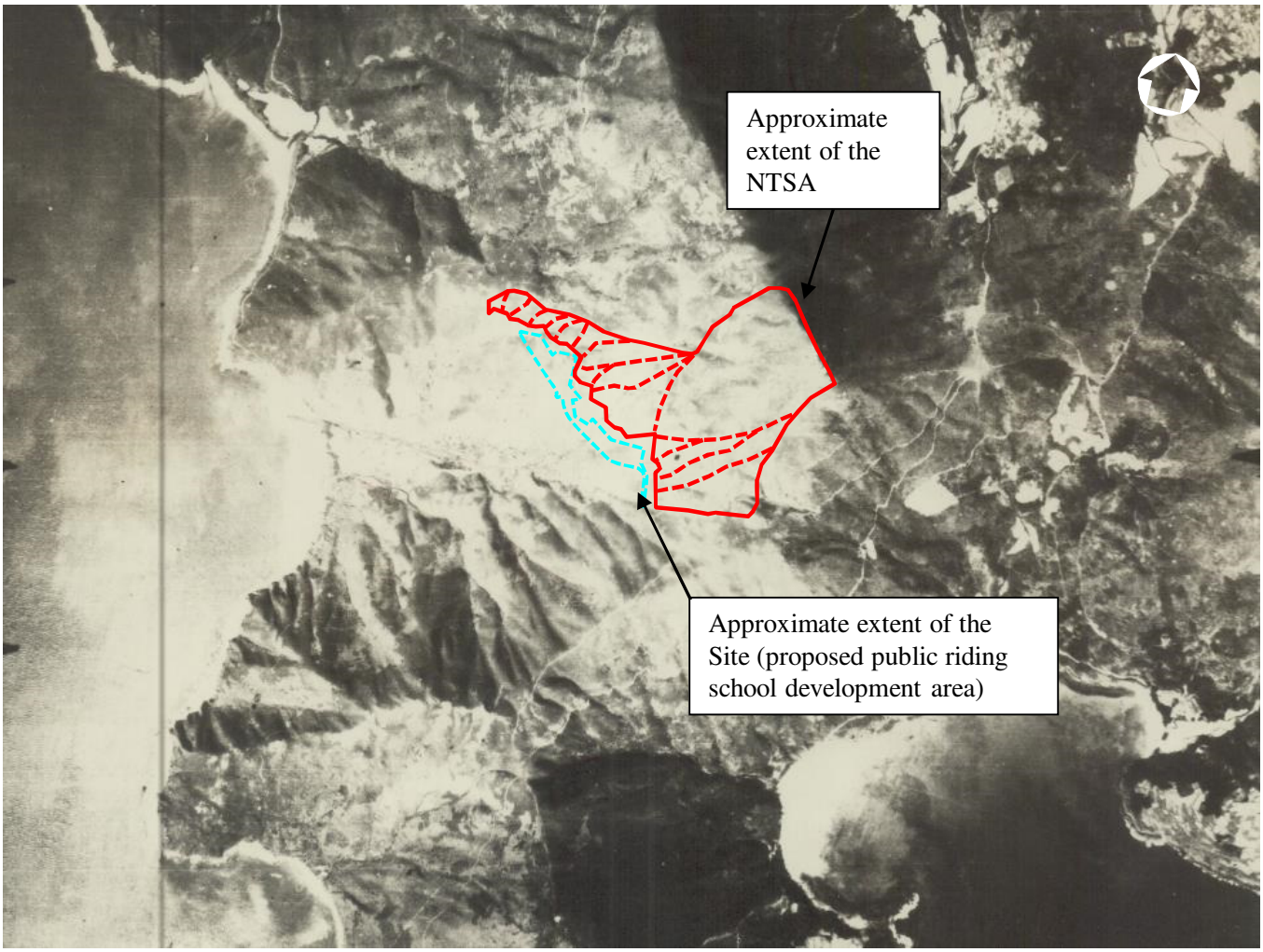
YEAR	OBSERVATIONS
	vegetation grew on the slope surface.
2009	Low altitude and high resolution colour stereo pairs.
	No observable significant change to the NTSA since 2008 except denser vegetation grew on the slope surface.
2010	Low altitude and high resolution colour stereo pairs.
	No observable significant change to the NTSA since 2009 except denser vegetation grew on the slope surface.
2011	Low altitude and high resolution colour stereo pairs.
	No observable significant change to the NTSA since 2010 except denser vegetation grew on the slope surface.
2012	Low altitude and high resolution colour stereo pairs.
	The stereo pairs only covered part of the NTSA. No observable significant change to the NTSA since 2011.
2013	Low altitude and high resolution colour stereo pairs.
	No observable significant change to the NTSA since 2012 except denser vegetation grew on the slope surface.
2014	Low altitude and high resolution colour stereo pairs.
	No observable significant change to the NTSA since 2013 except denser vegetation grew on the slope surface.
2015	Low altitude and high resolution colour stereo pairs.
	No observable significant change to the NTSA since 2014 except denser vegetation grew on the slope surface.
2016	Low altitude and high resolution colour stereo pairs.
	No observable significant change to the NTSA since 2015 except denser vegetation grew on the slope surface.
2017	Low altitude and high resolution colour stereo pairs.
	No observable significant change to the NTSA since 2016 except denser

YEAR	OBSERVATIONS
	vegetation grew on the slope surface.
2018 (Figure B19)	Low altitude and high resolution colour stereo pairs. No observable significant change to the NTSA since 2017 except vegetation clearance by anthropogenic activities at the upper portion of Catchment Nos. CD3 and OH5.
2019	Low altitude and high resolution colour stereo pairs. No observable significant change to the NTSA since 2018 except denser vegetation grew on the slope surface.
2020	Low altitude and high resolution colour stereo pairs. No observable significant change to the NTSA since 2019 except denser vegetation grew on the slope surface.
2021	Low altitude and high resolution colour stereo pairs. No observable significant change to the NTSA since 2020 except denser vegetation grew on the slope surface.

Table B1 – List of Photographs

Photo Year	Aerial Photo Reference No.	Flight Altitude (Feet)
1924	Y00031-2	12,500
1945	Y00433-4	20,000
1956	Y03253-4	-
1963	Y08354-5	3,900
1963	Y08392-3	3,900
1964	Y12906-7	12,500
1967	Y13343-4	6,250
1973	8037-8	12,500
1974	9304-5	4,000
1975	12055-6	12,500
1976	15928-9	12,500
1978	20763-4	12,500
1979	28028-9	10,000
1980	29753-5	4,000
1981	39036-7	10,000
1982	44514-5	10,000
1983	47499-501	4,000
1984	56489-90	11,000
1985	65987-8	4,000
1986	A04254-5	4,000
1987	A08668-9	4,000
1988	A12790-1	4,000
1989	A16793-4	4,000
1990	A24427-8	10,000
1991	A27706-7	4,000
1992	A32762-4	4,000
1993	A37382-3	4,000
1994	A39049-50	4,000
1995	CN10018-9	3,500
1996	A42220-1	4,000
1997	CN17110-1	4,000
1998	CN21383-4	4,000
1999	CN25165-6	4,000
2000	CN26669-70	4,000
2001	CW34867-8	4,000
2002	CW39242-3	3,000
2003	CW47869-70	4,000

Photo Year	Aerial Photo Reference No.	Flight Altitude (Feet)
2004	CW62910-1	4,000
2005	CW67596-7	4,000
2006	CS02206-8	6,000
2007	CS09051-2	6,000
2008	CS20259-60	6,000
2009	CS23448-9	6,000
2010	CS30143-4	6,000
2011	CW89762-4	3,000
2012	CW94555-6	2,000
2013	CS44655-7	6,000
2014	CS47084-6	6,000
2015	CS55027-9	6,000
2016	CS62116-7	6,000
2017	E027935-6C	6,900
2018	E046899-900C	6,900
2019	E079751-3C	6900
2020	E117651-3C	6,900
2021	E118313-5C	6,900



Photograph No.: Y00032 **Date of Photograph: 1924** **Altitude: 12,500'**

Legend:

Approximate Boundary of the NTSA

Catchment Boundary

Approximate Boundary of the Site (Proposed public riding school development area)

- The NTSA appears as southwest facing natural hillsides emerging from a northwest trending ridgeline below High Junk Peak.
- Due to the poor resolution of aerial photographs, the entire NTSA and the Site (proposed public riding school development area) appears as high reflectance, no detail observation can be examined.

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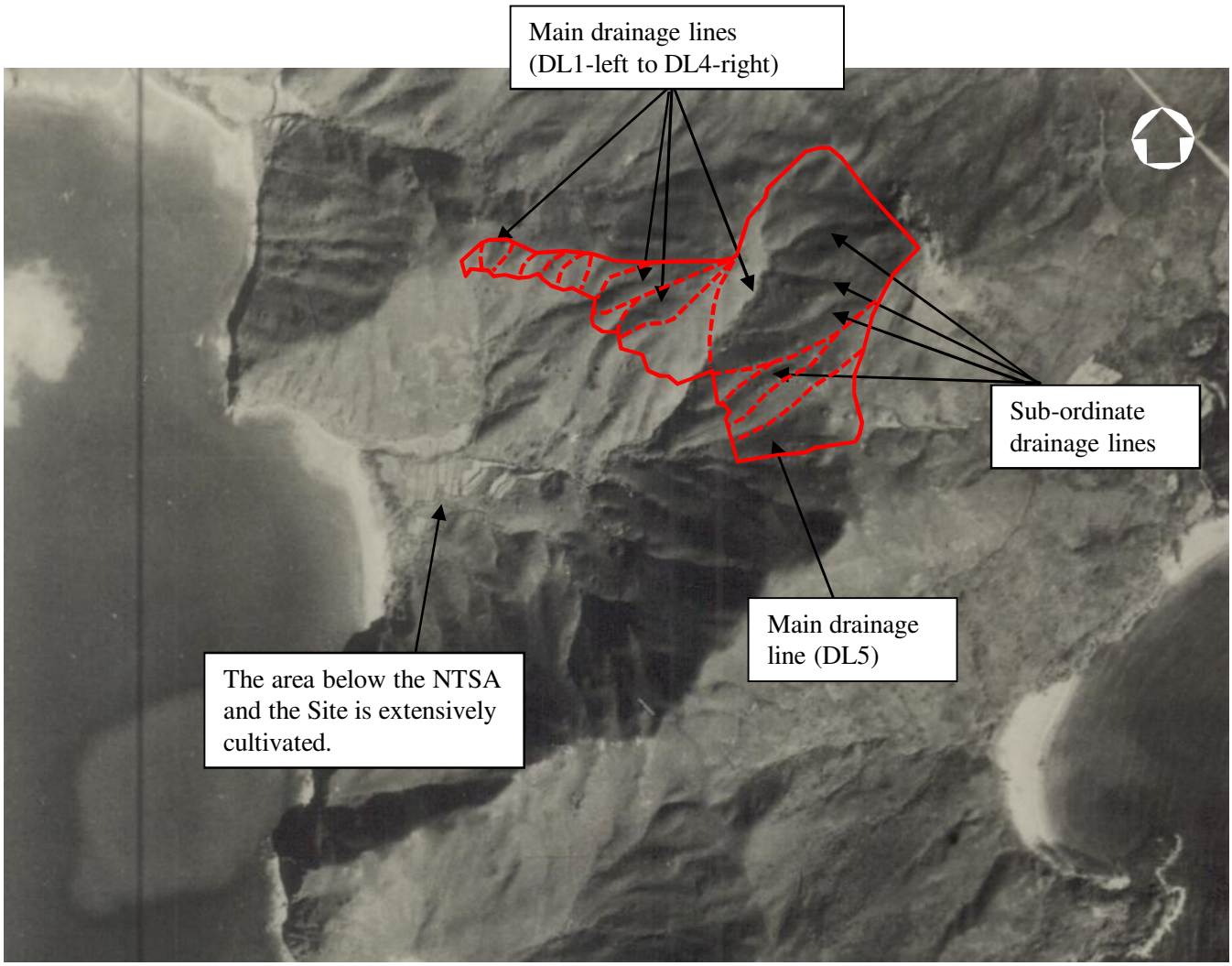
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FIGURE B1

Location
Landfill Site II/III, Tseung Kwan O

Scale NTS

Date 29 May 2022



Photograph No.: Y00433 **Date of Photograph: 11 Nov 1945** **Altitude: 20,000'**

Legend: Approximate Boundary of the NTSA Catchment Boundary

- The eastern and western boundary of the NTSA is bounded by indistinct rounded spurs.
- Several linear hollows, possibly ephemeral drainage lines DL1, DL2, DL3, DL4 and DL5 and their sub-ordinate drainage lines are observed within the NTSA.
- No perennial drainage line can be discerned within the NTSA.
- The area below the NTSA and the Site is extensively cultivated.

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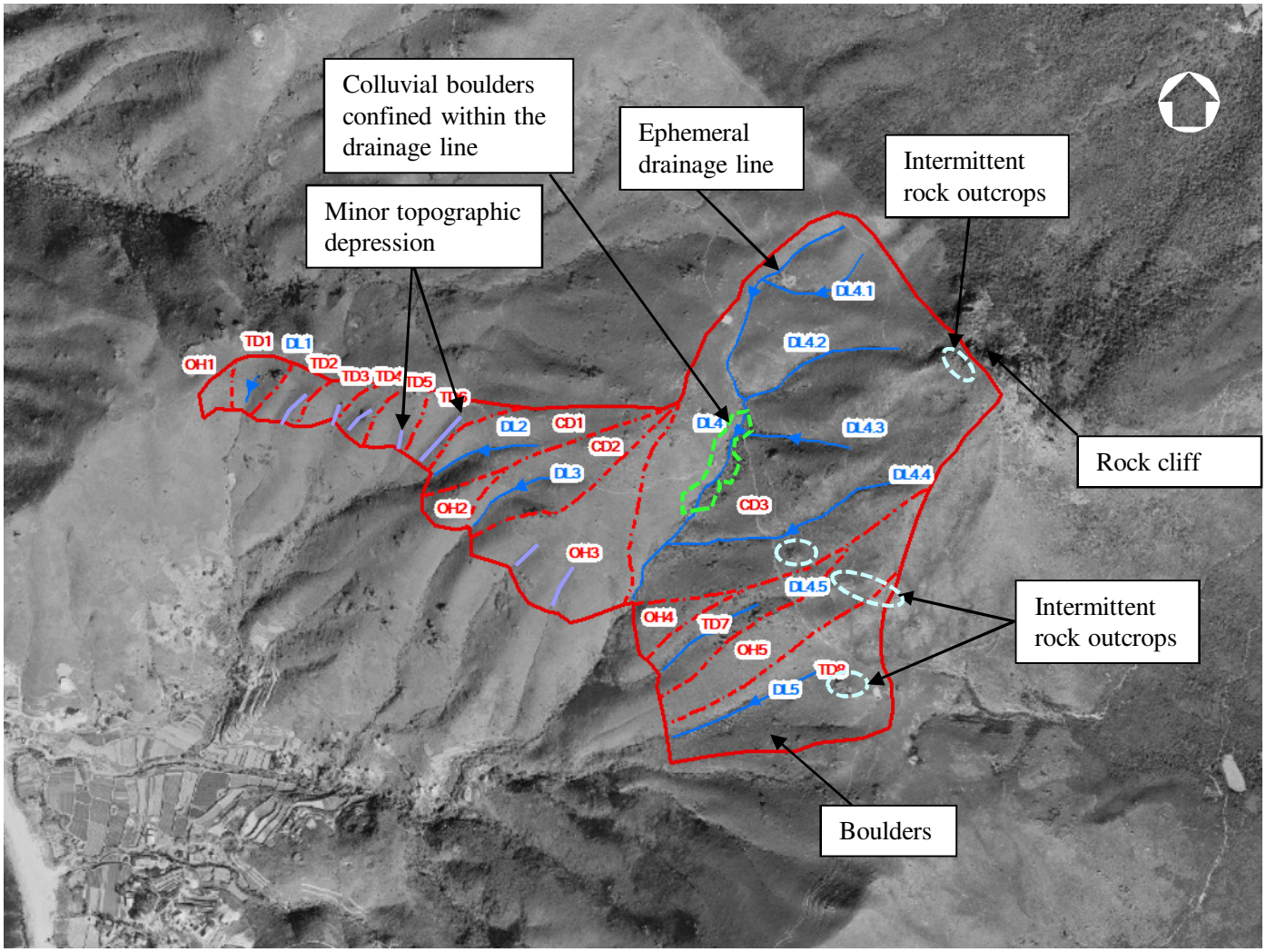
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FIGURE B2

Location
Landfill Site II/III, Tseung Kwan O

Scale NTS

Date 29 May 2022



Photograph No.: Y08354 **Date of Photograph: 17 Feb 1963** **Altitude: 3,900'**

Legend:

Approximate Boundary of the NTSA

Catchment Boundary

Intermittent rock outcrop

Colluvial boulders

Ephemeral drainage line

Minor topographic depression

- The smooth surface of the NTSA indicates the NTSA is probably covered by in-situ materials without significant mass wasting process, possibly a thin layer veneer (< 2m thick) of hillslope colluvium blanket the majority of the hillsides within the NTSA. Valley colluvium is confined along the drainage lines.
- Intermittent rock outcrops are discerned at the crest of the NTSA which located along the ridgeline at upper portion of Catchment Nos. CD3, OH5 and TD8. Some boulder fields were deposited at the middle portion of Catchment Nos. CD3.
- DL1 and DL5 appeared to be subtle depression, whilst DL2 and DL3 is relatively incisive, DL4 is the most distinctive. This probably indicates more water concentrate along DL4 and therefore the erosion of DL4 is more active than the other four drainage lines. Some boulders, probably colluvial boulders are concentrated along DL4.
- Morphologically, a convex change of slope is discerned immediately below the ridgeline which bounded the upper boundary of the NTSA. The convex change of slope is discerned at about +142mPD at Catchment No. OH1 and then extend up to about +234mPD at Catchment No. CD3. Another distinct convex change of slope is apparent at approximately +228mPD which located along the upper portion of Catchment Nos. TD7, OH5 and TD8. These convex changes of slope demarcate the upper and middle slope terrain. The upper slope terrain comprises of gentle slope with gradient less than 20° whilst the transportation middle slope terrain comprises of relatively steeper slope with gradient lies in between 25° to 35°.

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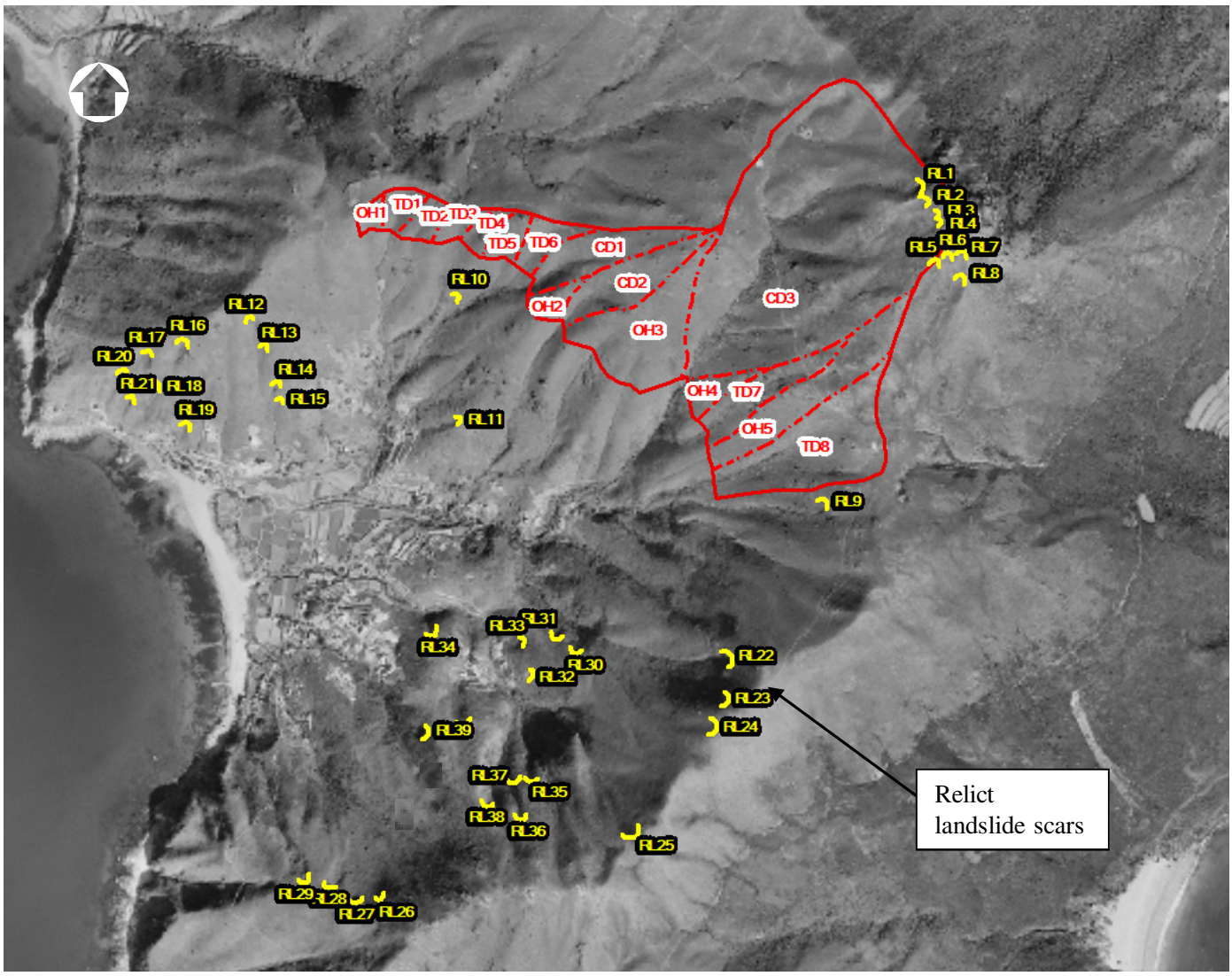
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FIGURE B3

Location
Landfill Site II/III, Tseung Kwan O

Scale NTS

Date 29 May 2022



Photograph No.: Y08354 **Date of Photograph: 17 Feb 1963** **Altitude: 3,900'**

Legend:

Approximate Boundary of the NTSA

Catchment Boundary

Relict landslide scar

- RL1 to RL39 are discerned in dark grey tone, therefore they probably occurred in a long period ago. All these landslide events are regarded as relict landslides.
- No recent landslide is discerned within or in the close vicinity of the NTSA.

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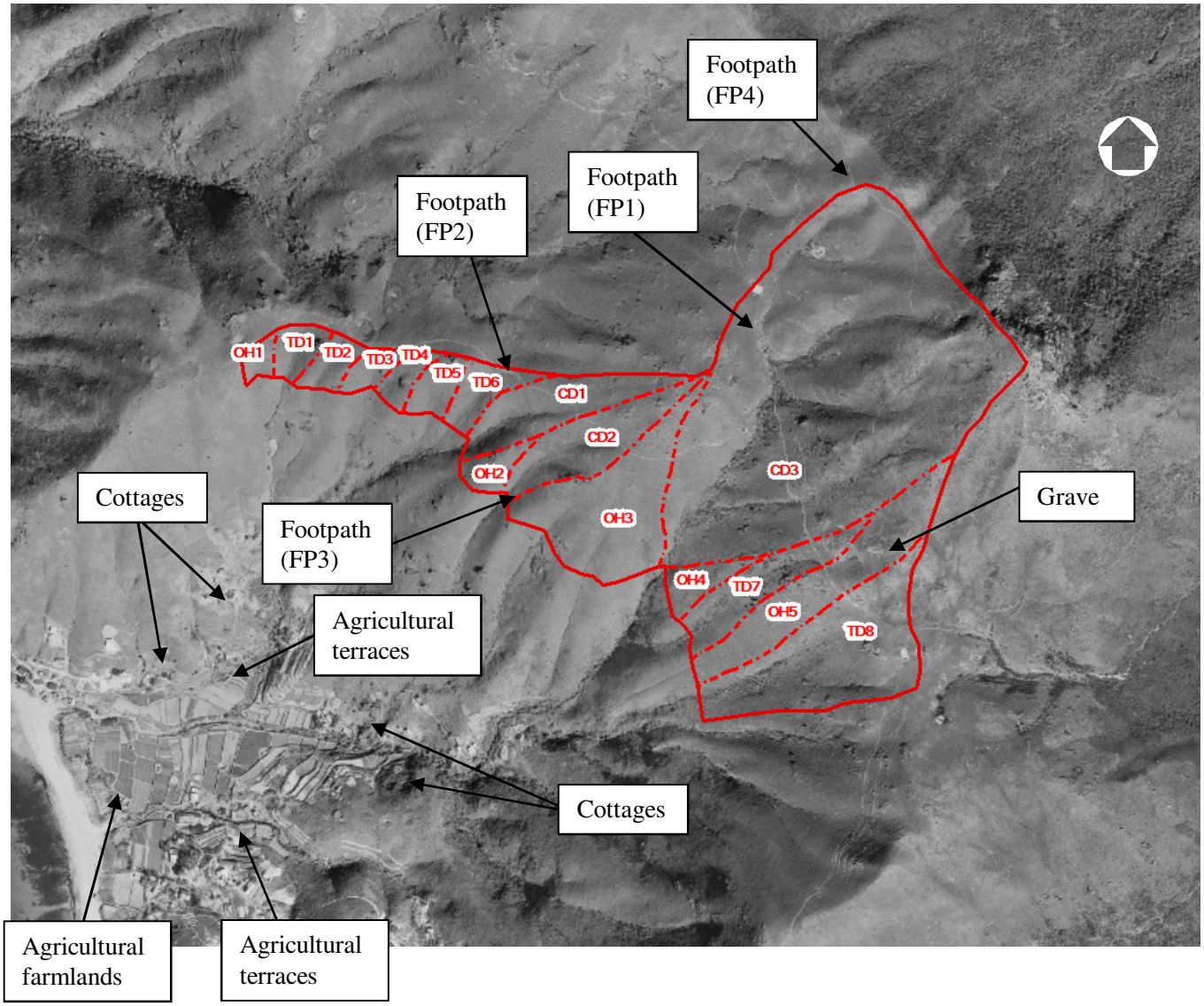
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FIGURE B4

Location
Landfill Site II/III, Tseung Kwan O

Scale NTS

Date 29 May 2022



Photograph No.: Y08354 **Date of Photograph: 17 Feb 1963** **Altitude: 3,900'**

Legend: Approximate Boundary of the NTSA — Catchment Boundary

- A spot of high reflectance feature was existed at the upper portion of Catchment No. OH5, possibly grave.
- Four high reflectance linear features were traversed within the NTSA, probably footpaths (FP1 to FP4). FP1 were present along the middle portion of Catchment No. CD3 downwards to the upper portion of Catchment Nos. TD7, OH5 and TD8. FP2 were discerned from the top of Catchment No. OH1 which run along the ridgeline across Catchment Nos. TD1, TD2, TD3, TD4, TD5, TD6, CD1, CD2, OH3 and finally CD3 adjoining FP1. FP3 was relatively less reflective, possibly lightly in use when compares to FP1 and FP2. It apparent at the top of Catchment No. TD6 then passed through Catchment Nos. CD1, OH2, CD2 and along the toe of Catchment Nos. OH3, CD3, OH4, TD7, OH5 and TD8. FP4 existed along the ridgeline which located at the crest of the NTSA.
- The agricultural terraces and farmlands observed below the NTSA in year 1945 were still actively in use.
- Many cottages were constructed around the agricultural terraces and farmlands.

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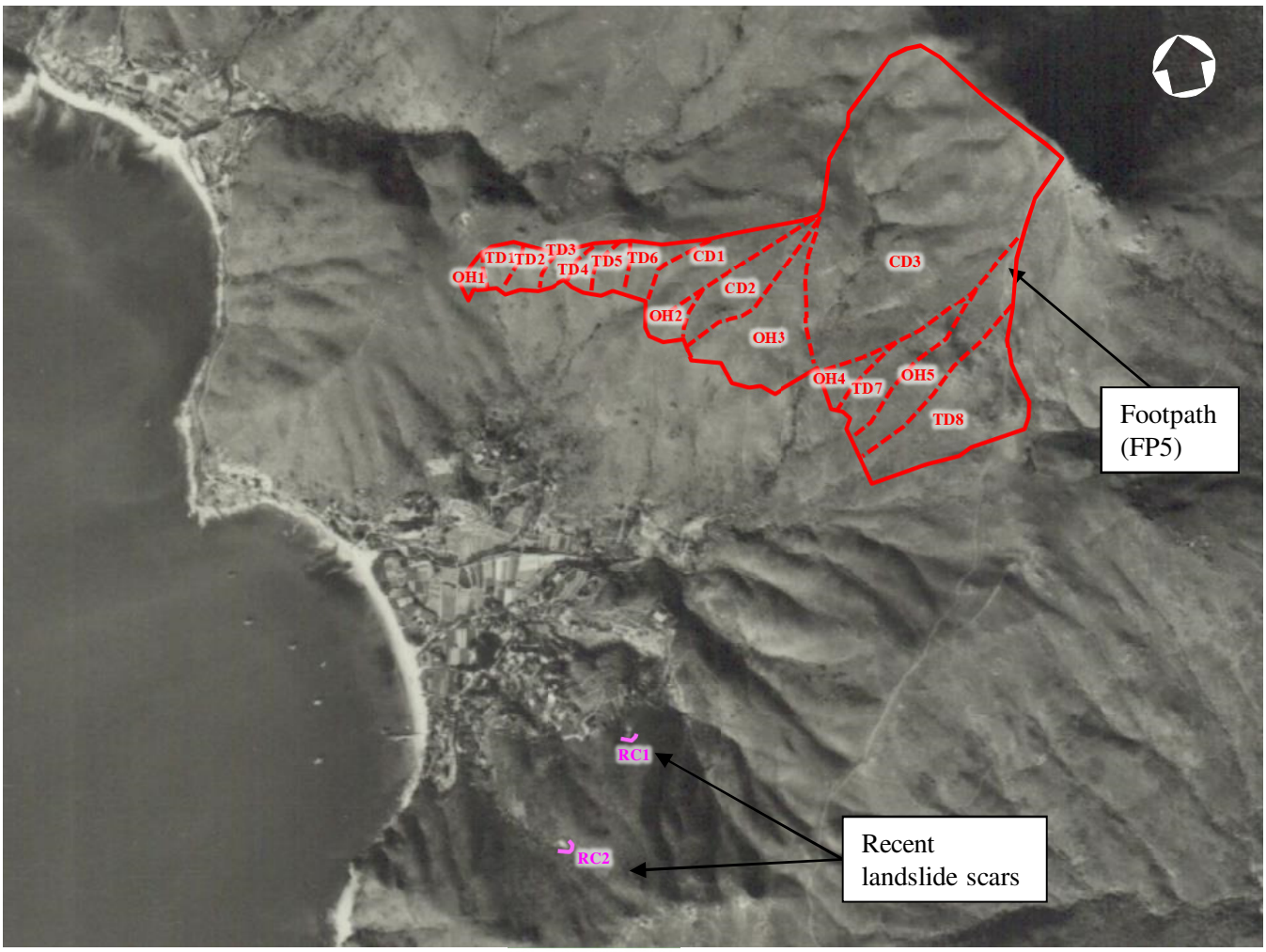
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FIGURE B5

Location
Landfill Site II/III, Tseung Kwan O

Scale NTS

Date 29 May 2022



Photograph No.: 8038 **Date of Photograph: 20 Dec 1973** **Altitude: 12,500'**

Legend:

Approximate Boundary of the NTSA

Catchment Boundary

Recent landslide scar

- Two high reflectance concave depressions are discerned approximately 415m and 535m adjacent to Catchment No. TD8, bare soil without any vegetation is observed, probably recent landslides (RC1 and RC2). RC1 is located on a topographic depression whilst RC2 located on the bank of a drainage line, both of them appears as shallow depressions. The estimated failure volumes of RC1 and RC2 are about 20m³ and 25m³ respectively. These two locations are registered as ENTLI Nos. 12SWA0376E (RC1) and 12SWA0377E (RC2).
- A new footpath (FP5) is formed along the eastern boundary of the NTSA which traversed along the spurline from the top of Catchment No. CD3 downslope to the top of Catchment No. TD8 which adjoining FP1.

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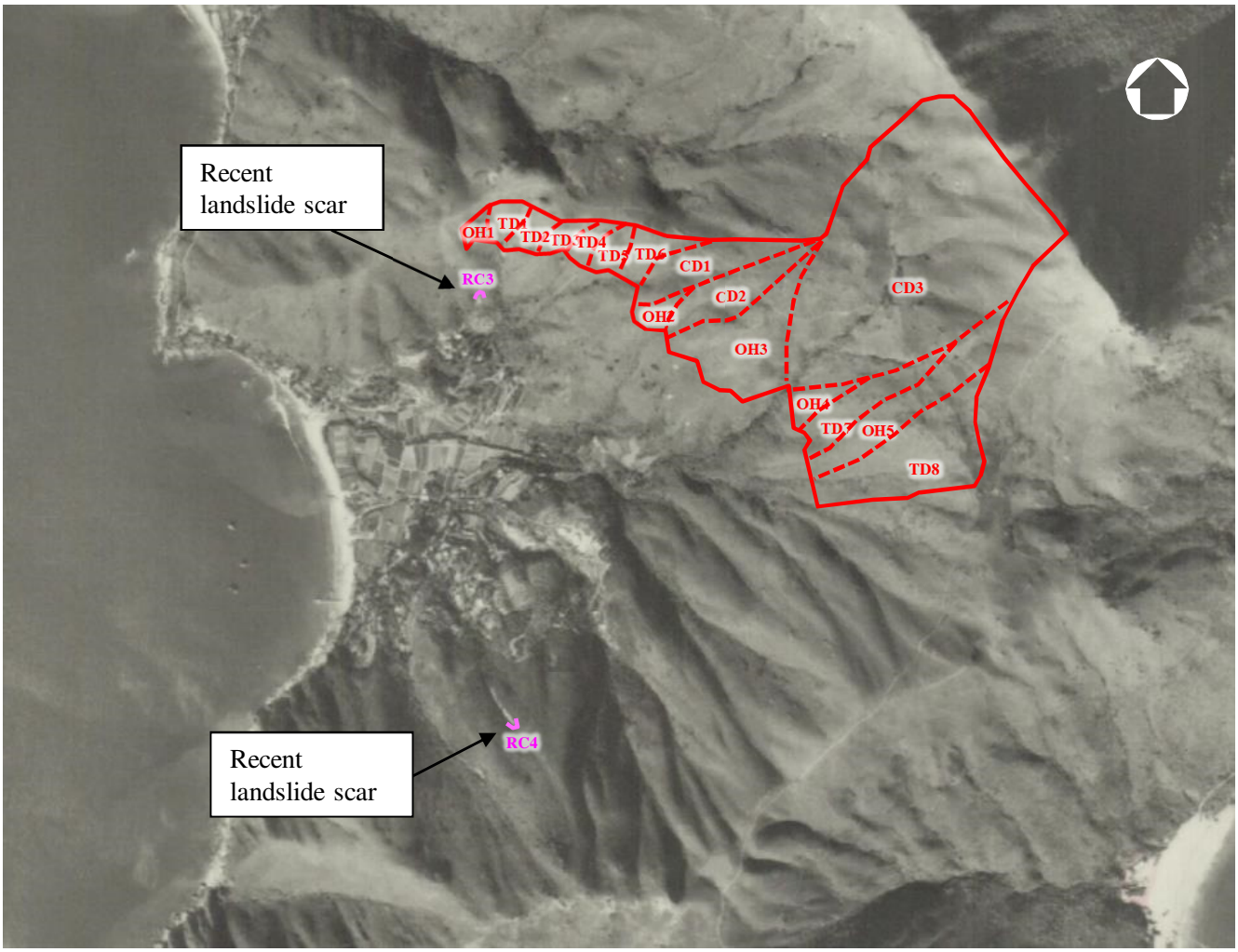
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FIGURE B6

Location
Landfill Site II/III, Tseung Kwan O

Scale NTS

Date 29 May 2022



Photograph No.: 12055 **Date of Photograph: 24 Dec 1975** **Altitude: 12,500'**

Legend: Approximate Boundary of the NTSA; Catchment Boundary; Recent landslide scar

- A very shallow depression is evident on an open hillslope at about 102m below Catchment No. OH1. It is highly reflective bare soil surface without any vegetation, possibly recent landslide RC3. The failure area is relatively small and therefore the estimated source volume is only about 10m³. This is probably the location of ENTLI No. 12SWA0378E.
- An elongated depression is apparent along a drainage line which located approximately 477m adjacent to Catchment No. TD8. It is highly reflective, bare soil is observed, probably a channelized debris flow (RC4) was occurred very recently due to no vegetation is present. The source area is narrow but long in shaped, and it is relatively incisive when compares to RC3. RC4 has an estimated failure source volume of 40m³. This recent landslide event is registered as ENTLI No. 12SWA0380E.

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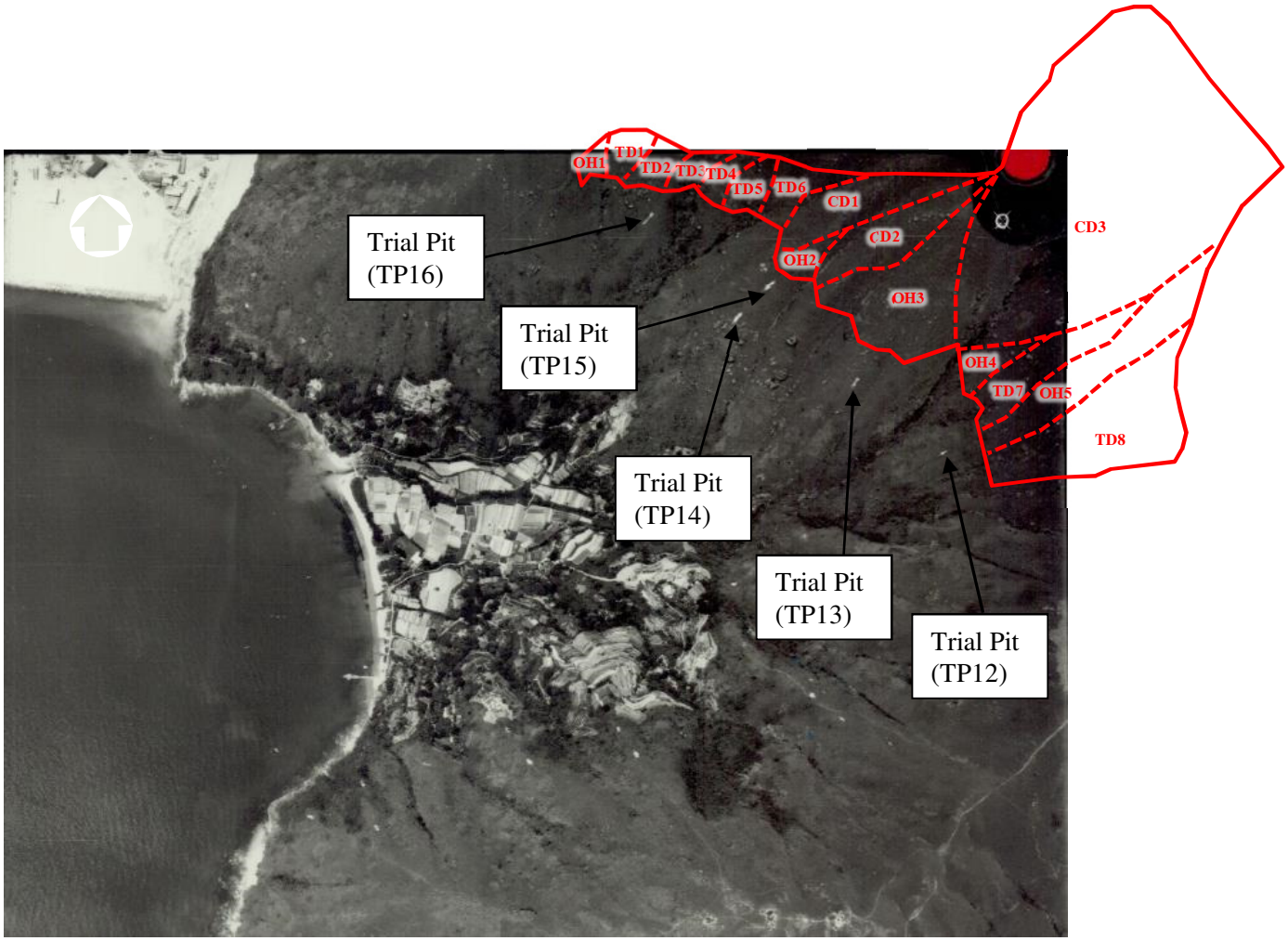
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FIGURE B7

Location: Landfill Site II/III, Tseung Kwan O

Scale: NTS

Date: 29 May 2022



Photograph No.: 65988 **Date of Photograph: 24 Apr 1985** **Altitude: 4,000'**

Legend: Approximate Boundary of the NTSA Catchment Boundary

- Several tiny high reflectance features are present below Catchment Nos. TD2, OH2, OH3 and TD7. Bare soil is observed, sharp break of slopes are discerned within the bare soil features. This is possibly due to minor excavation by anthropogenic activities, the excavated soil were then dumped and pushed downslope which formed the soil trails. The boundary in between the excavated areas and the soil trails formed the convex break of slopes. These locations are possibly the trial pit locations of TP12, TP13, TP14, TP15 and TP16 under GIU No. 05553.

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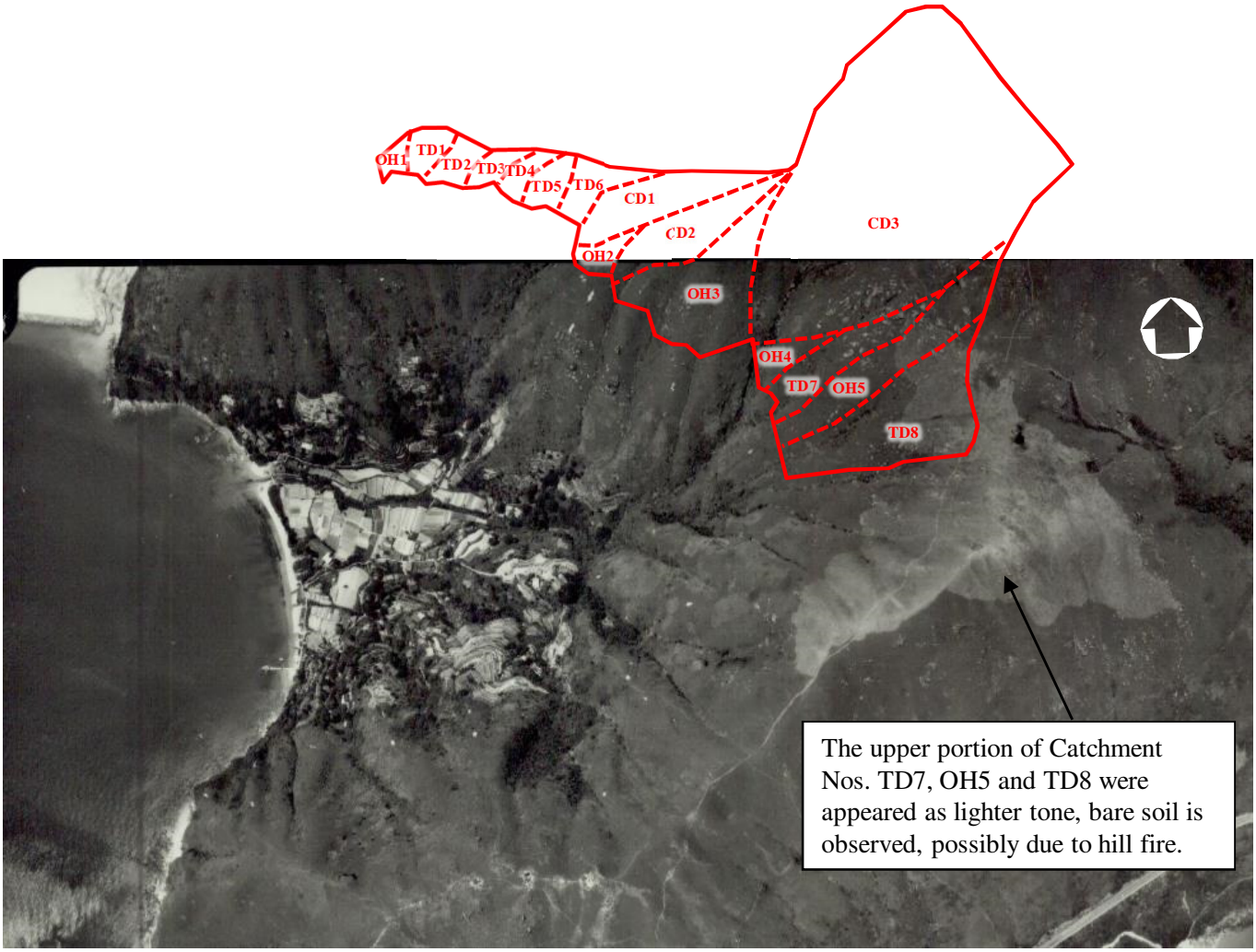
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FIGURE B18

Location
Landfill Site II/III, Tseung Kwan O

Scale NTS

Date 29 May 2022



Photograph No.: 65987 **Date of Photograph: 24 Apr 1985** **Altitude: 4,000'**

Legend: Approximate Boundary of the NTSA — Catchment Boundary

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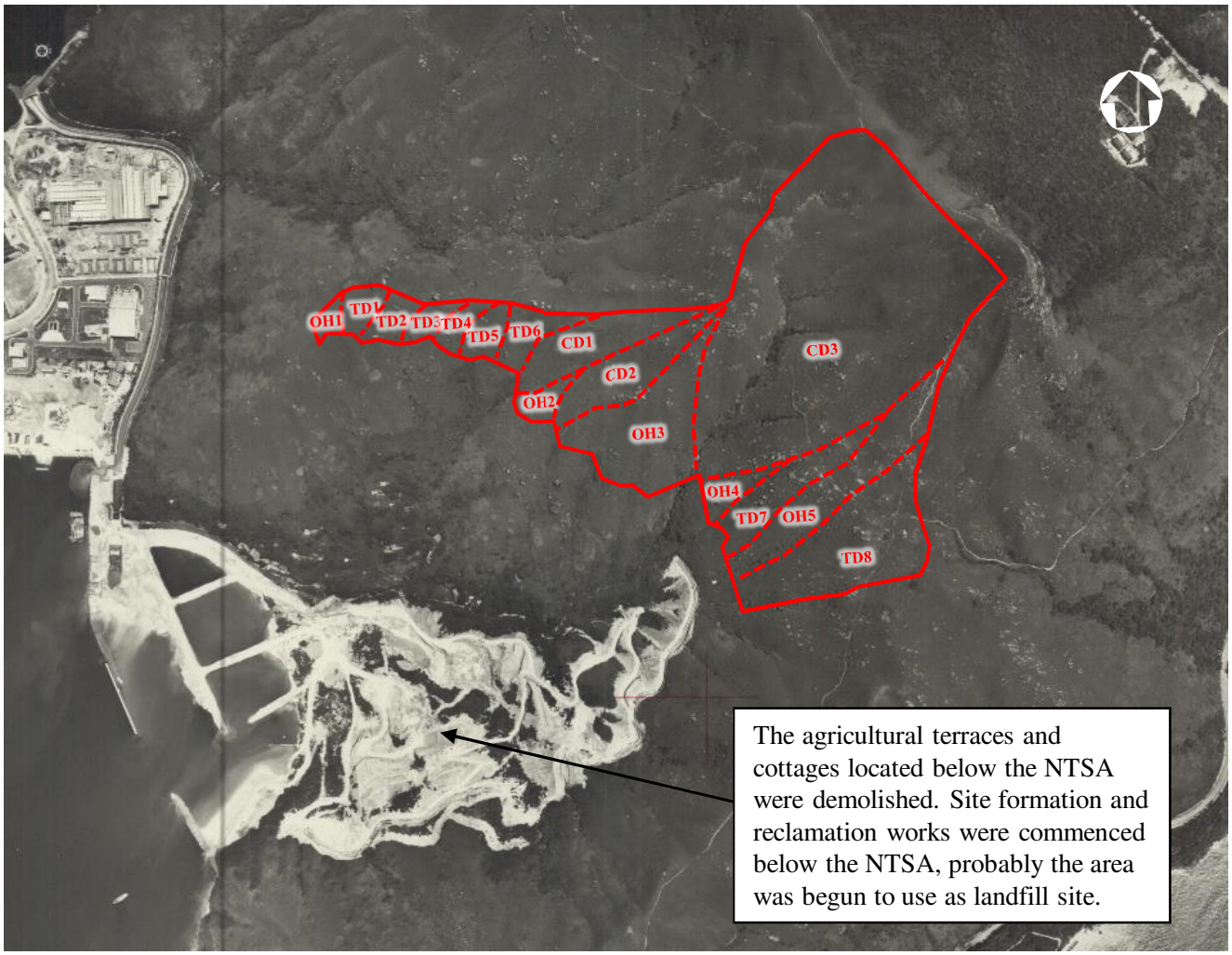
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FIGURE B9

Location
Landfill Site II/III, Tseung Kwan O

Scale NTS

Date 29 May 2022



Photograph No.: A12791 **Date of Photograph: 2 Jun 1988** **Altitude: 4,000'**

Legend: Approximate Boundary of the NTSA — — — Catchment Boundary

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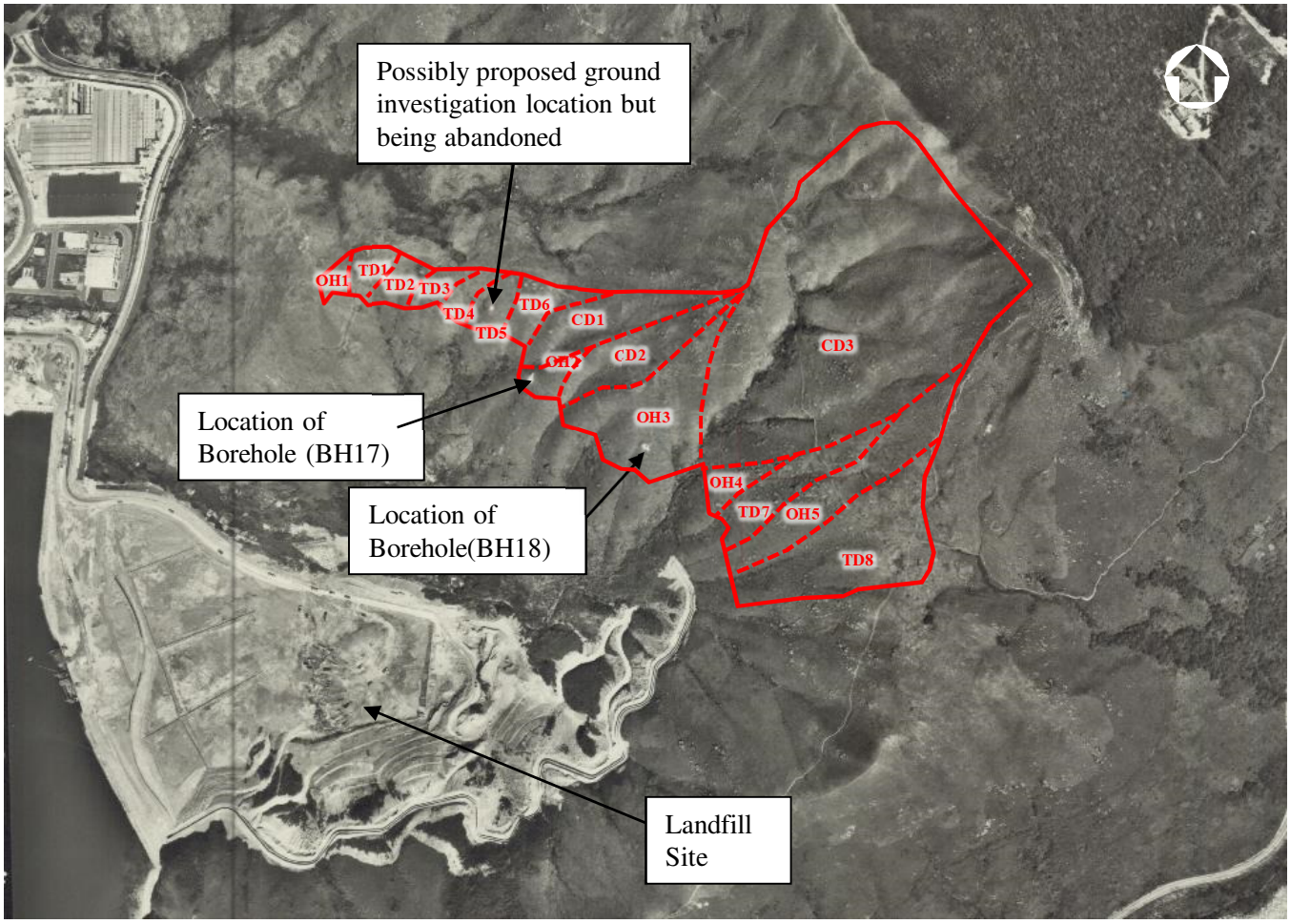
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FIGURE B10

Location
Landfill Site II/III, Tseung Kwan O

Scale NTS

Date 29 May 2022



Photograph No.: A16793 **Date of Photograph: 28 Mar 1989** **Altitude: 4,000'**

Legend: Approximate Boundary of the NTSA ---- Catchment Boundary

- The locations within Catchment Nos. OH2 and OH3 are possibly the Borehole locations of BH17 and BH18 under GIU No. 12800.
- The bare soil existed in Catchment No. TD5 appeared as rounded bare soil surface and thus likely created by anthropogenic activities, possibly this was a proposed ground investigation location but being abandoned, therefore no ground investigation record could be found.
- The site formation works below the NTSA was ongoing, the area was continued to serve as landfill site.

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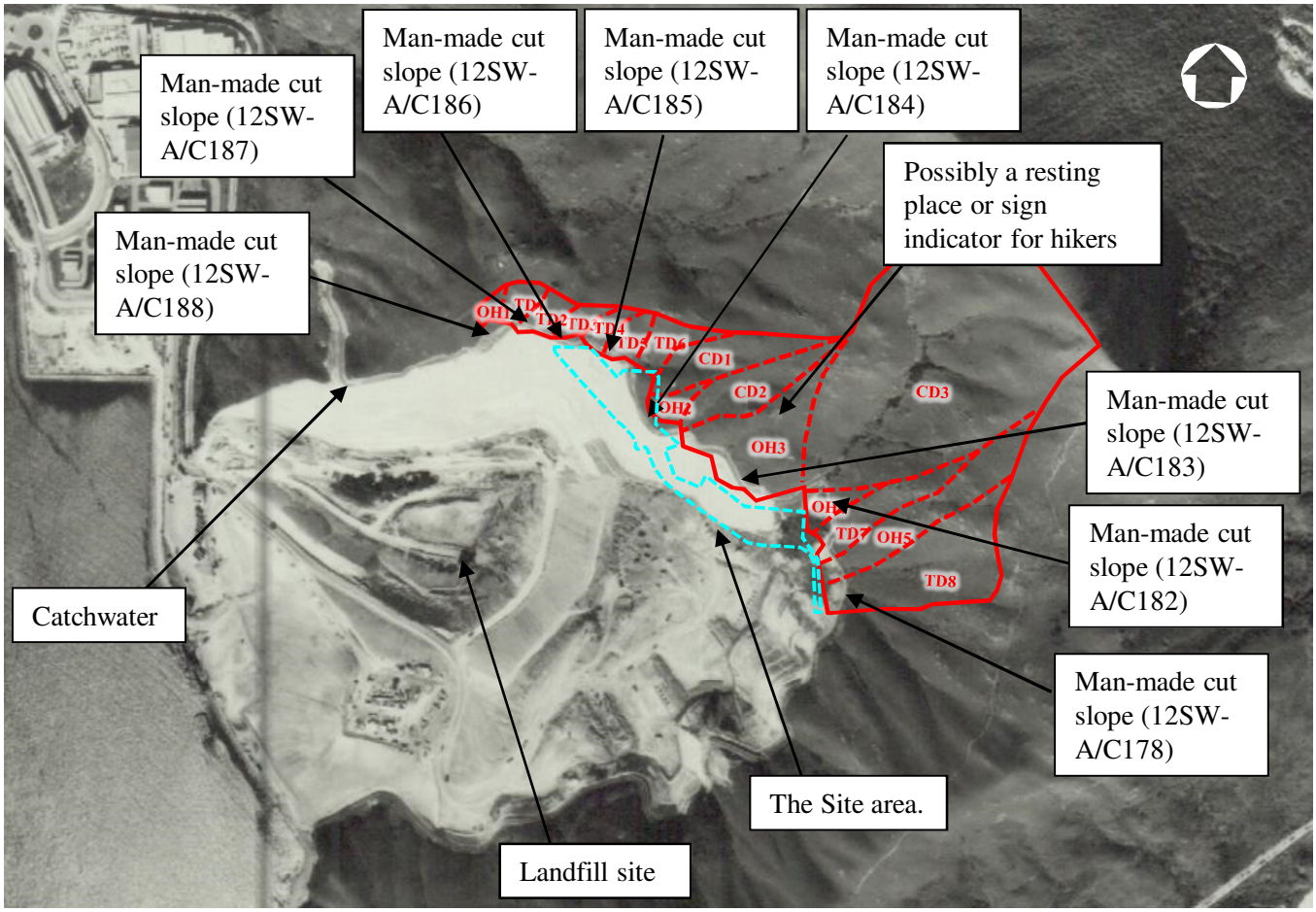
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FIGURE B11

Location: Landfill Site II/III, Tseung Kwan O

Scale: NTS

Date: 29 May 2022



Photograph No.: A24428 **Date of Photograph: 3 Dec 1990** **Altitude: 10,000'**

Legend:

Approximate Boundary of the NTSA

Catchment Boundary

Approximate Boundary of the Site (Proposed public riding school development area)

- A linear feature, probably catchwater is aligned along the toe of the NTSA. Formation of eight man-made cut slopes were commenced along the toe of the NTSA, probably in association with the alignment of the catchwater. They were registered as Feature Nos. 12SW-A/C178, 12SW-A/C182, 12SW-A/C183, 12SW-A/C184, 12SW-A/C185, 12SW-A/C186, 12SW-A/C187 and 12SW-A/C188.
- A cross-shaped features are apparent in the middle portion of Catchment No. OH3. It was located at the intersection of two footpaths, possibly a resting place or sign indicator for hikers.

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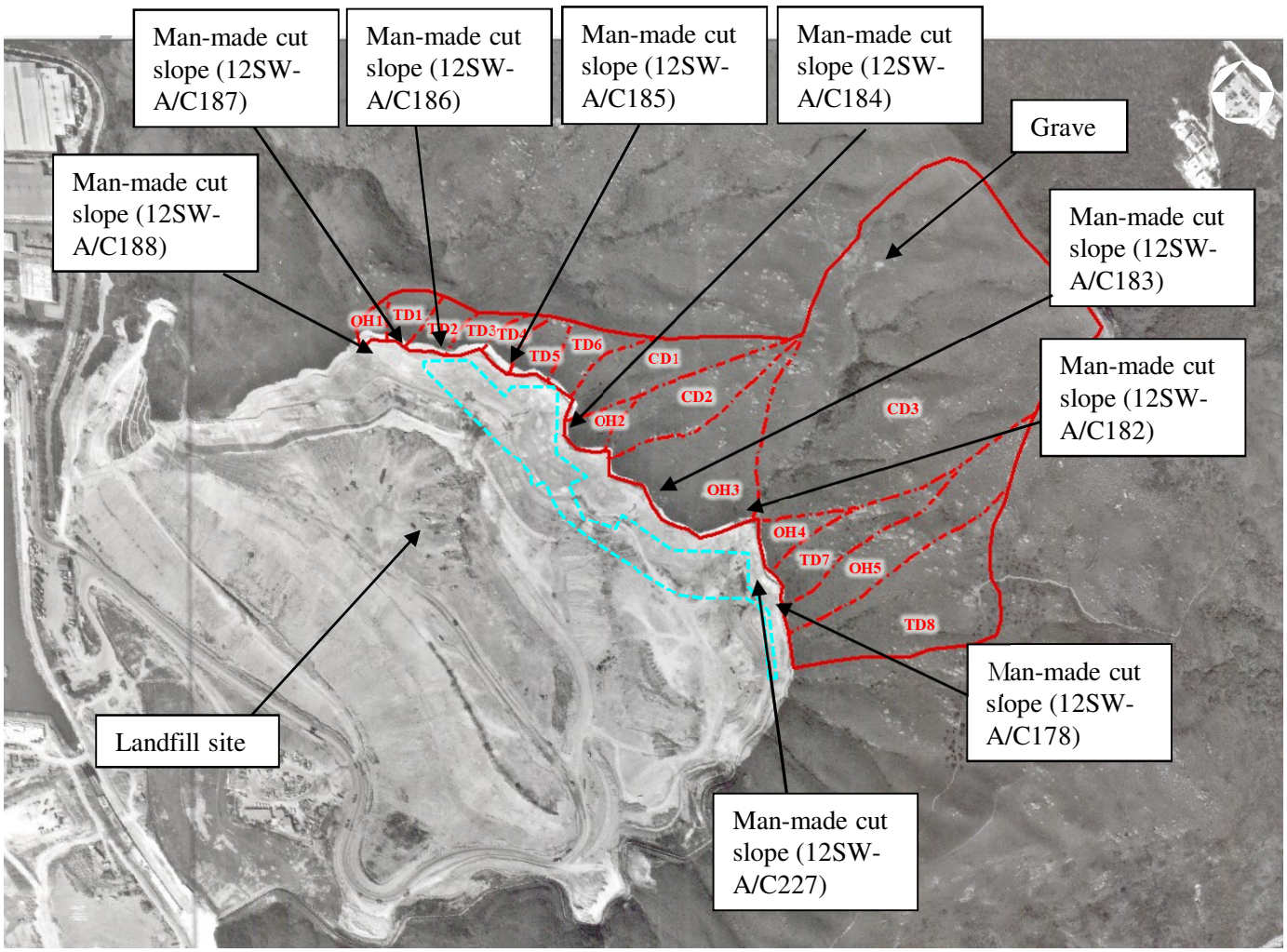
Project:
Natural Terrain Hazard Study for the Proposed Development of New Public Riding School at the Restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III)

FIGURE B12

Location
Landfill Site II/III, Tseung Kwan O

Scale NTS

Date 29 May 2022



Photograph No.: A32763 **Date of Photograph: 20 Oct 1992** **Altitude: 4,000'**

Legend:

Approximate Boundary of the NTSA

Catchment Boundary

Approximate Boundary of the Site (Proposed public riding school development area)

- A small patch of high reflectance bare soil is observed at the upper portion of Catchment No. CD3, possible a grave was constructed.
- Formation of feature Nos. 12SW-A/C178, 12SW-A/C182, 12SW-A/C183, 12SW-A/C184, 12SW-A/C185, 12SW-A/C186, 12SW-A/C187 and 12SW-A/C188 were completed.
- A cut slope was formed below Catchment Nos. TD7 and OH5, probably in association with the extension of the landfill site. This man-made slope was registered as Feature No. 12SW-A/C227.
- The area below the NTSA was continued to serve as landfill site.

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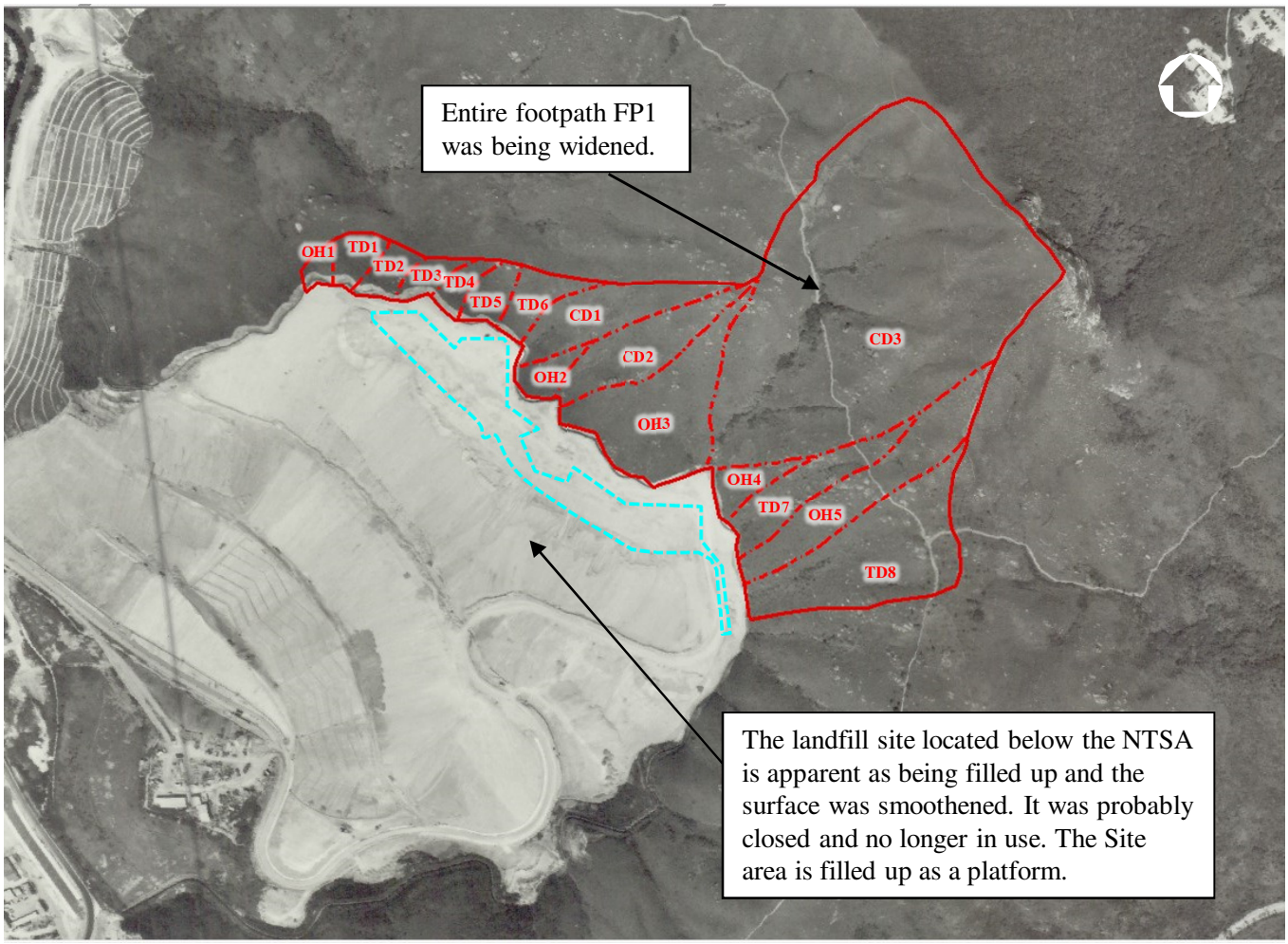
Project:
Natural Terrain Hazard Study for the Proposed Development of New Public Riding School at the Restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III)

FIGURE B13

Location
Landfill Site II/III, Tseung Kwan O

Scale NTS

Date 29 May 2022



Photograph No.: A39049 **Date of Photograph: 17 Oct 1994** **Altitude: 4,000'**

Legend:

Approximate Boundary of the NTSA

Catchment Boundary

Approximate Boundary of the Site (Proposed public riding school development area)

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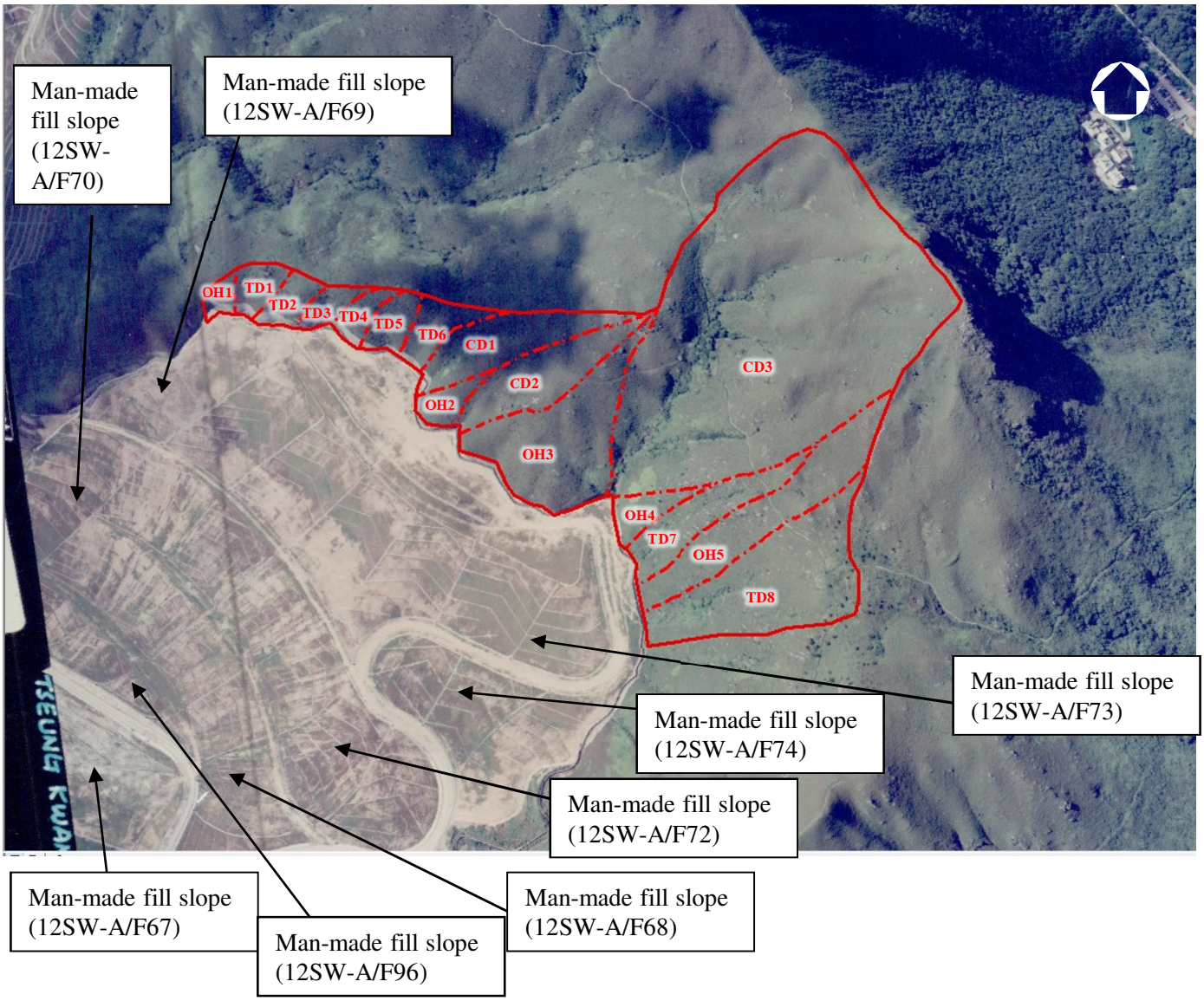
Project:
Natural Terrain Hazard Study for the Proposed Development of New Public Riding School at the Restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III)

FIGURE B14

Location
Landfill Site II/III, Tseung Kwan O

Scale NTS

Date 29 May 2022



Photograph No.: CN10018 **Date of Photograph: 18 Jul 1995** **Altitude: 3,500'**

Legend:

Approximate Boundary of the NTSA

Catchment Boundary

Approximate Boundary of the Site (Proposed public riding school development area)

- Eight man-made fill slopes were formed at the former landfill site which located below the NTSA. Man-made drainage channels are formed on the slope surfaces. They are registered as Feature Nos. 12SW-A/F67, 12SW-A/F68, 12SW-A/F69, 12SW-A/F70, 12SW-A/F72, 12SW-A/F73, 12SW-A/F74 and 12SW-A/F96.

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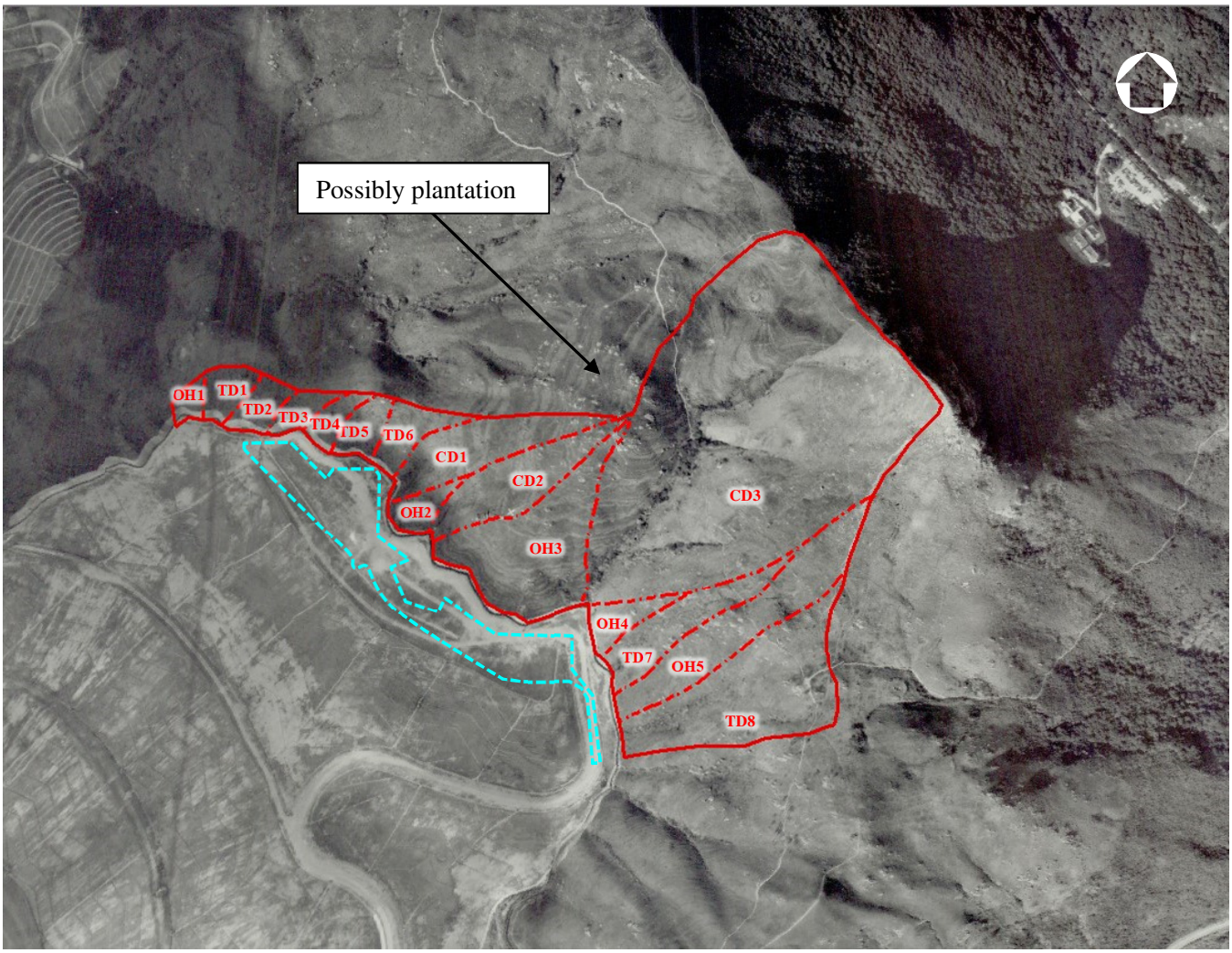
Project:
Natural Terrain Hazard Study for the Proposed Development of New Public Riding School at the Restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III)

FIGURE B15

Location
Landfill Site II/III, Tseung Kwan O

Scale NTS

Date 29 May 2022



Photograph No.: A42221 **Date of Photograph: 18 Jan 1996** **Altitude: 4,000'**

Legend:

Approximate Boundary of the NTSA

Catchment Boundary

Approximate Boundary of the Site (Proposed public riding school development area)

- Many linear features are apparent parallel to the contour lines in Catchment Nos. TD6, CD1, OH2, CD2, OH3 and CD3. A very thin layer of surface soil may be disturbed along these linear features by anthropogenic activities, possibly plantation.

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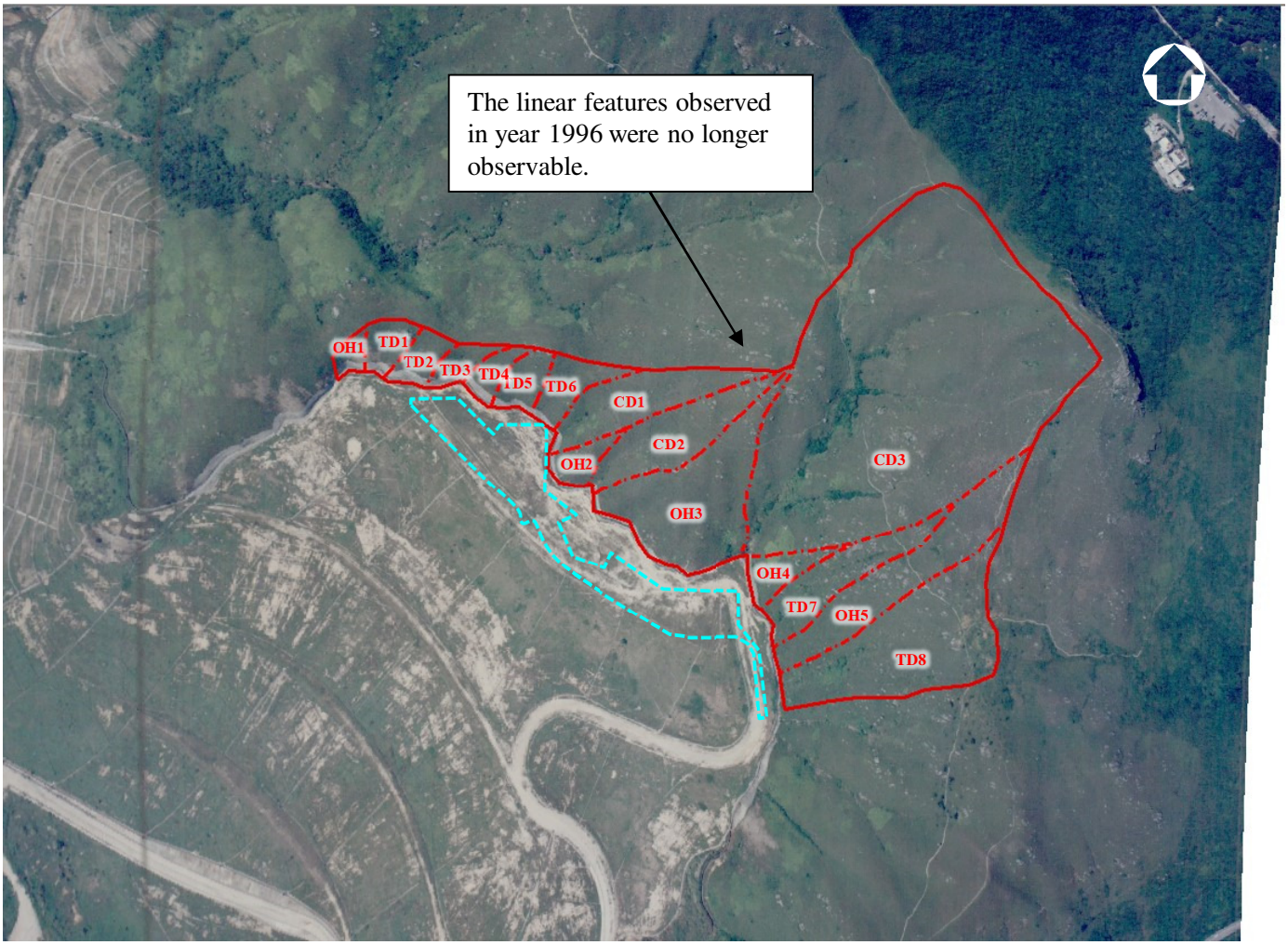
Project:
Natural Terrain Hazard Study for the Proposed Development of New Public Riding School at the Restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III)

FIGURE B16

Location
Landfill Site II/III, Tseung Kwan O

Scale NTS

Date 29 May 2022



Photograph No.: CN17111 **Date of Photograph: 26 May 1997** **Altitude: 4,000'**

Legend:

Approximate Boundary of the NTSA

Catchment Boundary

Approximate Boundary of the Site (Proposed public riding school development area)

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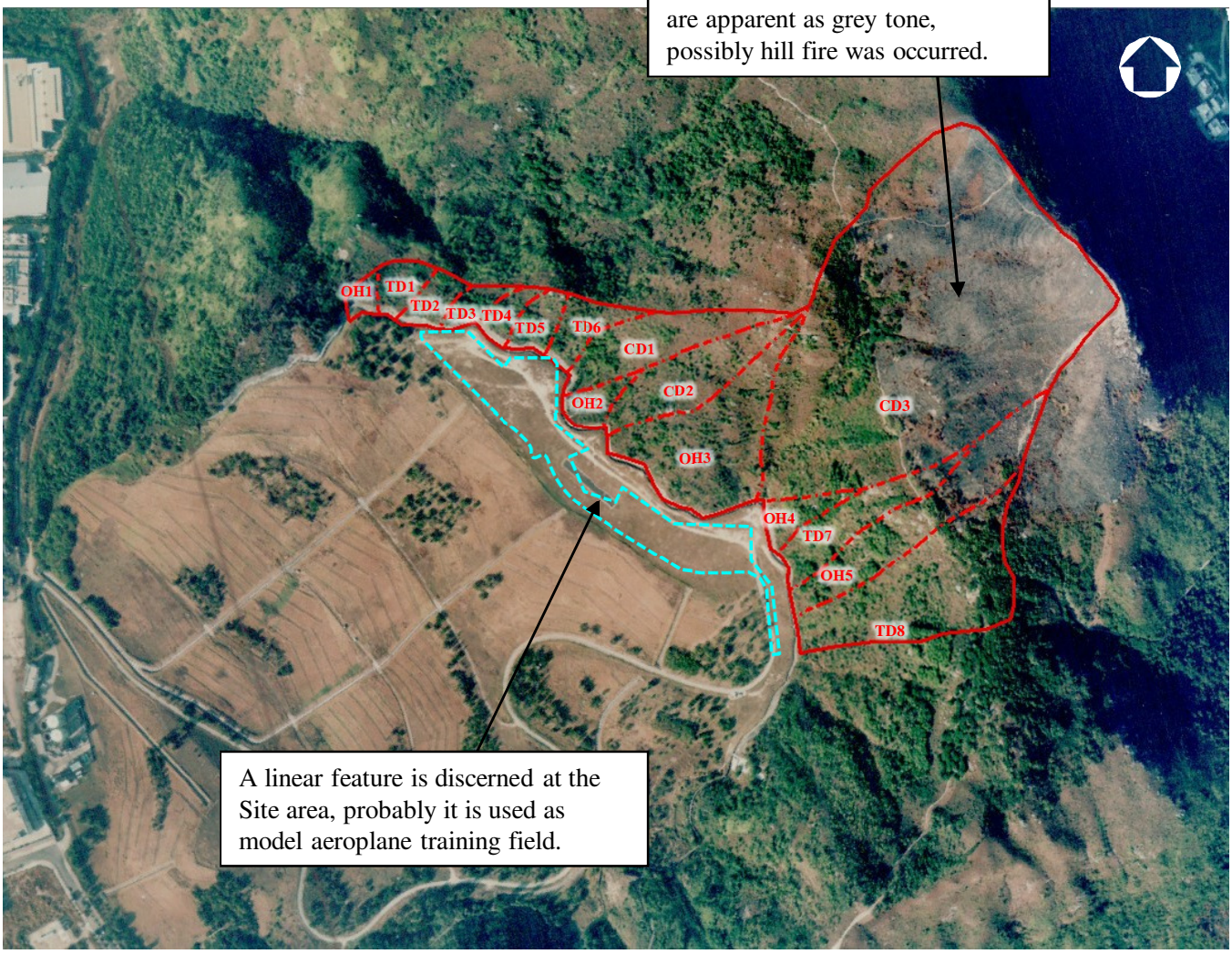
Project:
Natural Terrain Hazard Study for the Proposed Development of New Public Riding School at the Restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III)

FIGURE B17

Location
Landfill Site II/III, Tseung Kwan O

Scale NTS

Date 29 May 2022



Photograph No.: CW62911 **Date of Photograph: 16 Dec 2004** **Altitude: 4,000'**

Legend:

Approximate Boundary of the NTSA

Catchment Boundary

Approximate Boundary of the Site (Proposed public riding school development area)

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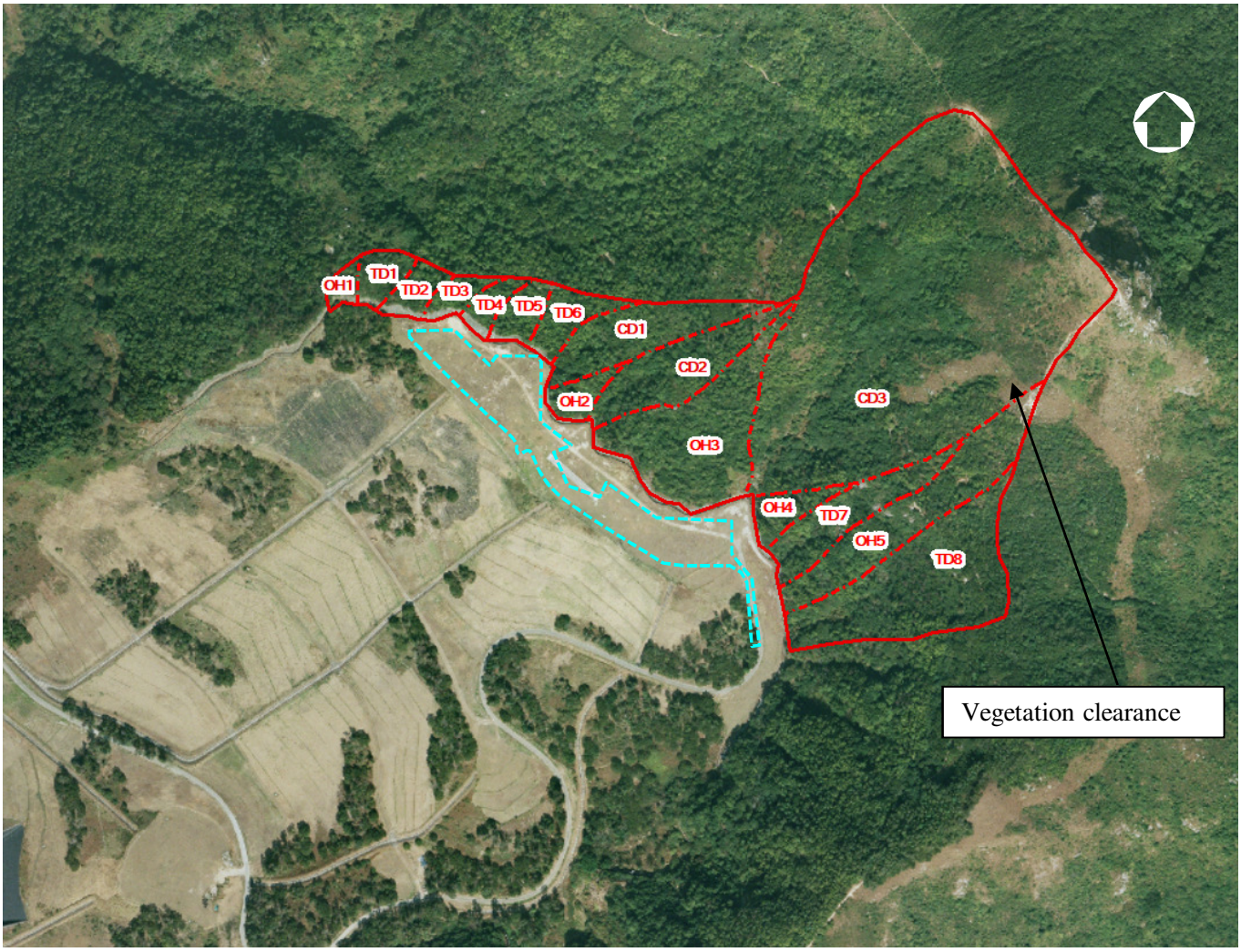
Project:
Natural Terrain Hazard Study for the Proposed Development of New Public Riding School at the Restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III)

FIGURE B18

Location
Landfill Site II/III, Tseung Kwan O

Scale NTS

Date 29 May 2022



Photograph No.: E046899C **Date of Photograph: 5 Oct 2018** **Altitude: 6,900'**

Legend:

Approximate Boundary of the NTSA

Catchment Boundary

Approximate Boundary of the Site (Proposed public riding school development area)

- No observable significant change to the NTSA since 2010s till present except the vegetation growth or clearance.

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Project:
Natural Terrain Hazard Study for the Proposed Development of New Public Riding School at the Restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III)

FIGURE B19

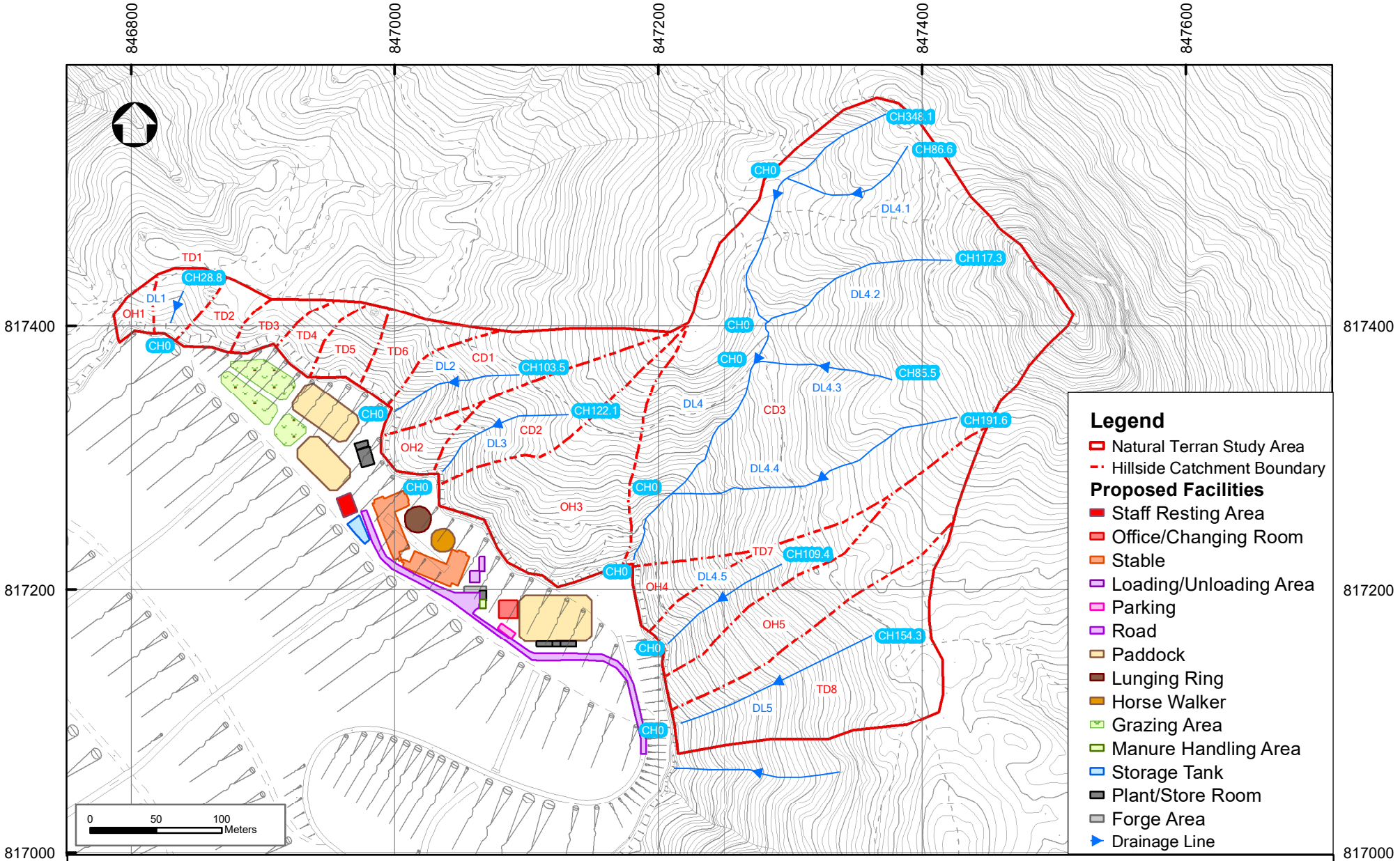
Location
Landfill Site II/III, Tseung Kwan O

Scale NTS

Date 29 May 2022

Appendix C

Drainage Line Records



PROJECT: Natural Terrain Hazard Study for the Proposed Development of New Public Riding School at the Restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III)

TITLE: Ephemeral Drainage Lines within NTSA	SCALE: 1 :4000	Modern Consulting Engineers Limited In association with Calvint Geo-Services Limited	FIGURE NO : FIGURE C1



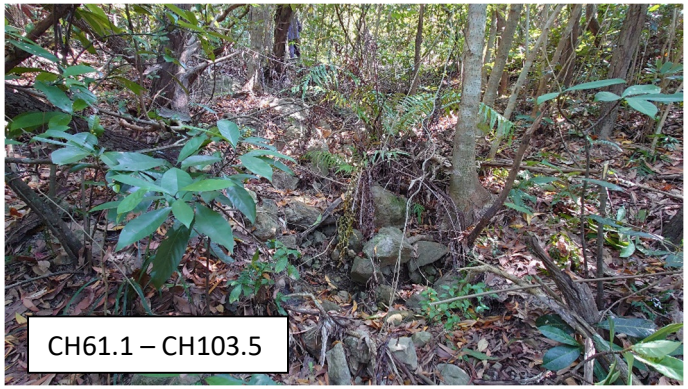
Downstream



Downstream



Plate C1 General View of Drainage Line DL1 in Catchment No. TD1







Downstream





Downstream

Plate C2 General View of Drainage Line DL2 in Catchment No. CD1







Downstream







Downstream

Plate C3 General View of Drainage Line DL3 in Catchment No. CD2









Downstream











Downstream









Downstream

Plate C4 General View of Drainage Line DL4 in Catchment No. CD3





Downstream





Downstream

Plate C5 General View of Sub-ordinate Drainage Line DL4.1 in Catchment No. CD3





Downstream







Downstream

Plate C6 General View of Sub-ordinate Drainage Line DL4.2 in Catchment No. CD3





Downstream





Downstream

Plate C7 General View of Sub-ordinate Drainage Line DL4.3 in Catchment No. CD3

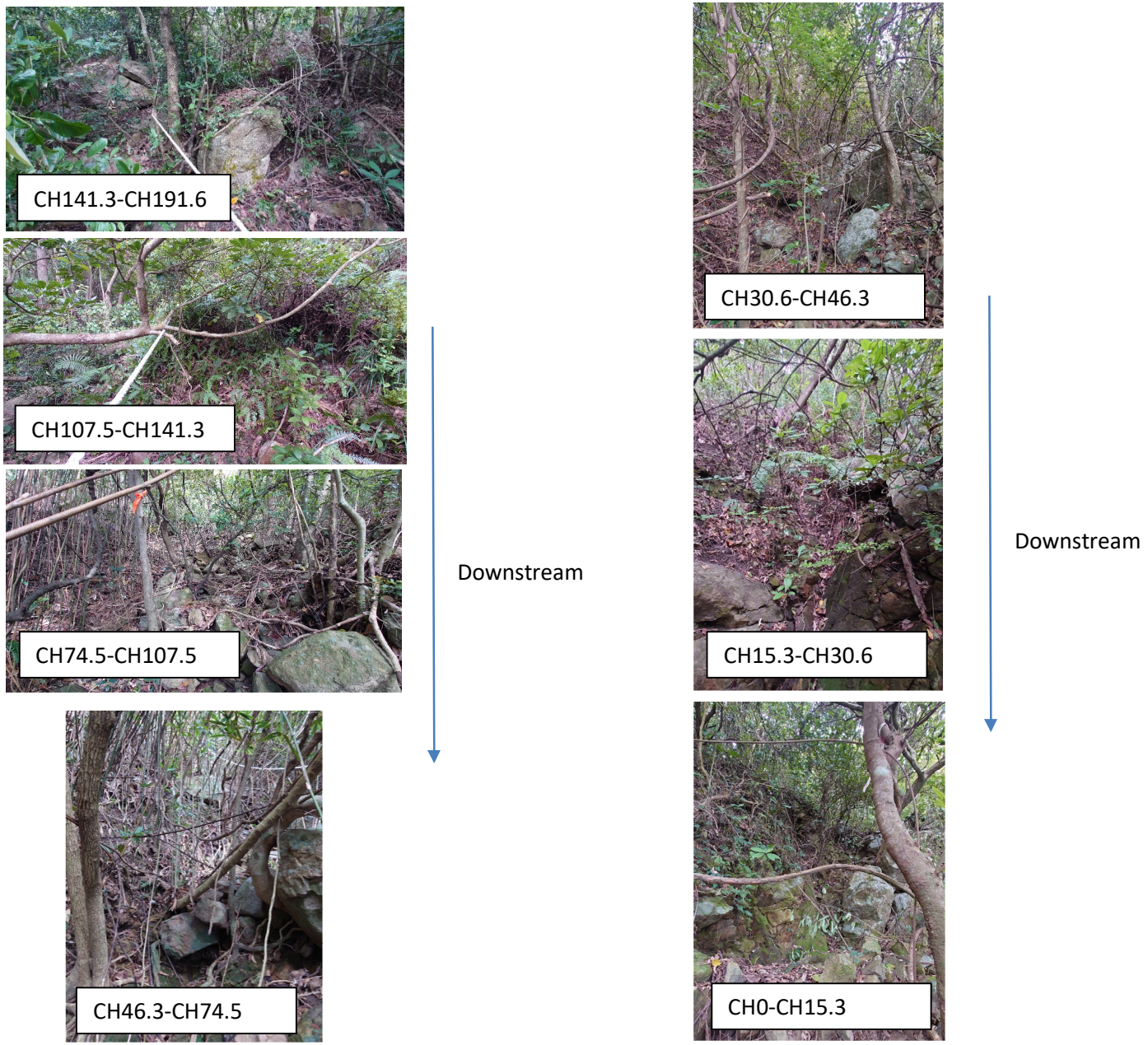


Plate C8 General View of Sub-ordinate Drainage Line DL4.4 in Catchment No. CD3

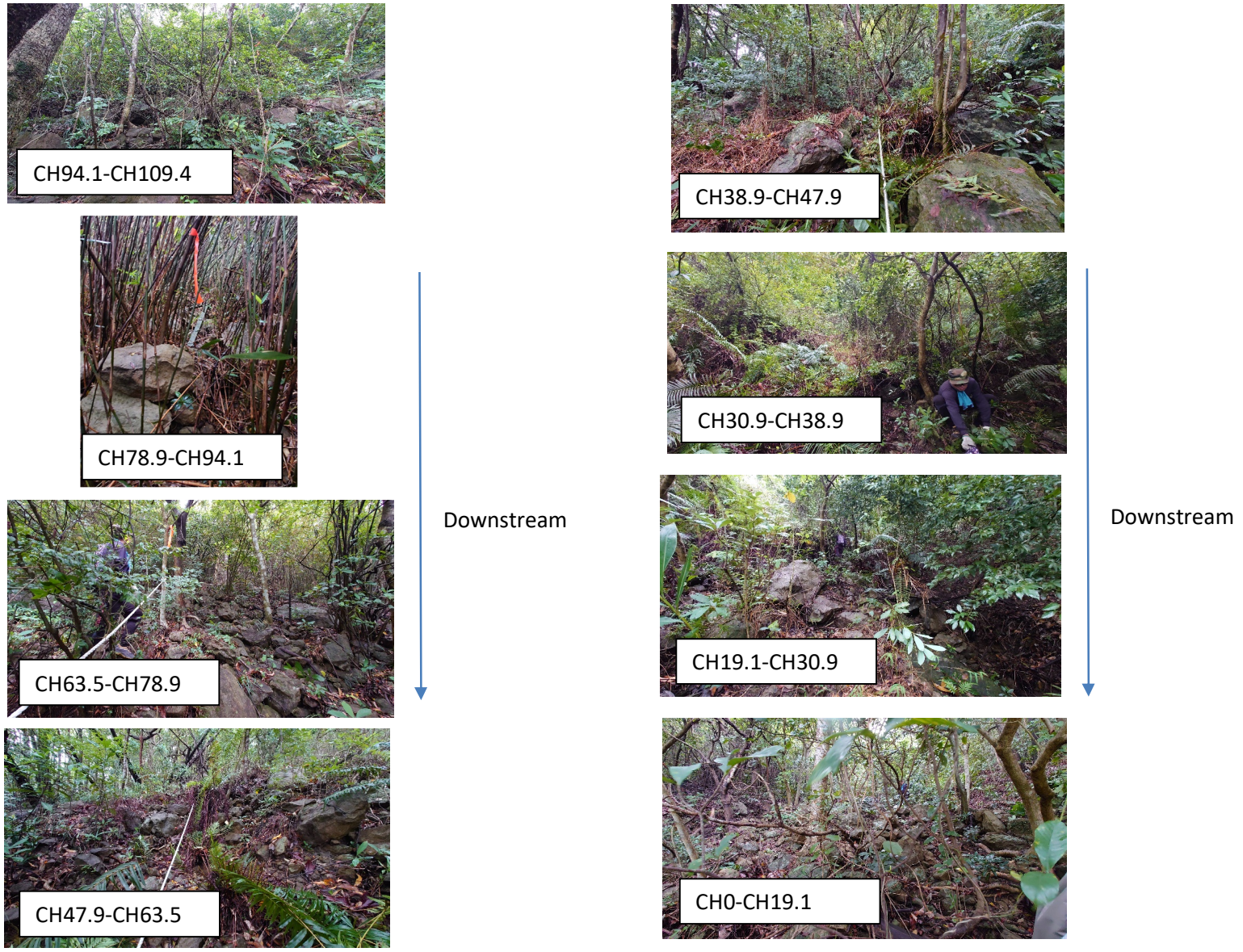


Plate 9 General View of Sub-ordinate Drainage Line DL4.5 in Catchment No. TD2

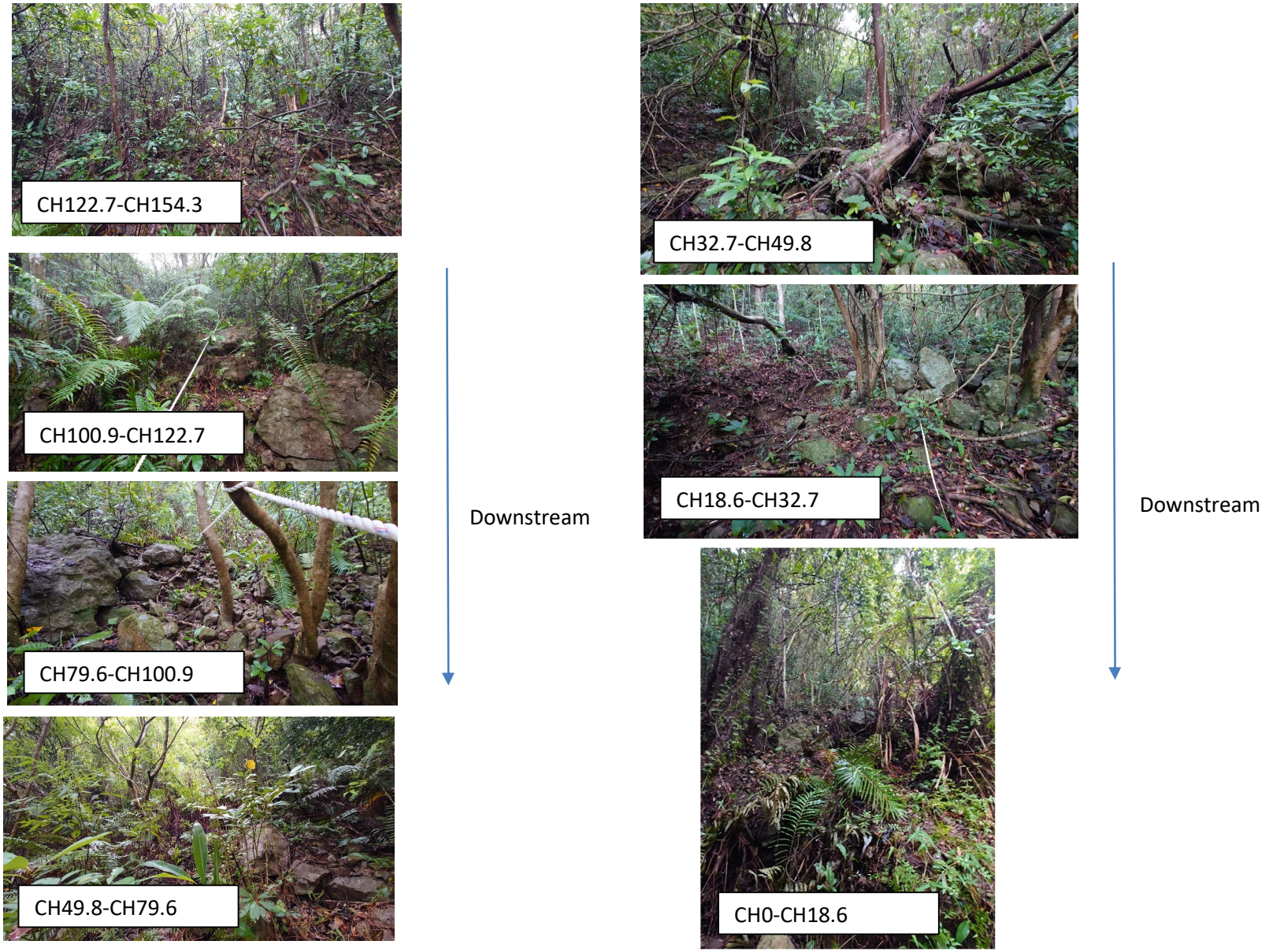
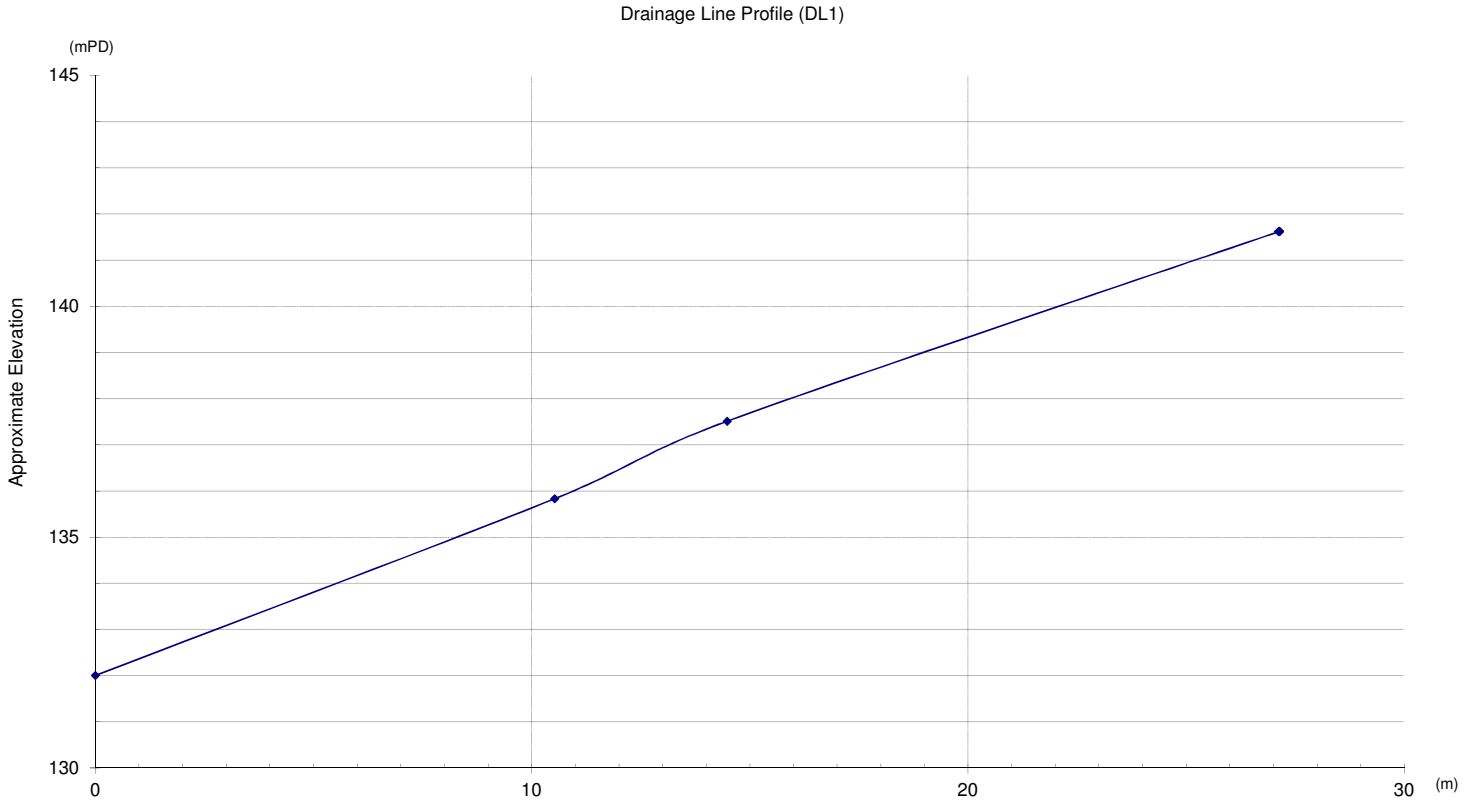


Plate C10 General View of Drainage Line DL5 in Catchment No. TD3

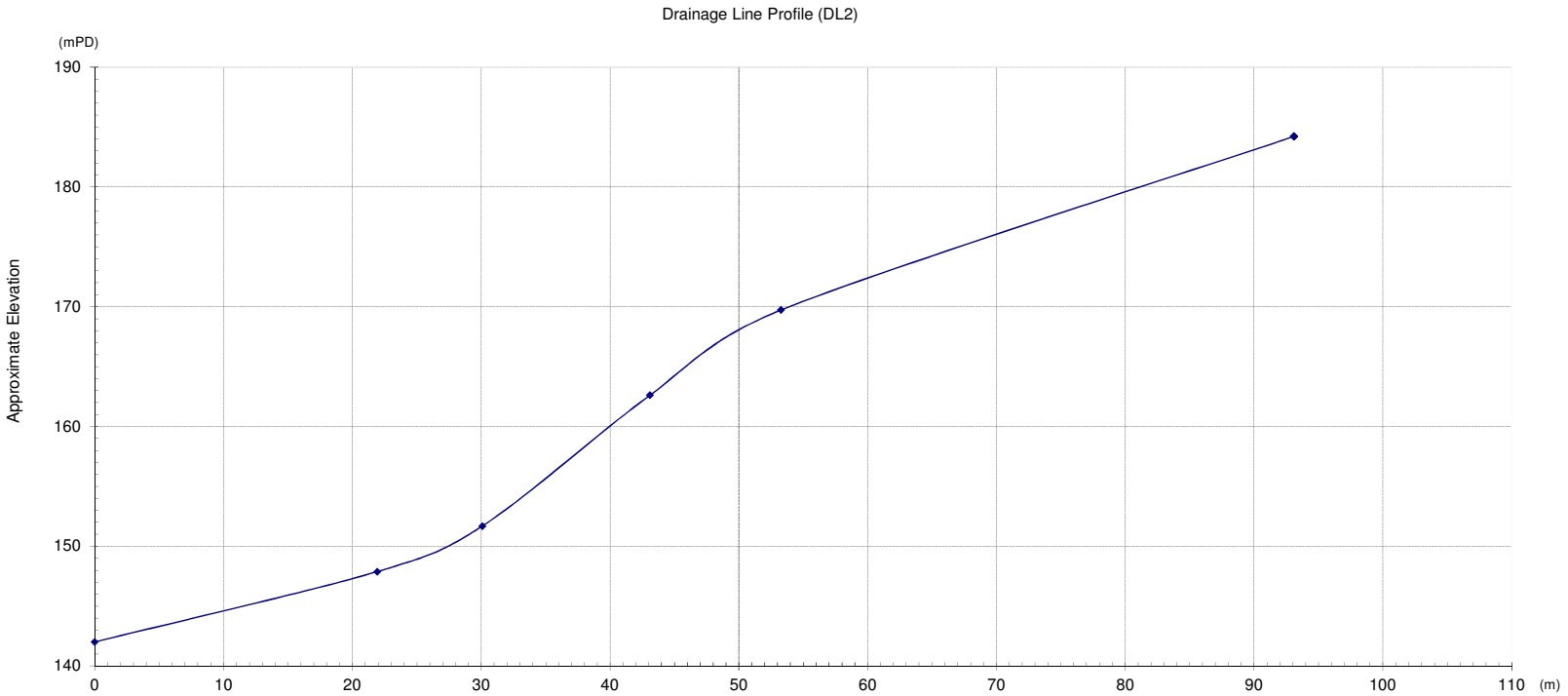


FIELD RECORD

Chainage (m)	0-11.2	11.2-15.5	15.5-28.8
Section Length (m)	11.2	4.3	13.3
Channel Width (m)	2.5	2.7	2
Channel Depth (m)	0.5	0.3	0.4
Inclination (°)	20	23	18
Side Slopes Angles (°)	15,10	10,5	10,5
Channelisation Ratio	5.0	9.0	5.0
Channel Bed Materials #	Cs,Cb	Cs	Cs,Cb
Side Slopes Materials #	Cs	Cs	Cs
Thickness of Entrainment Material (m)	0.2	0.2	0.2
Approx. Channel Shape *	H	H	H

F = Fill; Cb = Colluvial Boulders; Cs = Colluvium; CD = Completely Decomposed Rock; HD = Highly Decomposed Rock; R = Bedrock

* U = U-shaped; V = V-shaped; H= Half-rounded; R = Rectangular-shaped

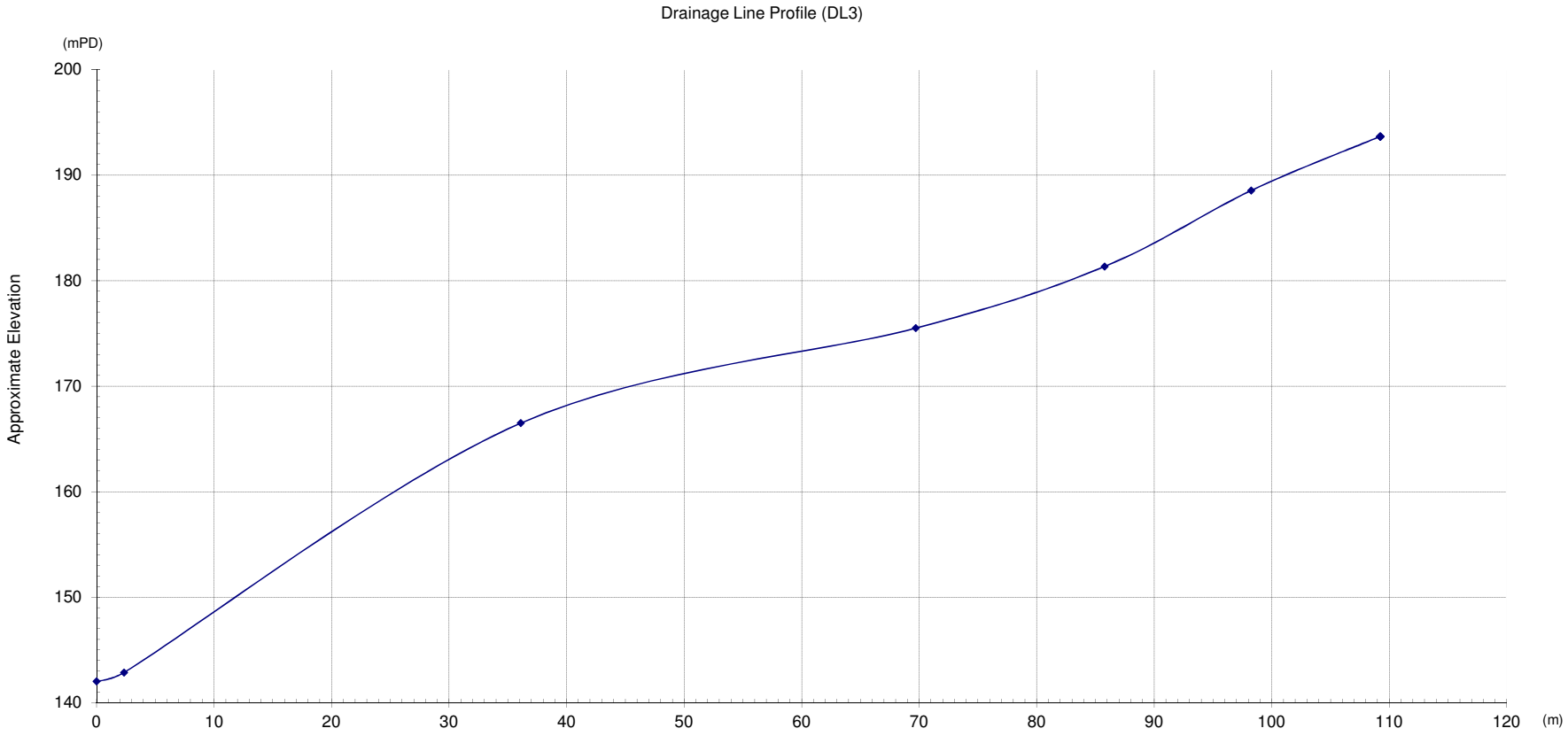


FIELD RECORD

Chainage (m)	0-22.7	22.7-31.7	31.7-48.7	48.7-61.1	61.1-103.5
Section Length (m)	22.7	9	17	12.4	42.4
Channel Width (m)	2	3.3	3.2	3.5	3.7
Channel Depth (m)	0.8	0.9	0.8	0.8	0.5
Inclination (°)	15	25	40	35	20
Side Slopes Angles (°)	55,20	70,40	60,30	10,70	10,15
Channelisation Ratio	2.5	3.7	4.0	4.4	7.4
Channel Bed Materials #	Cb,Cs	Cb,Cs	Cb,Cs	Cb, R	Cb,Cs
Side Slopes Materials #	Cs	Cs	Cs	Cs	Cs
Thickness of Entrainment Material (m)	0.1	0.3	0.2	0.1	0.2
Approx. Channel Shape *	H	H	H	H	H

F = Fill; Cb = Colluvial Boulders; Cs = Colluvium; CD = Completely Decomposed Rock; HD = Highly Decomposed Rock; R = Bedrock

* U = U-shaped; V = V-shaped; H= Half-rounded; R = Rectangular-shaped



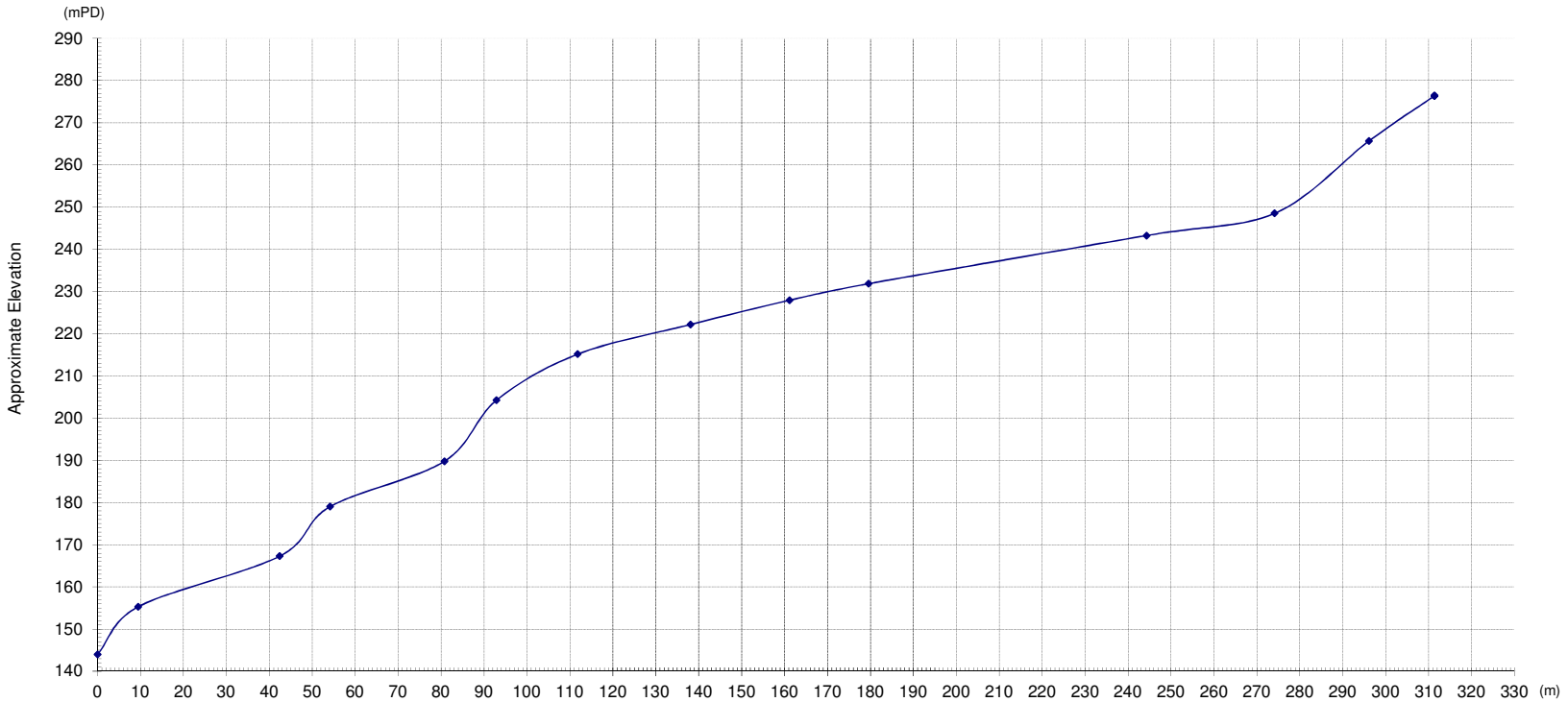
FIELD RECORD

Chainage (m)	0-2.5	2.5-43.7	43.7-78.5	78.5-95.6	95.6-110.0	110.0-122.1
Section Length (m)	2.5	41.2	34.8	17.1	14.4	12.1
Channel Width (m)	3.4	4.3	5.2	2.9	2.6	3.3
Channel Depth (m)	0.7	0.7	0.6	0.6	0.5	0.5
Inclination (°)	20	35	15	20	30	25
Side Slopes Angles (°)	40,50	15,35	10,10	5,20	5,15	5,10
Channelisation Ratio	4.9	6.1	8.7	4.8	5.2	6.6
Channel Bed Materials #	Cs,Cb,R	Cs,Cb	Cs,Cb	Cs,Cb	Cs,Cb	Cs,Cb
Side Slopes Materials #	Cs	Cs	Cs	Cs	Cs	Cs
Thickness of Entrainment Material (m)	0.1	0.2	0.3	0.3	0.2	0.2
Approx. Channel Shape *	H	H	H	H	H	H

F = Fill; Cb = Colluvial Boulders; Cs = Colluvium; CD = Completely Decomposed Rock; HD = Highly Decomposed Rock; R = Bedrock

* U = U-shaped; V = V-shaped; H= Half-rounded; R = Rectangular-shaped

Drainage Line Profile (DL4)

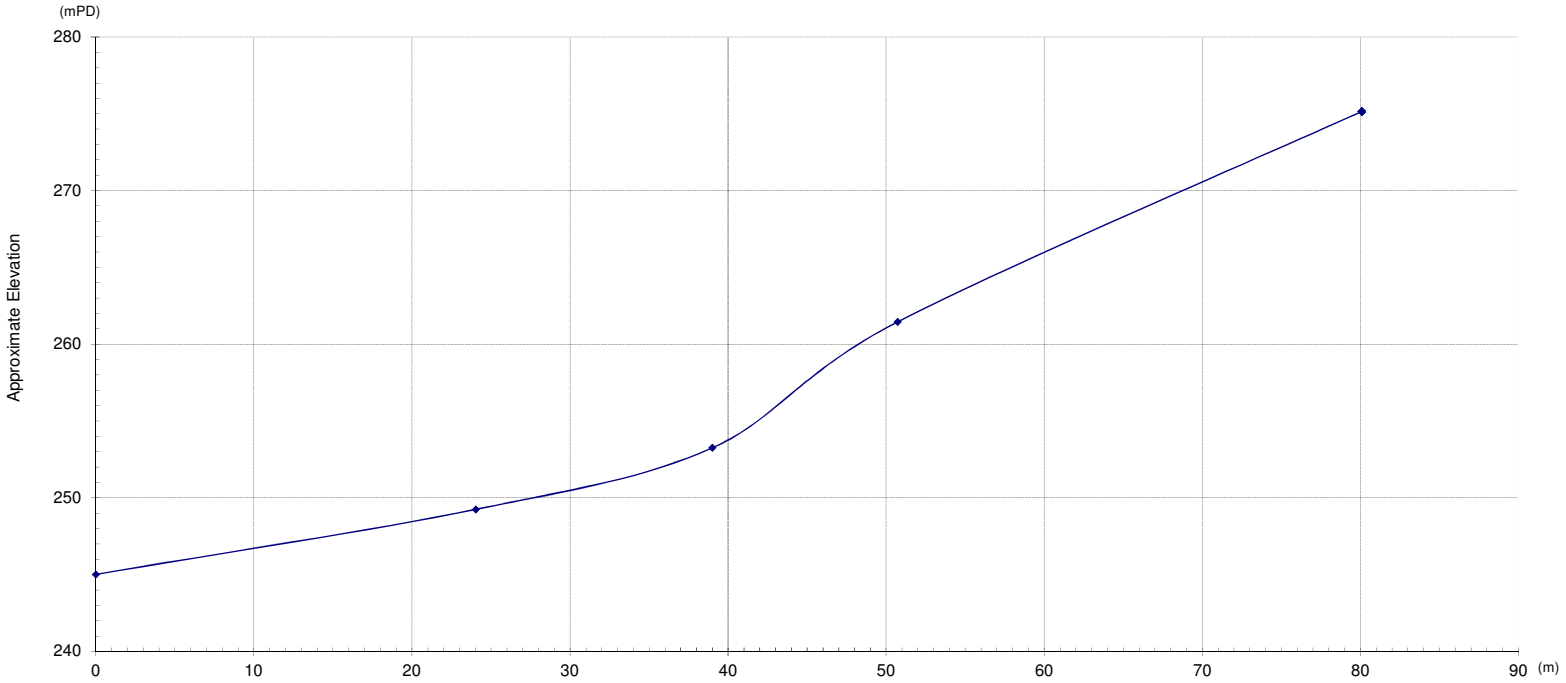


FIELD RECORD

Chainage (m)	0-14.7	14.7-49.8	49.8-66.4	66.4-95.1	95.1-114.0	114.0-135.8	135.8-163.0	163.0-186.8	186.8-205.6	205.6-271.3	271.3-301.6	301.6-329.5	329.5-348.1
Section Length (m)	14.7	35.1	16.6	28.7	18.9	21.8	27.2	23.8	18.8	65.7	30.3	27.9	18.6
Channel Width (m)	2.5	5.5	6.1	9.2	5.5	6.1	4.6	3.4	3.5	6.2	2.6	3.4	4.6
Channel Depth (m)	0.9	1.4	1.5	1.1	1.7	1.8	0.9	0.6	0.9	0.8	0.4	1.1	0.7
Inclination (°)	50	20	45	22	50	30	15	14	12	10	10	38	35
Side Slopes Angles (°)	60,60	45,20	20,15	10,5	70,30	40,35	10,15	20,20	25,15	10,25	5,5	30,45	50,10
Channelisation Ratio	2.8	3.9	4.1	8.4	3.2	3.4	5.1	5.7	3.9	7.8	6.5	3.1	6.6
Channel Bed Materials #	Cb,Cs	R,Cs	R,Cs	Cs,Cb	Cb,R	Cb,Cs	Cb,Cs	Cb,Cs	R,Cs	R,Cs	Cb,Cs	Cb,Cs	Cb,Cs
Side Slopes Materials #	Cs	Cs	Cs	Cs	Cs	Cs	Cs	Cs	Cs	Cs	Cs	Cs	Cs
Thickness of Entrainment Material (m)	0.3	0.3	0.1	0.5	0.5	0.4	0.4	0.4	0.1	0.1	0.2	0.4	0.2
Approx. Channel Shape *	V	H	H	H	V	V	H	H	H	H	H	V	H

F = Fill; Cb = Colluvial Boulders; Cs = Colluvium; CD = Completely Decomposed Rock; HD = Highly Decomposed Rock; R = Bedrock
* U = U-shaped; V = V-shaped; H= Half-rounded; R = Rectangular-shaped

Drainage Line Profile (DL4.1)

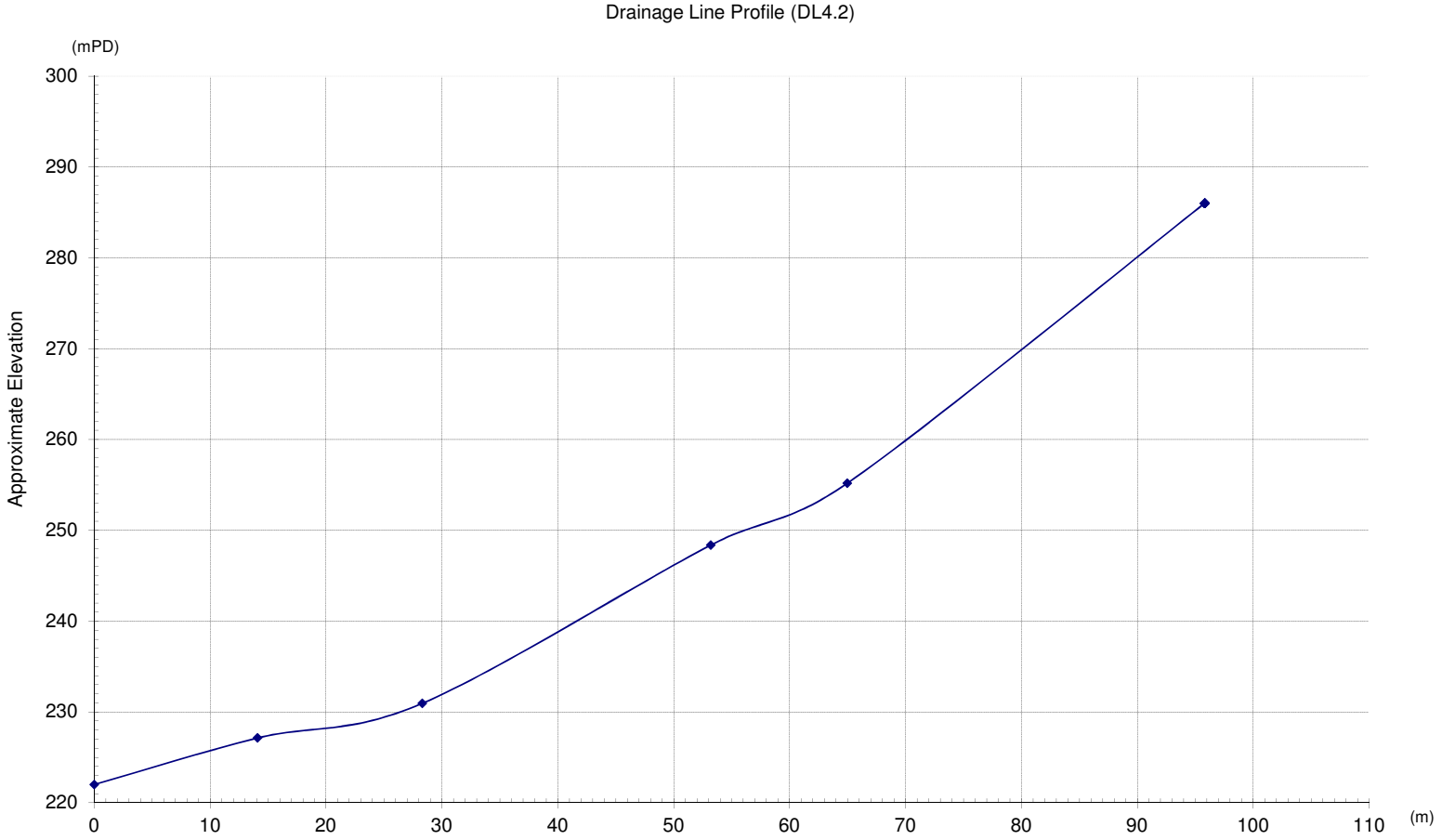


FIELD RECORD

Chainage (m)	0-24.4	24.4-39.9	39.9-54.2	54.2-86.6
Section Length (m)	24.4	15.5	14.3	32.4
Channel Width (m)	2	2.1	4.7	3
Channel Depth (m)	0.6	0.8	1.1	0.4
Inclination (°)	10	15	35	25
Side Slopes Angles (°)	5,5	25,10	45,20	10,15
Channelisation Ratio	3.3	2.6	4.3	7.5
Channel Bed Materials #	Cs,Cb	Cs,Cb	Cs,Cb	Cs,Cb
Side Slopes Materials #	Cs	Cs	Cs	Cs
Thickness of Entrainment Material (m)	0.2	0.2	0.3	0.1
Approx. Channel Shape *	H	V	H	H

F = Fill; Cb = Colluvial Boulders; Cs = Colluvium; CD = Completely Decomposed Rock; HD = Highly Decomposed Rock; R = Bedrock

* U = U-shaped; V = V-shaped; H= Half-rounded; R = Rectangular-shaped

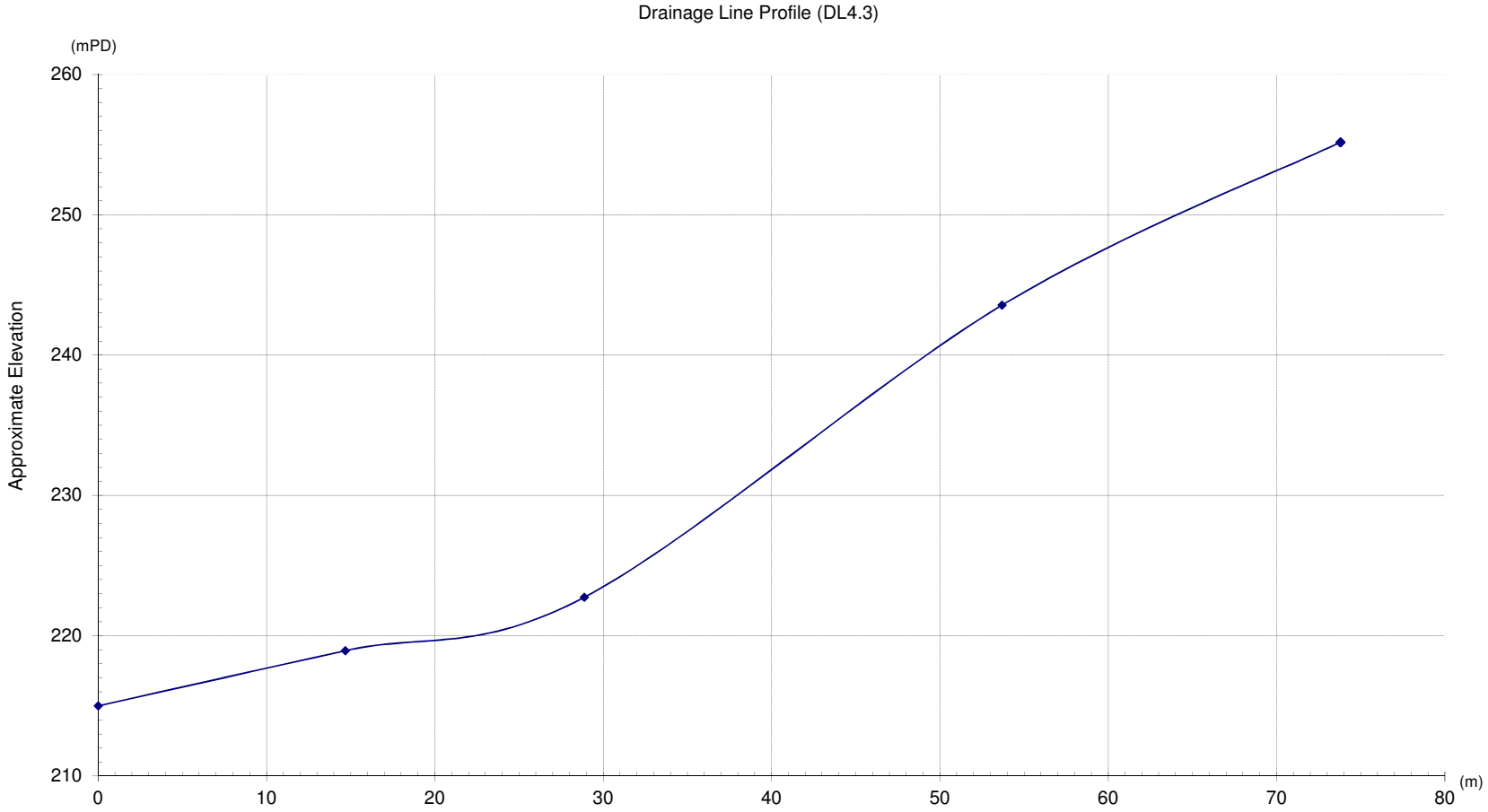


FIELD RECORD

Chainage (m)	0-15	15-29.7	29.7-60.1	60.1-73.7	73.7-117.3
Section Length (m)	15	14.7	30.4	13.6	43.6
Channel Width (m)	3.1	4.1	4.4	4.4	4.9
Channel Depth (m)	0.9	1.1	1.5	0.6	1.1
Inclination (°)	20	15	35	30	45
Side Slopes Angles (°)	20,20	10,10	40,15	15,25	55,15
Channelisation Ratio	3.4	3.7	2.9	7.3	4.5
Channel Bed Materials #	Cs,Cb	Cs,Cb	Cs,Cb	Cs,Cb	Cs,Cb
Side Slopes Materials #	Cs	Cs	Cs	Cs	Cs
Thickness of Entrainment Material (m)	0.2	0.3	0.2	0.2	0.4
Approx. Channel Shape *	H	H	V	H	H

F = Fill; Cb = Colluvial Boulders; Cs = Colluvium; CD = Completely Decomposed Rock; HD = Highly Decomposed Rock; R = Bedrock

* U = U-shaped; V = V-shaped; H= Half-rounded; R = Rectangular-shaped

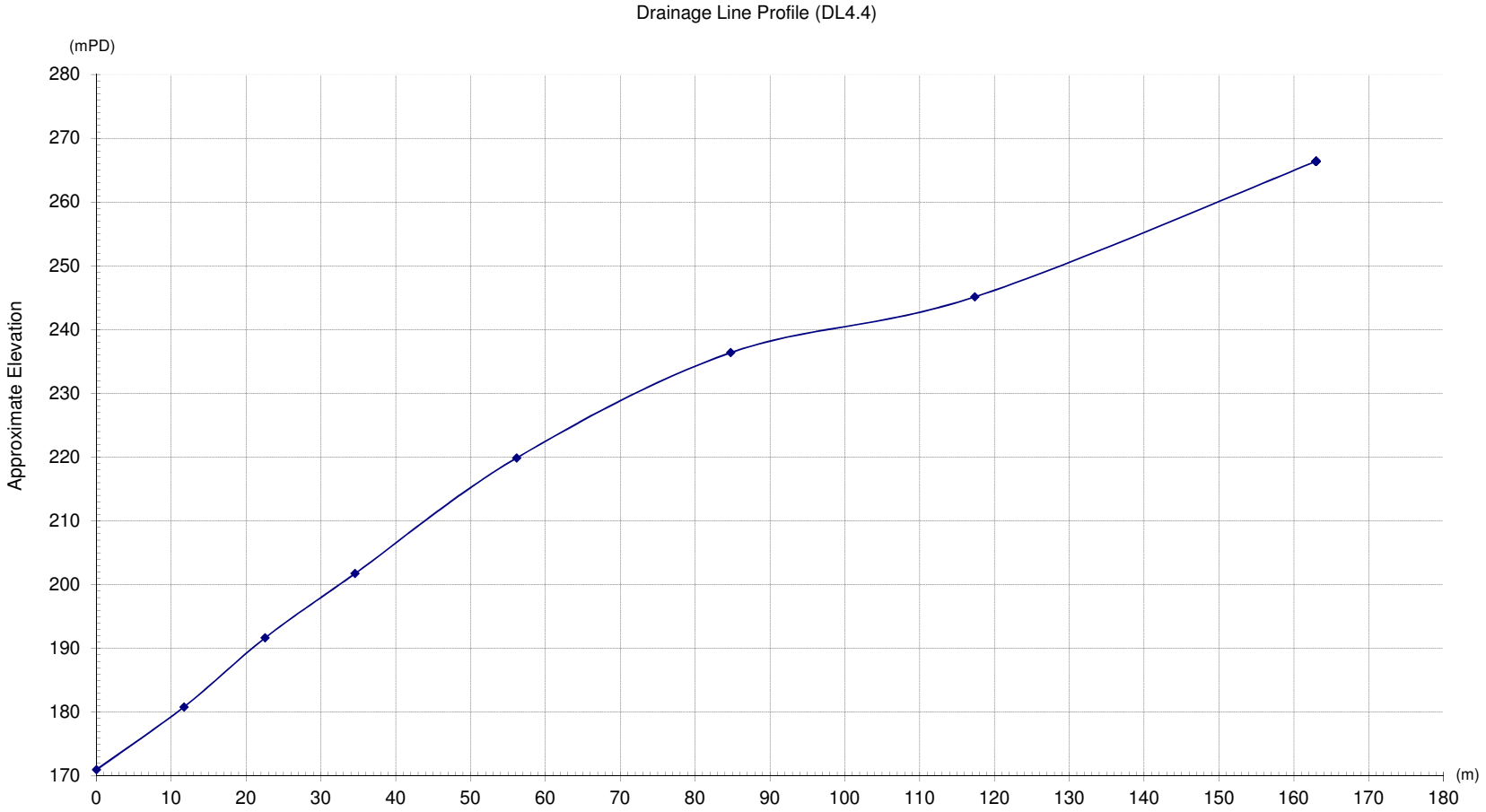


FIELD RECORD

Chainage (m)	0-15.2	15.2-29.9	29.9-62.3	62.3-85.5
Section Length (m)	15.2	14.7	32.4	23.2
Channel Width (m)	2	2.7	5	3.3
Channel Depth (m)	0.8	0.5	1.4	0.6
Inclination (°)	15	15	40	30
Side Slopes Angles (°)	80,5	20,5	60,15	30,10
Channelisation Ratio	2.5	5.4	3.6	5.5
Channel Bed Materials #	Cs,Cb	Cs,Cb	Cs,Cb	Cs,Cb
Side Slopes Materials #	Cs	Cs	Cs	Cs
Thickness of Entrainment Material (m)	0.2	0.1	0.3	0.1
Approx. Channel Shape *	V	H	H	H

F = Fill; Cb = Colluvial Boulders; Cs = Colluvium; CD = Completely Decomposed Rock; HD = Highly Decomposed Rock; R = Bedrock

* U = U-shaped; V = V-shaped; H= Half-rounded; R = Rectangular-shaped



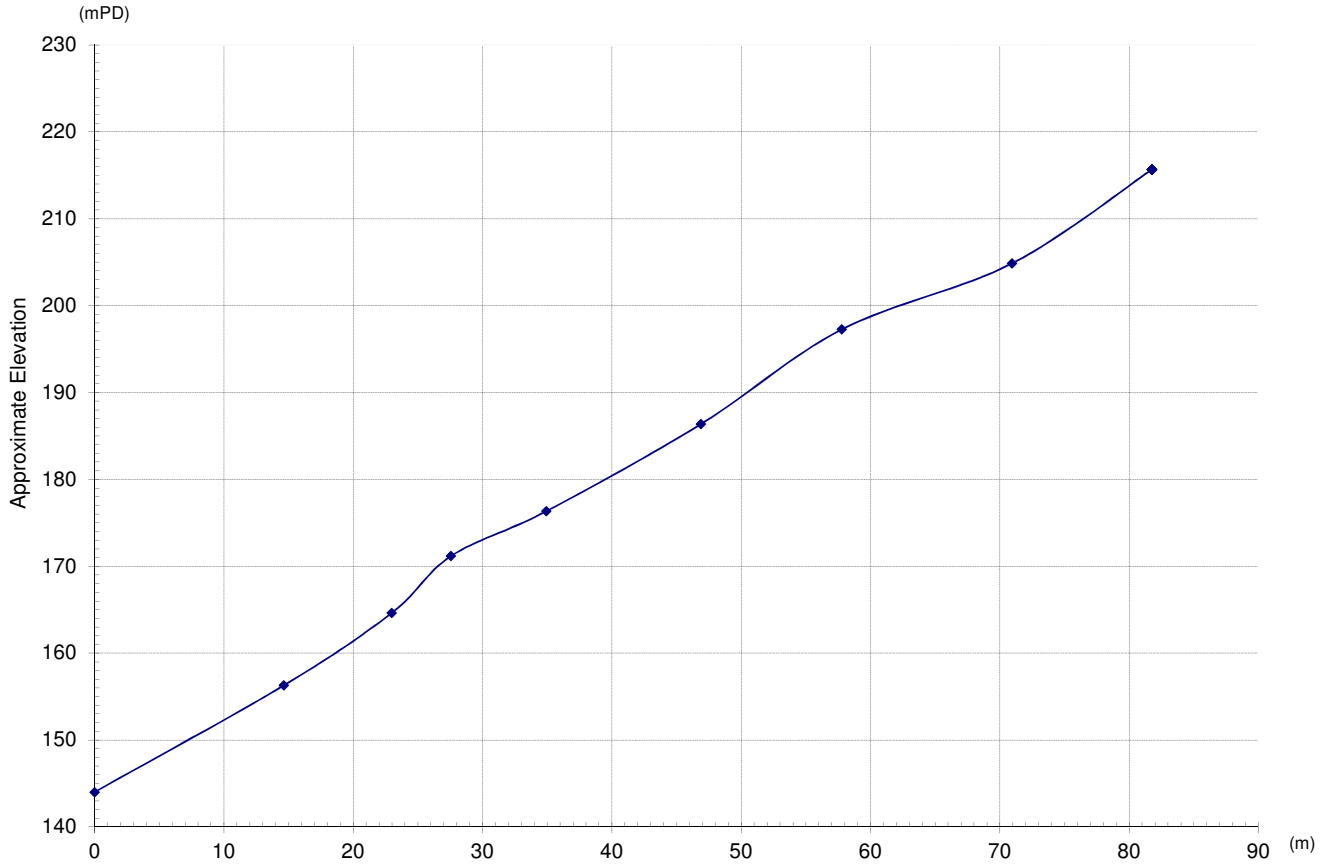
FIELD RECORD

Chainage (m)	0-15.3	15.3-30.6	30.6-46.3	46.3-74.5	74.5-107.5	107.5-141.3	141.3-191.6
Section Length (m)	15.3	15.3	15.7	28.2	33	33.8	50.3
Channel Width (m)	4.7	4.7	8.5	4.4	3.6	3.9	2.4
Channel Depth (m)	1.1	2.2	2.2	1.6	1.1	0.4	0.5
Inclination (°)	40	45	40	40	30	15	25
Side Slopes Angles (°)	85,45	75,10	75,5	75,5	30,35	5,5	5,5
Channelisation Ratio	4.3	2.1	3.9	2.8	3.3	9.8	4.8
Channel Bed Materials #	Cs,Cb,R	Cs,R	Cs,Cb	R,Cb,Cs	Cs	Cs,Cb	Cs,Cb
Side Slopes Materials #	R,Cb	R,Cs	Cs	R,Cs	Cs	Cs	Cs
Thickness of Entrainment Material (m)	0.1	0.3	0.5	0.2	0.2	0.1	0.1
Approx. Channel Shape *	H	H	H	H	H	H	H

F = Fill; Cb = Colluvial Boulders; Cs = Colluvium; CD = Completely Decomposed Rock; HD = Highly Decomposed Rock; R = Bedrock

* U = U-shaped; V = V-shaped; H= Half-rounded; R = Rectangular-shaped

Drainage Line Profile (DL4.5)

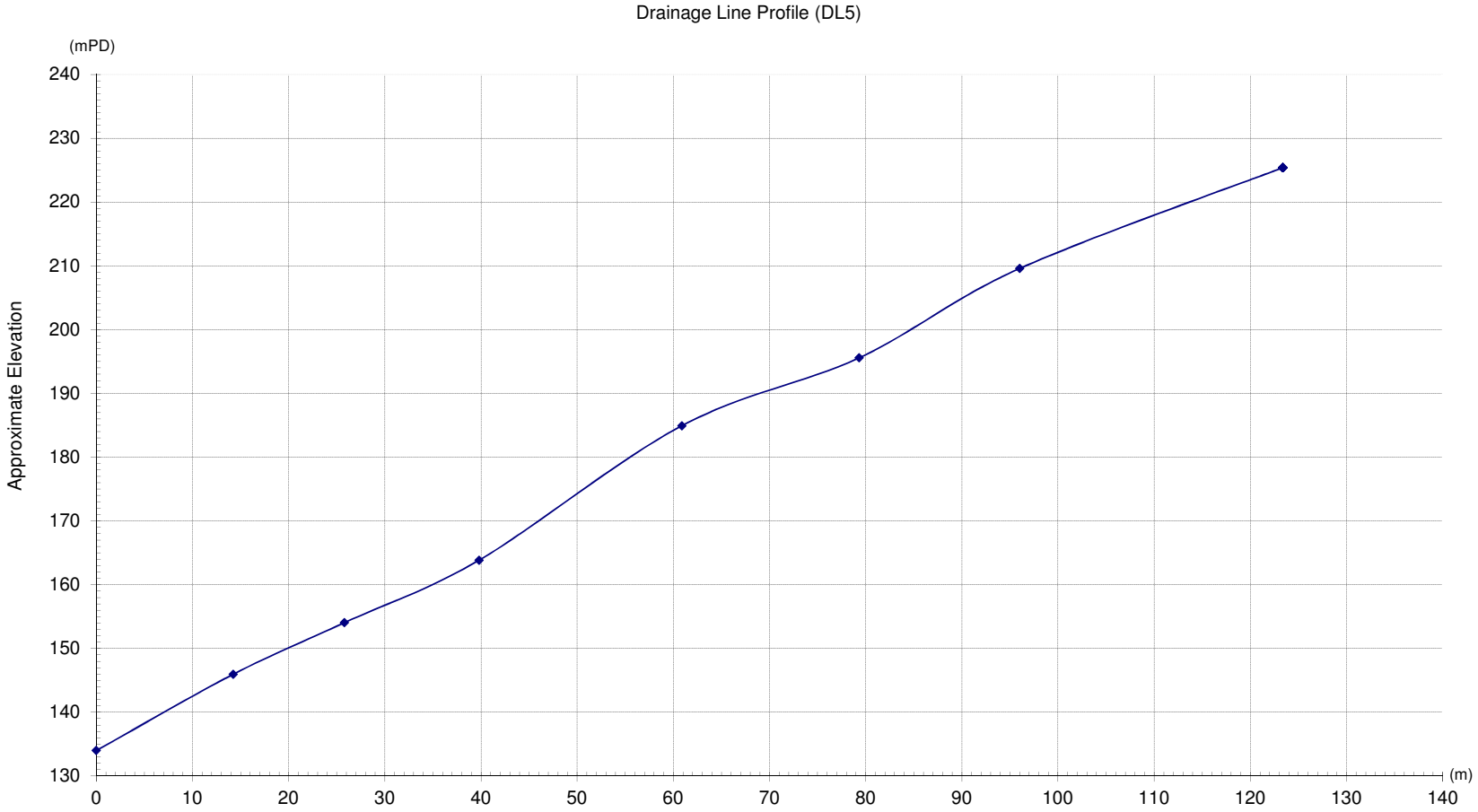


FIELD RECORD

Chainage (m)	0-19.1	19.1-30.9	30.9-38.9	38.9-47.9	47.9-63.5	63.5-78.9	78.9-94.1	94.1-109.4
Section Length (m)	19.1	11.8	8	9	15.6	15.4	15.2	15.3
Channel Width (m)	7.7	6.4	5.9	4.7	8.3	4.3	5.7	5.4
Channel Depth (m)	1.6	1.4	0.9	0.8	1	0.6	0.6	0.6
Inclination (°)	40	45	55	35	40	45	30	45
Side Slopes Angles (°)	45,50	35,45	25,40	20,35	45,30	10,25	20,20	10,15
Channelisation Ratio	4.8	4.6	6.6	5.9	8.3	7.2	9.5	9.0
Channel Bed Materials #	Cs,Cb	Cs,Cb,R	Cs,Cb	Cs,Cb	Cs,Cb	Cs,Cb	Cs,Cb	Cs,Cb
Side Slopes Materials #	Cs	Cs	Cs	Cs	Cs	Cs	Cs	Cs
Thickness of Entrainment Material (m)	0.5	0.5	0.4	0.4	0.4	0.3	0.3	0.2
Approx. Channel Shape *	H	H	H	H	H	H	H	H

F = Fill; Cb = Colluvial Boulders; Cs = Colluvium; CD = Completely Decomposed Rock; HD = Highly Decomposed Rock; R = Bedrock

* U = U-shaped; V = V-shaped; H= Half-rounded; R = Rectangular-shaped



FIELD RECORD

Chainage (m)	0-18.6	18.6-32.7	32.7-49.8	49.8-79.6	79.6-100.9	100.9-122.7	122.7-154.3
Section Length (m)	18.6	14.1	17.1	29.8	21.3	21.8	31.6
Channel Width (m)	4	8.3	7.1	7.9	7.4	7	8
Channel Depth (m)	1	1.1	1.5	0.9	0.8	0.8	0.8
Inclination (°)	40	35	35	45	30	40	30
Side Slopes Angles (°)	35,20	20,10	60,15	40,15	15,10	10,20	10,15
Channelisation Ratio	4.0	7.5	4.7	8.8	9.3	8.8	10.0
Channel Bed Materials #	Cs,Cb	Cs,Cb	Cs,Cb	Cs,Cb	Cs,Cb	Cs,Cb	Cs,Cb
Side Slopes Materials #	Cs	Cs	Cs	Cs	Cs	Cs	Cs
Thickness of Entrainment Material (m)	0.4	0.4	0.6	0.5	0.5	0.4	0.3
Approx. Channel Shape *	H	H	H	H	H	H	H

F = Fill; Cb = Colluvial Boulders; Cs = Colluvium; CD = Completely Decomposed Rock; HD = Highly Decomposed Rock; R = Bedrock

* U = U-shaped; V = V-shaped; H= Half-rounded; R = Rectangular-shaped

Appendix D

Debris Mobility Modelling

D1. Introduction

The debris mobility assessment for the NTSA was performed by a computer programme, DAN-W developed by O. Hungr Geotechnical Research Inc.

D2. Debris mobility analysis for the NTSA

D2.1 Credible runout paths

Based on the location of probable landslide source area, 18 steepest paths (credible debris runout paths, RP1 – RP18) are generated from the topographic map using ArcGIS (Figure D1).

D2.2 Input parameters

The initial source volume is based on the Design Event Source Volume = 40m^3. The width of the modelled landslide mass is assumed to be about 10 m by reference to the landslide data obtained from landslide records within and in the vicinity of the NTSA and also the widths of the topographic depressions and drainage lines were based on field mapping. The input parameters for the analysis are summarized below table:

Input parameters	Value	Remark & References
Rheological Model	Friction (For OHL)	GEO Report No.104, TGN 34
	Voellmy (For DF)	TGN 38
	Voellmy (For CDF)	GEO Report No.104 , TGN 29
Apparent Angle of Friction	25° (For OHL)	TGN34
	18° (For DF)	TGN38
	11° (For CDF)	GEO Report No.104, TGN 29
Turbulence Coefficient	1000m/s² (For DF)	TGN38
	500m/s² (For CDF)	GEO Report No. 104
Unit Weight of Debris	22kN/m³	Based on DN 1/2012, assuming debris will comprise colluvium and residual soil

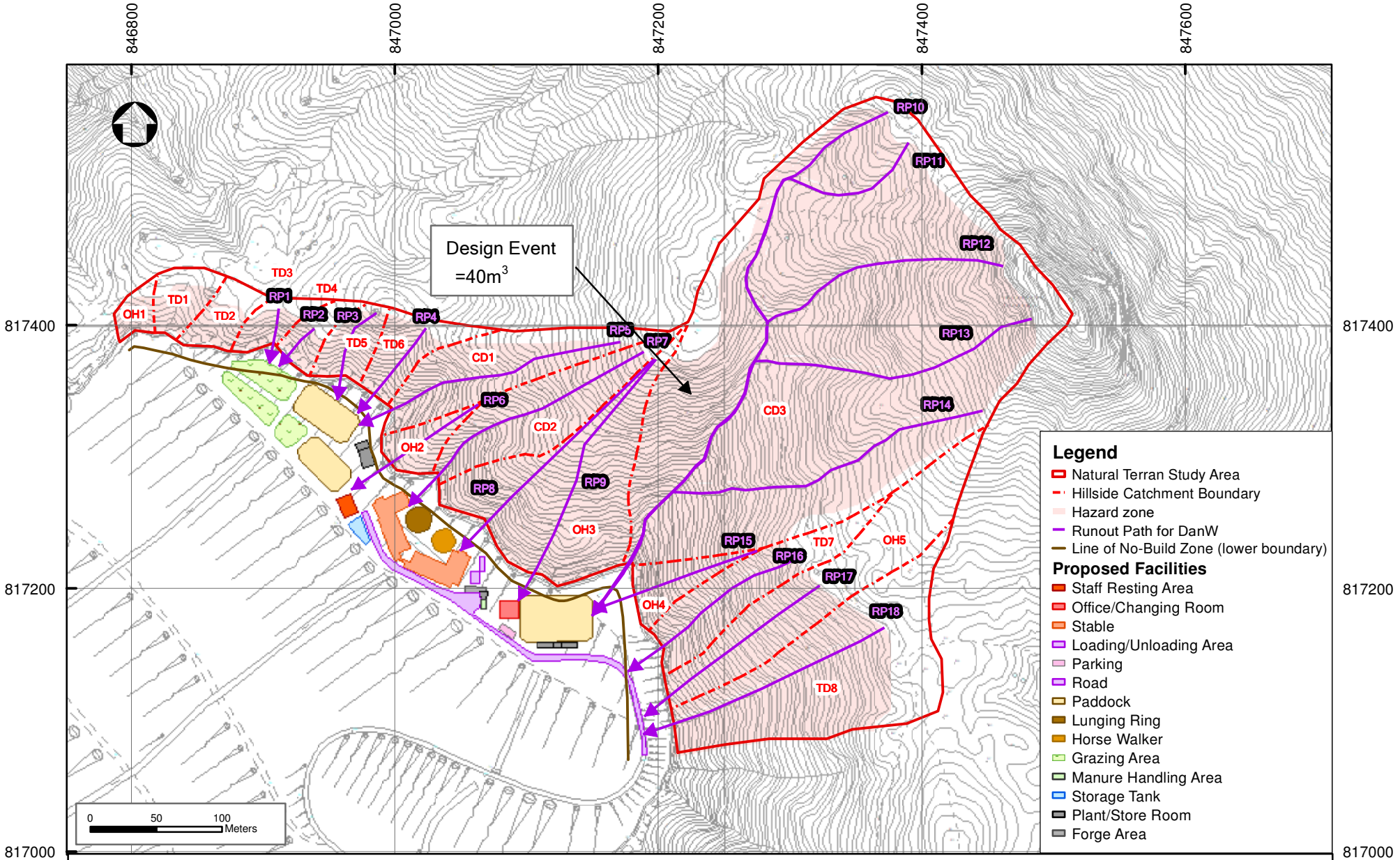
D3. Result of the analysis

Results of the analysis is shown in Figure D2 to D30 and summarized in below table:

Terrain Unit	Catchment No.	Runout Path No.	Source Volume (m^3)	Analytical Model	Final Volume (m^3)	Entrainment Volume (m^3)	Travel Distance (m)	Landslide Debris Reaching the Proposed Facilities
Middle slope	TD3	RP1	40.24	Friction & Voellmy	40.24	-	11.58	No
	TD4	RP2	40.41	Friction & Voellmy	40.41	-	27.02	No
	TD5	RP3	40.63	Friction & Voellmy	40.63	-	53.78	No
	TD6	RP4 (Case 1)	40.55	Friction & Voellmy	40.55	-	13.92	No
		RP4 (Case 2)	40.34	Friction & Voellmy	40.34	-	35.46	No
	CD1	RP5 (Case 1)	40.84	Friction & Voellmy	40.84	-	25.16	No
		RP5 (Case 2)	40.22	Friction & Voellmy	107.11	66.89	114.16	No
	OH2	RP6 (Case 1)	40.90	Friction	40.90	-	27.63	No
		RP6 (Case 2)	40.87	Friction	40.87	-	4.75	No
	CD2	RP7 (Case 1)	40.43	Friction & Voellmy	40.43	-	5.74	No
		RP7 (Case 2)	40.50	Friction & Voellmy	143.05	102.55	117.90	No
	OH3	RP8 (Case 1)	40.65	Friction	40.65	-	2.45	No
		RP8 (Case 2)	40.26	Friction	40.26	-	46.01	No
		RP9 (Case 1)	40.27	Friction	40.27	-	75.2	No
		RP9 (Case 2)	40.18	Friction	40.18	-	34.95	No
	CD3	RP10 (Case 1)	40.58	Friction & Voellmy	106.83	66.25	95.63	No

		RP10 (Case 2)	40.14	Friction & Voellmy	43.68	-	7.07	No
		RP11 (Case 1)	40.50	Friction & Voellmy	41.00	0.5	35.35	No
		RP11 (Case 2)	40.10	Friction & Voellmy	382.83	342.73	154.81	No
		RP12 (Case 1)	40.07	Friction & Voellmy	517.11	477.04	402.06	No
		RP12 (Case 2)	40.34	Friction & Voellmy	196.99	156.65	140.64	No
		RP13 (Case 1)	40.51	Friction & Voellmy	40.51	-	104.65	No
		RP13 (Case 2)	40.81	Friction & Voellmy	96.65	55.84	67.08	No
		RP14 (Case 1)	40.88	Friction & Voellmy	41.54	-	89.85	No
		RP14 (Case 2)	40.17	Friction & Voellmy	272.87	232.70	193.52	No
	OH4	RP15	40.67	Friction	40.67	-	100.87	No
	TD7	RP16	40.28	Friction & Voellmy	321.11	280.83	129.70	No
	OH5	RP17	40.89	Friction	40.89	-	135.74	No
	TD8	RP18	40.61	Friction & Voellmy	434.97	394.36	180.95	No

The result indicated that the modelled landslide debris on the all credible flow paths for all catchments would not reach the proposed facilities. Volume of the Potential entrainment materials along the biggest CD catchment CD3 is estimated in the range between 7.07m^3 and 402.06m^3. Most of the modelled landslide debris would either be deposited at the shallow hillsides or retained at the concrete catchwater channel at the toe of the NTSA.



PROJECT: Natural Terrain Hazard Study for the Proposed Development of New Public Riding School at the Restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III)

TITLE: Runout Paths for Debris Mobility Analysis	SCALE: 1 :4000	Modern Consulting Engineers Limited In association with Calvint Geo-Services Limited	FIGURE NO : FIGURE D1

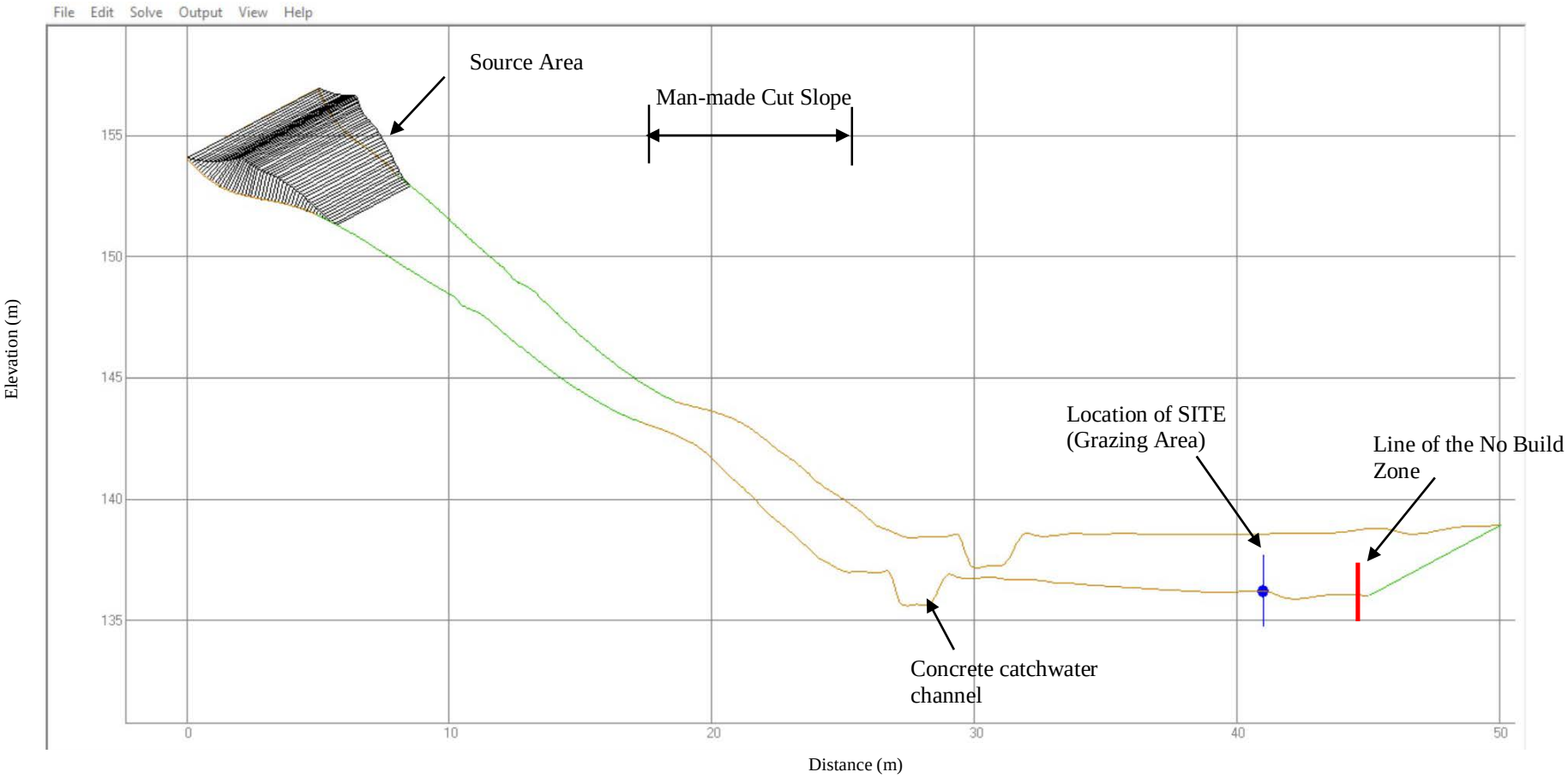
Debris Mobility Analysis for the Credible Runout Path RP1 within Catchment No. TD3

Landslide Type = DF

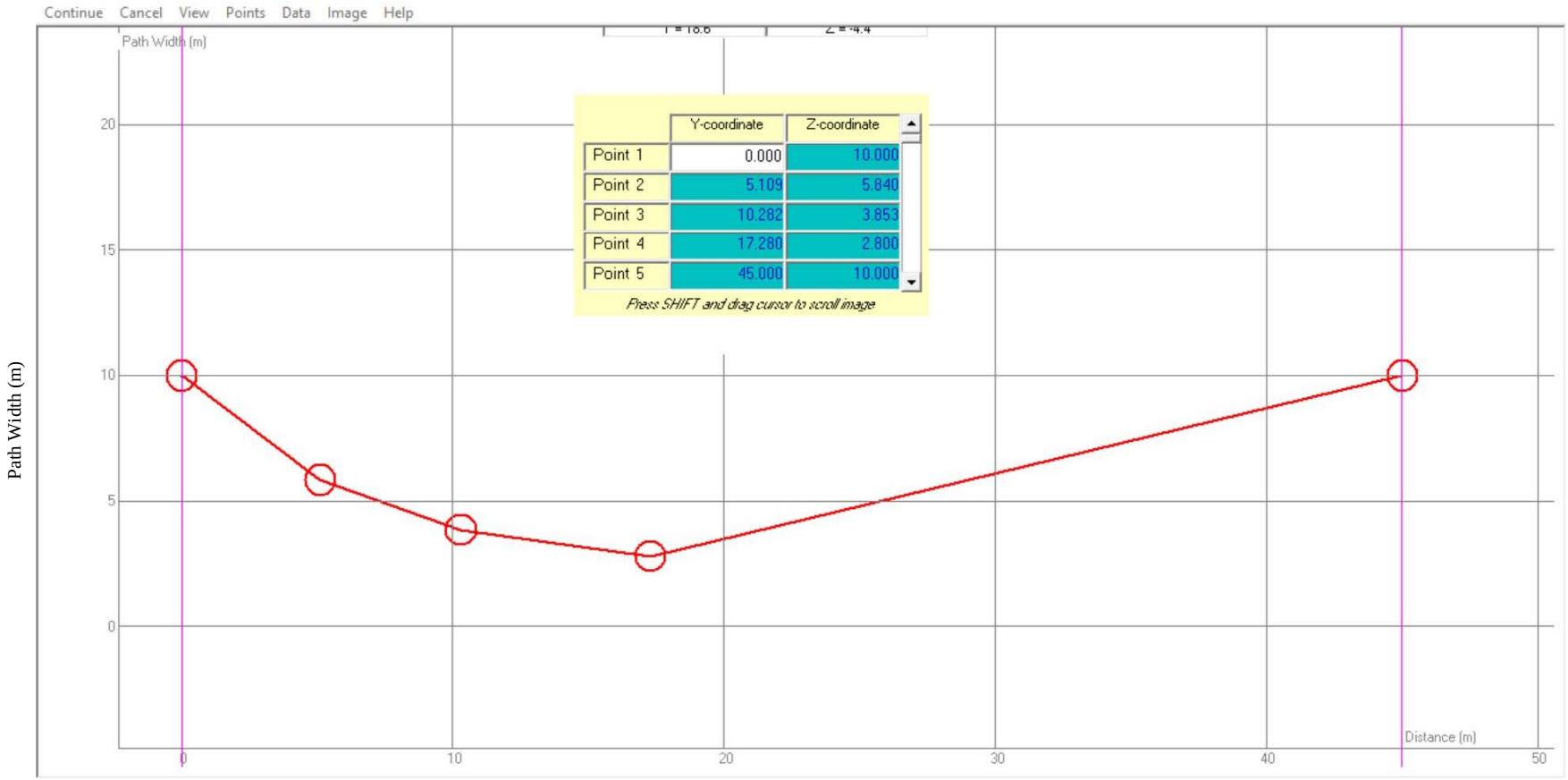
Design Source Volume = 40m^3

Figure D2

Section Profile – (pre-sliding)



Width Profile



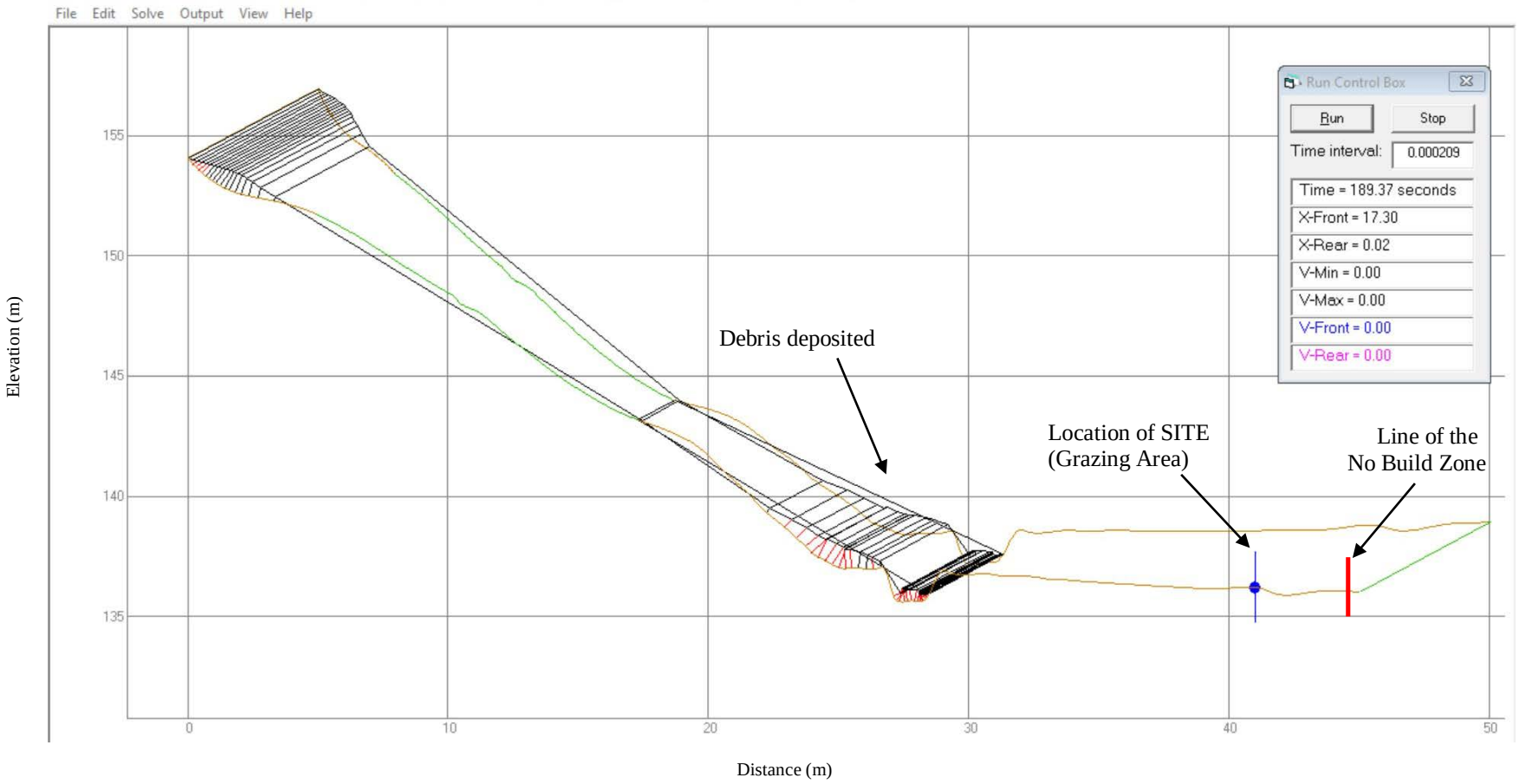
Path Width (m)

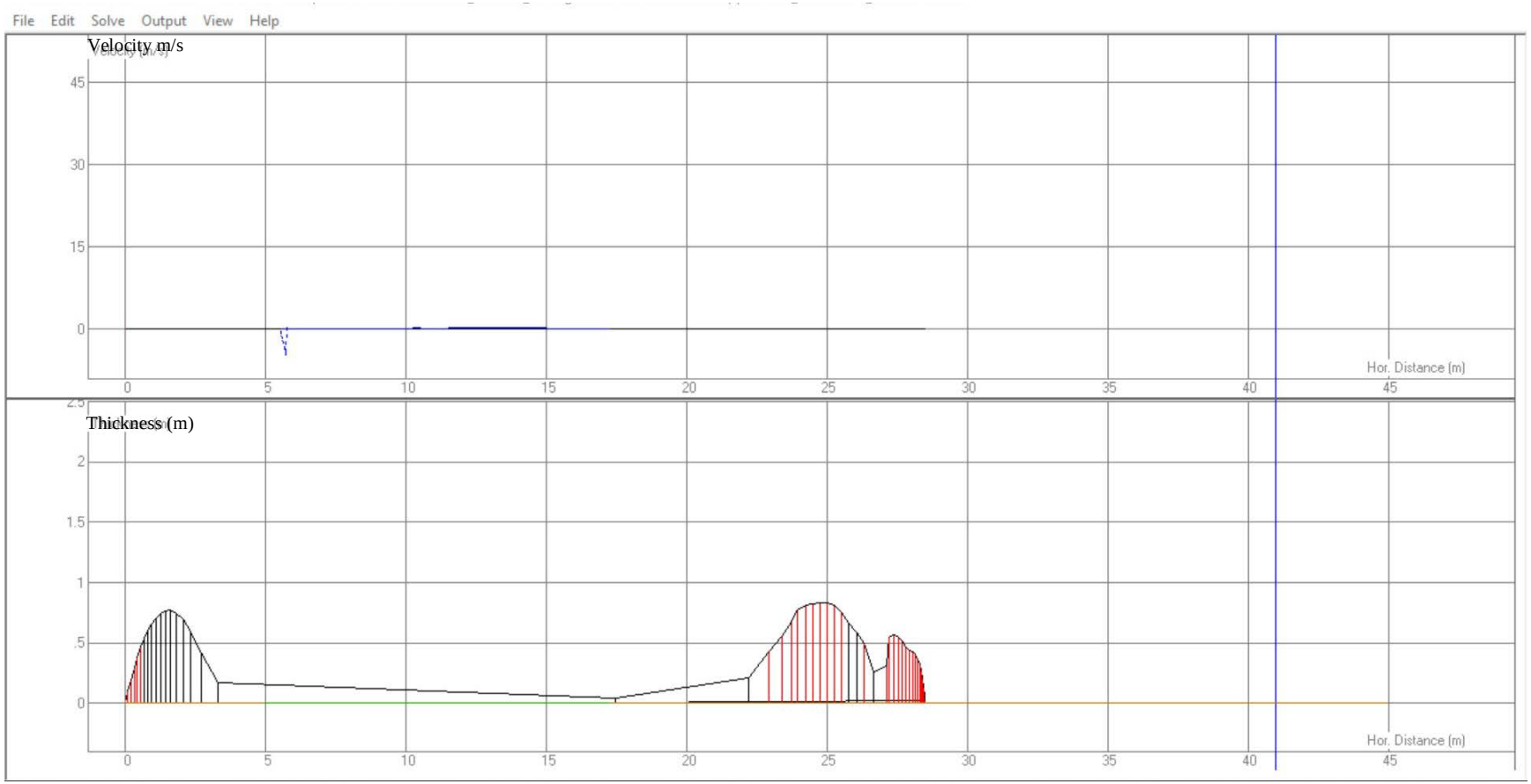
Distance (m)

Result of Debris Mobility Analysis

Source Volume (m^3)	Final Volume (m^3)	Travel Distance (m)	Debris Reached Proposed SITE Facility
40.24	40.24	11.58	No

Section Profile – (post-sliding)




File Edit Solve Output View Help
Velocity m/s
45
30
15
0
0 5 10 15 20 25 30 35 40 45
Hor. Distance (m)
Thickness (m)
2
1.5
1
0
0 5 10 15 20 25 30 35 40 45
Hor. Distance (m)

Distance (m)

No of Blocks = 50

Time step = 0.0002 seconds

End at time = 0.00 seconds

Configuration = 3-dimensional

Boundary Block Geometry = Normal

Shape factor = 1.00

Maximum velocity = 172.39 at X = 5.83

Maximum front velocity = 0.38 at X =5.76

CENTRE OF GRAVITY: X-Source = 2.31

Z-Source = 153.15

X-Depos. = 14.30

Z-Depos. = 144.76

CG Ratio = 0.70

Travel angle = 34.96

FAHRBOSCHUNG = 32.19

FRONT DISPLACEMENT: X = 17.295 Z = 143.175

Curvilinear Displ.= 14.226

Horiz. Displ. = 11.58

REAR DISPLACEMENT: X = 0.02 Z = 154.04

Curvilinear Displ.= 0.03

Horiz. Displ. = 0.02

SLIDE VOLUME: Initial = 40.24

Final = 40.24

AREA IN PLAN: Initial = 43.92

Final = 99.77

Runout not completed, V-MAX = 0.00

Export Print Close Help

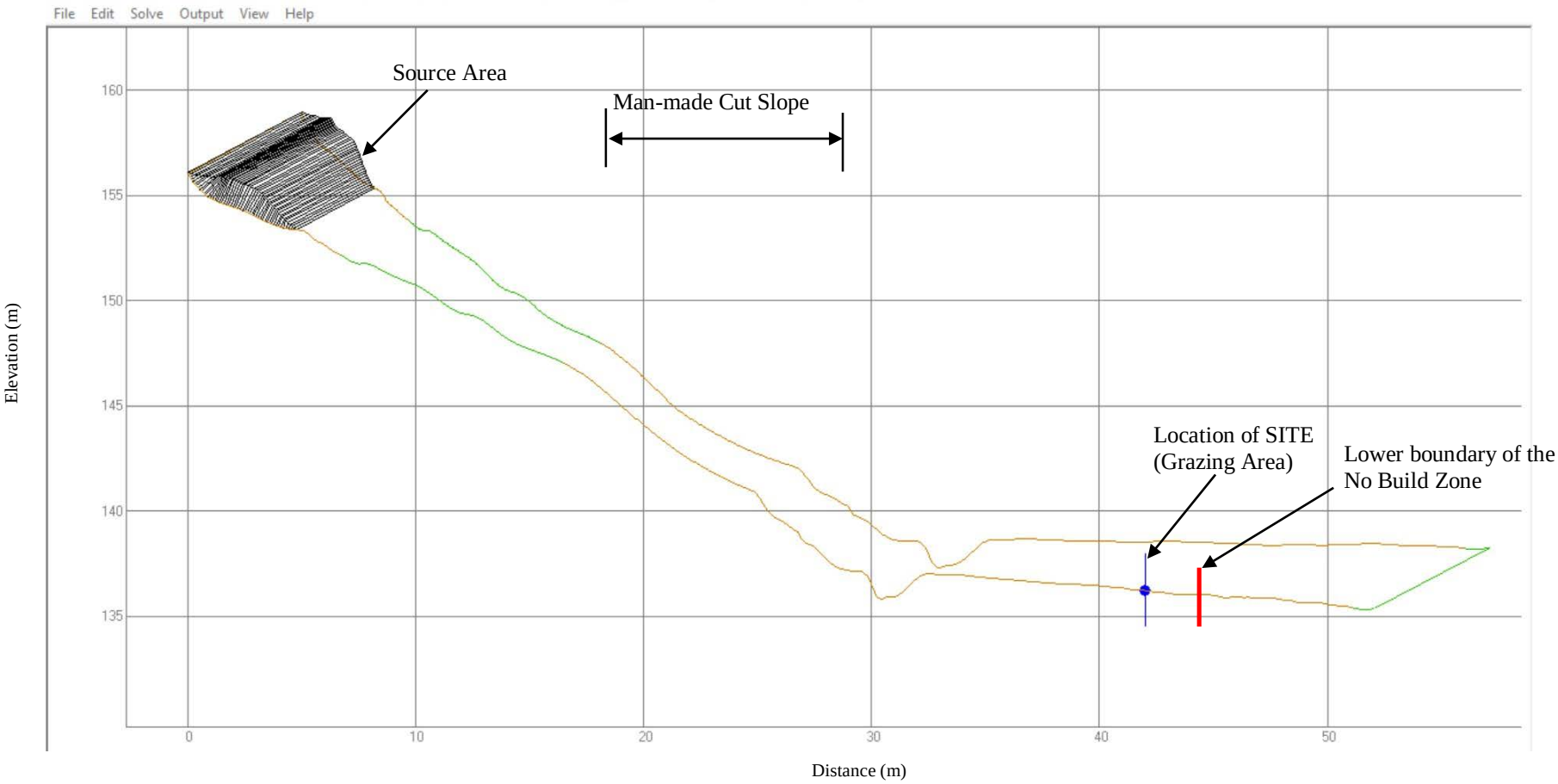
Debris Mobility Analysis for the Credible Runout Path RP2 within Catchment No. TD4

Landslide Type = DF

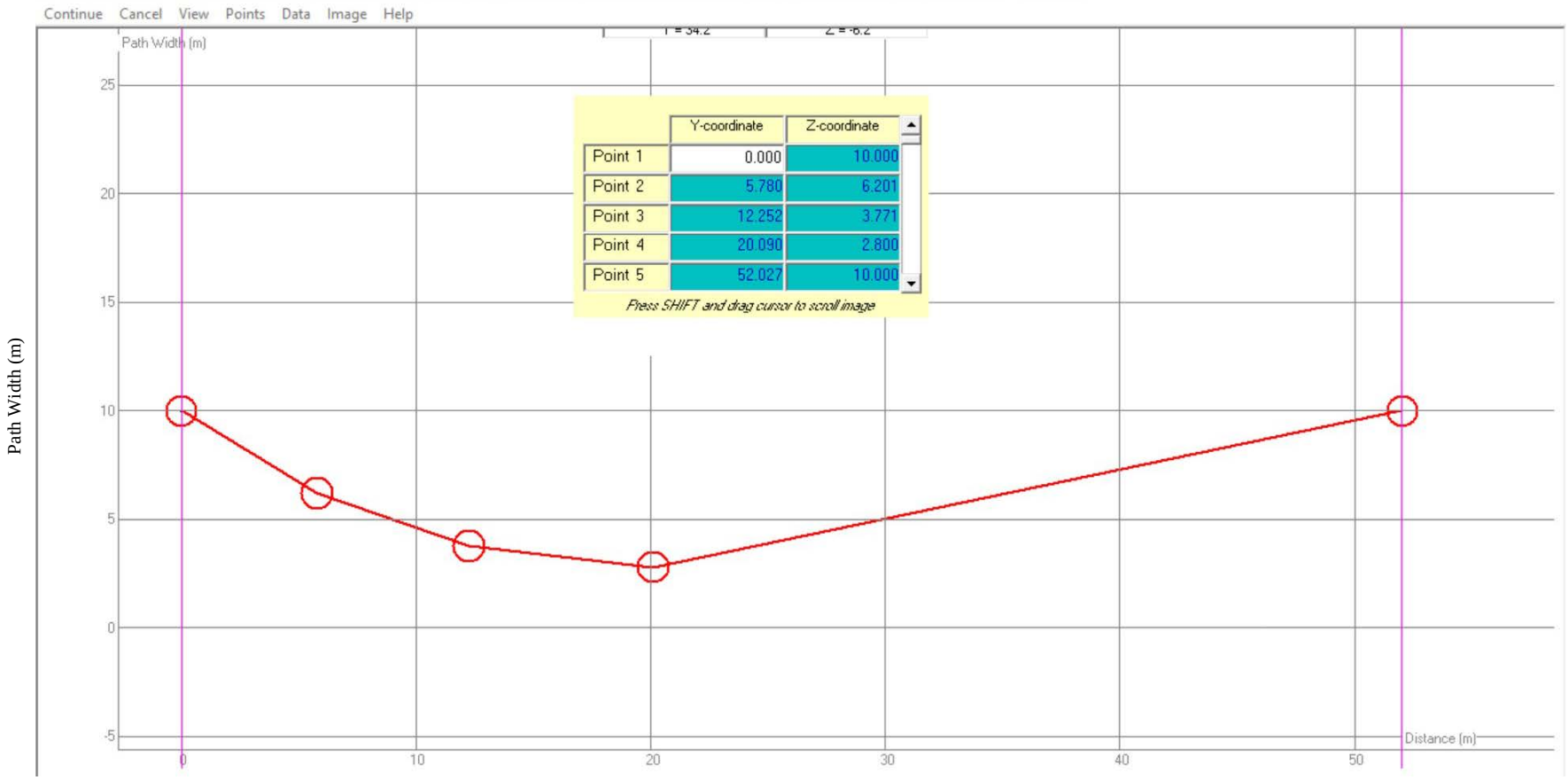
Design Source Volume = 40m^3

Figure D3

Section Profile – (pre-sliding)



Width Profile



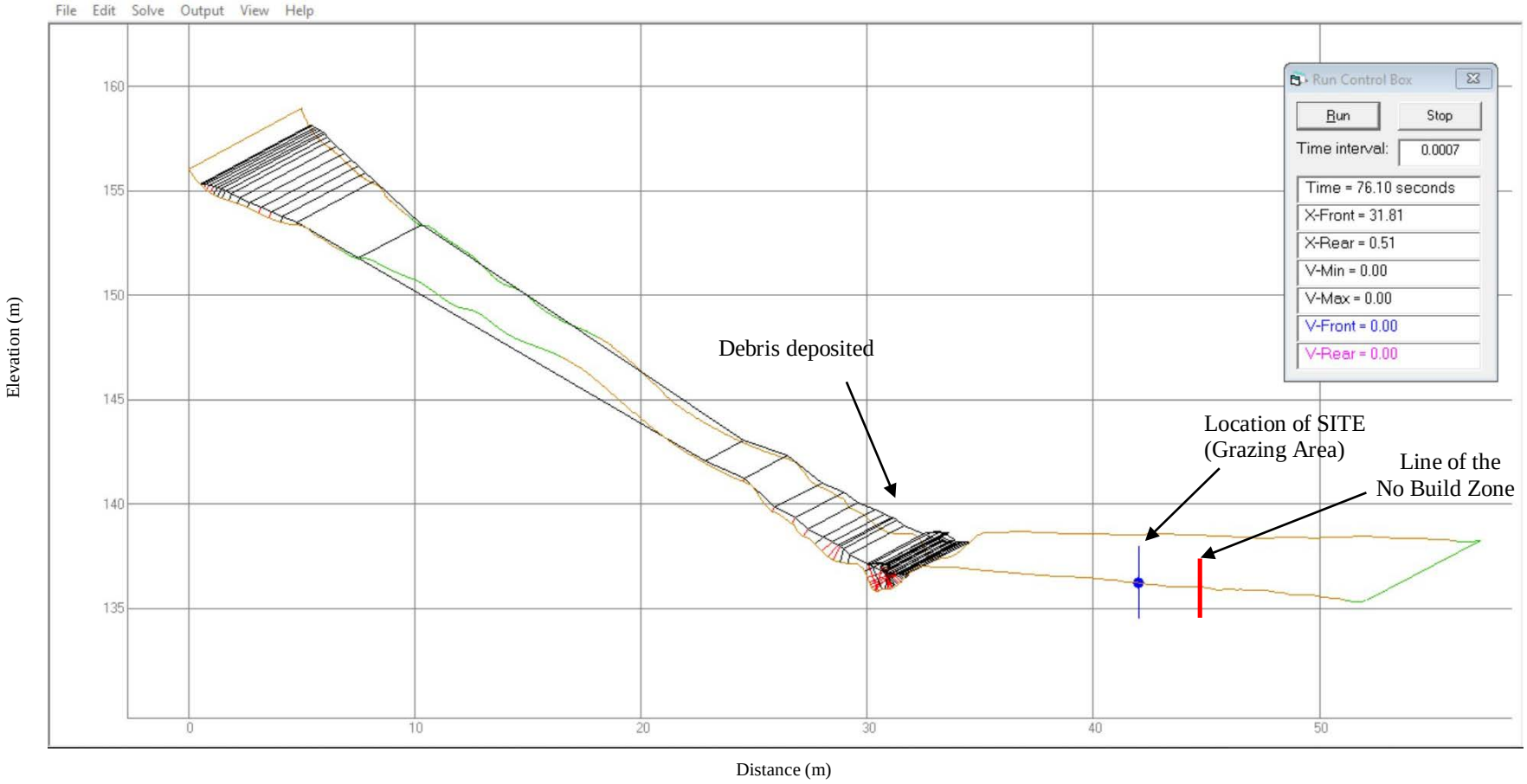
Path Width (m)

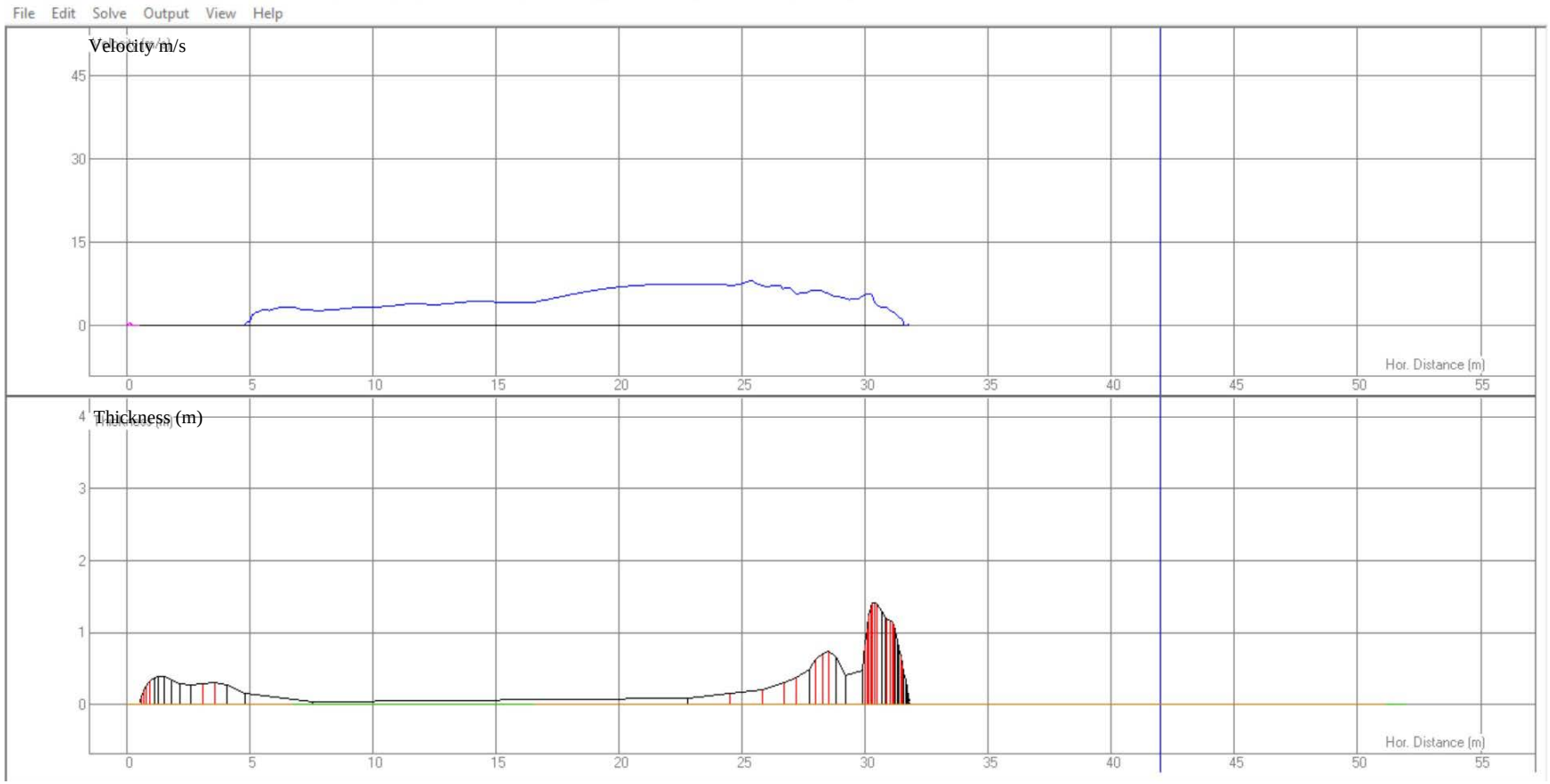
Distance (m)

Result of Debris Mobility Analysis

Source Volume (m^3)	Final Volume (m^3)	Travel Distance (m)	Debris Reached Proposed SITE Facility
40.41	40.41	27.02	No

Section Profile – (post-sliding)




File Edit Solve Output View Help
Velocity m/s
45
30
15
0
0 5 10 15 20 25 30 35 40 45 50 55
Hor. Distance (m)
Thickness (m)
4
3
2
1
0
0 5 10 15 20 25 30 35 40 45 50 55
Hor. Distance (m)

Distance (m)

Final Report

\Esther\Desktop\Freelance\# NTHS\005_Modern_Tseung Kwan O Landfill NTHS\Appendix X_DanW\RP5_D

No of Blocks = 50

Time step = 0.0007 seconds

End at time = 0.00 seconds

Configuration = 3-dimensional

Boundary Block Geometry = Normal

Shape factor = 1.00

Maximum velocity = 8.08 at X = 25.35

Maximum front velocity = 8.08 at X =25.35

CENTRE OF GRAVITY: X-Source = 2.16

Z-Source = 154.95

X-Depos. = 20.42

Z-Depos. = 143.07

CG Ratio = 0.65

Travel angle = 33.04

FAHRBOSCHUNG = 31.44

FRONT DISPLACEMENT: X = 31.810 Z = 136.589

Curvilinear Displ.= 33.492

Horiz. Displ. = 27.02

REAR DISPLACEMENT: X = 0.51 Z = 155.30

Curvilinear Displ.= 0.90

Horiz. Displ. = 0.51

SLIDE VOLUME: Initial = 40.41

Final = 40.41

AREA IN PLAN: Initial = 40.34

Final = 160.56

Runout not completed, V-MAX = 0.00

Export Print Close Help

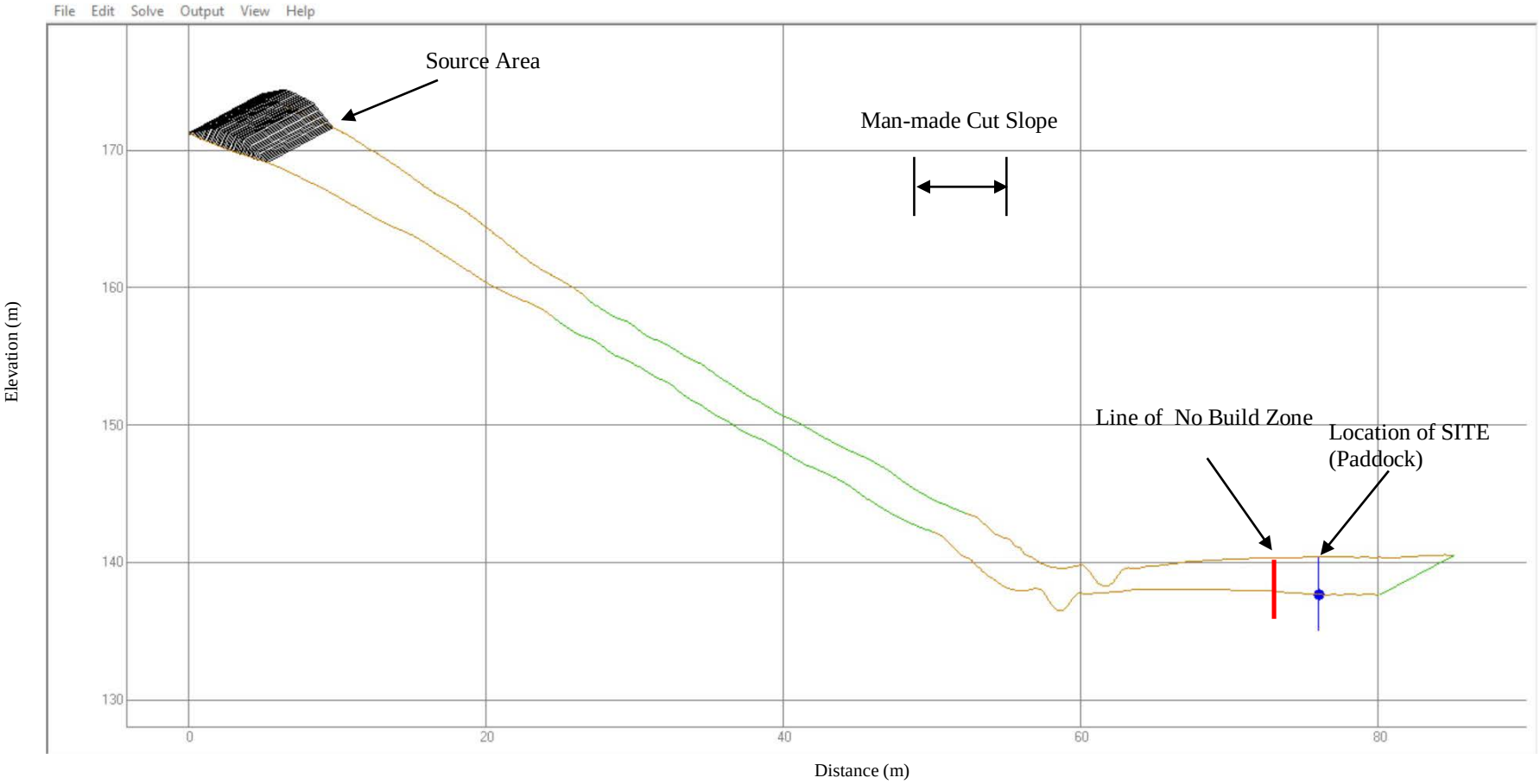
Debris Mobility Analysis for the Credible Runout Path RP3 within Catchment No. TD5

Landslide Type = DF

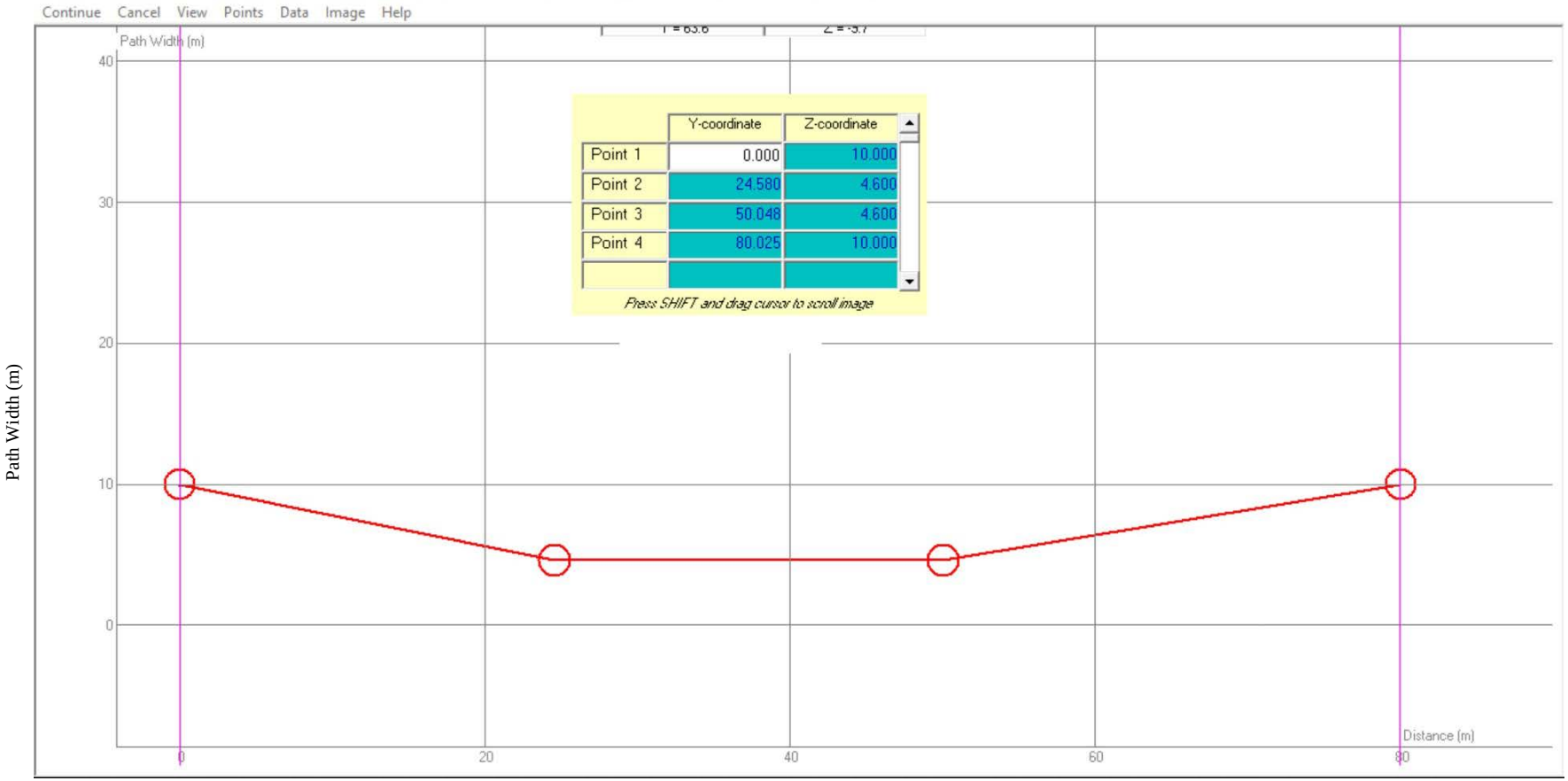
Design Source Volume = 40m^3

Figure D4

Section Profile – (pre-sliding)



Width Profile



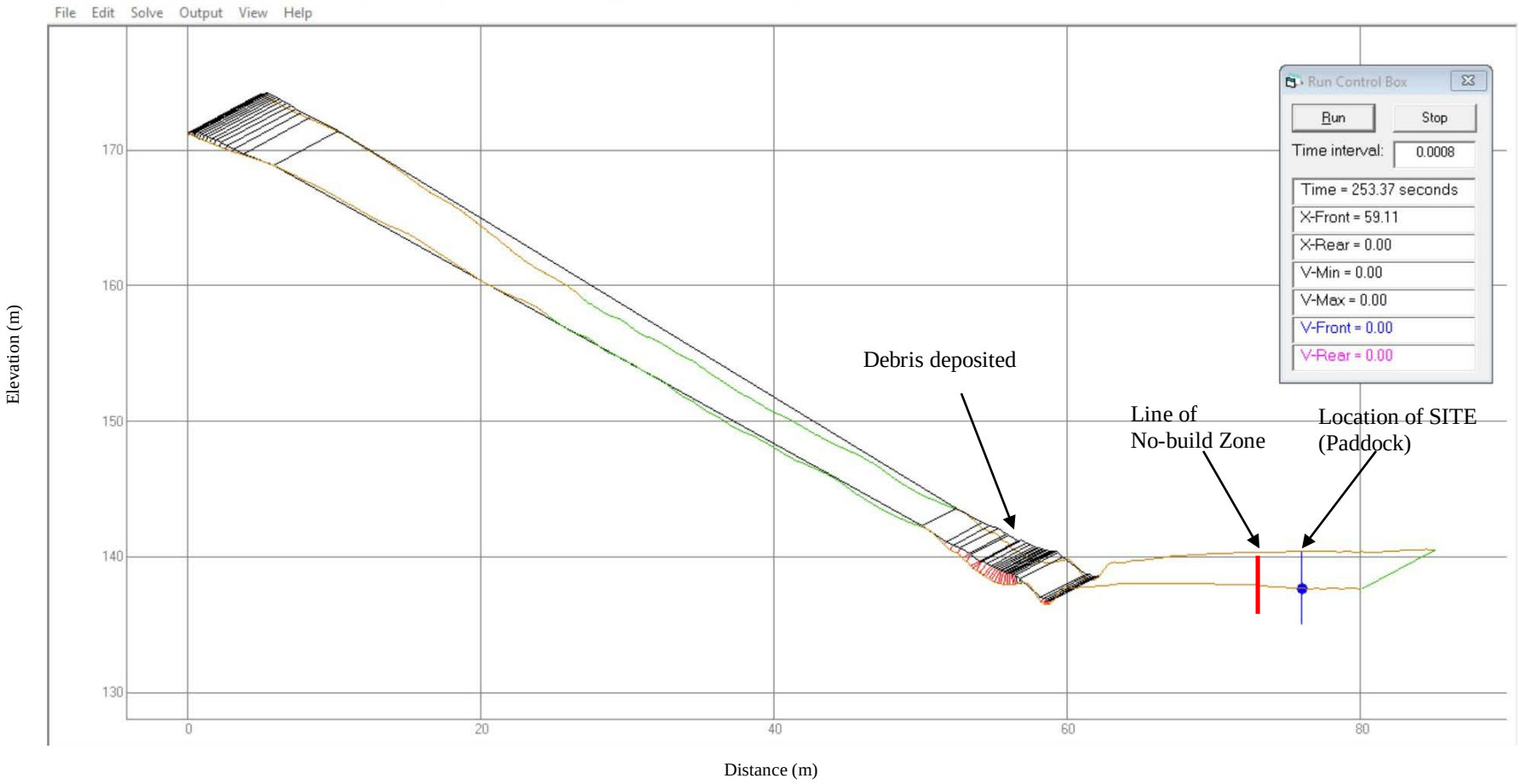
Path Width (m)

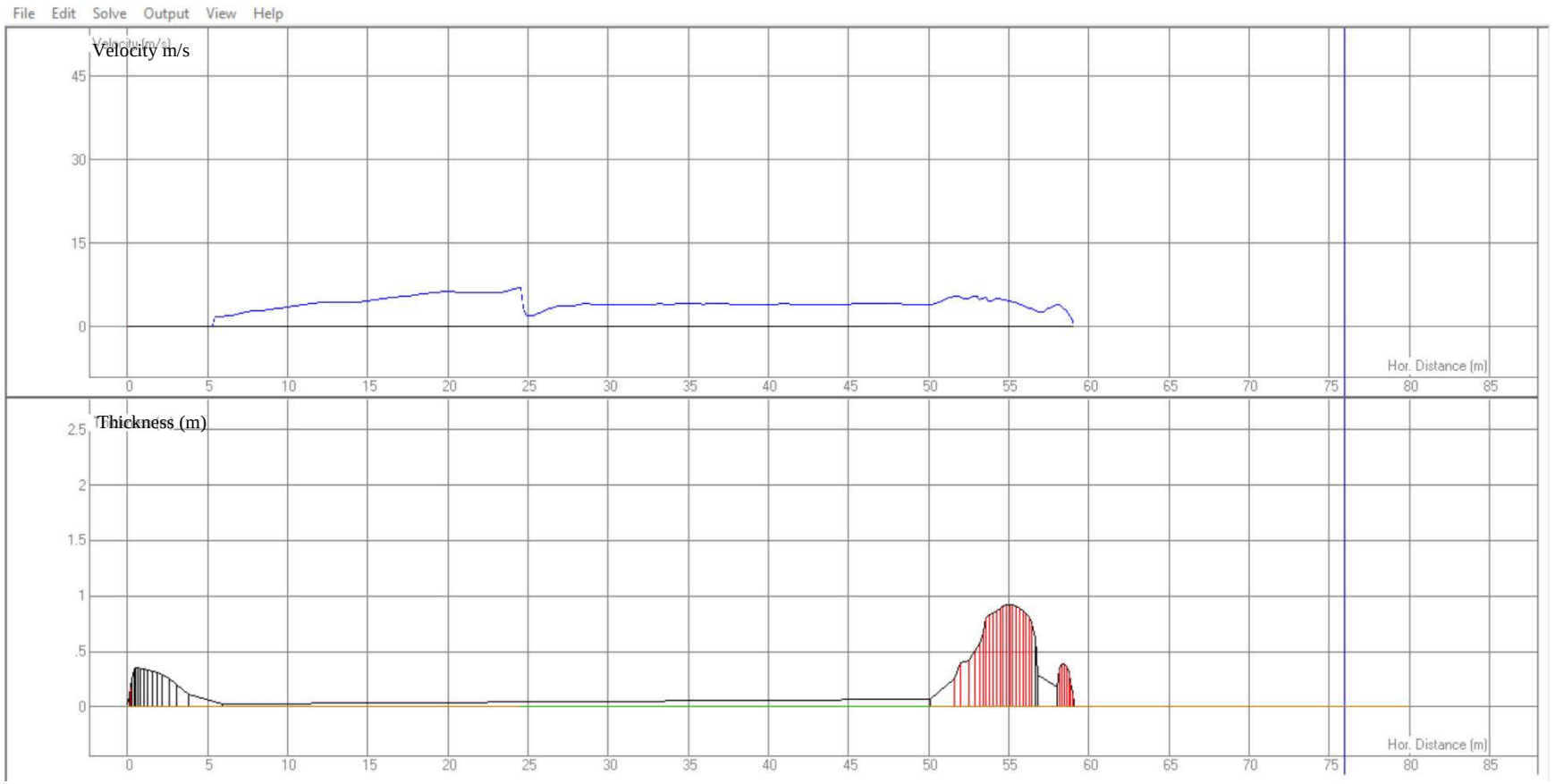
Distance (m)

Result of Debris Mobility Analysis

Source Volume (m^3)	Final Volume (m^3)	Travel Distance (m)	Debris Reached Proposed SITE Facility
40.63	40.63	53.78	No

Section Profile – (post-sliding)




File Edit Solve Output View Help
Velocity m/s
45
30
15
0
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85
Hor. Distance (m)
Thickness (m)
2.5
2
1.5
1
.5
0
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85
Hor. Distance (m)

Distance (m)

No of Blocks = 50

Time step = 0.0008 seconds

End at time = 0.00 seconds

Configuration = 3-dimensional

Boundary Block Geometry = Normal

Shape factor = 1.00

Maximum velocity = 7.07 at X = 24.58

Maximum front velocity = 7.07 at X =24.58

CENTRE OF GRAVITY: X-Source = 2.65

Z-Source = 170.61

X-Depos. = 38.79

Z-Depos. = 148.58

CG Ratio = 0.61

Travel angle = 31.36

FAHRBOSCHUNG = 30.23

FRONT DISPLACEMENT: X = 59.107 Z = 136.809

Curvilinear Displ.= 63.944

Horiz. Displ. = 53.78

REAR DISPLACEMENT: X = 0.00 Z = 171.25

Curvilinear Displ.= 0.00

Horiz. Displ. = 0.00

SLIDE VOLUME: Initial = 40.63

Final = 40.63

AREA IN PLAN: Initial = 50.11

Final = 398.32

Runout not completed, V-MAX = 0.00

Export Print Close Help

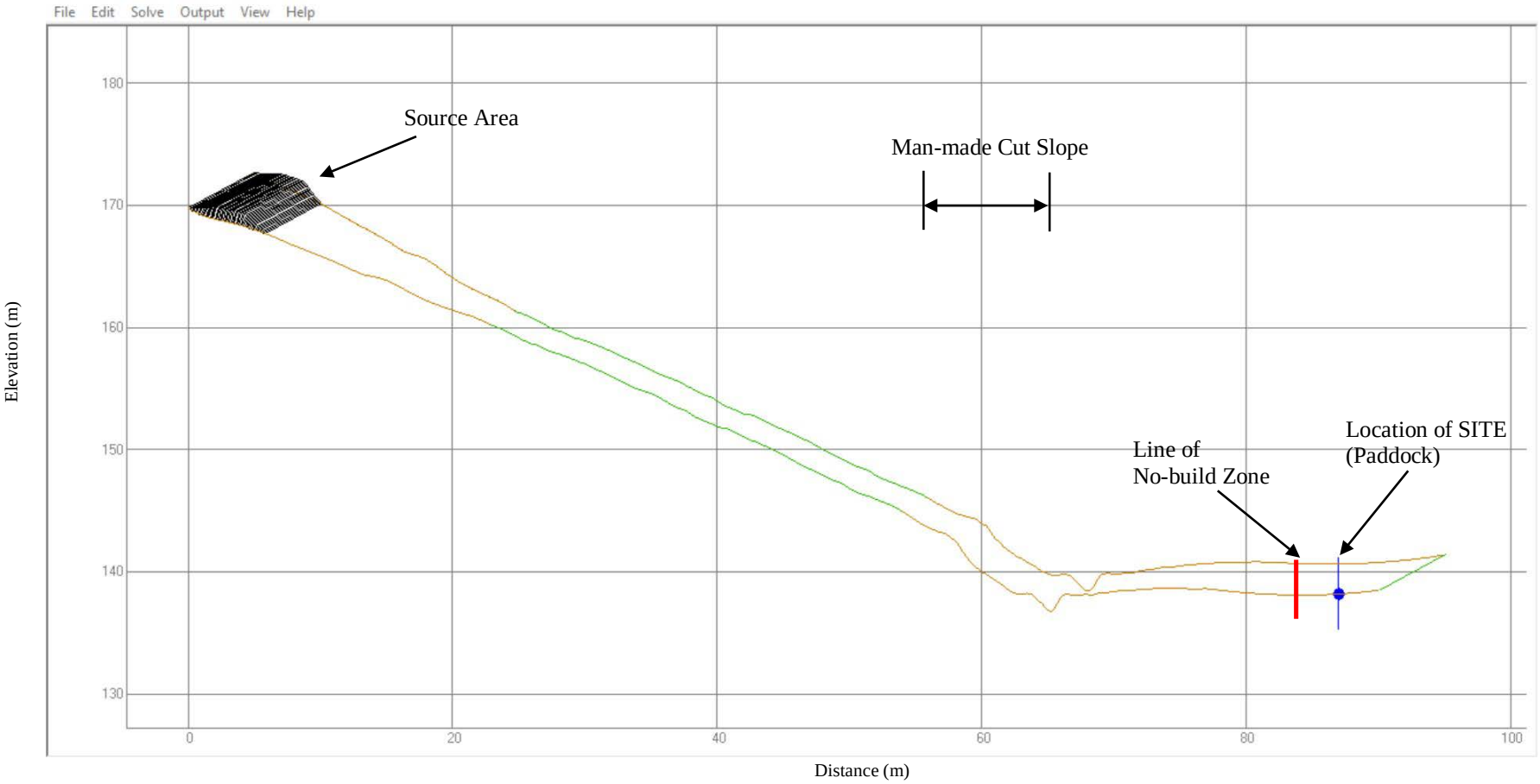
Debris Mobility Analysis for the Credible Runout Path RP4 (Case 1) within Catchment No. TD6

Landslide Type = DF

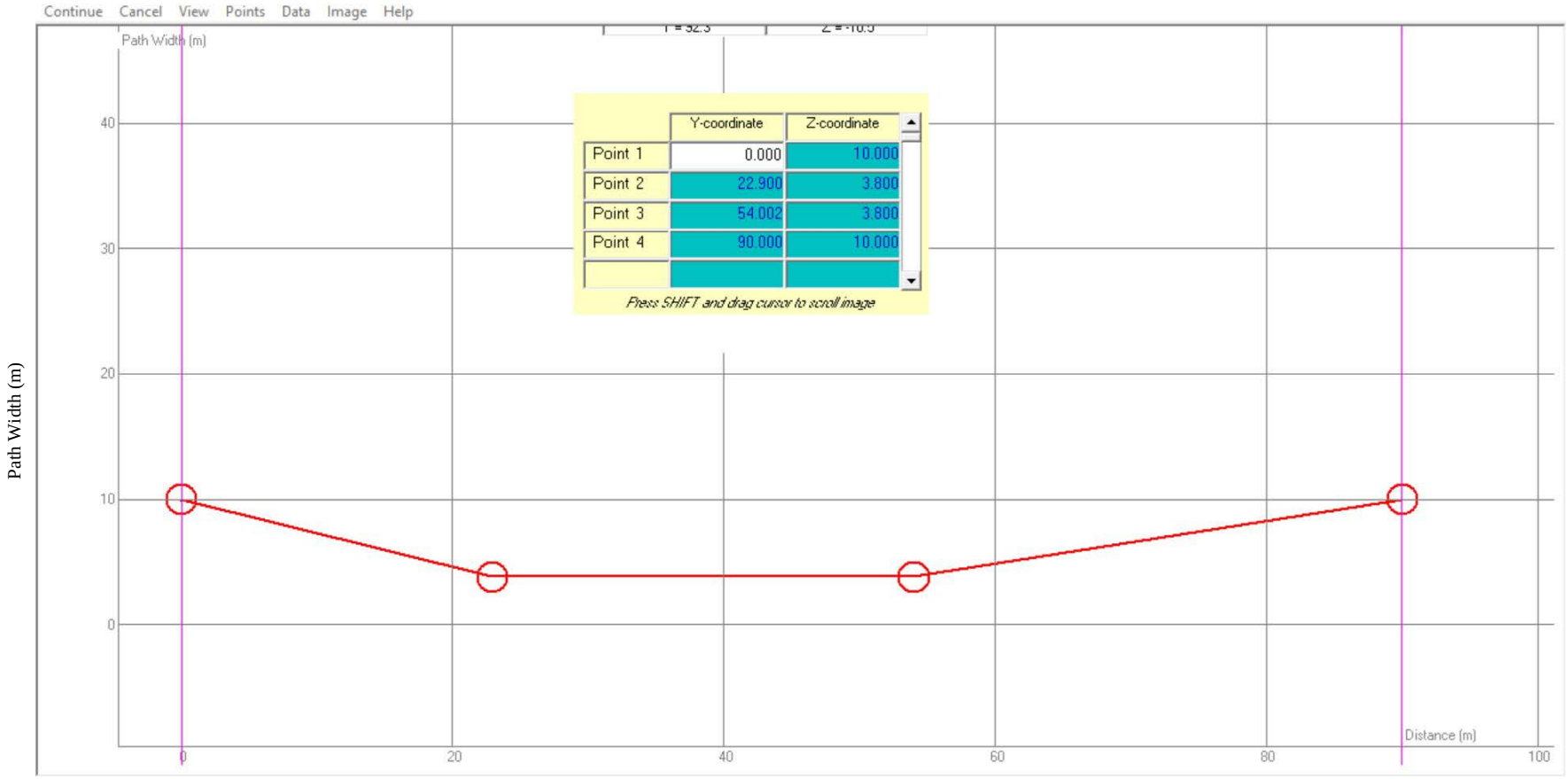
Design Source Volume = 40m^3

Figure D5

Section Profile – (pre-sliding)



Width Profile



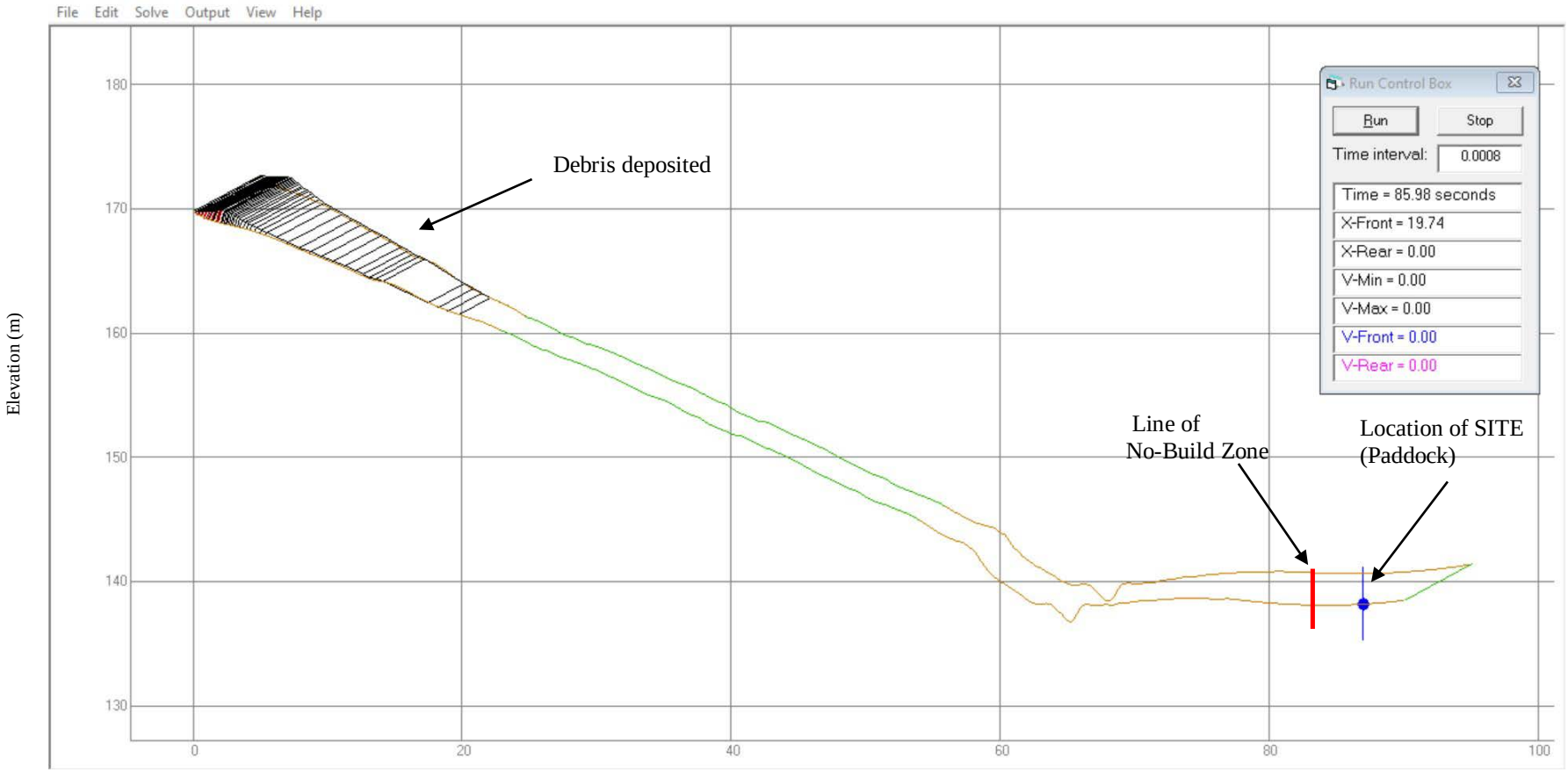
Path Width (m)

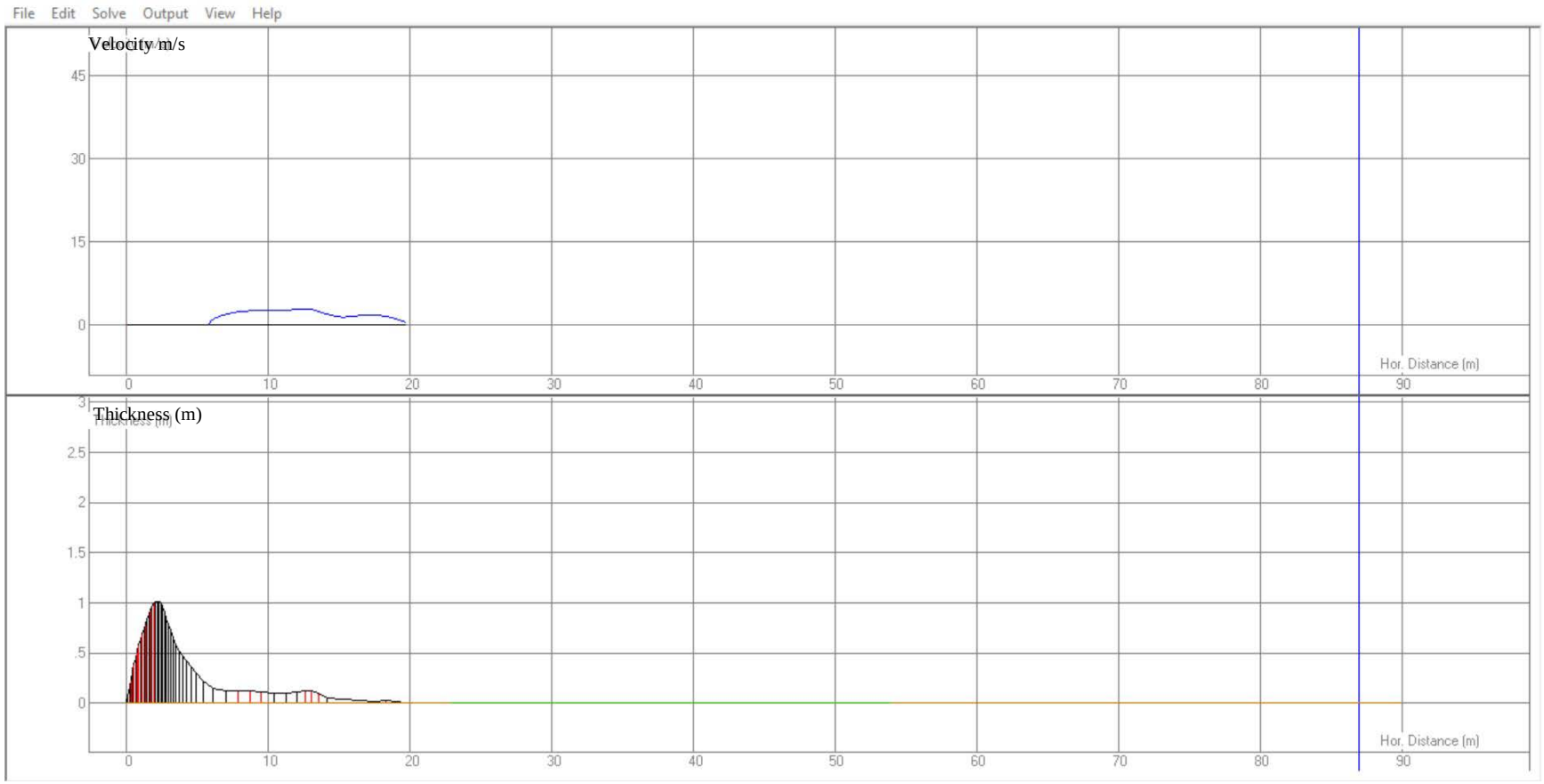
Distance (m)

Result of Debris Mobility Analysis

Source Volume (m^3)	Final Volume (m^3)	Travel Distance (m)	Debris Reached Proposed SITE Facility
40.55	40.55	13.92	No

Section Profile – (post-sliding)




File Edit Solve Output View Help
Velocity m/s
45
30
15
0
0 10 20 30 40 50 60 70 80 90
Hor. Distance (m)
Thickness (m)
2.5
2
1.5
1
.5
0
0 10 20 30 40 50 60 70 80 90
Hor. Distance (m)

Distance (m)

No of Blocks = 50

Time step = 0.0008 seconds

End at time = 0.00 seconds

Configuration = 3-dimensional

Boundary Block Geometry = Normal

Shape factor = 1.00

Maximum velocity = 3.00 at X = 12.62

Maximum front velocity = 3.00 at X =12.62

CENTRE OF GRAVITY: X-Source = 2.93

Z-Source = 169.10

X-Depos. = 4.16

Z-Depos. = 168.44

CG Ratio = 0.54

Travel angle = 28.31

FAHRBOSCHUNG = 22.67

FRONT DISPLACEMENT: X = 19.743 Z = 161.514

Curvilinear Displ.= 15.279

Horiz. Displ. = 13.92

REAR DISPLACEMENT: X = 0.00 Z = 169.76

Curvilinear Displ.= 0.00

Horiz. Displ. = 0.00

SLIDE VOLUME: Initial = 40.55

Final = 40.55

AREA IN PLAN: Initial = 53.66

Final = 144.66

Runout not completed, V-MAX = 0.00

Export Print Close Help

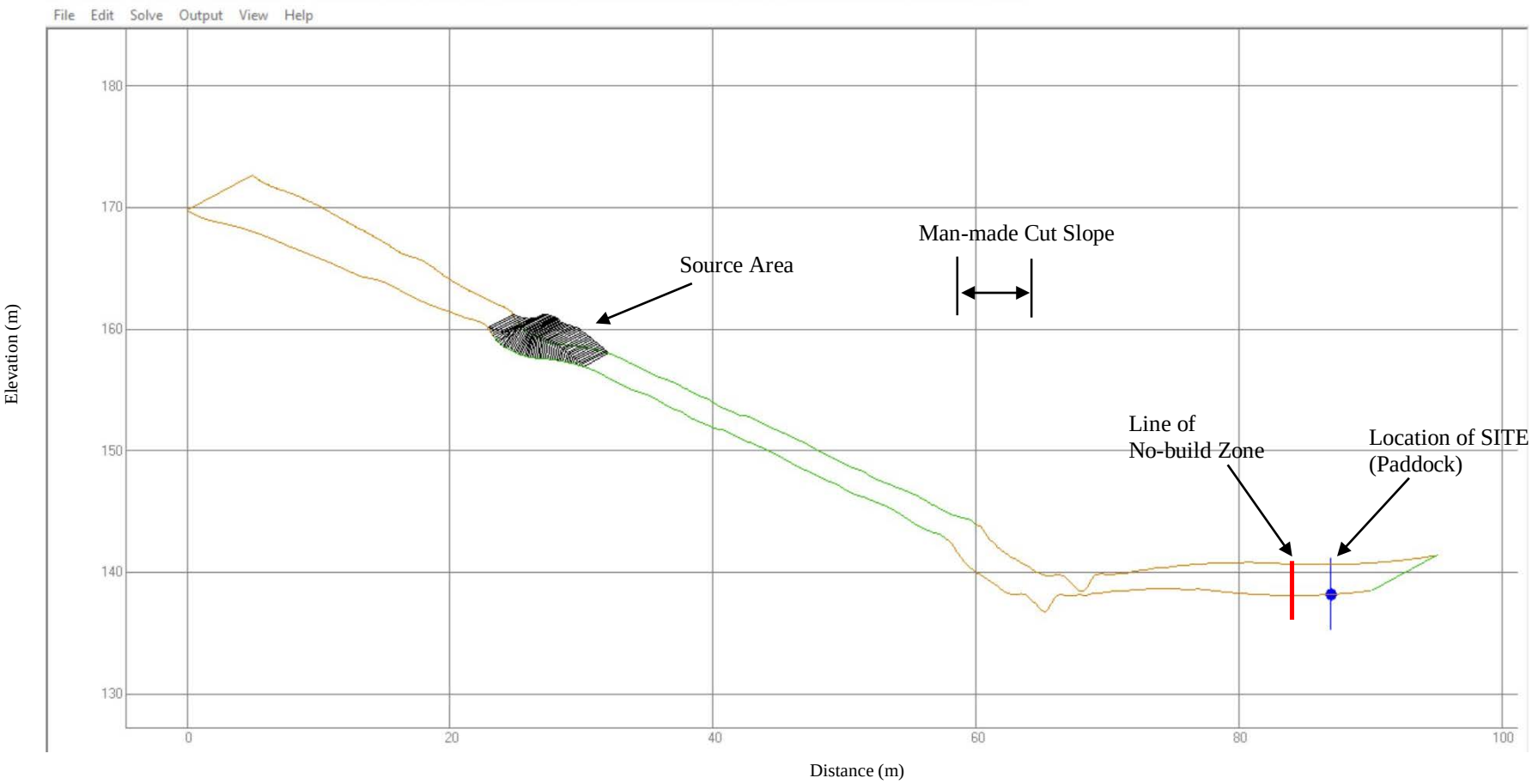
Debris Mobility Analysis for the Credible Runout Path RP4 (Case 2) within Catchment No. TD6

Landslide Type = DF

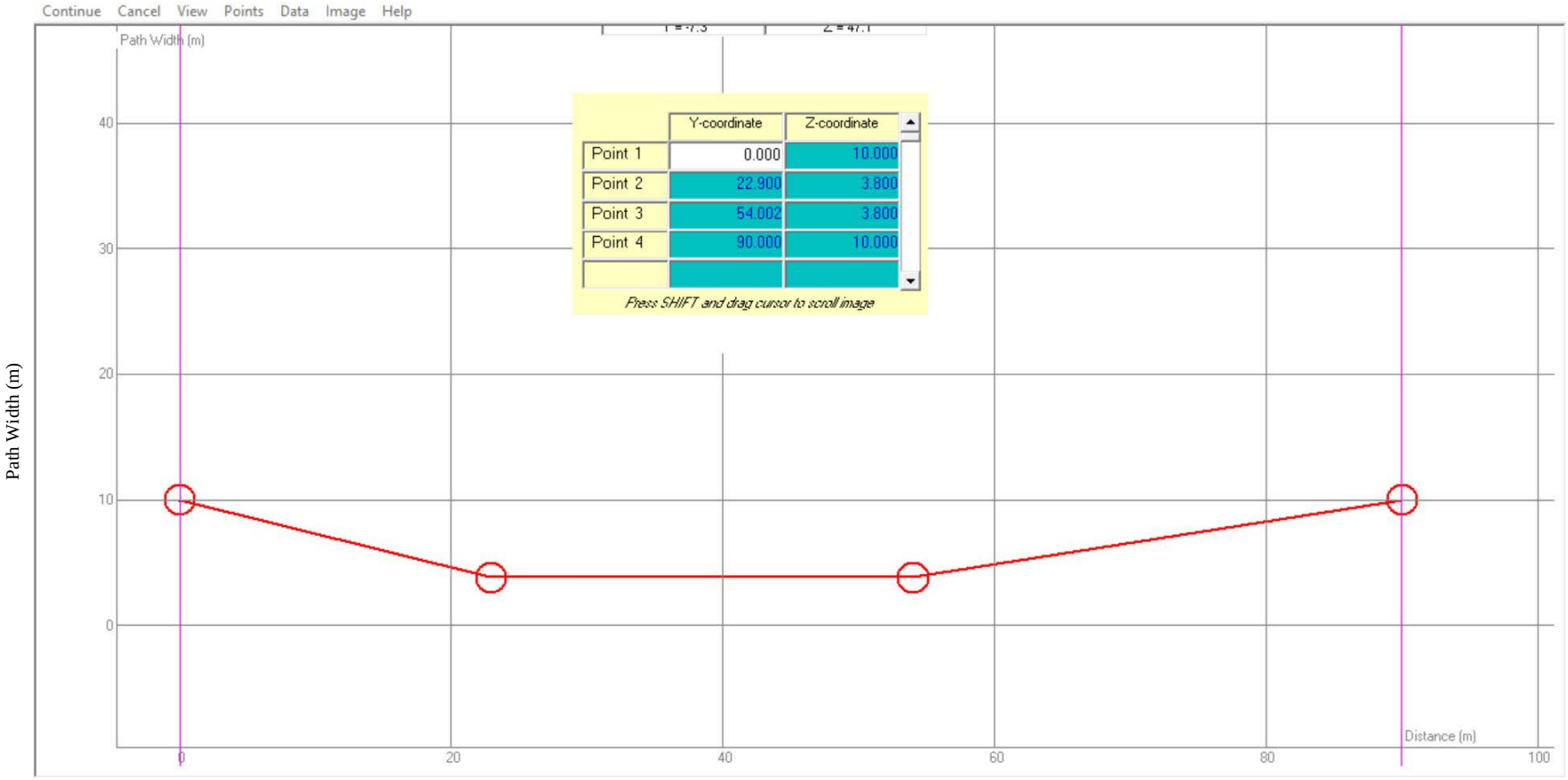
Design Source Volume = 40m^3

Figure D6

Section Profile – (pre-sliding)



Width Profile



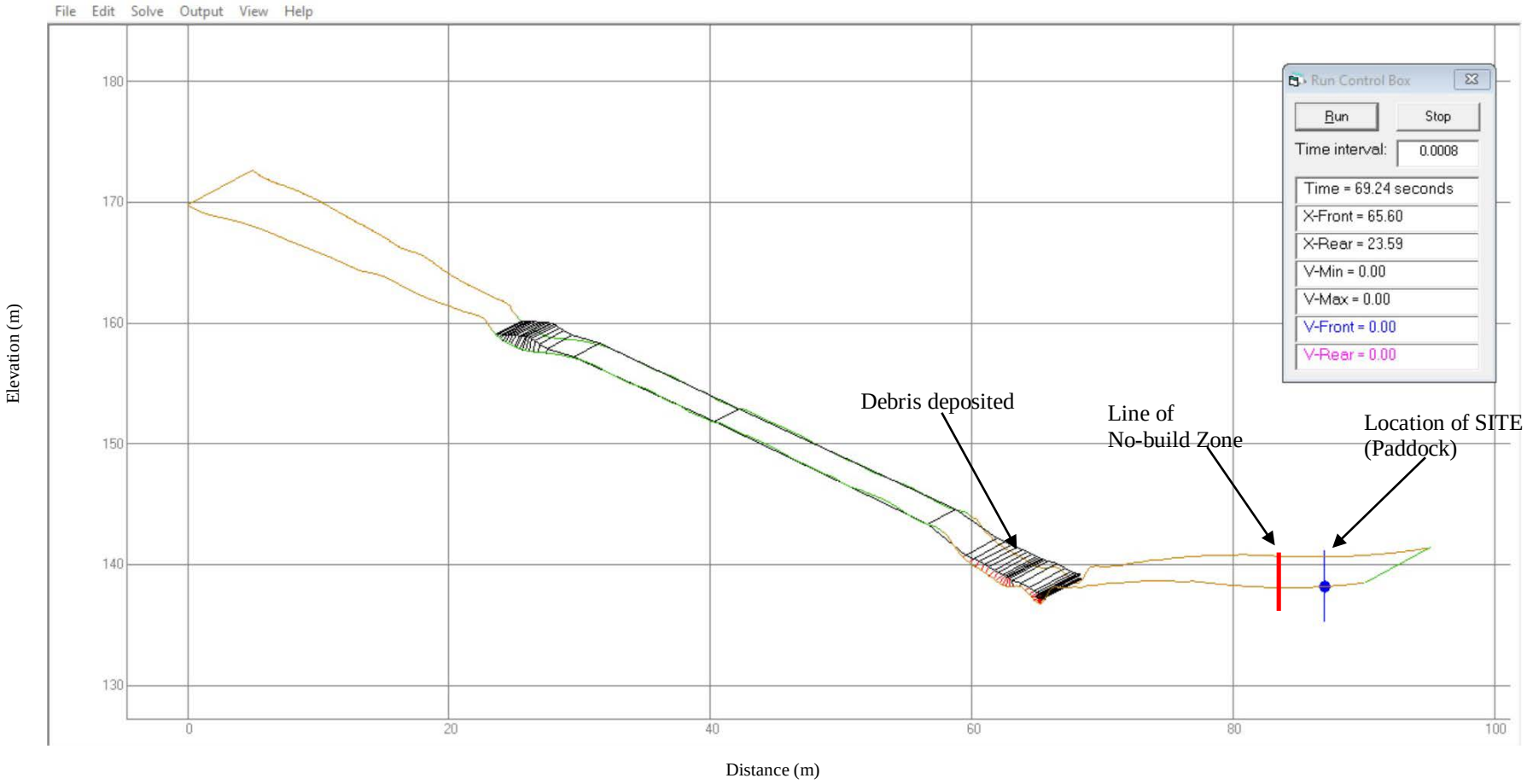
Path Width (m)

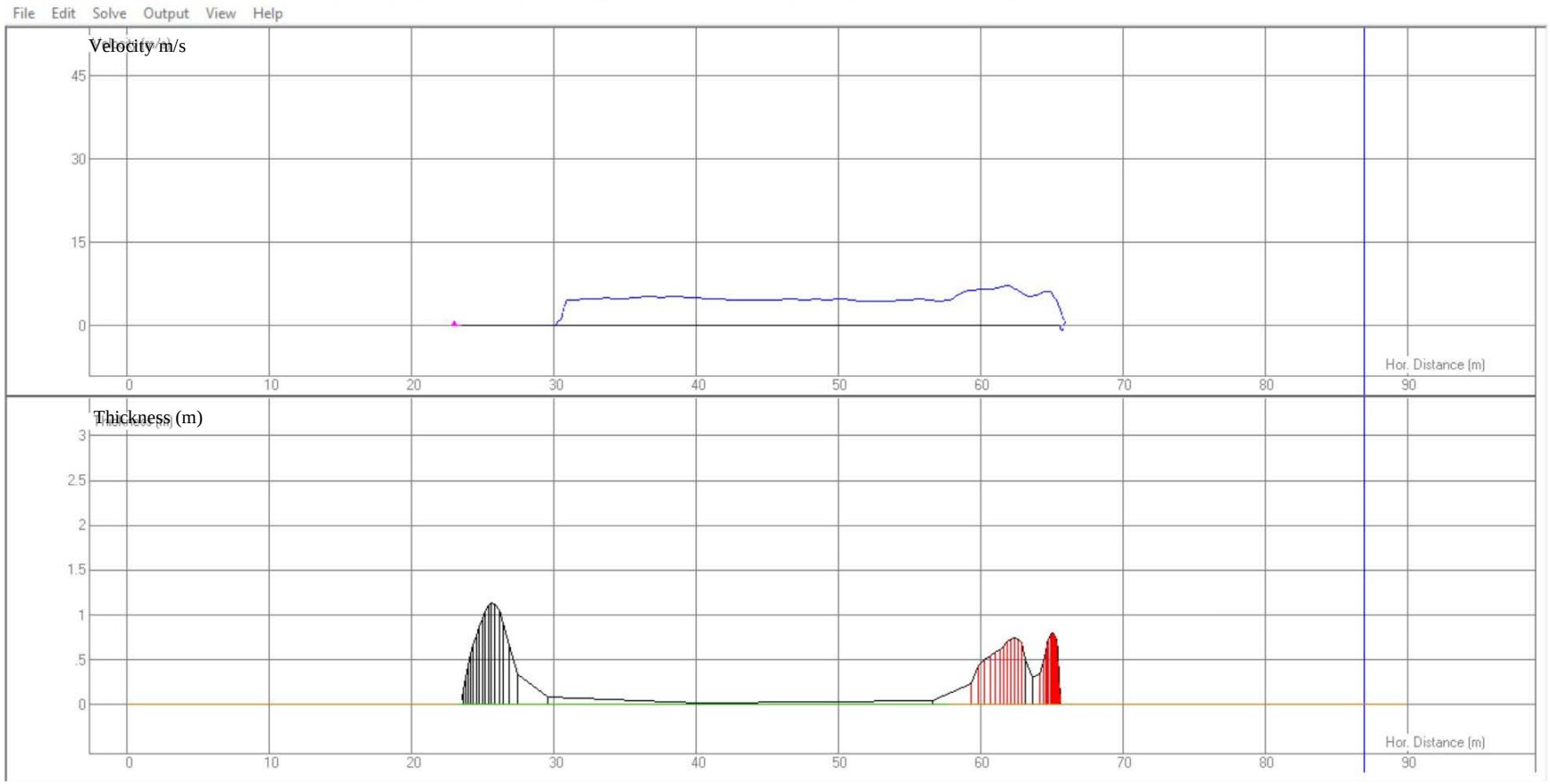
Distance (m)

Result of Debris Mobility Analysis

Source Volume (m^3)	Final Volume (m^3)	Travel Distance (m)	Debris Reached Proposed SITE Facility
40.34	40.34	35.46	No

Section Profile – (post-sliding)




File Edit Solve Output View Help
Velocity m/s
45
30
15
0
0 10 20 30 40 50 60 70 80 90
Hor. Distance (m)
Thickness (m)
3
2.5
2
1.5
1
.5
0
0 10 20 30 40 50 60 70 80 90
Hor. Distance (m)

Distance (m)

No of Blocks = 50

Time step = 0.0008 seconds

End at time = 0.00 seconds

Configuration = 3-dimensional

Boundary Block Geometry = Normal

Shape factor = 1.00

Maximum velocity = 7.27 at X = 61.88

Maximum front velocity = 7.27 at X =61.88

CENTRE OF GRAVITY: X-Source = 26.14

Z-Source = 158.73

X-Depos. = 48.62

Z-Depos. = 146.28

CG Ratio = 0.55

Travel angle = 28.99

FAHRBOSCHUNG = 28.22

FRONT DISPLACEMENT: X = 65.600 Z = 137.174

Curvilinear Displ.= 41.685

Horiz. Displ. = 35.46

REAR DISPLACEMENT: X = 23.59 Z = 159.04

Curvilinear Displ.= 1.27

Horiz. Displ. = 0.70

SLIDE VOLUME: Initial = 40.34

Final = 40.34

AREA IN PLAN: Initial = 27.57

Final = 174.33

Runout not completed, V-MAX = 0.00

Export Print Close Help

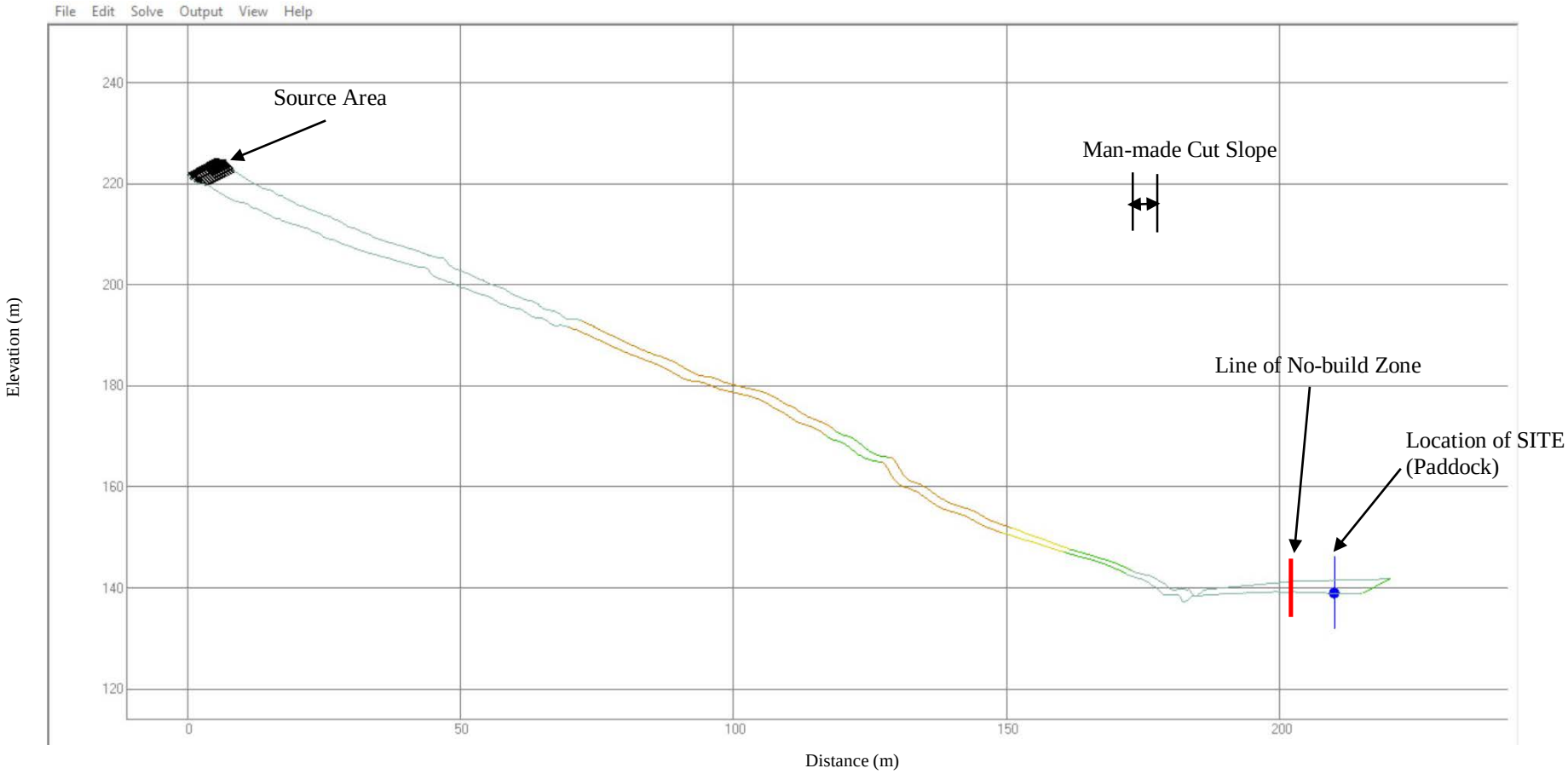
Debris Mobility Analysis for the Credible Runout Path RP5 (Case 1) within Catchment No. CD1

Landslide Type = CDF

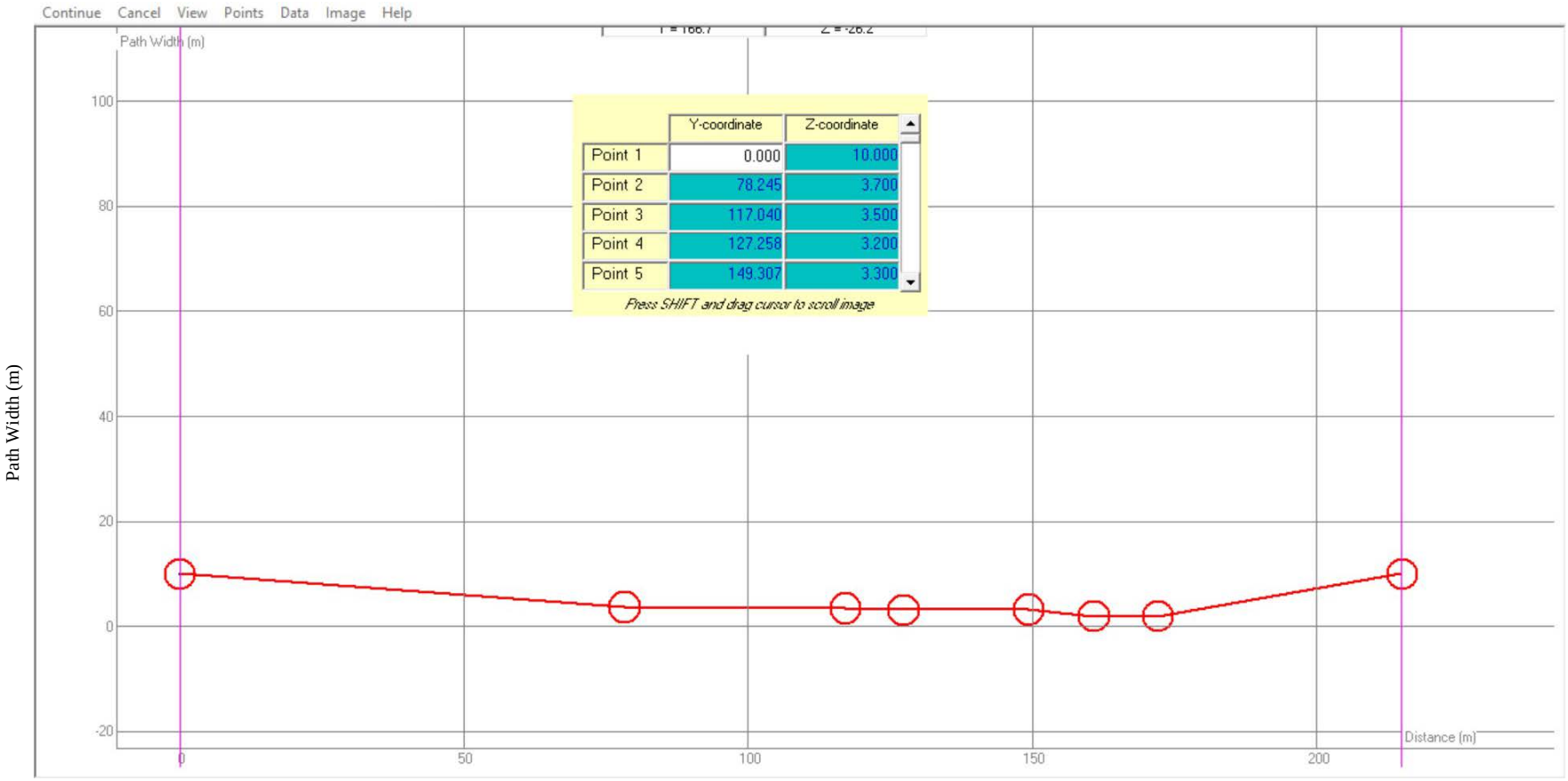
Design Source Volume = 40m^3

Figure D7

Section Profile – (pre-sliding)



Width Profile



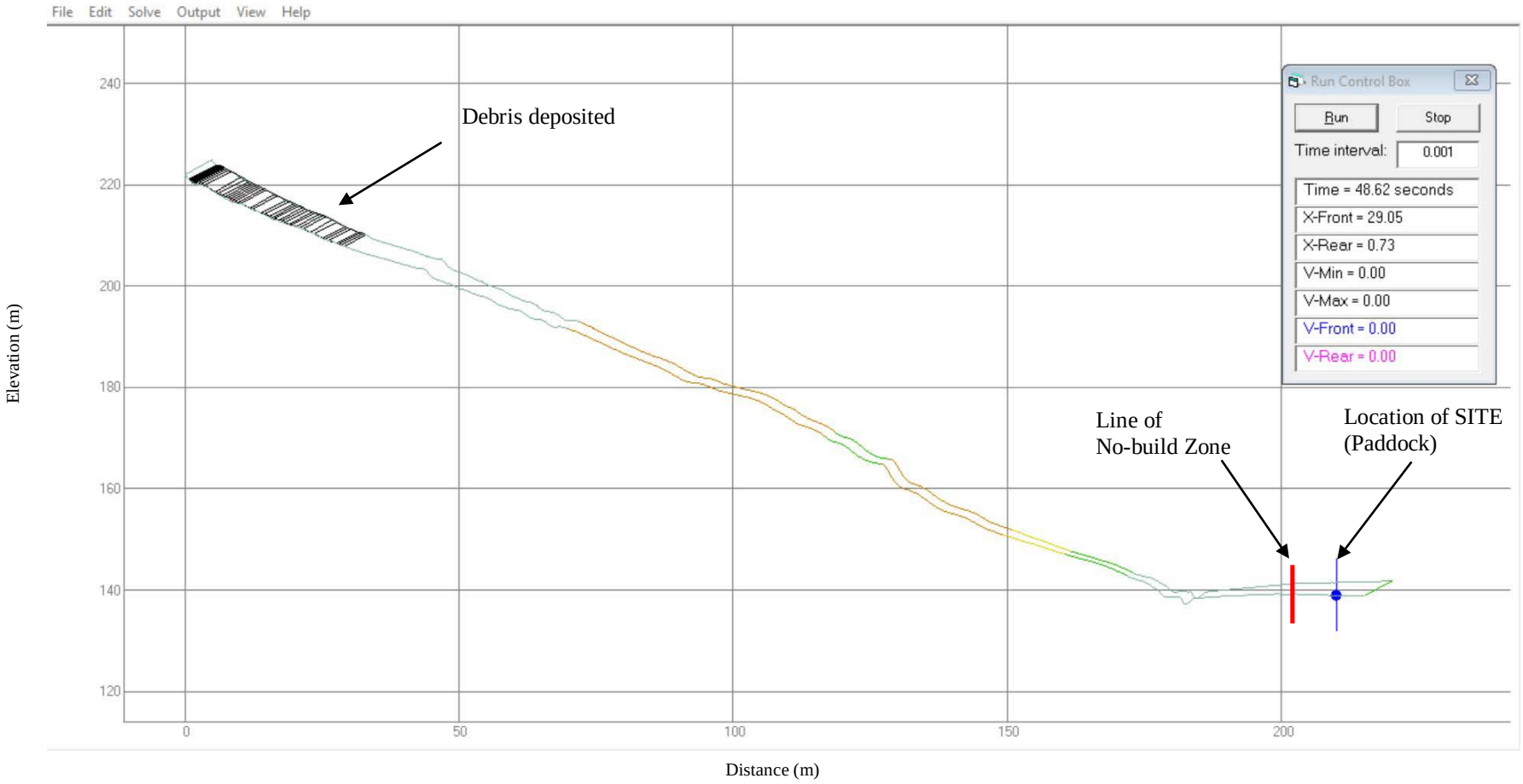
Path Width (m)

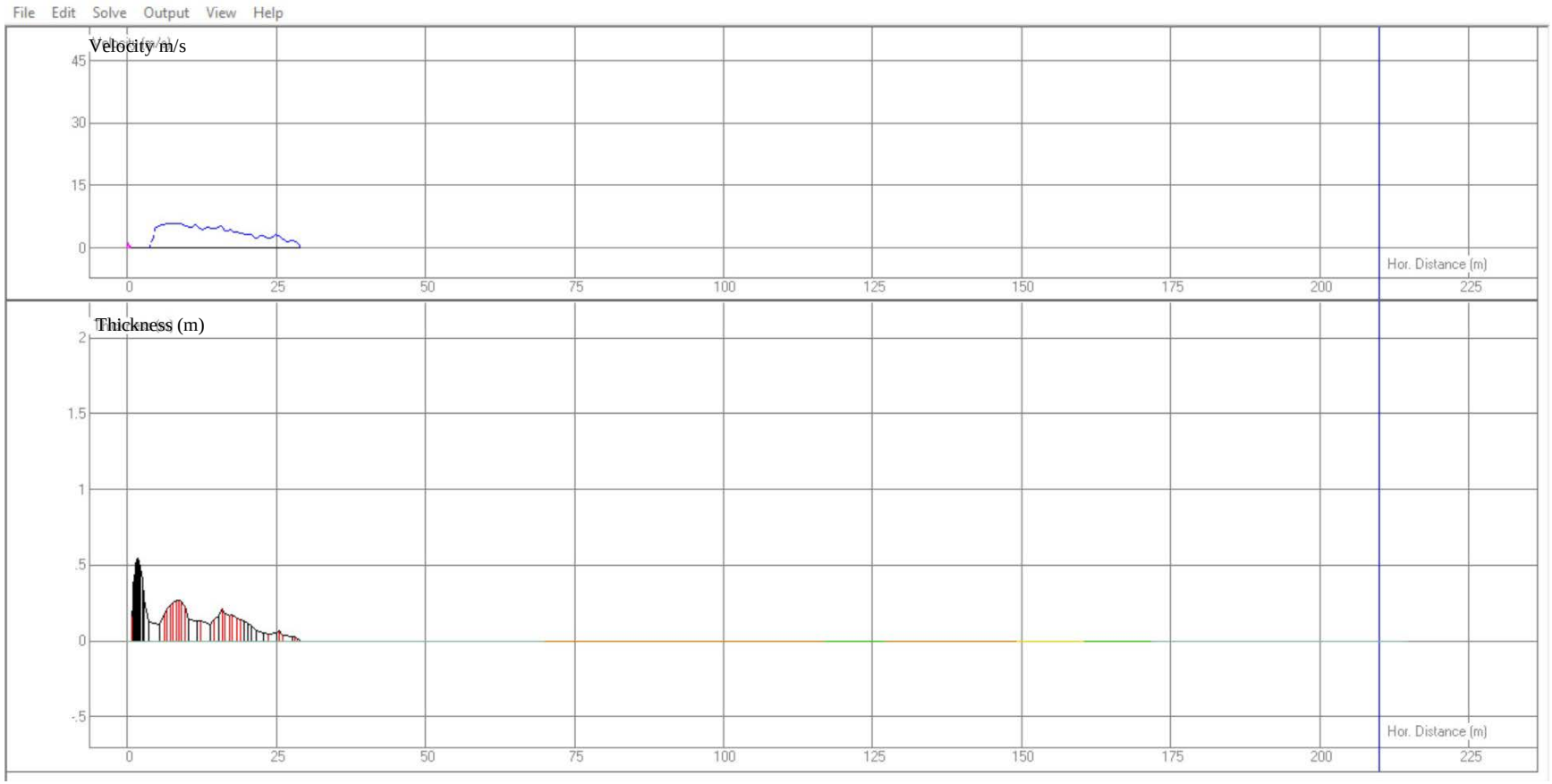
Distance (m)

Result of Debris Mobility Analysis

Source Volume (m^3)	Final Volume (m^3)	Travel Distance (m)	Debris Reached Proposed SITE Facility
40.84	40.84	25.16	No

Section Profile – (post-sliding)




File Edit Solve Output View Help
Velocity m/s
45
30
15
0
Hor. Distance (m)
0 25 50 75 100 125 150 175 200 225
Thickness (m)
2
1.5
1
.5
0
-.5
Hor. Distance (m)
0 25 50 75 100 125 150 175 200 225

Distance (m)

No of Blocks = 50

Time step = 0.001 seconds

End at time = 0.00 seconds

Configuration = 3-dimensional

Boundary Block Geometry = Normal

Shape factor = 1.00

Maximum velocity = 5.97 at X = 7.84

Maximum front velocity = 5.97 at X =7.84

CENTRE OF GRAVITY: X-Source = 1.81

Z-Source = 220.98

X-Depos. = 9.85

Z-Depos. = 216.50

CG Ratio = 0.56

Travel angle = 29.11

FAHRBOSCHUNG = 25.89

FRONT DISPLACEMENT: X = 29.050 Z = 207.918

Curvilinear Displ.= 28.078

Horiz. Displ. = 25.16

REAR DISPLACEMENT: X = 0.73 Z = 221.00

Curvilinear Displ.= 1.25

Horiz. Displ. = 0.73

SLIDE VOLUME: Initial = 40.84

Final = 40.84

AREA IN PLAN: Initial = 38.30

Final = 249.25

Runout not completed, V-MAX = 0.00

Export Print Close Help

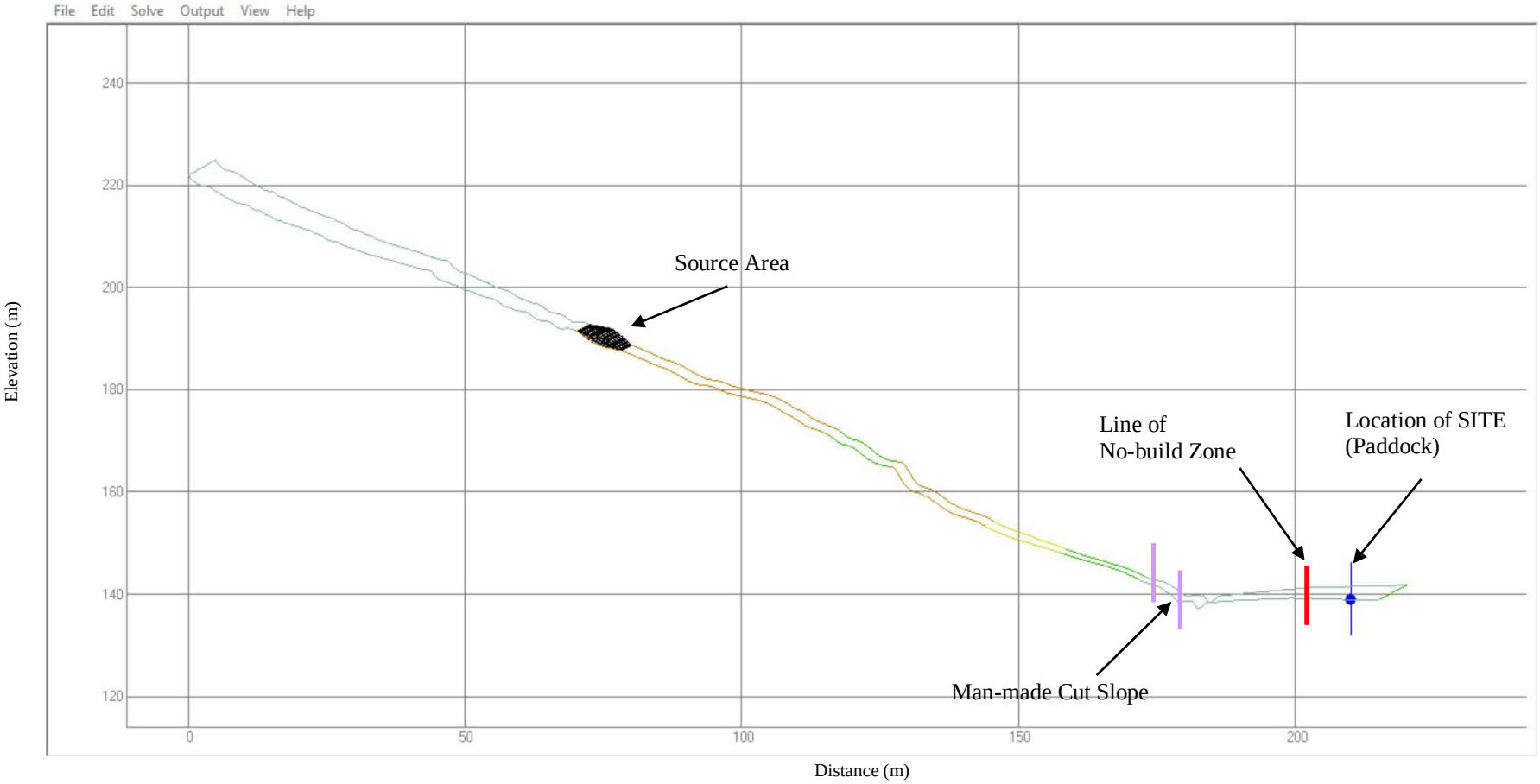
Debris Mobility Analysis for the Credible Runout Path RP5 (Case 2) within Catchment No. CD1

Landslide Type = CDF

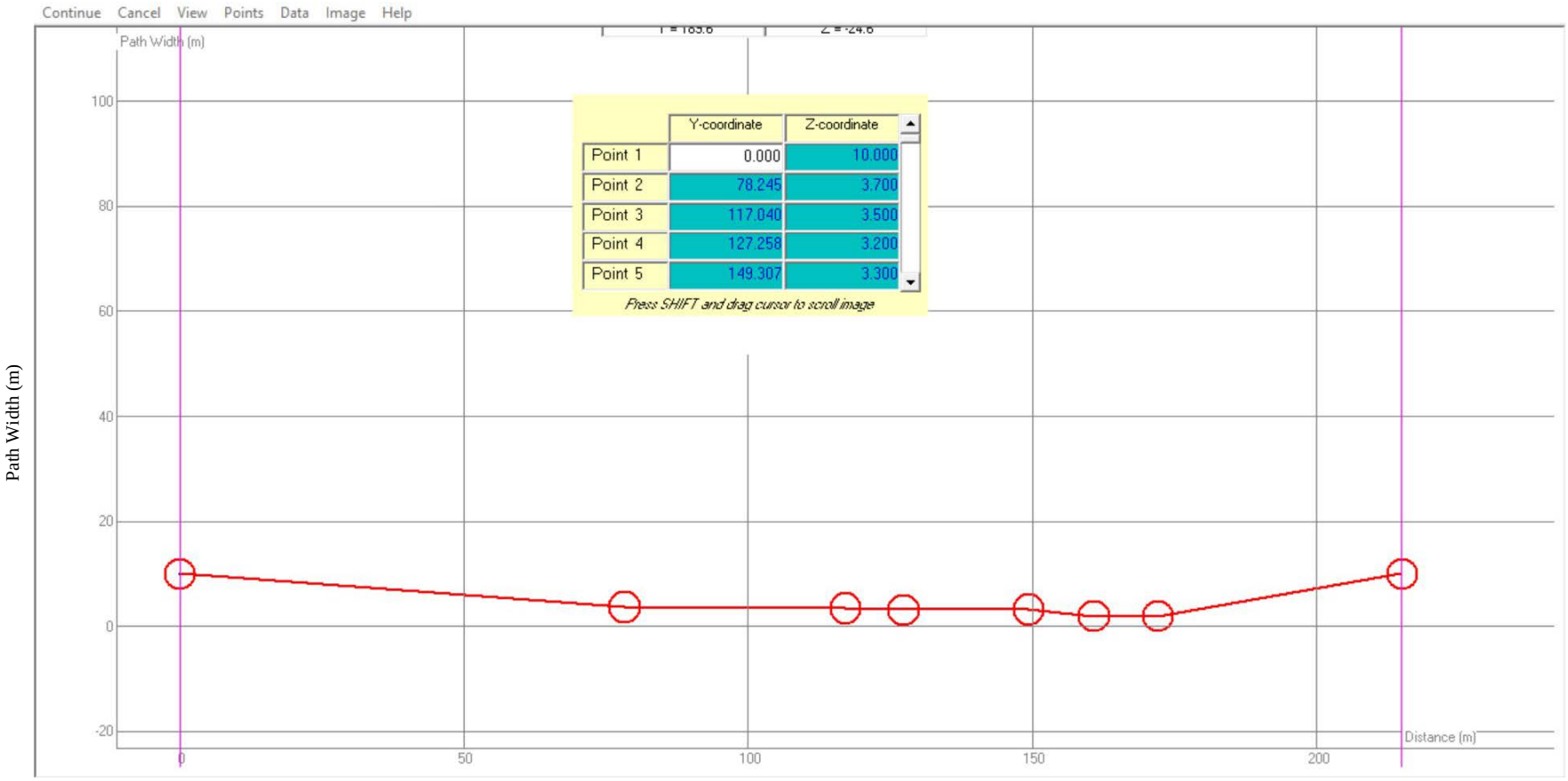
Design Source Volume = 40m^3

Figure D8

Section Profile – (pre-sliding)



Width Profile



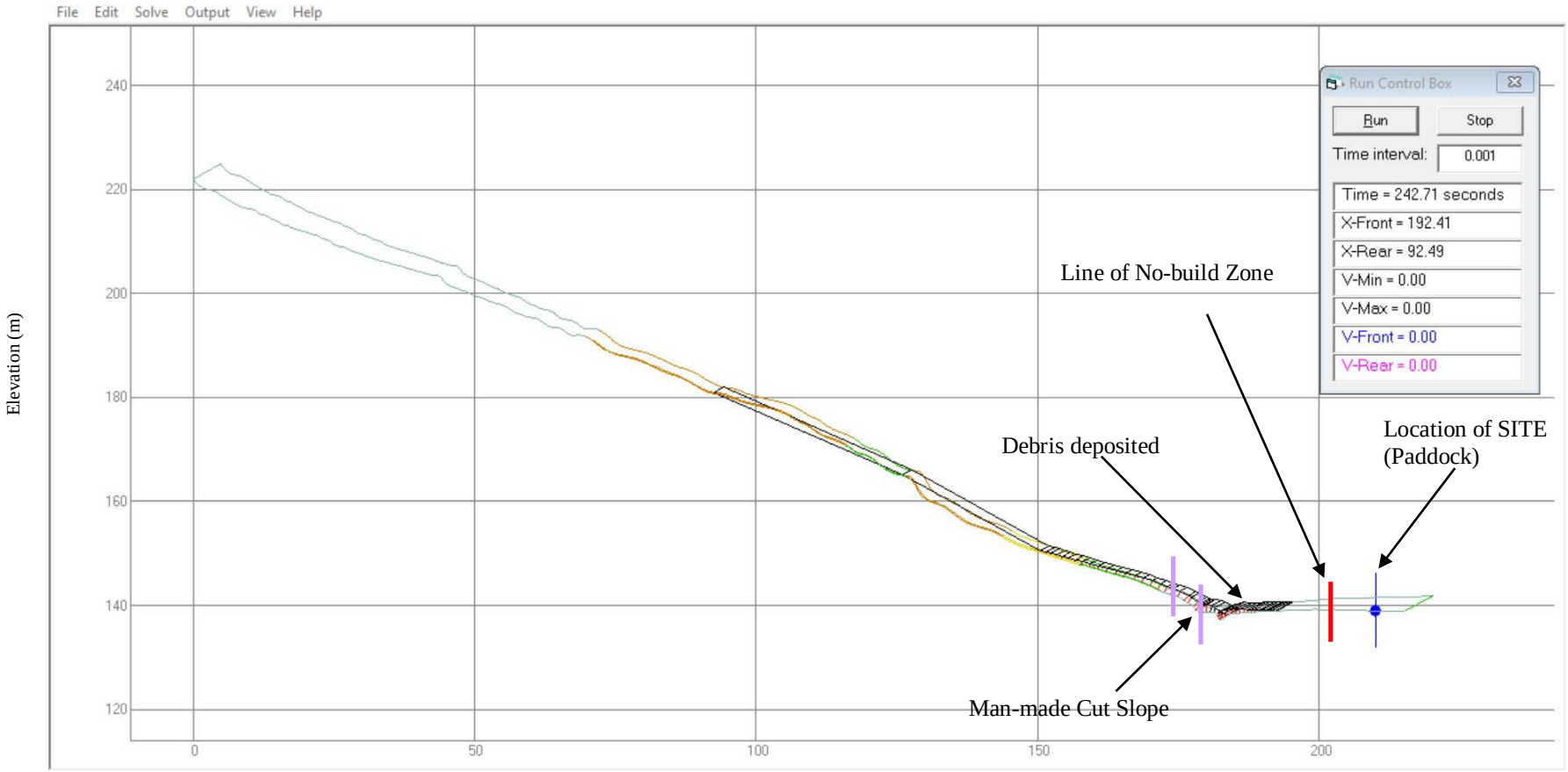
Path Width (m)

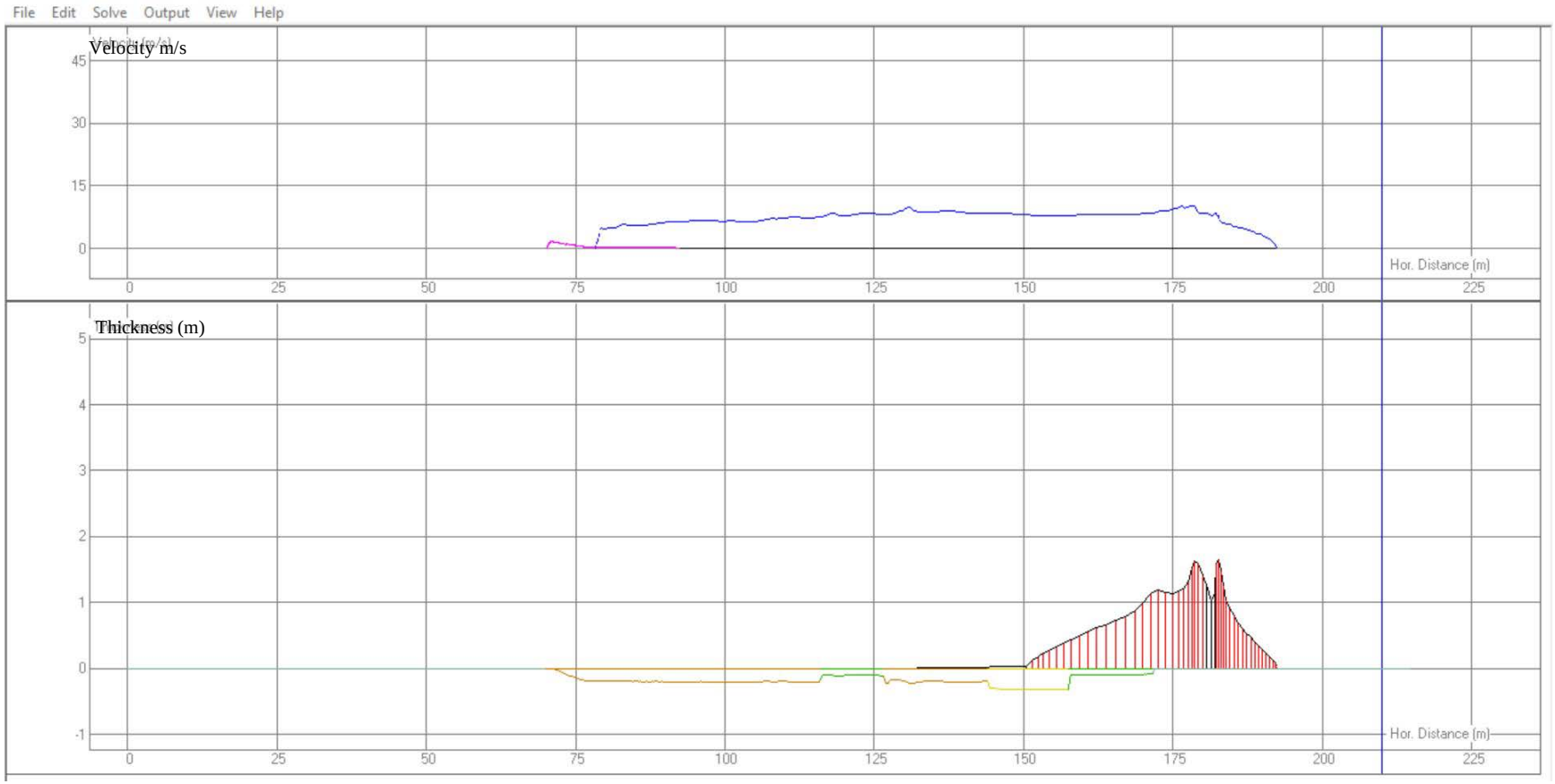
Distance (m)

Result of Debris Mobility Analysis

Source Volume (m^3)	Final Volume (m^3)	Travel Distance (m)	Debris Reached Proposed SITE Facility
40.22	107.11	114.16	No

Section Profile – (post-sliding)




File Edit Solve Output View Help
Velocity m/s
45
30
15
0
0 25 50 75 100 125 150 175 200 225
Hor. Distance (m)
Thickness (m)
5
4
3
2
1
0
-1
0 25 50 75 100 125 150 175 200 225
Hor. Distance (m)

Distance (m)

No of Blocks = 50

Time step = 0.001 seconds

End at time = 0.00 seconds

Configuration = 3-dimensional

Boundary Block Geometry = Normal

Shape factor = 1.00

Maximum velocity = 10.35 at X = 178.45

Maximum front velocity = 10.35 at X =178.45

CENTRE OF GRAVITY: X-Source = 74.31

Z-Source = 189.67

X-Depos. = 176.48

Z-Depos. = 141.43

CG Ratio = 0.47

Travel angle = 25.27

FAHRBOSCHUNG = 23.27

FRONT DISPLACEMENT: X = 192.407 Z = 138.917

Curvilinear Displ.= 128.578

Horiz. Displ. = 114.16

REAR DISPLACEMENT: X = 92.49 Z = 180.91

Curvilinear Displ.= 24.80

Horiz. Displ. = 22.23

SLIDE VOLUME: Initial = 40.22

Final = 107.11

AREA IN PLAN: Initial = 32.15

Final = 322.16

Runout not completed, V-MAX = 0.00

Export Print Close Help

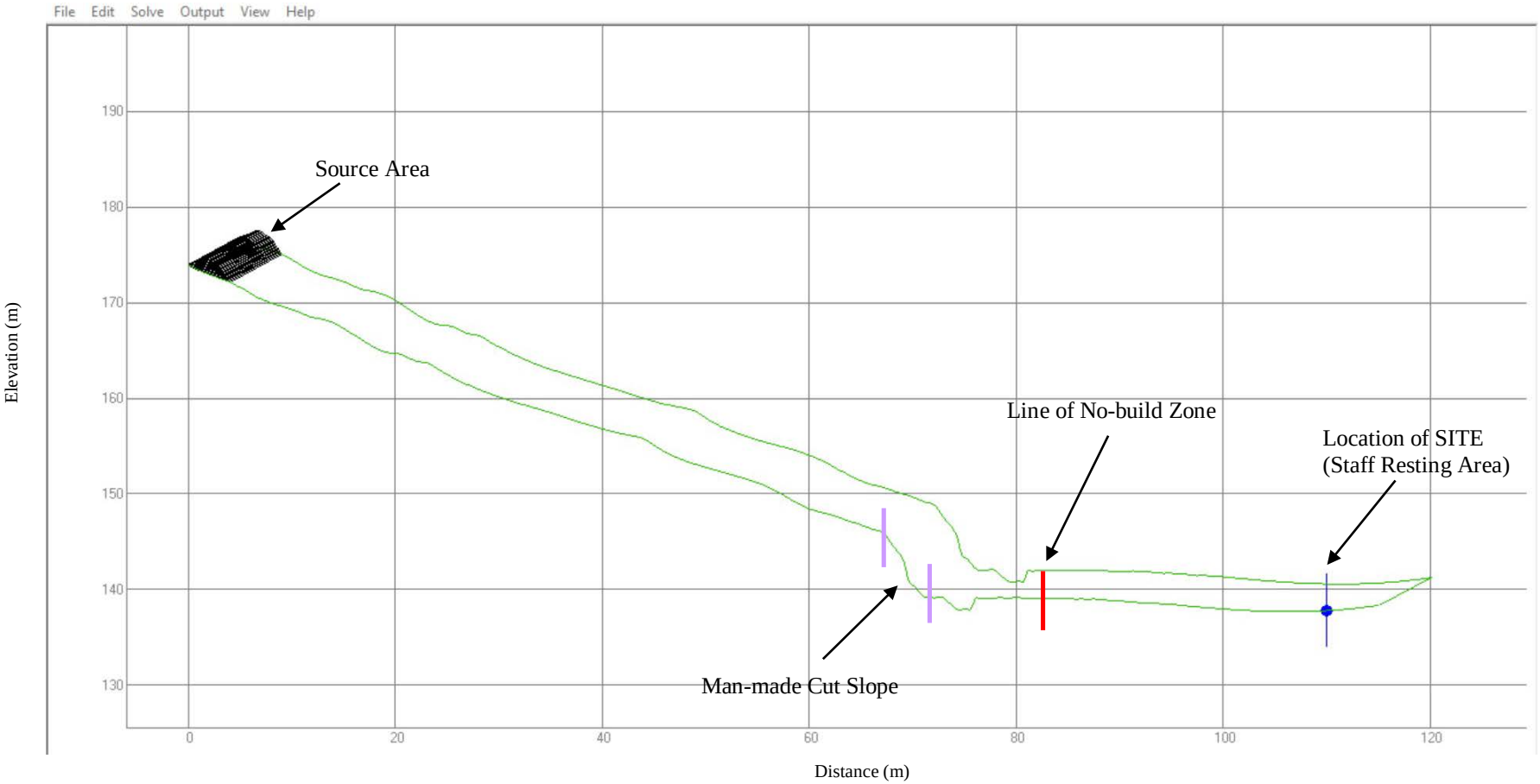
Debris Mobility Analysis for the Credible Runout Path RP6 (Case 1) within Catchment No. OH2

Landslide Type = OHL

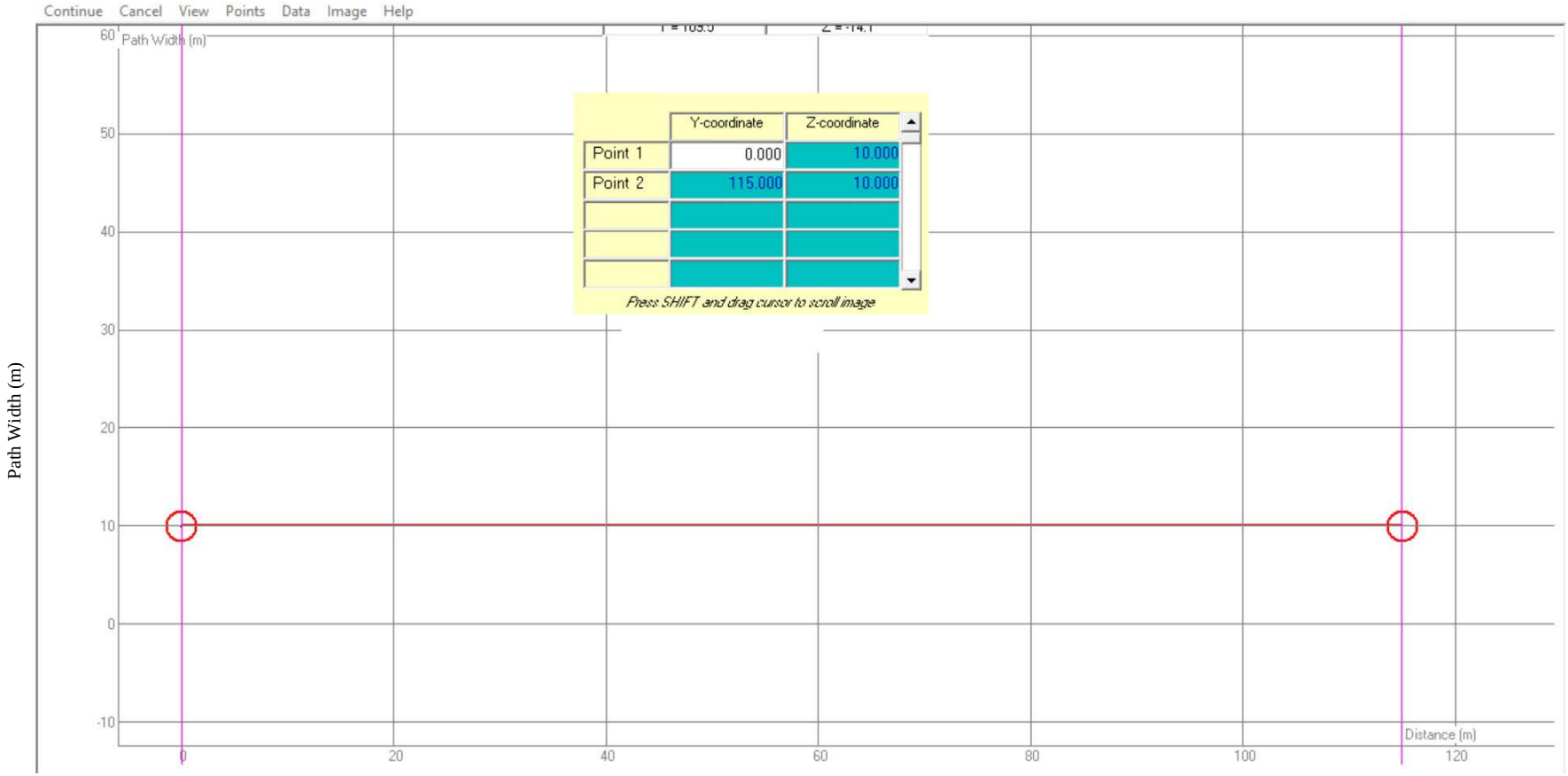
Design Source Volume = 40m^3

Figure D9

Section Profile – (pre-sliding)



Width Profile



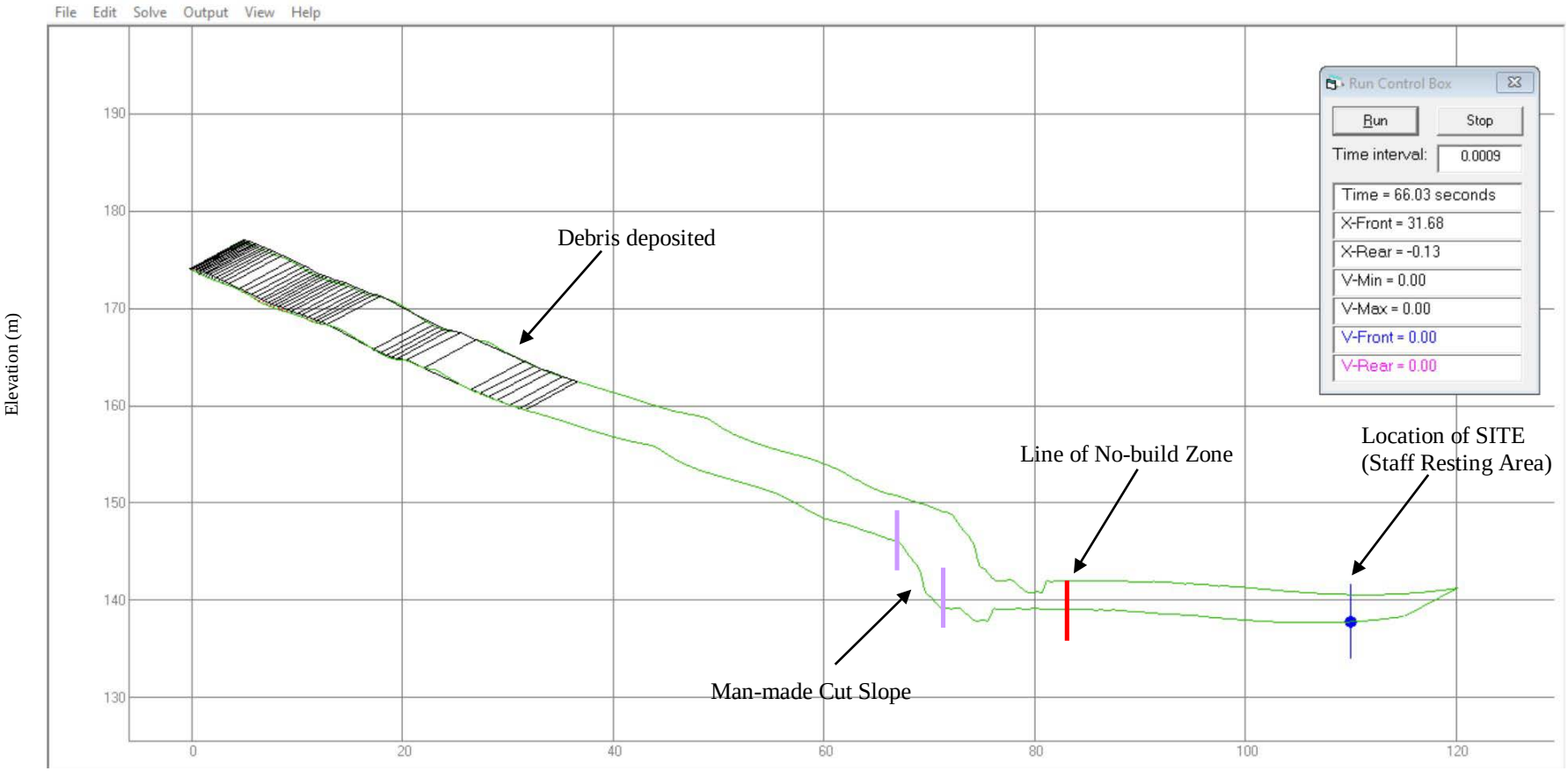
Path Width (m)

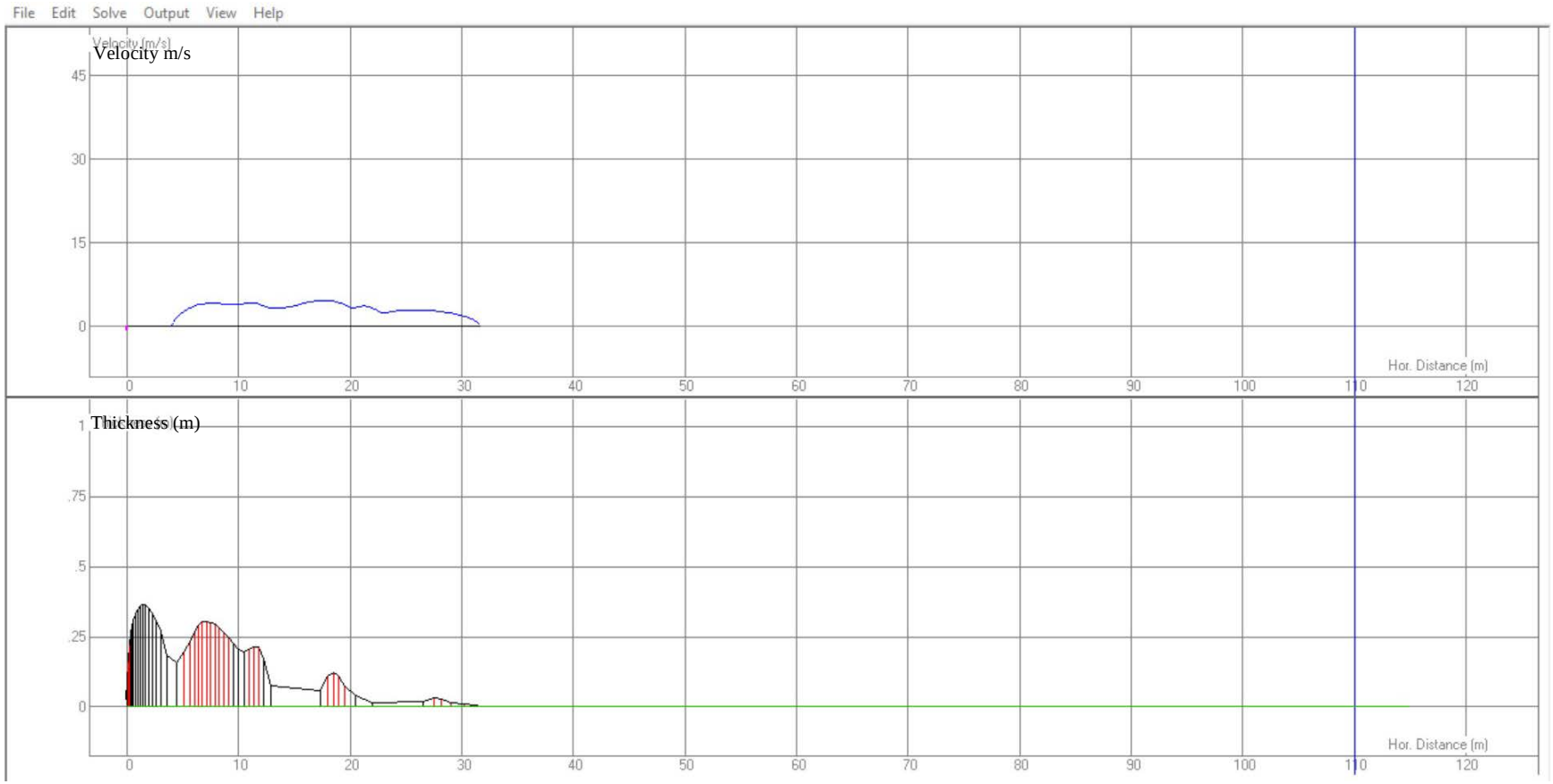
Distance (m)

Result of Debris Mobility Analysis

Source Volume (m^3)	Final Volume (m^3)	Travel Distance (m)	Debris Reached Proposed SITE Facility
40.90	40.90	27.63	No

Section Profile – (post-sliding)




File Edit Solve Output View Help
Velocity m/s
45
30
15
0
Hor. Distance (m)
0 10 20 30 40 50 60 70 80 90 100 110 120
Thickness (m)
1
.75
.5
.25
0
Hor. Distance (m)
0 10 20 30 40 50 60 70 80 90 100 110 120

Distance (m)

No of Blocks = 50

Time step = 0.0009 seconds

End at time = 0.00 seconds

Configuration = 3-dimensional

Boundary Block Geometry = Normal

Shape factor = 1.00

Maximum velocity = 4.73 at X = 17.71

Maximum front velocity = 4.73 at X =17.71

CENTRE OF GRAVITY: X-Source = 2.07

Z-Source = 173.59

X-Depos. = 8.02

Z-Depos. = 170.29

CG Ratio = 0.56

Travel angle = 29.05

FAHRBOSCHUNG = 24.49

FRONT DISPLACEMENT: X = 31.678 Z = 159.572

Curvilinear Displ.= 30.647

Horiz. Displ. = 27.63

REAR DISPLACEMENT: X = -0.13 Z = 174.09

Curvilinear Displ.= -0.16

Horiz. Displ. = -0.13

SLIDE VOLUME: Initial = 40.90

Final = 40.90

AREA IN PLAN: Initial = 40.43

Final = 318.07

Runout not completed, V-MAX = 0.00

Export Print Close Help

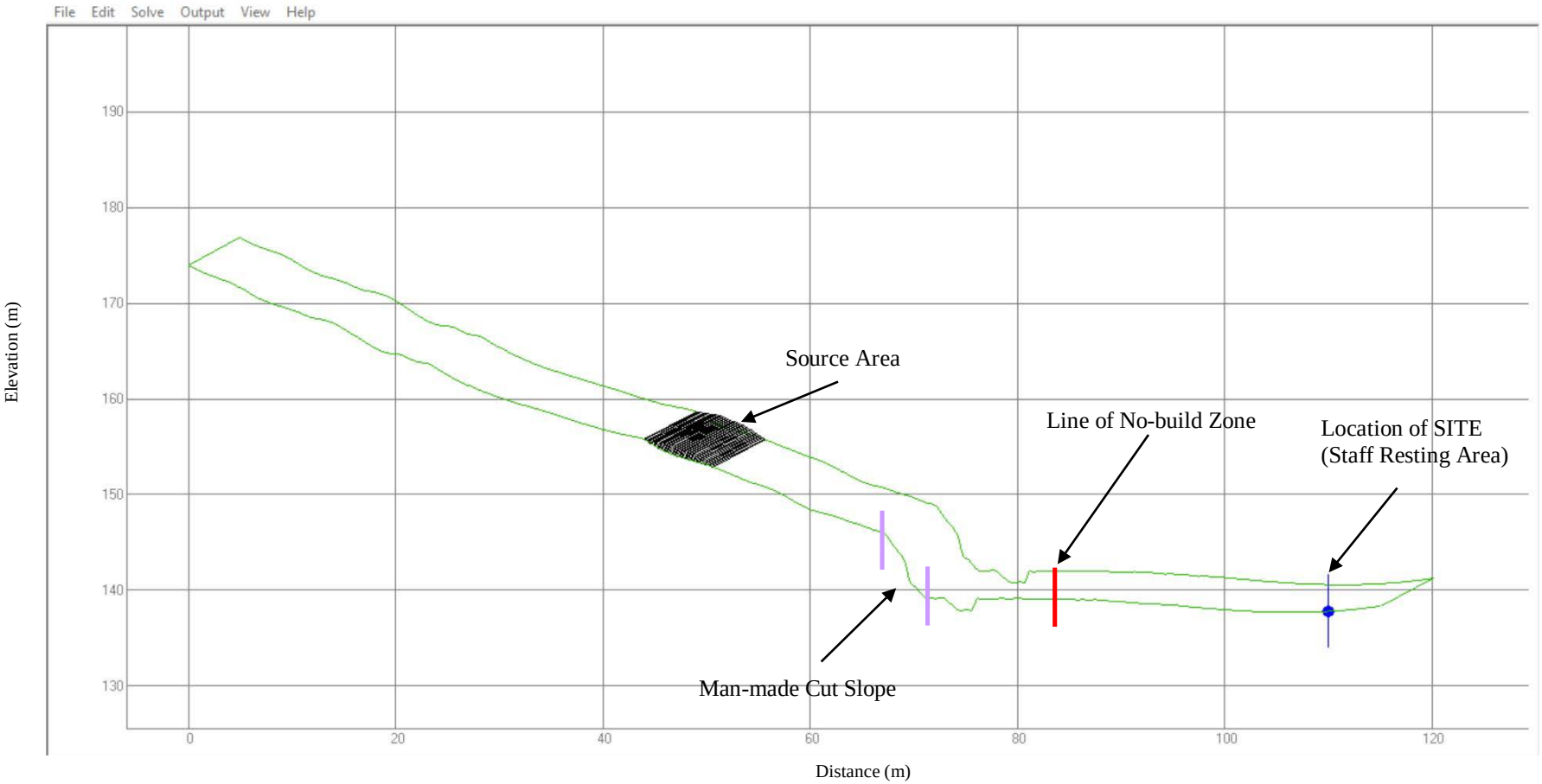
Debris Mobility Analysis for the Credible Runout Path RP6 (Case 2) within Catchment No. OH2

Landslide Type = OHL

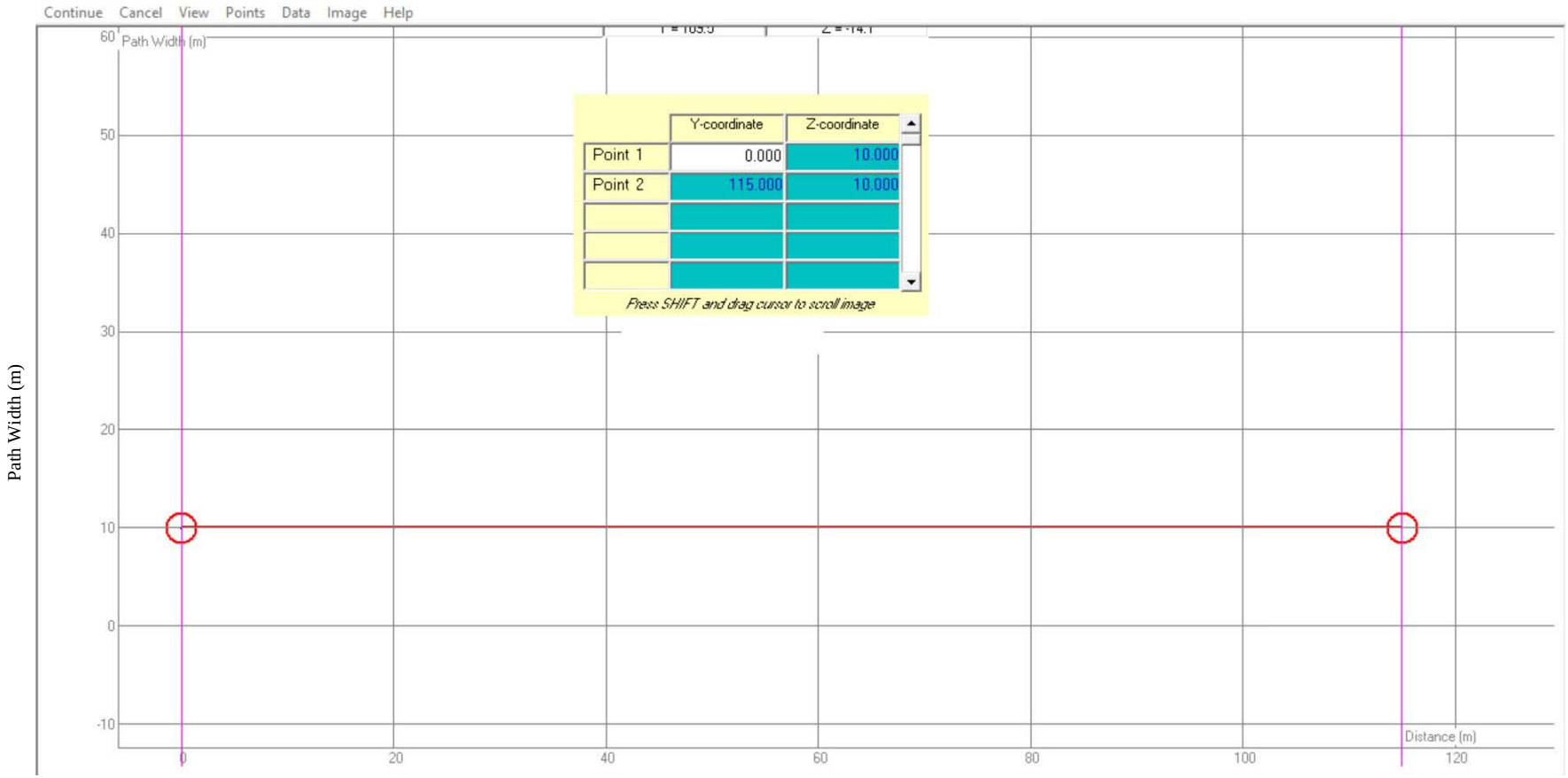
Design Source Volume = 40m^3

Figure D10

Section Profile – (pre-sliding)



Width Profile



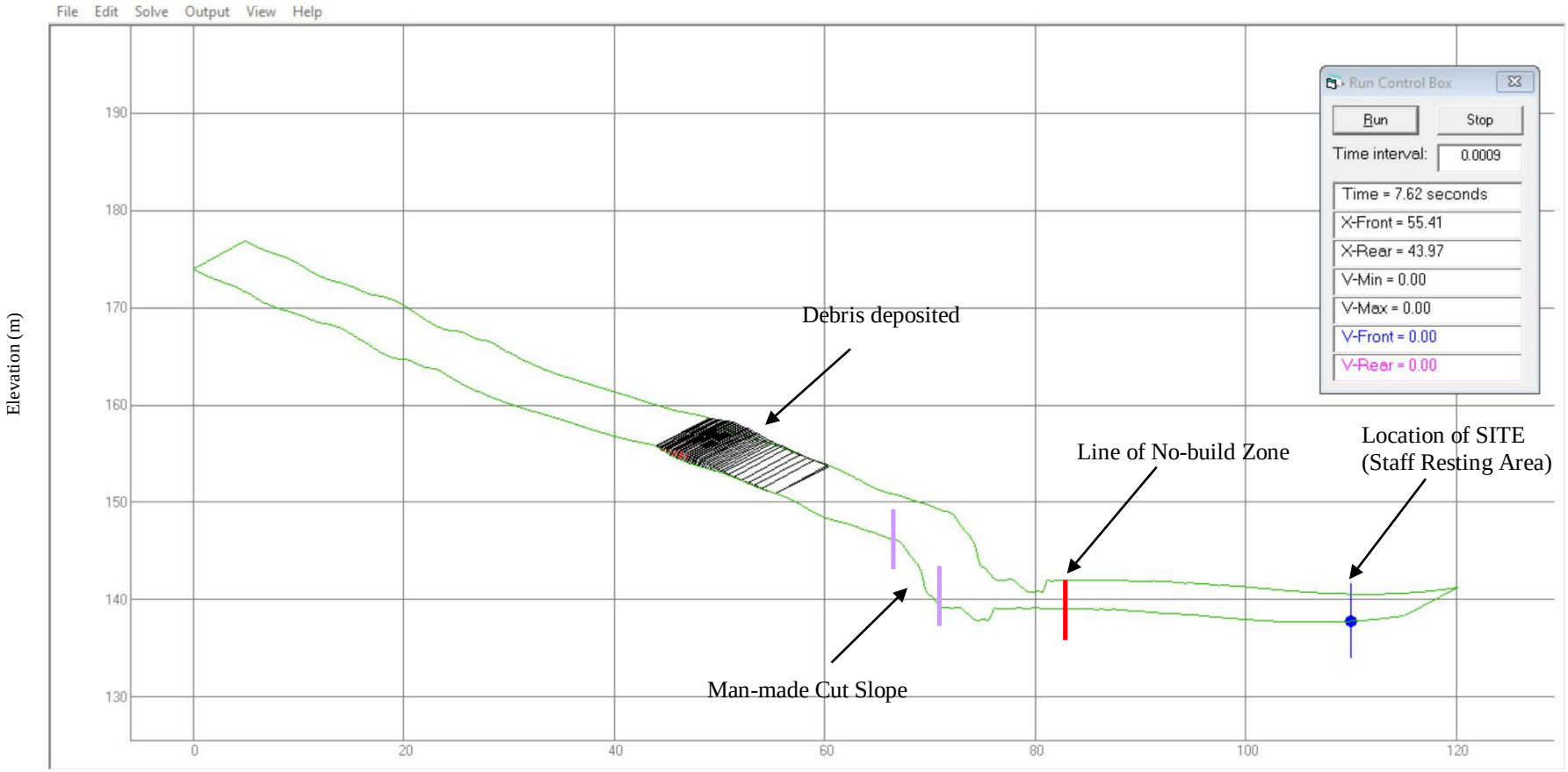
Path Width (m)

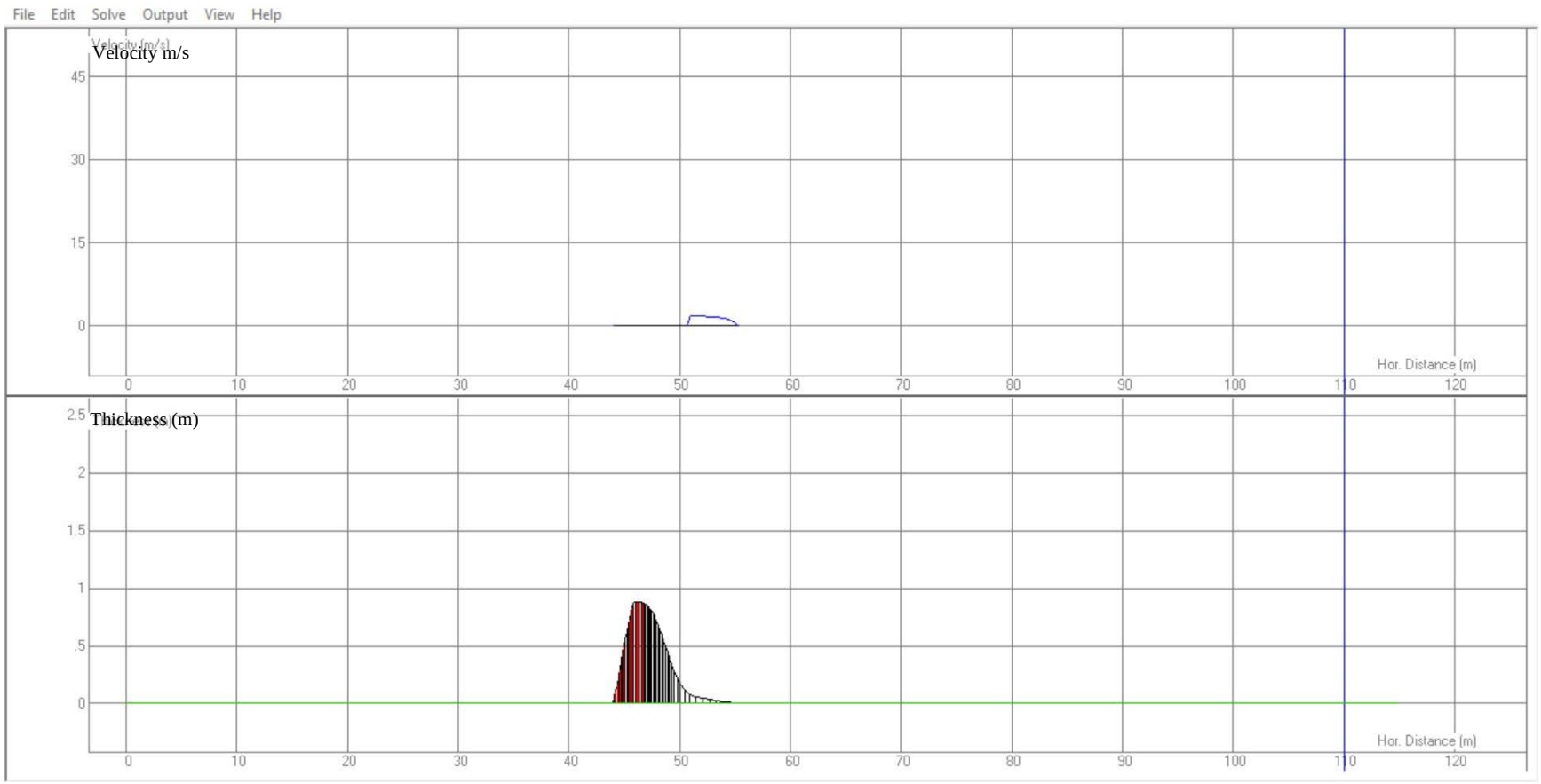
Distance (m)

Result of Debris Mobility Analysis

Source Volume (m^3)	Final Volume (m^3)	Travel Distance (m)	Debris Reached Proposed SITE Facility
40.87	40.87	4.75	No

Section Profile – (post-sliding)




File Edit Solve Output View Help
Velocity m/s
45
30
15
0
0 10 20 30 40 50 60 70 80 90 100 110 120
Hor. Distance (m)
Thickness (m)
2.5
2
1.5
1
.5
0
0 10 20 30 40 50 60 70 80 90 100 110 120
Hor. Distance (m)

Distance (m)

No of Blocks = 50

Time step = 0.0009 seconds

End at time = 0.00 seconds

Configuration = 3-dimensional

Boundary Block Geometry = Normal

Shape factor = 1.00

Maximum velocity = 1.96 at X = 51.02

Maximum front velocity = 1.96 at X =51.02

CENTRE OF GRAVITY: X-Source = 47.17

Z-Source = 154.48

X-Depos. = 47.30

Z-Depos. = 154.41

CG Ratio = 0.55

Travel angle = 28.89

FAHRBOSCHUNG = 23.18

FRONT DISPLACEMENT: X = 55.407 Z = 150.873

Curvilinear Displ.= 5.155

Horiz. Displ. = 4.75

REAR DISPLACEMENT: X = 43.97 Z = 155.77

Curvilinear Displ.= 0.00

Horiz. Displ. = 0.00

SLIDE VOLUME: Initial = 40.87

Final = 40.87

AREA IN PLAN: Initial = 66.86

Final = 114.37

Runout not completed, V-MAX = 0.00

Export Print Close Help

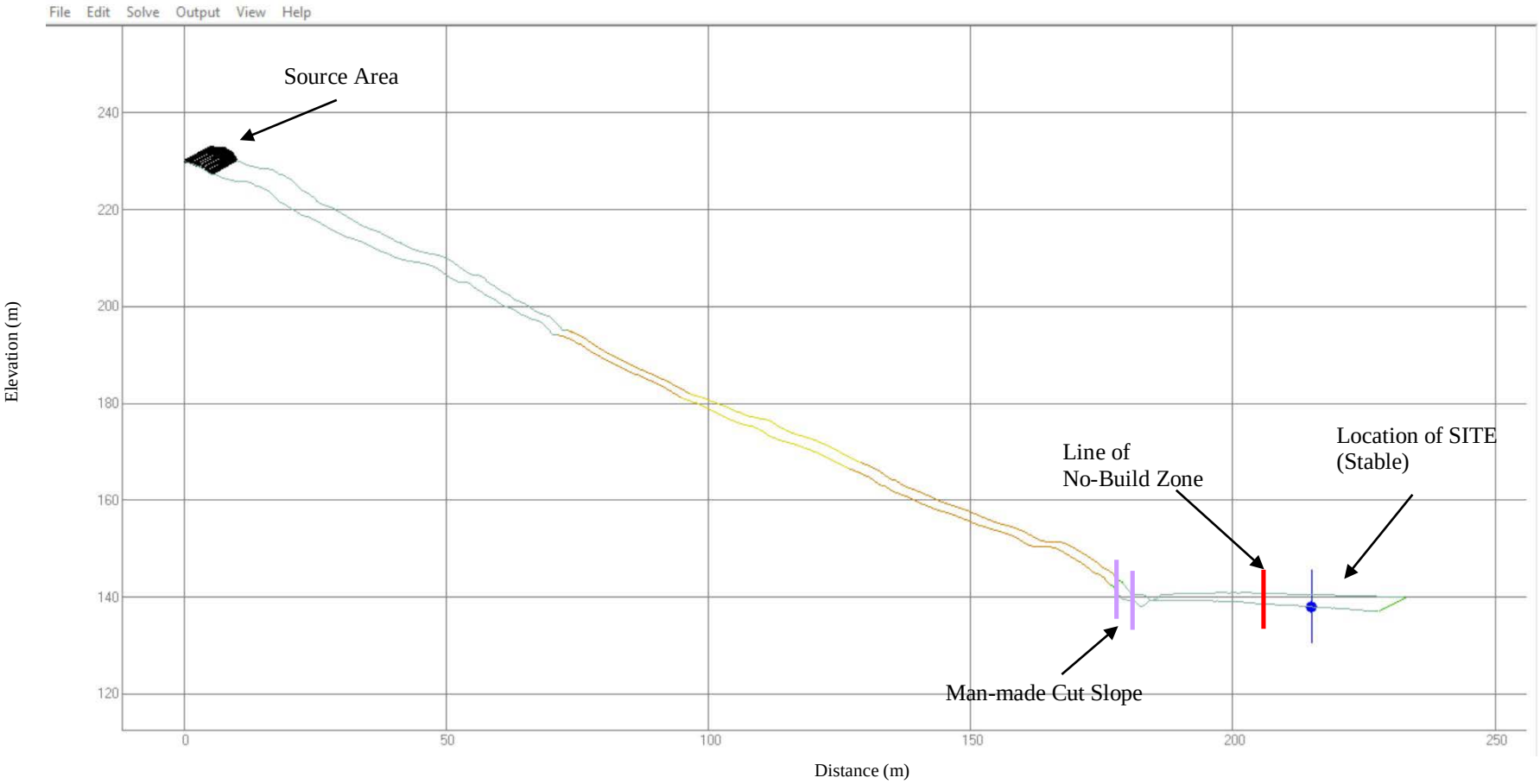
Debris Mobility Analysis for the Credible Runout Path RP7 (Case 1) within Catchment No. CD2

Landslide Type = CDF

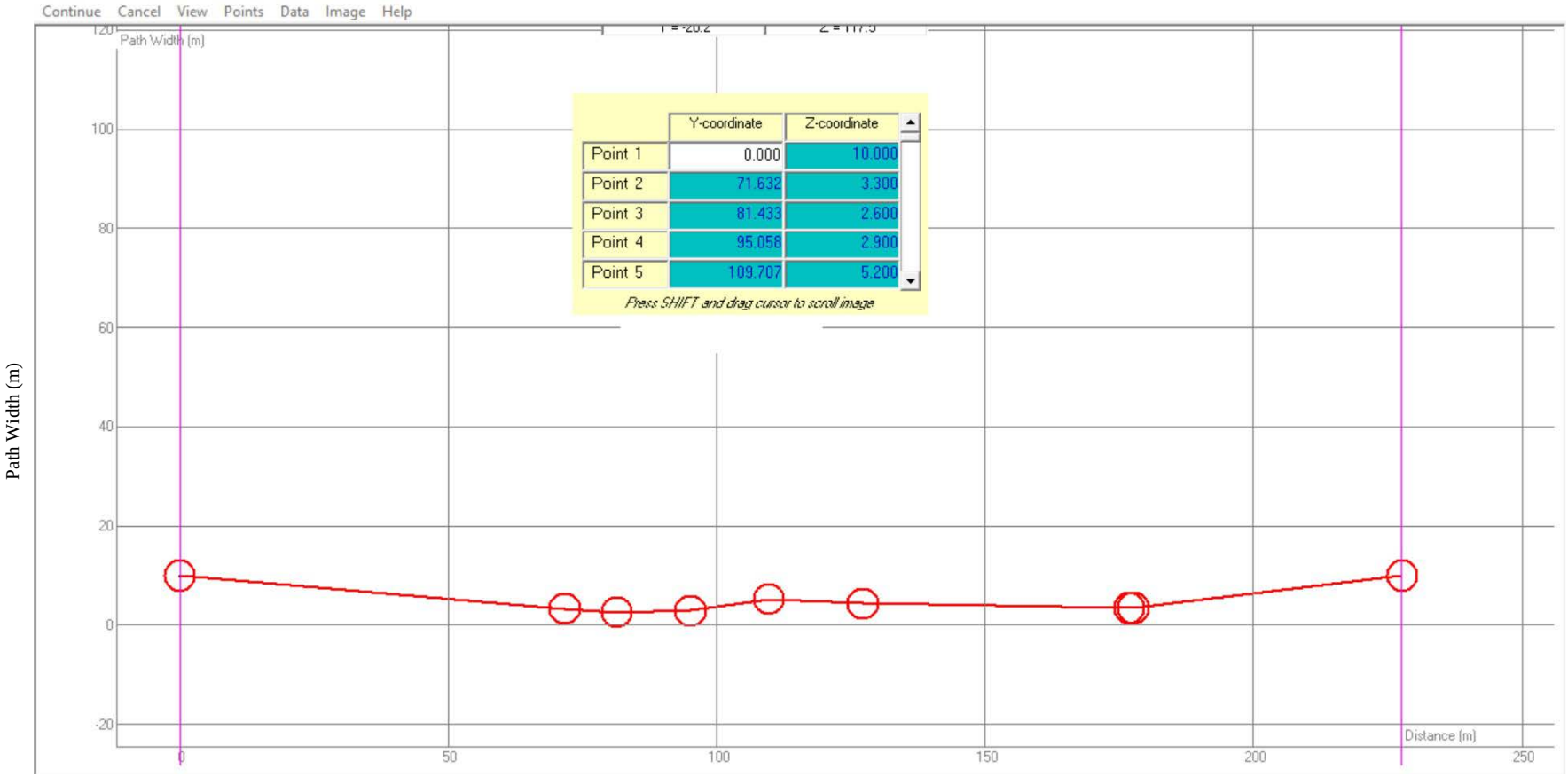
Design Source Volume = 40m^3

Figure D11

Section Profile – (pre-sliding)



Width Profile



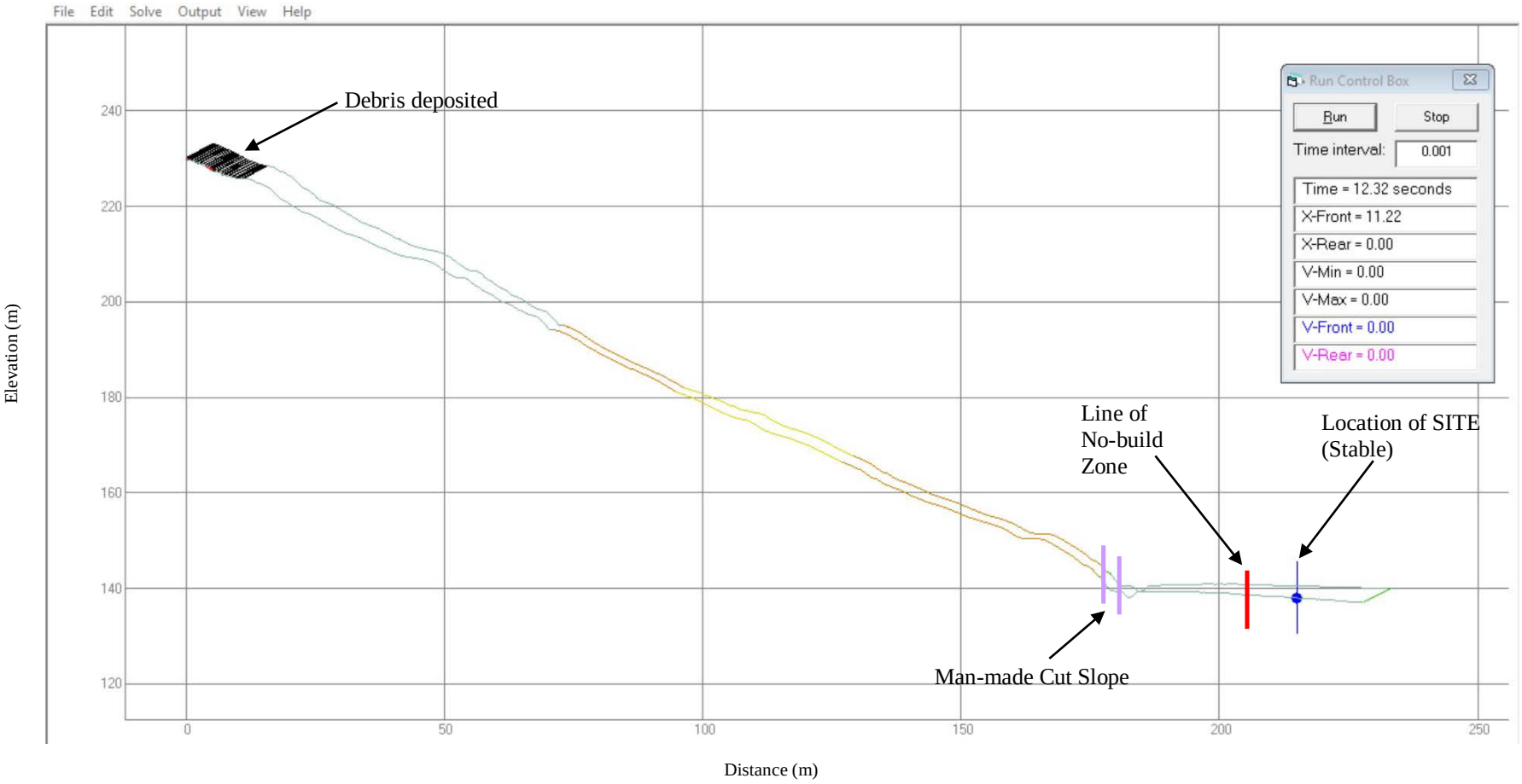
Path Width (m)

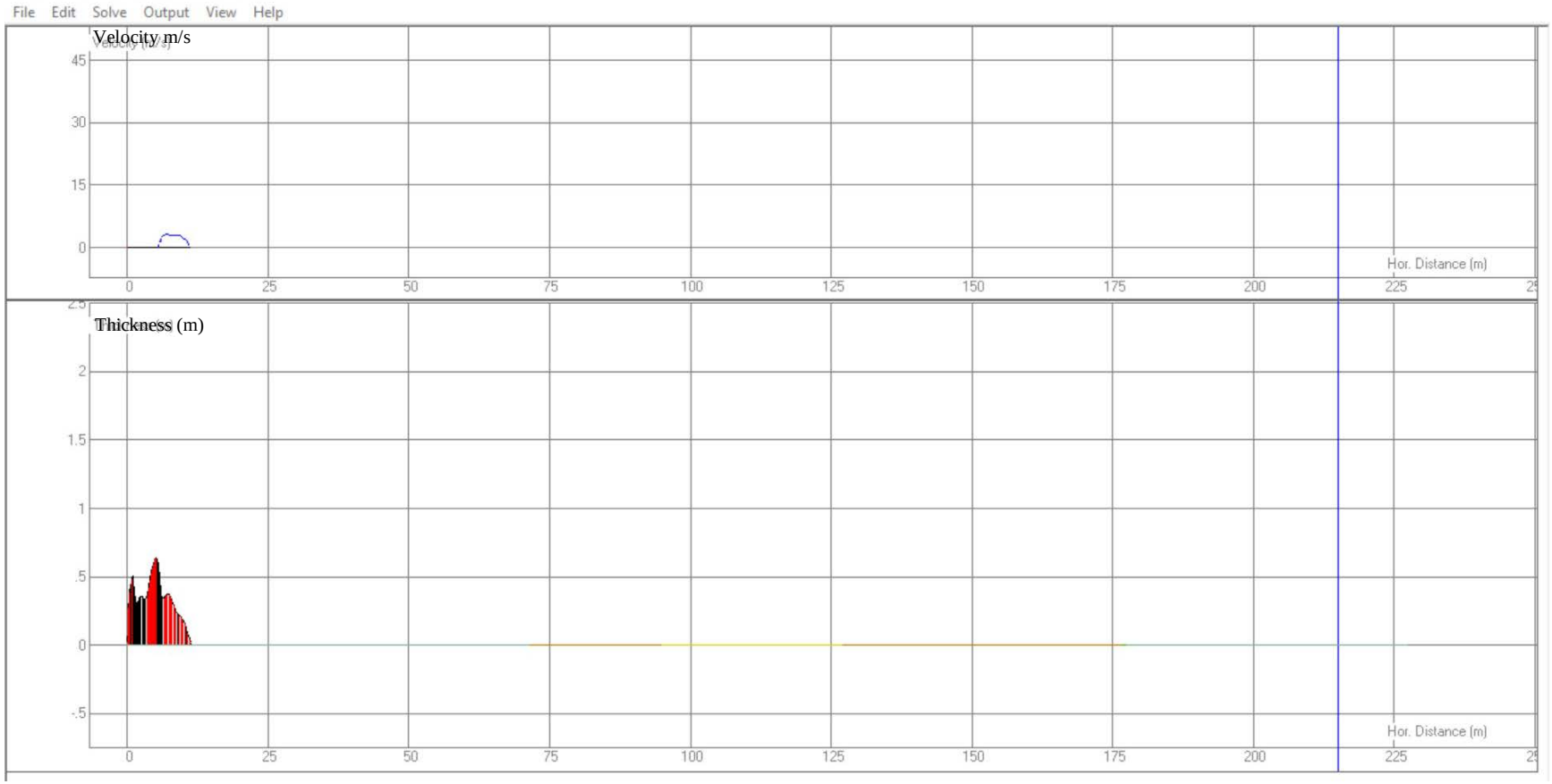
Distance (m)

Result of Debris Mobility Analysis

Source Volume (m^3)	Final Volume (m^3)	Travel Distance (m)	Debris Reached Proposed SITE Facility
40.43	40.43	5.74	No

Section Profile – (post-sliding)




File Edit Solve Output View Help
Velocity m/s
45
30
15
0
Hor. Distance (m)
0 25 50 75 100 125 150 175 200 225
Thickness (m)
2
1.5
1
.5
0
-.5
Hor. Distance (m)
0 25 50 75 100 125 150 175 200 225

Distance (m)

No of Blocks = 50

Time step = 0.001 seconds

End at time = 0.00 seconds

Configuration = 3-dimensional

Boundary Block Geometry = Normal

Shape factor = 1.00

Maximum velocity = 3.15 at X = 6.98

Maximum front velocity = 3.15 at X =6.98

CENTRE OF GRAVITY: X-Source = 3.03

Z-Source = 229.15

X-Depos. = 4.90

Z-Depos. = 228.05

CG Ratio = 0.59

Travel angle = 30.56

FAHRBOSCHUNG = 20.87

FRONT DISPLACEMENT: X = 11.222 Z = 225.852

Curvilinear Displ.= 5.993

Horiz. Displ. = 5.74

REAR DISPLACEMENT: X = 0.00 Z = 230.13

Curvilinear Displ.= 0.00

Horiz. Displ. = 0.00

SLIDE VOLUME: Initial = 40.43

Final = 40.43

AREA IN PLAN: Initial = 53.46

Final = 106.30

Runout not completed, V-MAX = 0.00

Export Print Close Help

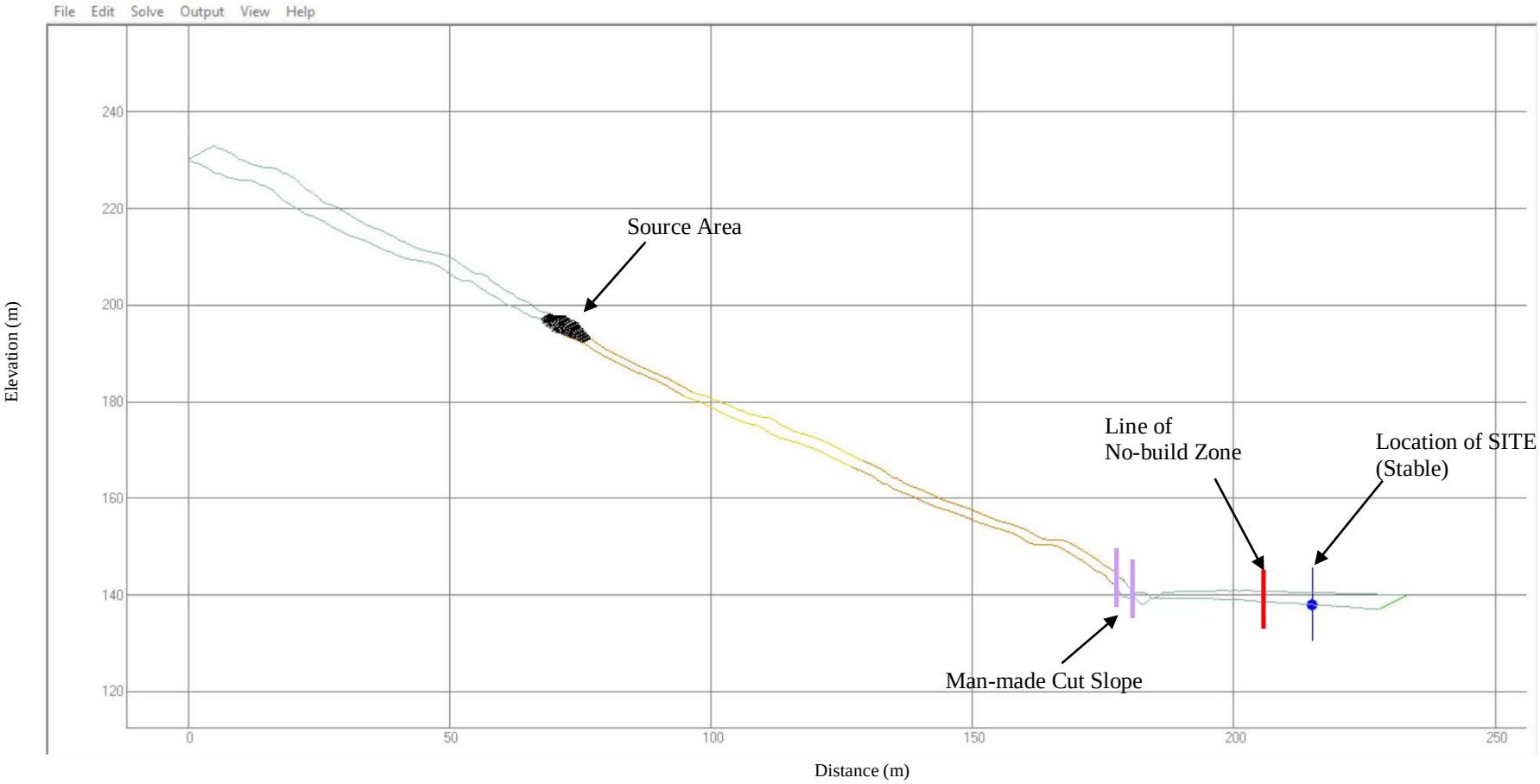
Debris Mobility Analysis for the Credible Runout Path RP7 (Case 2) within Catchment No. CD2

Landslide Type = CDF

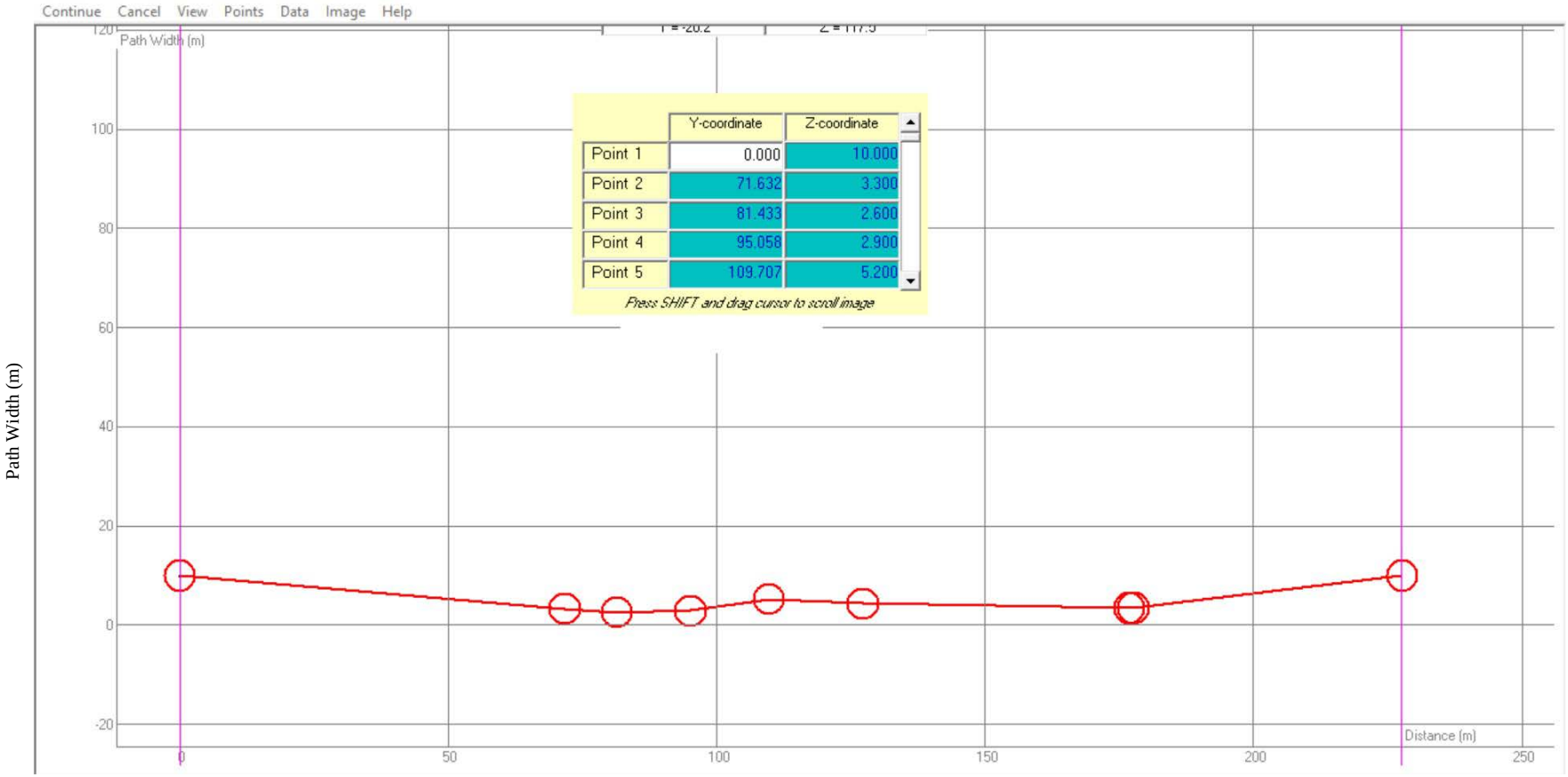
Design Source Volume = 40m^3

Figure D12

Section Profile – (pre-sliding)



Width Profile



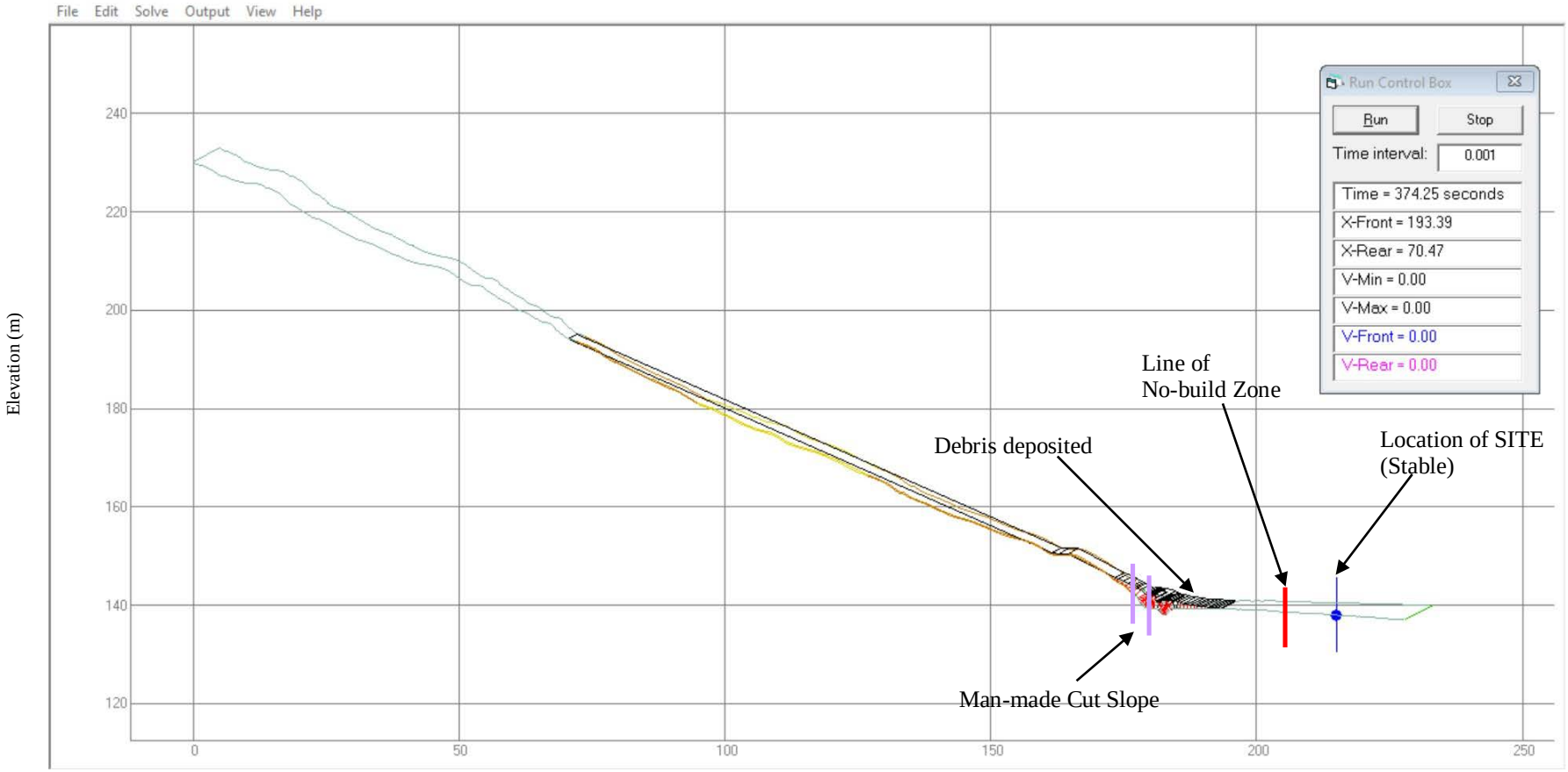
Path Width (m)

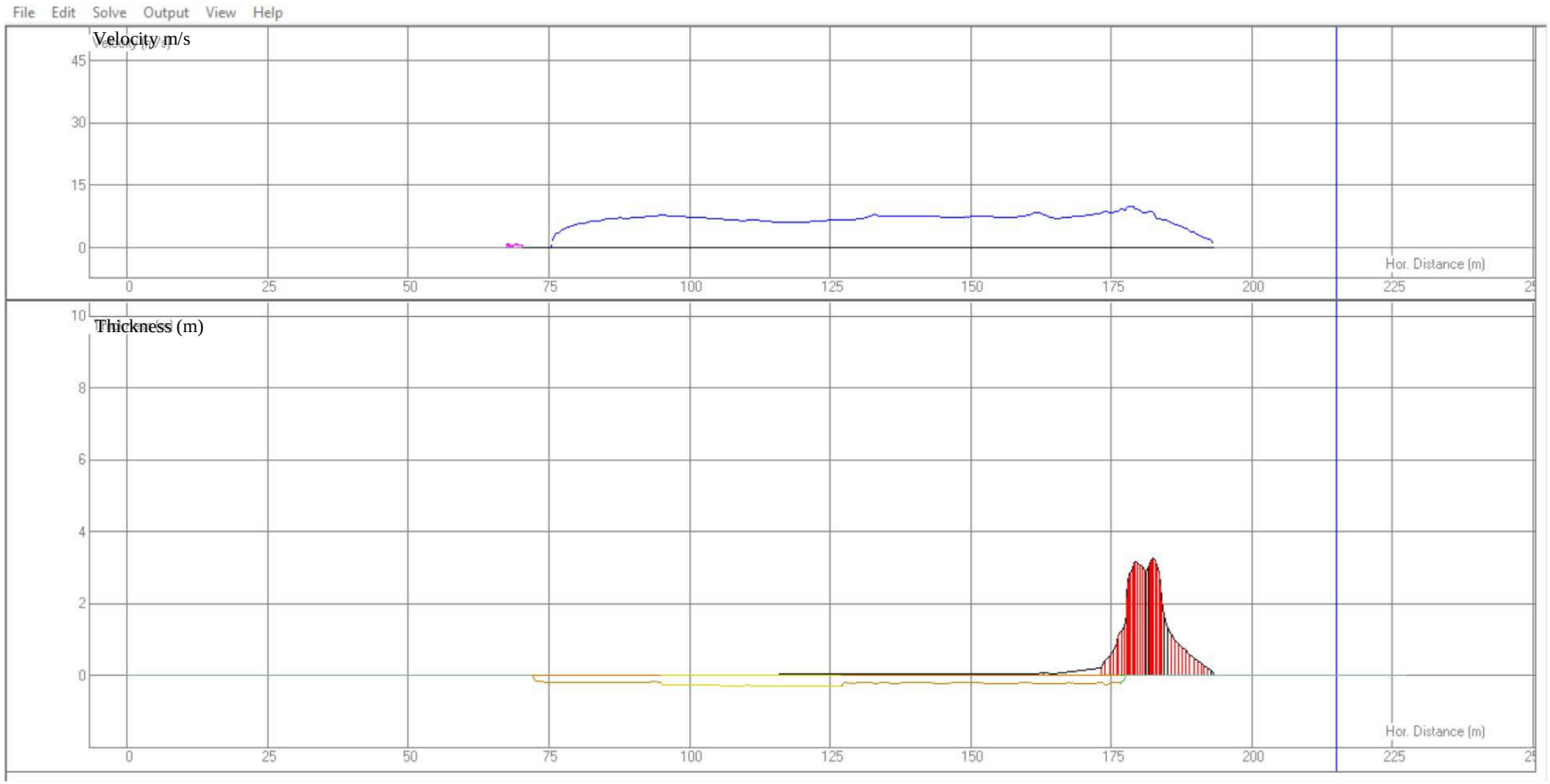
Distance (m)

Result of Debris Mobility Analysis

Source Volume (m^3)	Final Volume (m^3)	Travel Distance (m)	Debris Reached Proposed SITE Facility
40.50	143.05	117.90	No

Section Profile – (post-sliding)




File Edit Solve Output View Help
Velocity m/s
45
30
15
0
0 25 50 75 100 125 150 175 200 225
Hor. Distance (m)
Thickness (m)
10
8
6
4
2
0
0 25 50 75 100 125 150 175 200 225
Hor. Distance (m)

Distance (m)

No of Blocks = 50

Time step = 0.001 seconds

End at time = 0.00 seconds

Configuration = 3-dimensional

Boundary Block Geometry = Normal

Shape factor = 1.00

Maximum velocity = 9.94 at X = 178.89

Maximum front velocity = 9.94 at X =178.89

CENTRE OF GRAVITY: X-Source = 71.13

Z-Source = 195.13

X-Depos. = 181.72

Z-Depos. = 140.78

CG Ratio = 0.49

Travel angle = 26.17

FAHRBOSCHUNG = 24.67

FRONT DISPLACEMENT: X = 193.386 Z = 139.261

Curvilinear Displ.= 133.041

Horiz. Displ. = 117.90

REAR DISPLACEMENT: X = 70.47 Z = 194.30

Curvilinear Displ.= 4.19

Horiz. Displ. = 3.03

SLIDE VOLUME: Initial = 40.50

Final = 143.05

AREA IN PLAN: Initial = 26.87

Final = 449.55

Runout not completed, V-MAX = 0.00

Export Print Close Help

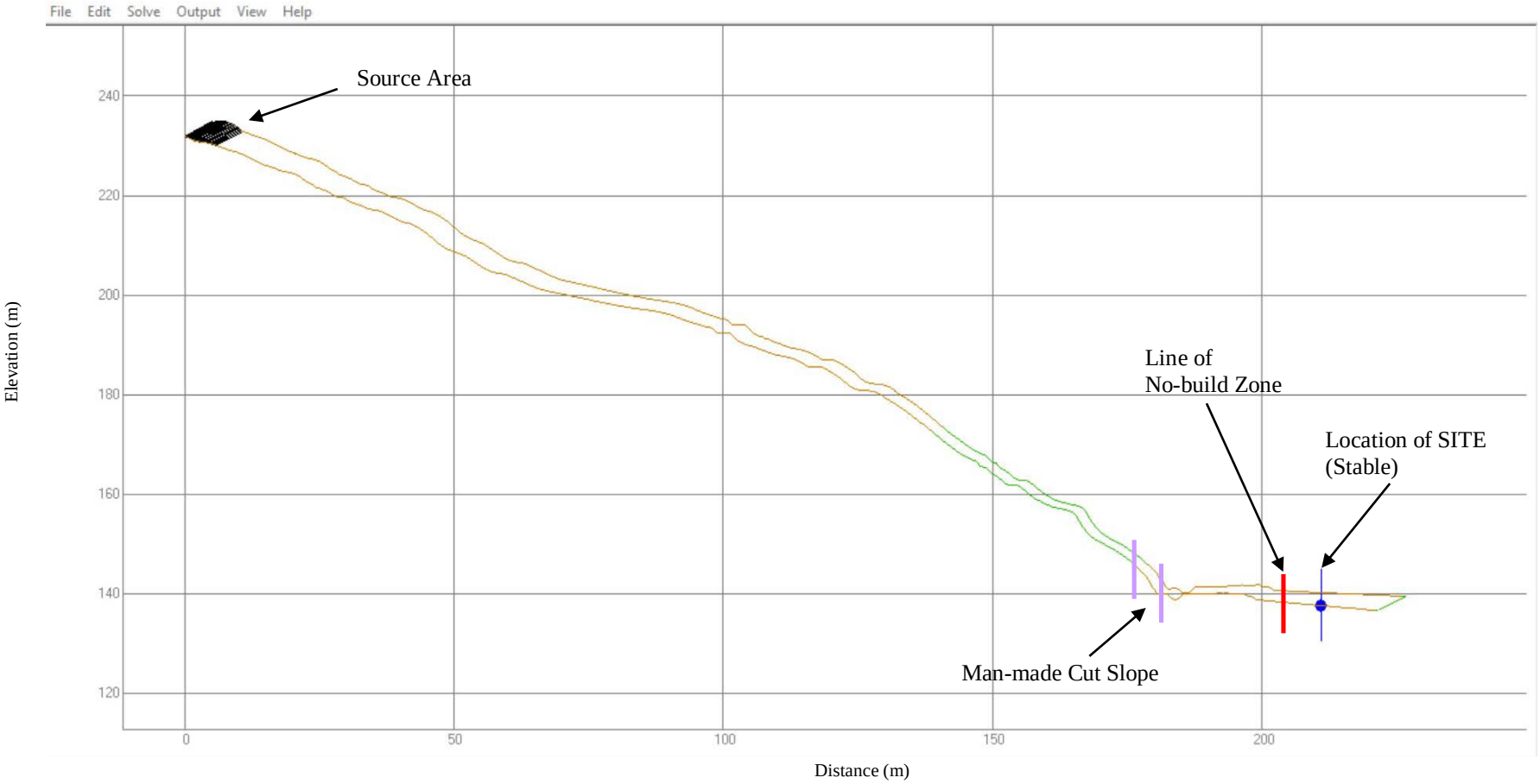
Debris Mobility Analysis for the Credible Runout Path RP8 (Case 1) within Catchment No. OH3

Landslide Type = OHL

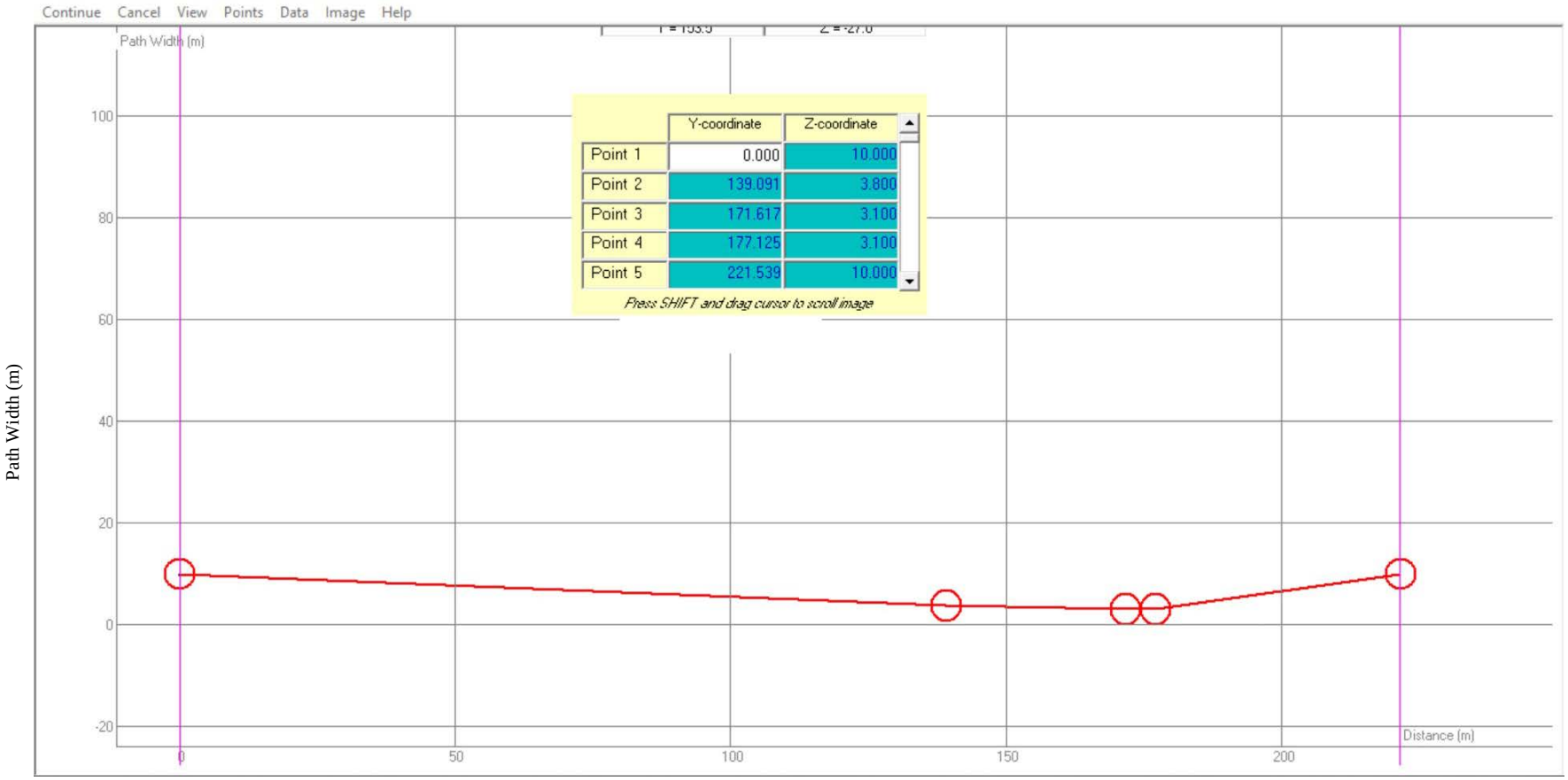
Design Source Volume = 40m^3

Figure D13

Section Profile – (pre-sliding)



Width Profile



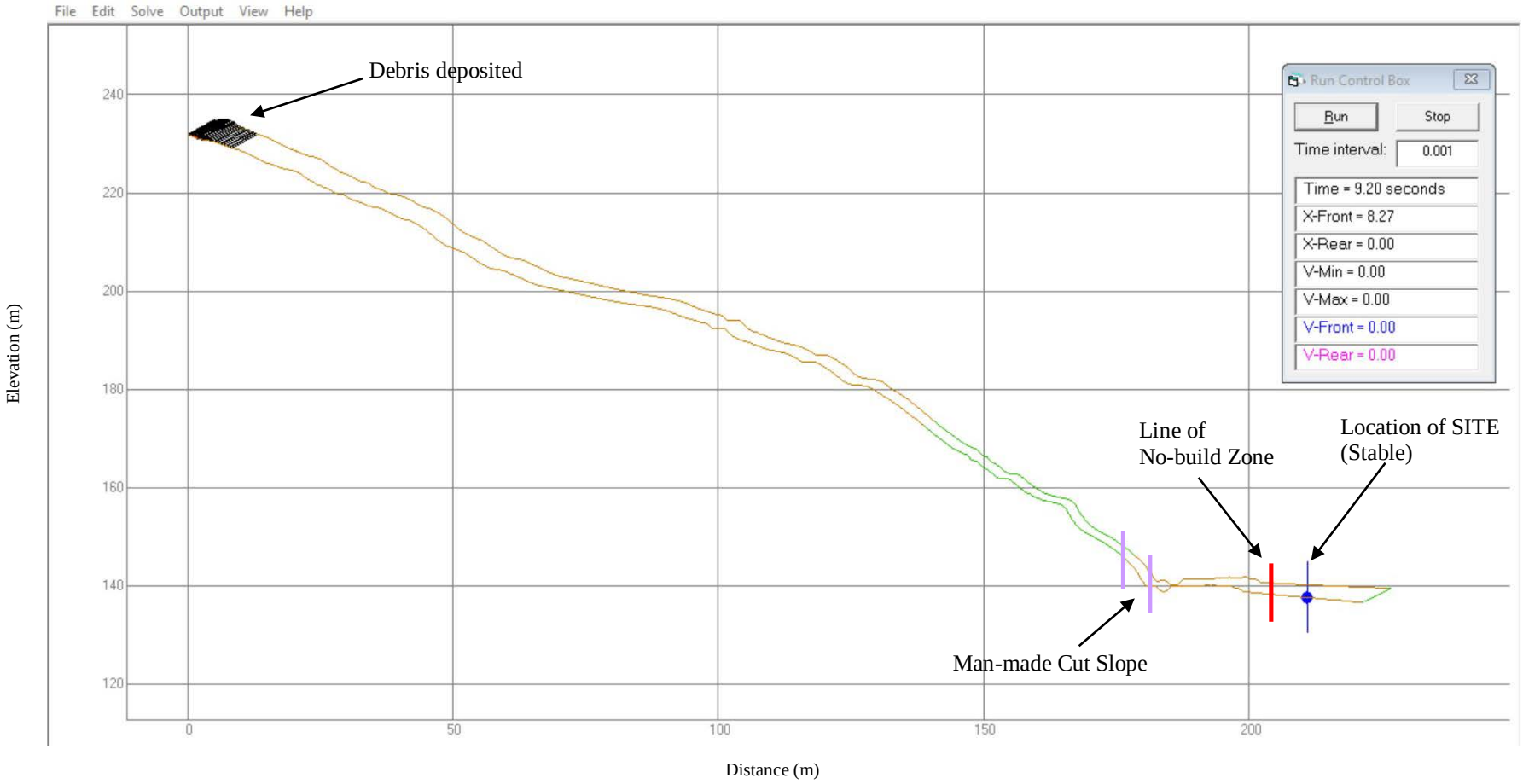
Path Width (m)

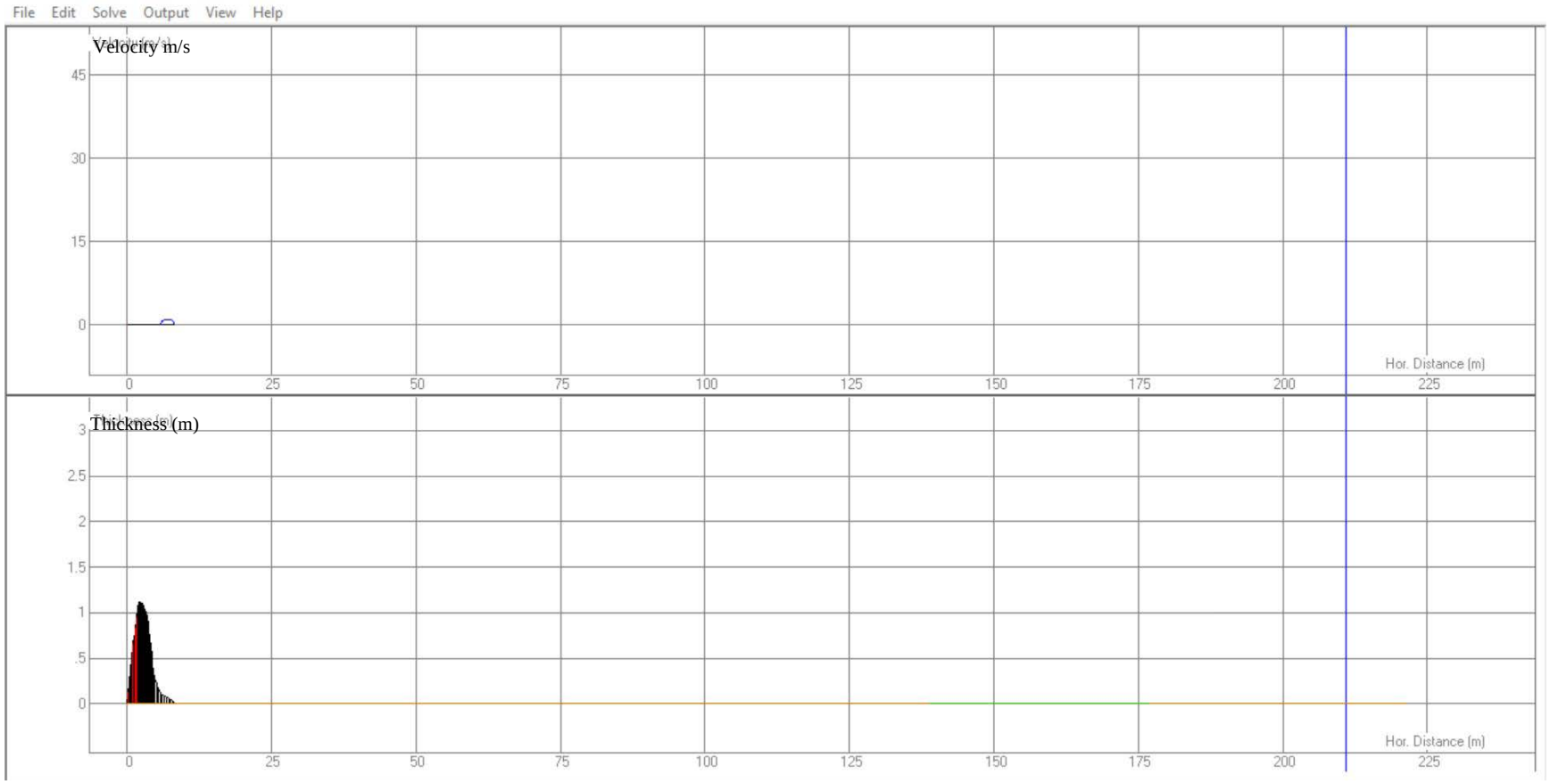
Distance (m)

Result of Debris Mobility Analysis

Source Volume (m^3)	Final Volume (m^3)	Travel Distance (m)	Debris Reached Proposed SITE Facility
40.65	40.65	2.45	No

Section Profile – (post-sliding)




File Edit Solve Output View Help
Velocity m/s
45
30
15
0
Hor. Distance (m)
0 25 50 75 100 125 150 175 200 225
Thickness (m)
3
2.5
2
1.5
1
.5
0
Hor. Distance (m)
0 25 50 75 100 125 150 175 200 225

Distance (m)

No of Blocks = 50

Time step = 0.001 seconds

End at time = 0.00 seconds

Configuration = 3-dimensional

Boundary Block Geometry = Normal

Shape factor = 1.00

Maximum velocity = 1.05 at X = 7.00

Maximum front velocity = 1.05 at X =7.00

CENTRE OF GRAVITY: X-Source = 2.83

Z-Source = 231.31

X-Depos. = 2.93

Z-Depos. = 231.25

CG Ratio = 0.59

Travel angle = 30.46

FAHRBOSCHUNG = 18.56

FRONT DISPLACEMENT: X = 8.270 Z = 229.153

Curvilinear Displ.= 2.625

Horiz. Displ. = 2.45

REAR DISPLACEMENT: X = 0.00 Z = 231.93

Curvilinear Displ.= 0.00

Horiz. Displ. = 0.00

SLIDE VOLUME: Initial = 40.65

Final = 40.65

AREA IN PLAN: Initial = 57.46

Final = 81.18

Runout not completed, V-MAX = 0.00

Export Print Close Help

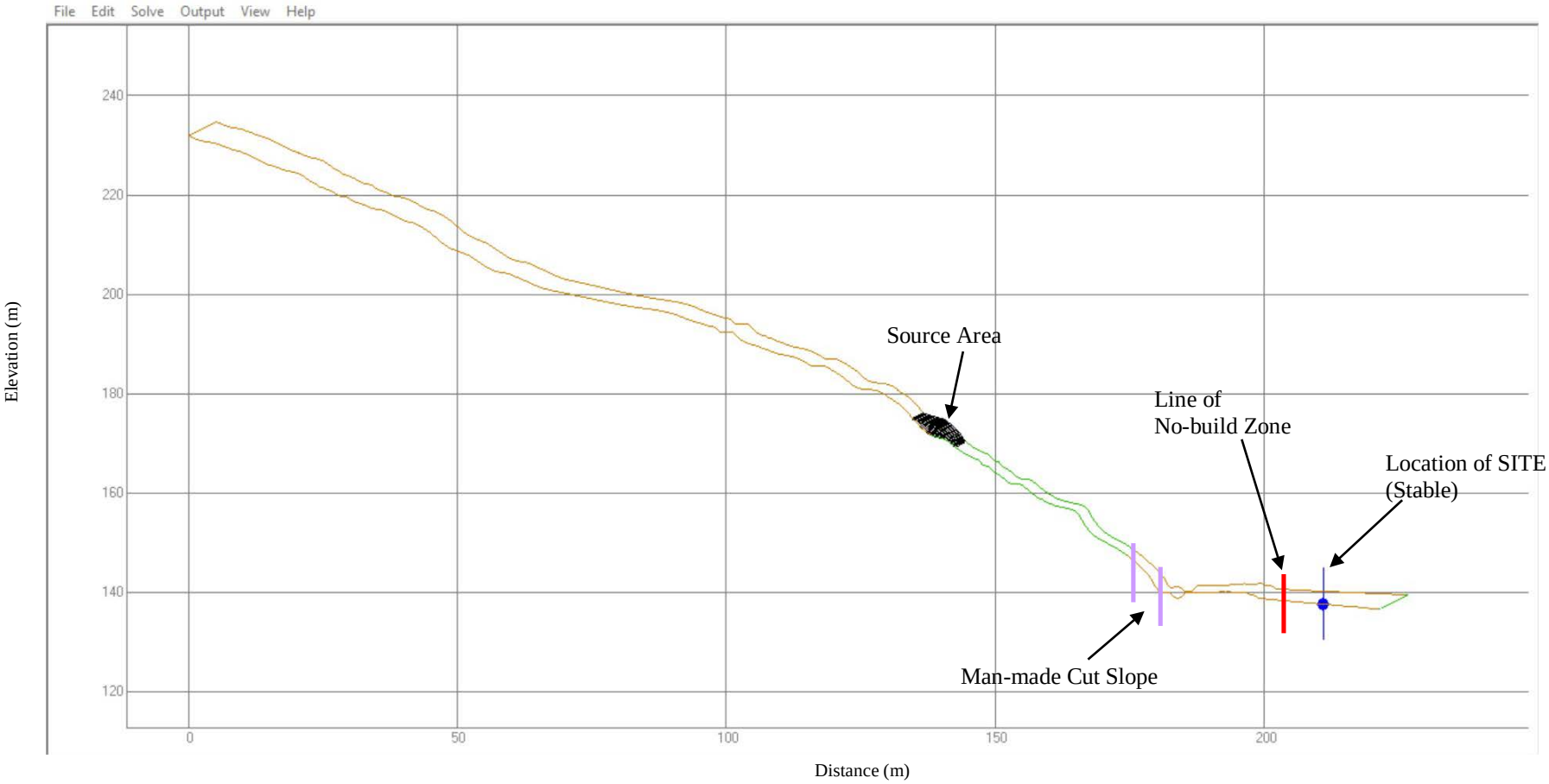
Debris Mobility Analysis for the Credible Runout Path RP8 (Case 2) within Catchment No. OH3

Landslide Type = OHL

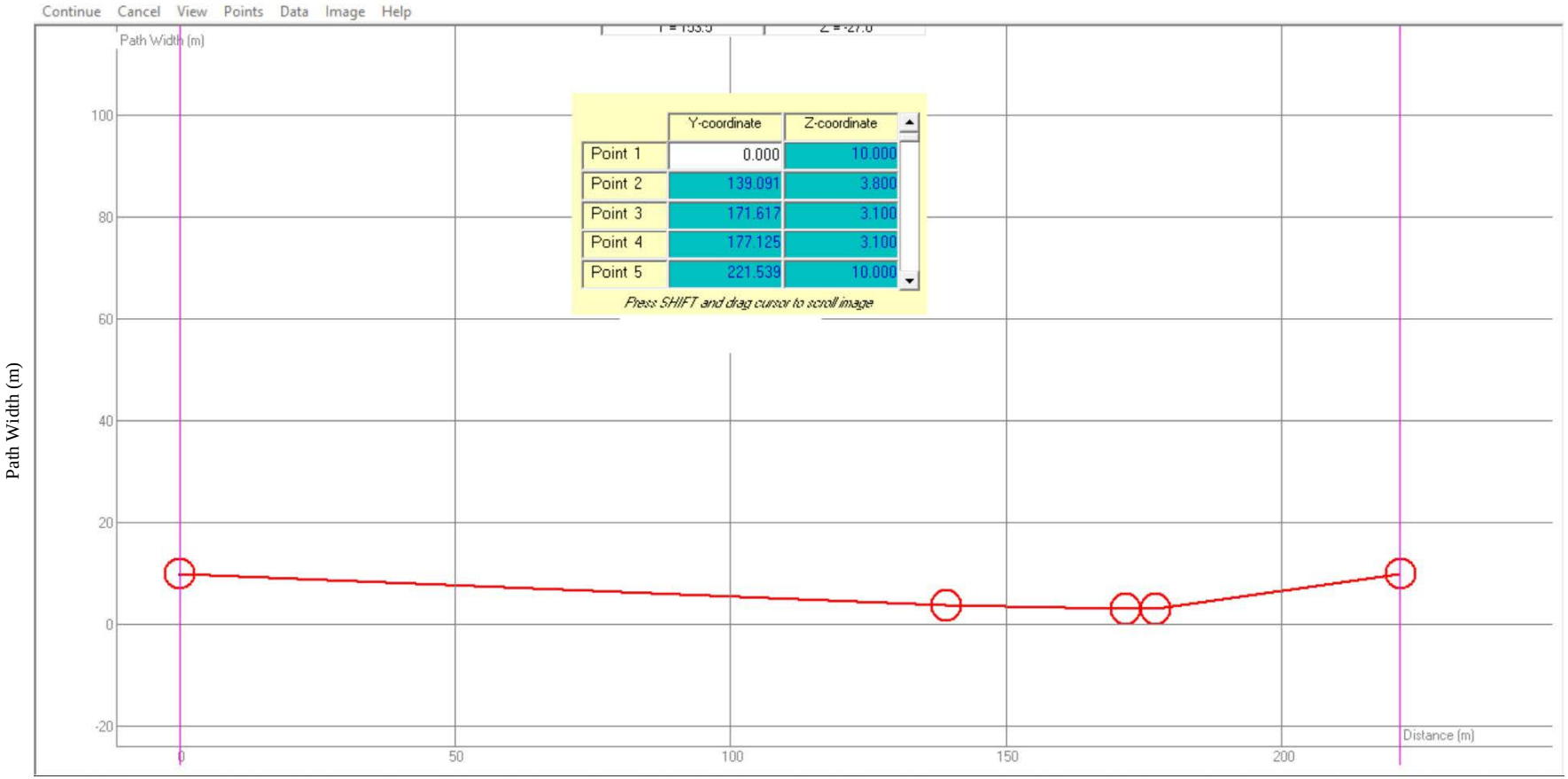
Design Source Volume = 40m^3

Figure D14

Section Profile – (pre-sliding)



Width Profile



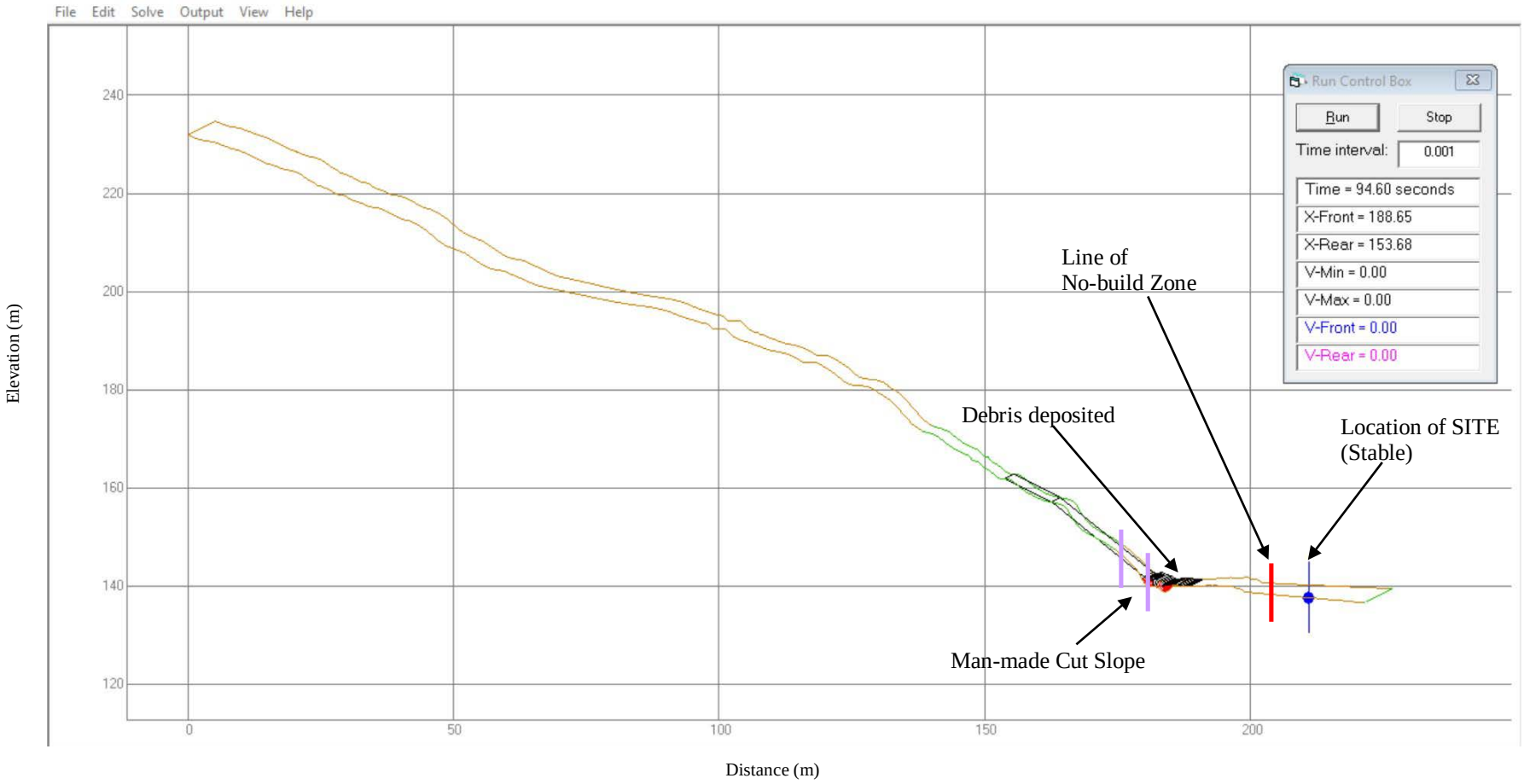
Path Width (m)

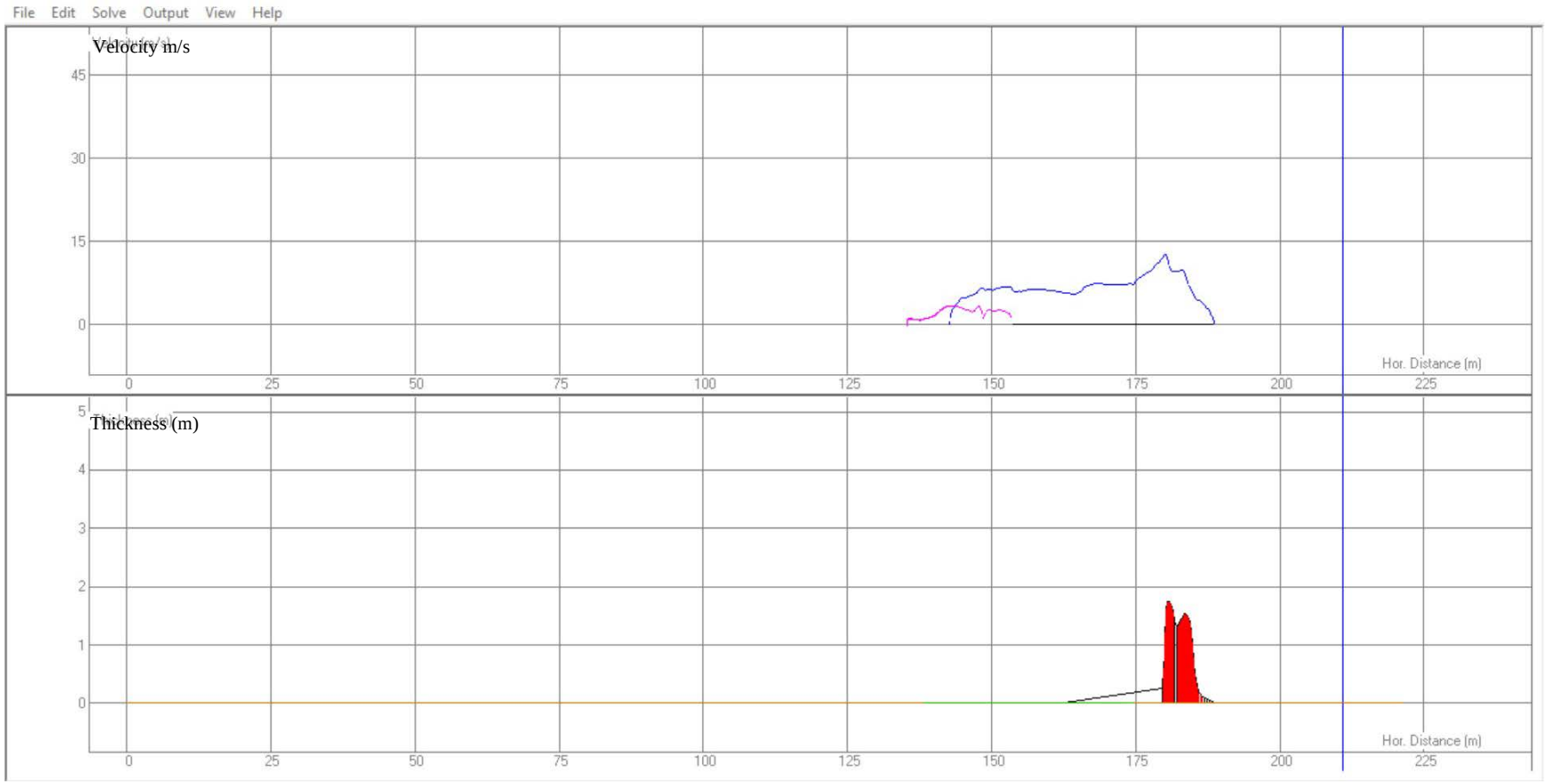
Distance (m)

Result of Debris Mobility Analysis

Source Volume (m^3)	Final Volume (m^3)	Travel Distance (m)	Debris Reached Proposed SITE Facility
40.26	40.26	46.01	No

Section Profile – (post-sliding)




File Edit Solve Output View Help
Velocity m/s
45
30
15
0
0 25 50 75 100 125 150 175 200 225
Hor. Distance (m)
Thickness (m)
5
4
3
2
1
0
0 25 50 75 100 125 150 175 200 225
Hor. Distance (m)

Distance (m)

No of Blocks = 50

Time step = 0.001 seconds

End at time = 0.00 seconds

Configuration = 3-dimensional

Boundary Block Geometry = Normal

Shape factor = 1.00

Maximum velocity = 12.73 at X = 180.12

Maximum front velocity = 12.73 at X =180.12

CENTRE OF GRAVITY: X-Source = 138.56

Z-Source = 172.48

X-Depos. = 182.37

Z-Depos. = 140.51

CG Ratio = 0.73

Travel angle = 36.12

FAHRBOSCHUNG = 32.78

FRONT DISPLACEMENT: X = 188.647 Z = 139.898

Curvilinear Displ.= 58.689

Horiz. Displ. = 46.01

SLIDE VOLUME: Initial = 40.26

Final = 40.26

AREA IN PLAN: Initial = 27.86

Final = 125.88

REAR DISPLACEMENT: X = 153.68 Z = 161.70

Curvilinear Displ.= 22.75

Horiz. Displ. = 18.34

Runout not completed, V-MAX = 0.00

Export Print Close Help

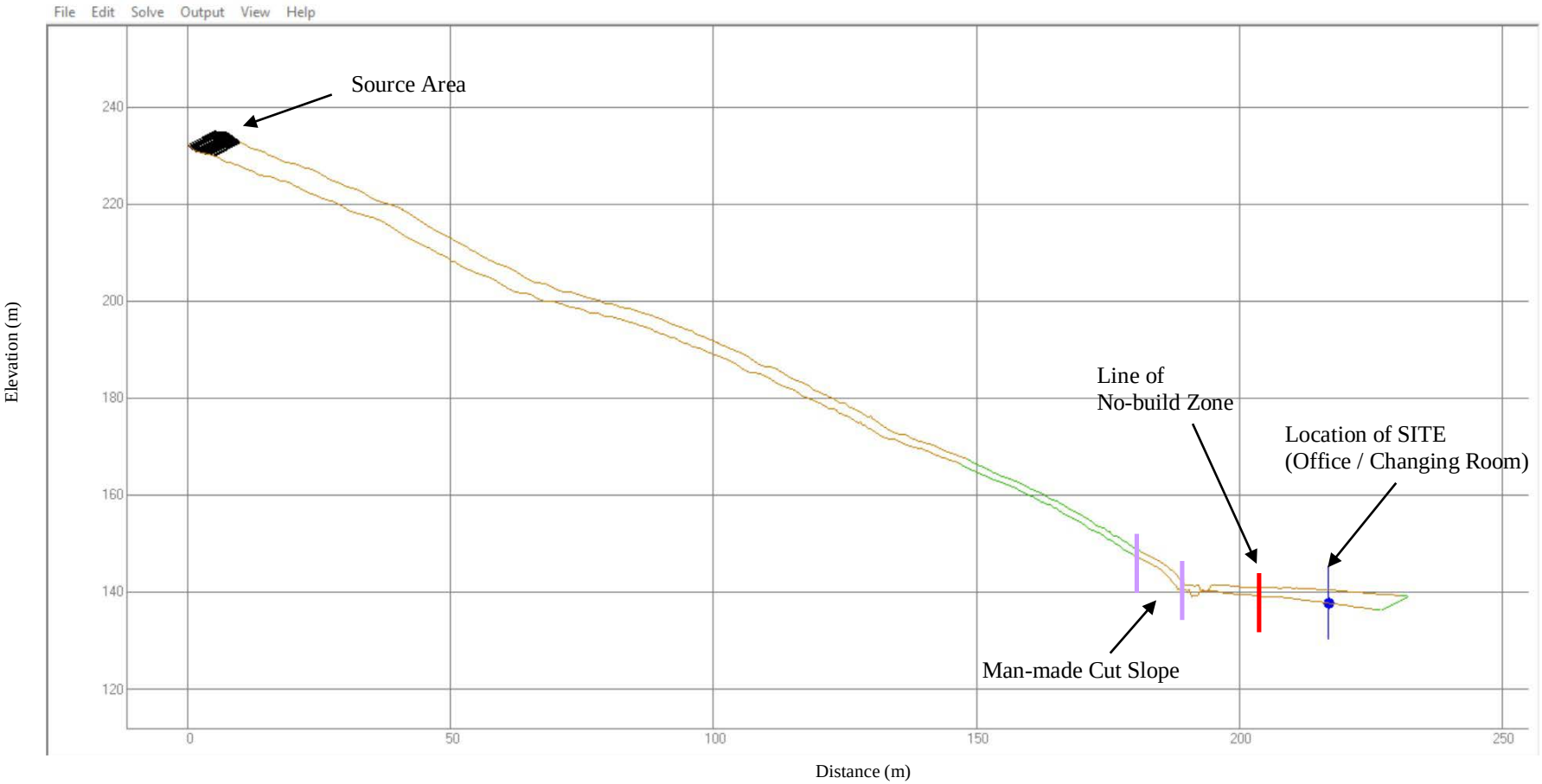
Debris Mobility Analysis for the Credible Runout Path RP9 (Case 1) within Catchment No. OH3

Landslide Type = OHL

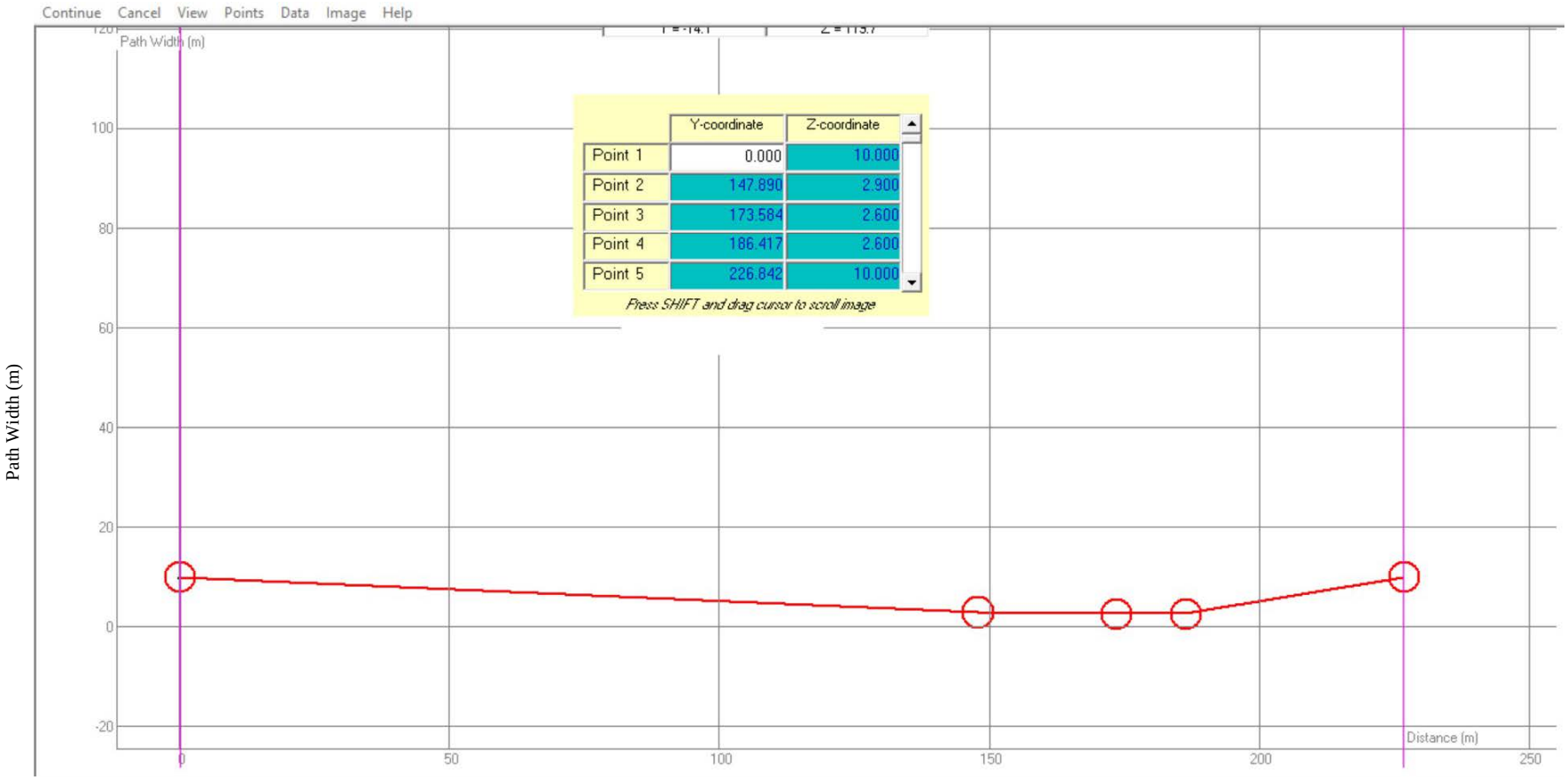
Design Source Volume = 40m^3

Figure D15

Section Profile – (pre-sliding)



Width Profile



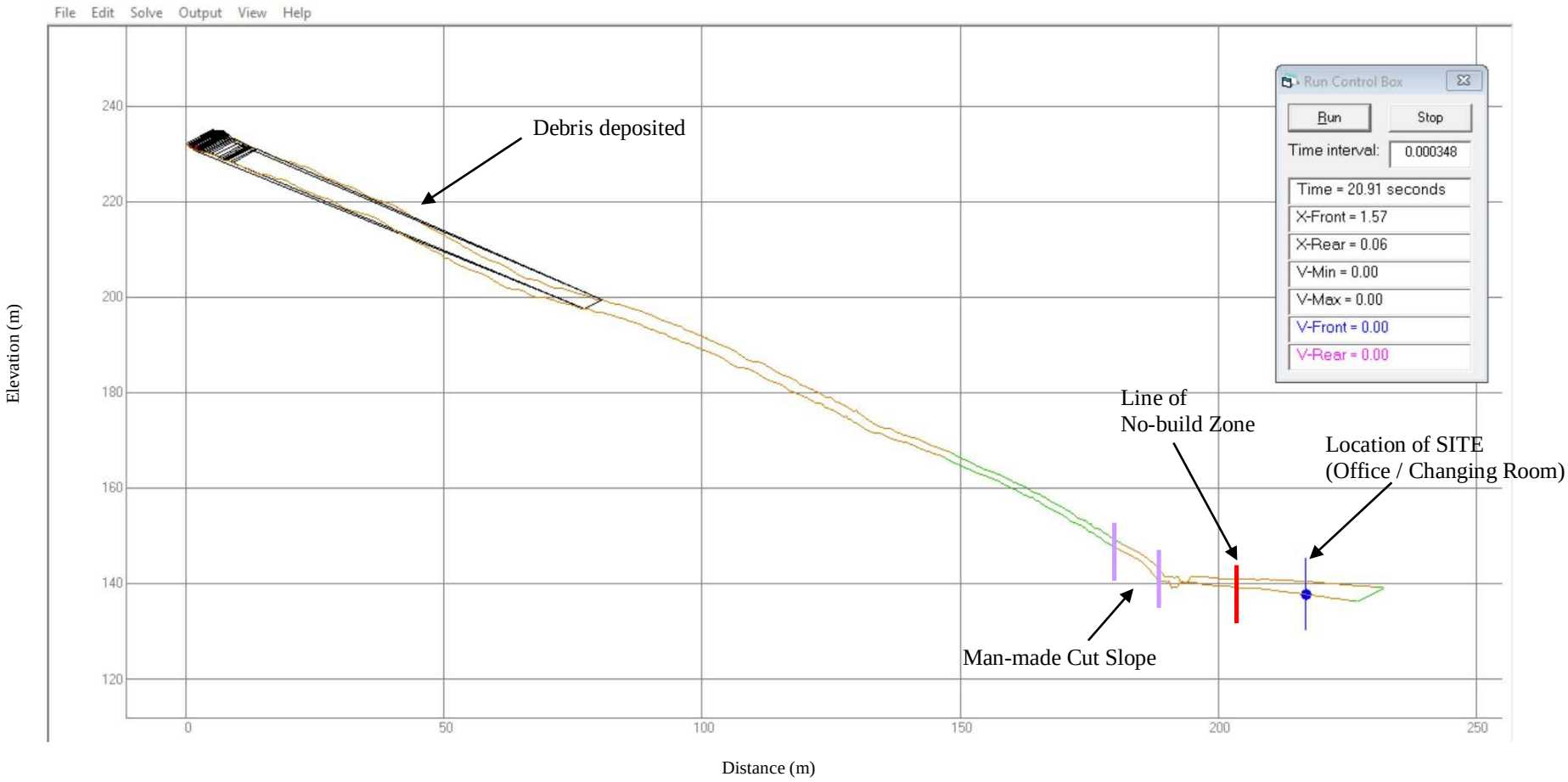
Path Width (m)

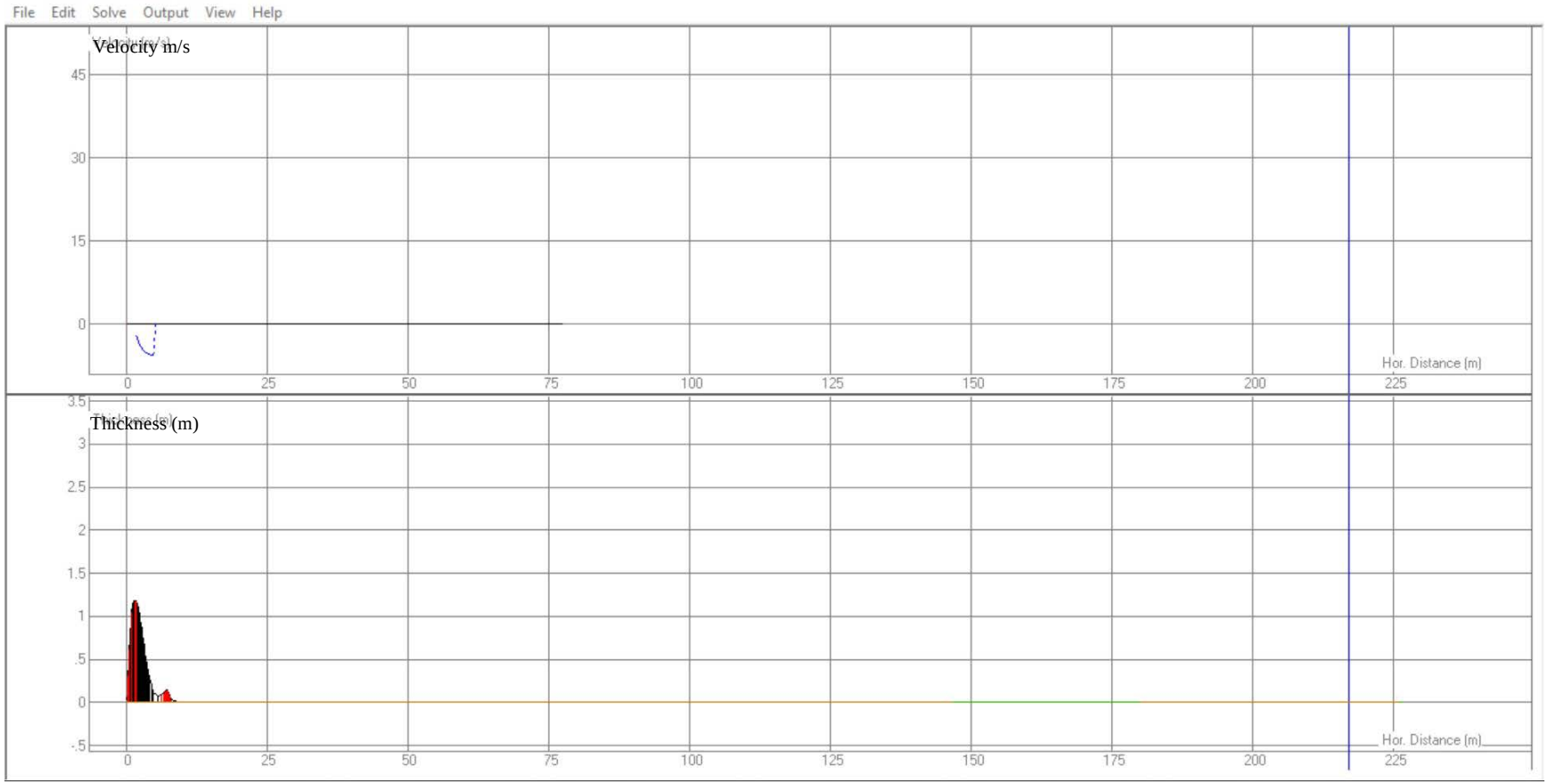
Distance (m)

Result of Debris Mobility Analysis

Source Volume (m^3)	Final Volume (m^3)	Travel Distance (m)	Debris Reached Proposed SITE Facility
40.27	40.27	75.2	No

Section Profile – (post-sliding)




File Edit Solve Output View Help
Velocity m/s
45
30
15
0
0 25 50 75 100 125 150 175 200 225
Hor. Distance (m)
Thickness (m)
3.5
3
2.5
2
1.5
1
.5
0
-.5
0 25 50 75 100 125 150 175 200 225
Hor. Distance (m)

Distance (m)

No of Blocks = 50

Time step = 0.0003 seconds

End at time = 0.00 seconds

Configuration = 3-dimensional

Boundary Block Geometry = Normal

Shape factor = 1.00

Maximum velocity = 57.91 at X = 7.02

Maximum front velocity = 0.03 at X =5.13

CENTRE OF GRAVITY: X-Source = 2.27

Z-Source = 231.23

X-Depos. = 2.54

Z-Depos. = 231.07

CG Ratio = 0.61

Travel angle = 31.55

FAHRBOSCHUNG = 39.52

FRONT DISPLACEMENT: X = 1.569 Z = 230.883

Curvilinear Displ.= -3.714

Horiz. Displ. = -3.56

REAR DISPLACEMENT: X = 0.06 Z = 232.13

Curvilinear Displ.= 0.01

Horiz. Displ. = 0.01

SLIDE VOLUME: Initial = 40.27

Final = 40.27

AREA IN PLAN: Initial = 50.17

Final = 15.06

Runout not completed, V-MAX = 0.00

Export Print Close Help

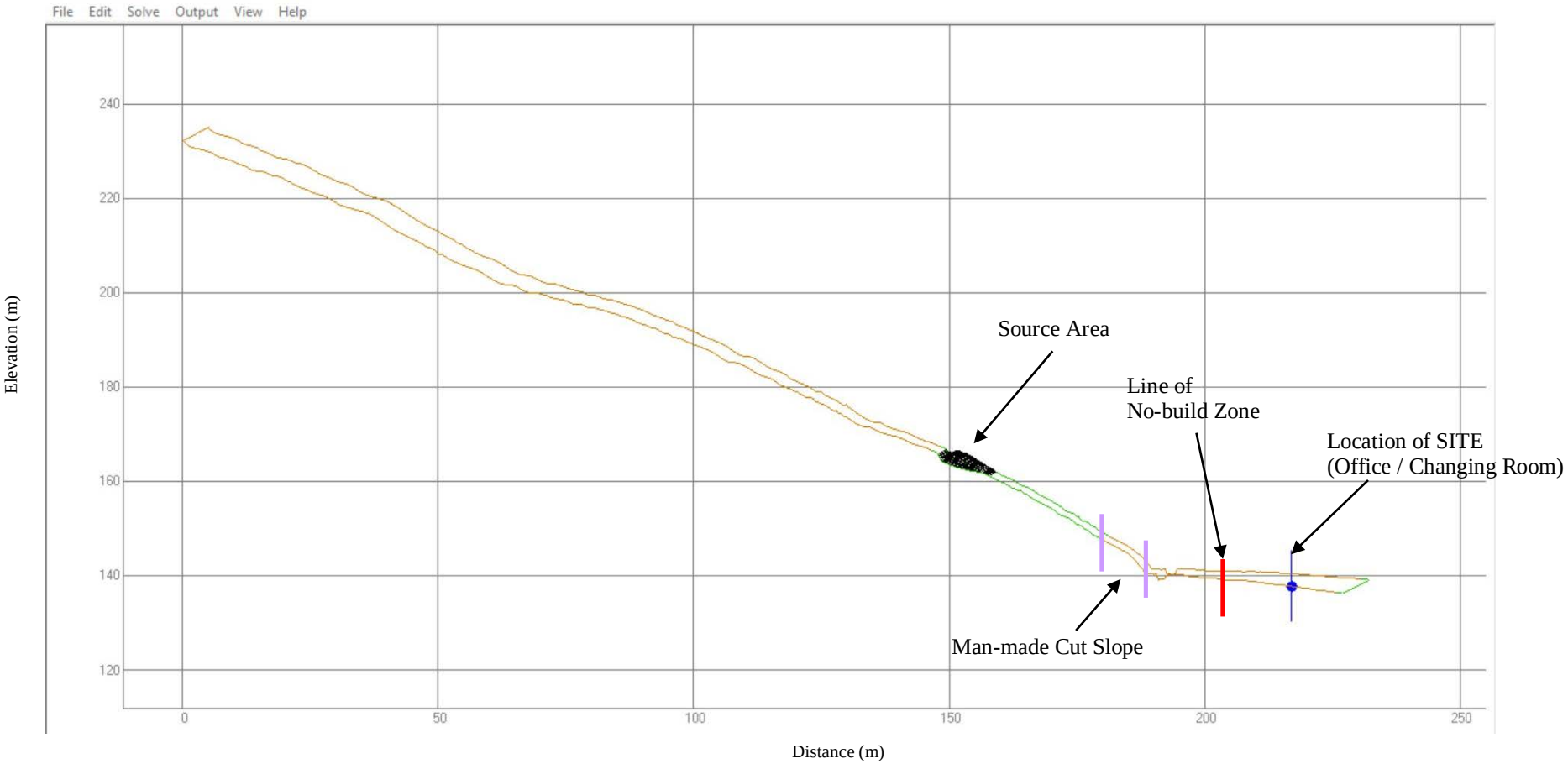
Debris Mobility Analysis for the Credible Runout Path RP9 (Case 2) within Catchment No. OH3

Landslide Type = OHL

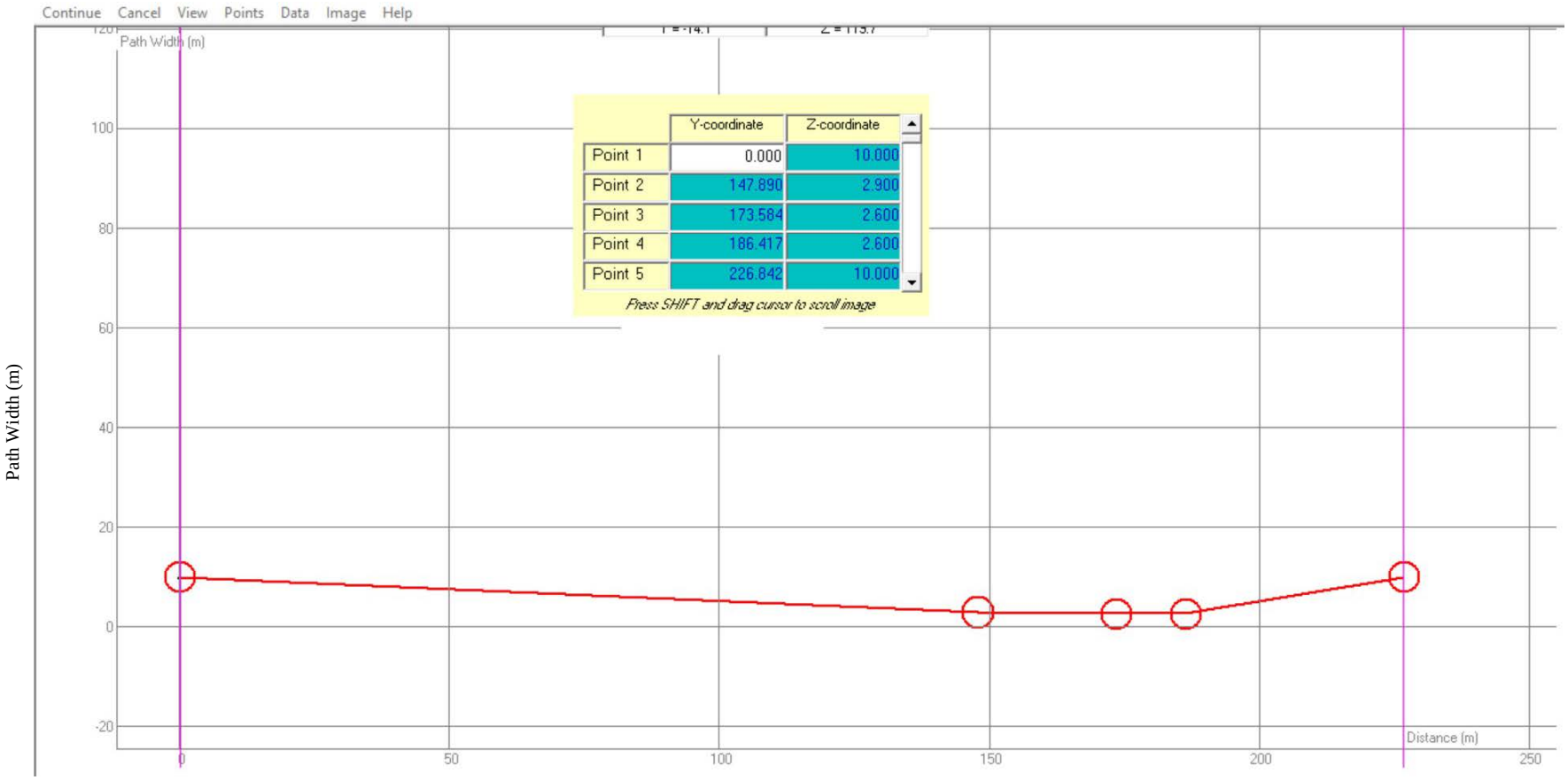
Design Source Volume = 40m^3

Figure D16

Section Profile – (pre-sliding)



Width Profile



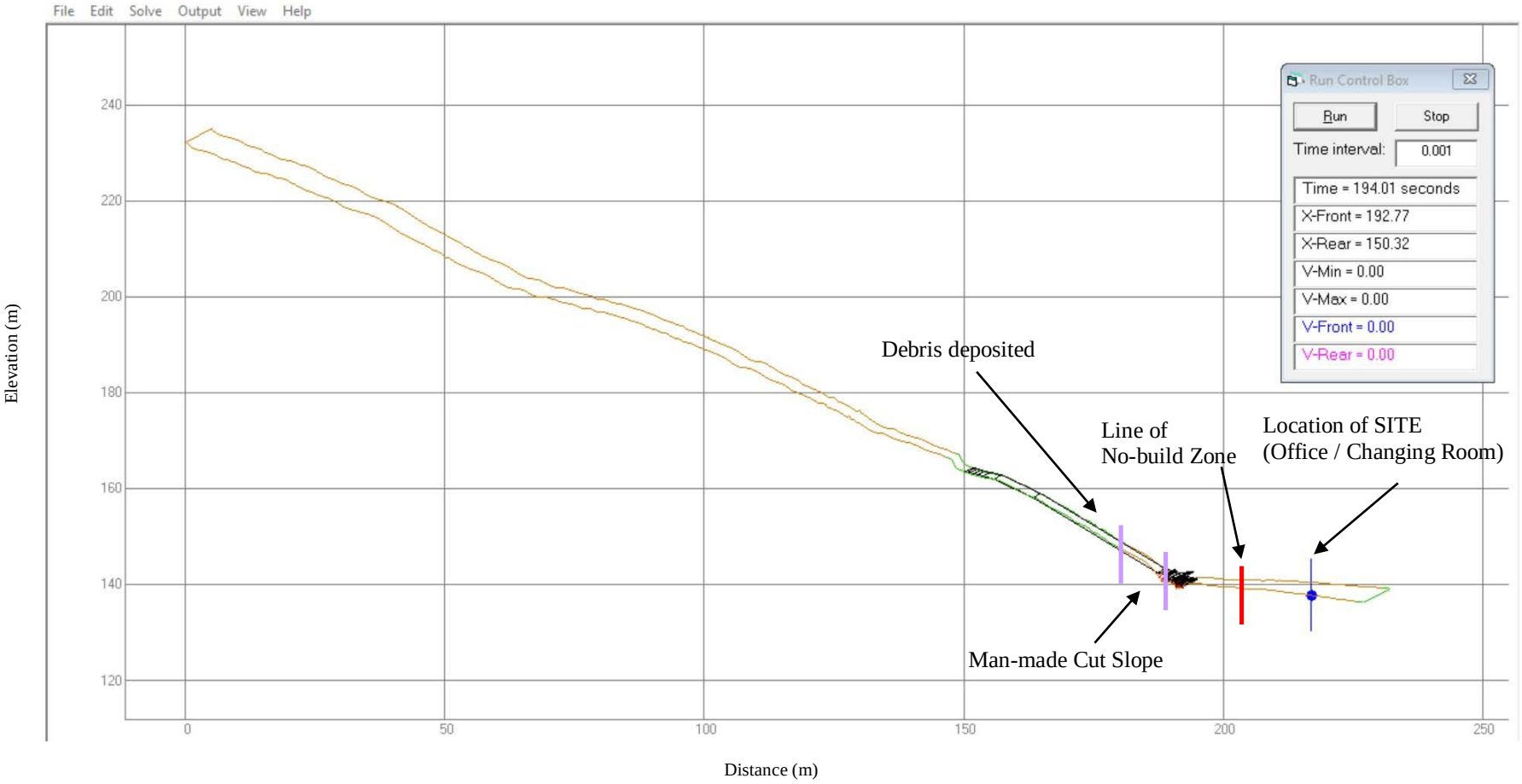
Path Width (m)

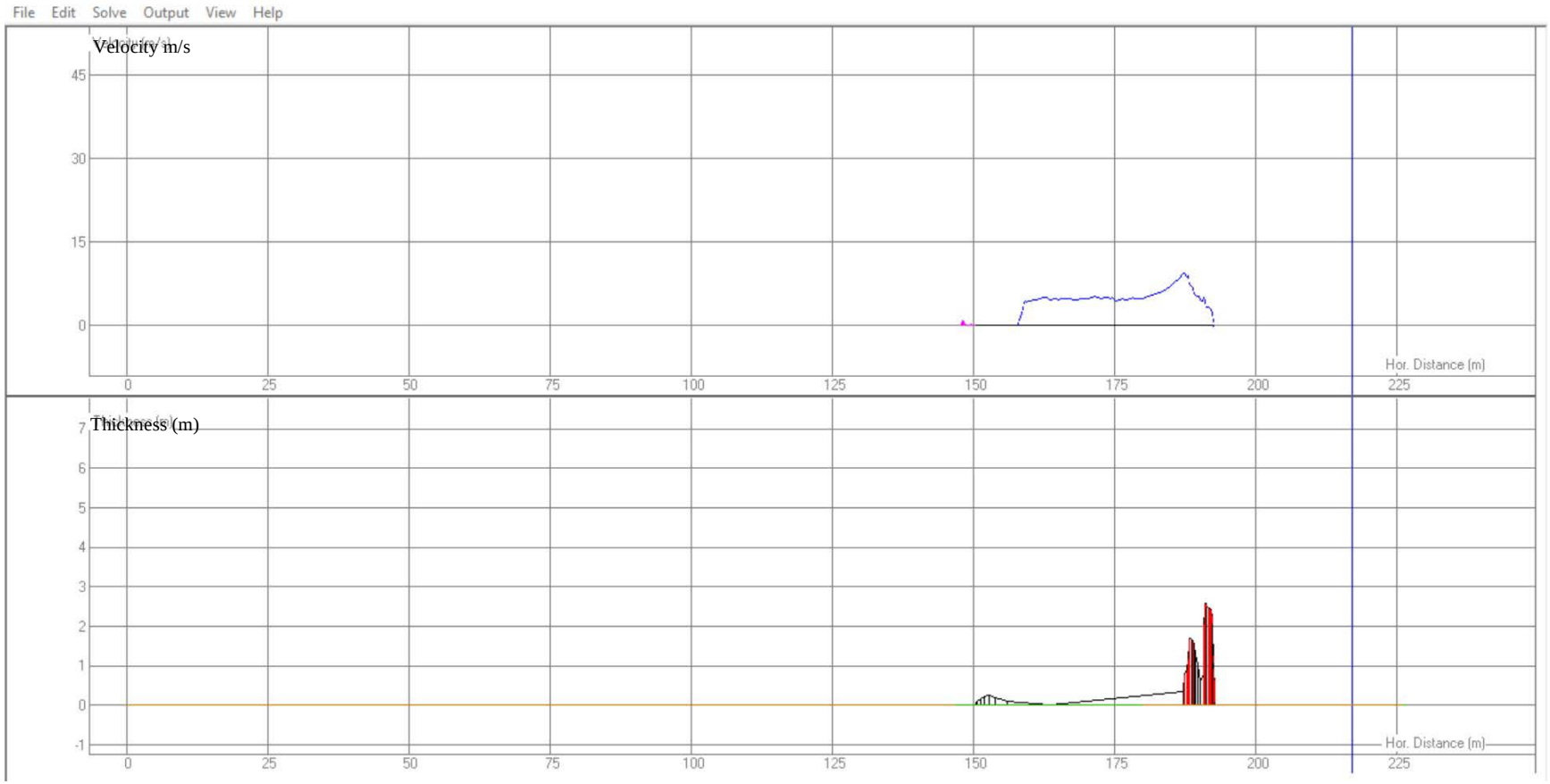
Distance (m)

Result of Debris Mobility Analysis

Source Volume (m^3)	Final Volume (m^3)	Travel Distance (m)	Debris Reached Proposed SITE Facility
40.18	40.18	34.95	No

Section Profile – (post-sliding)




File Edit Solve Output View Help
Velocity m/s
45
30
15
0
0 25 50 75 100 125 150 175 200 225
Hor. Distance (m)
Thickness (m)
7
6
5
4
3
2
1
0
-1
0 25 50 75 100 125 150 175 200 225
Hor. Distance (m)

Distance (m)

No of Blocks = 50

Time step = 0.001 seconds

End at time = 0.00 seconds

Configuration = 3-dimensional

Boundary Block Geometry = Normal

Shape factor = 1.00

Maximum velocity = 9.41 at X = 187.32

Maximum front velocity = 9.41 at X =187.32

CENTRE OF GRAVITY: X-Source = 151.85

Z-Source = 163.90

X-Depos. = 186.35

Z-Depos. = 143.09

CG Ratio = 0.60

Travel angle = 31.10

FAHRBOSCHUNG = 29.64

FRONT DISPLACEMENT: X = 192.772 Z = 140.273

Curvilinear Displ.= 43.640

Horiz. Displ. = 34.95

REAR DISPLACEMENT: X = 150.32 Z = 163.46

Curvilinear Displ.= 3.54

Horiz. Displ. = 2.43

SLIDE VOLUME: Initial = 40.18

Final = 40.18

AREA IN PLAN: Initial = 28.22

Final = 119.38

Runout not completed, V-MAX = 0.00

Export Print Close Help

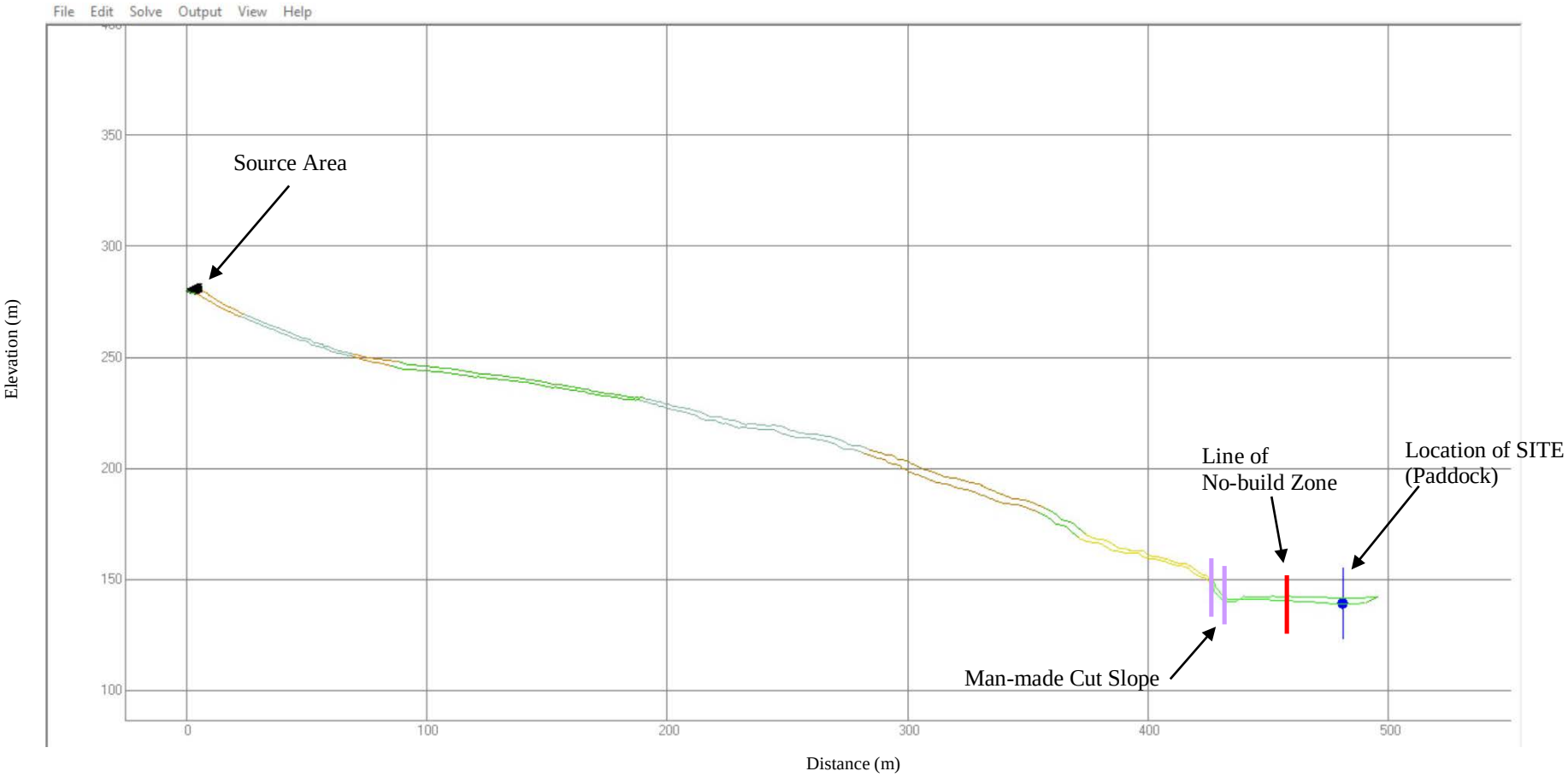
Debris Mobility Analysis for the Credible Runout Path RP10 (Case 1) within Catchment No. CD3

Landslide Type = CDF

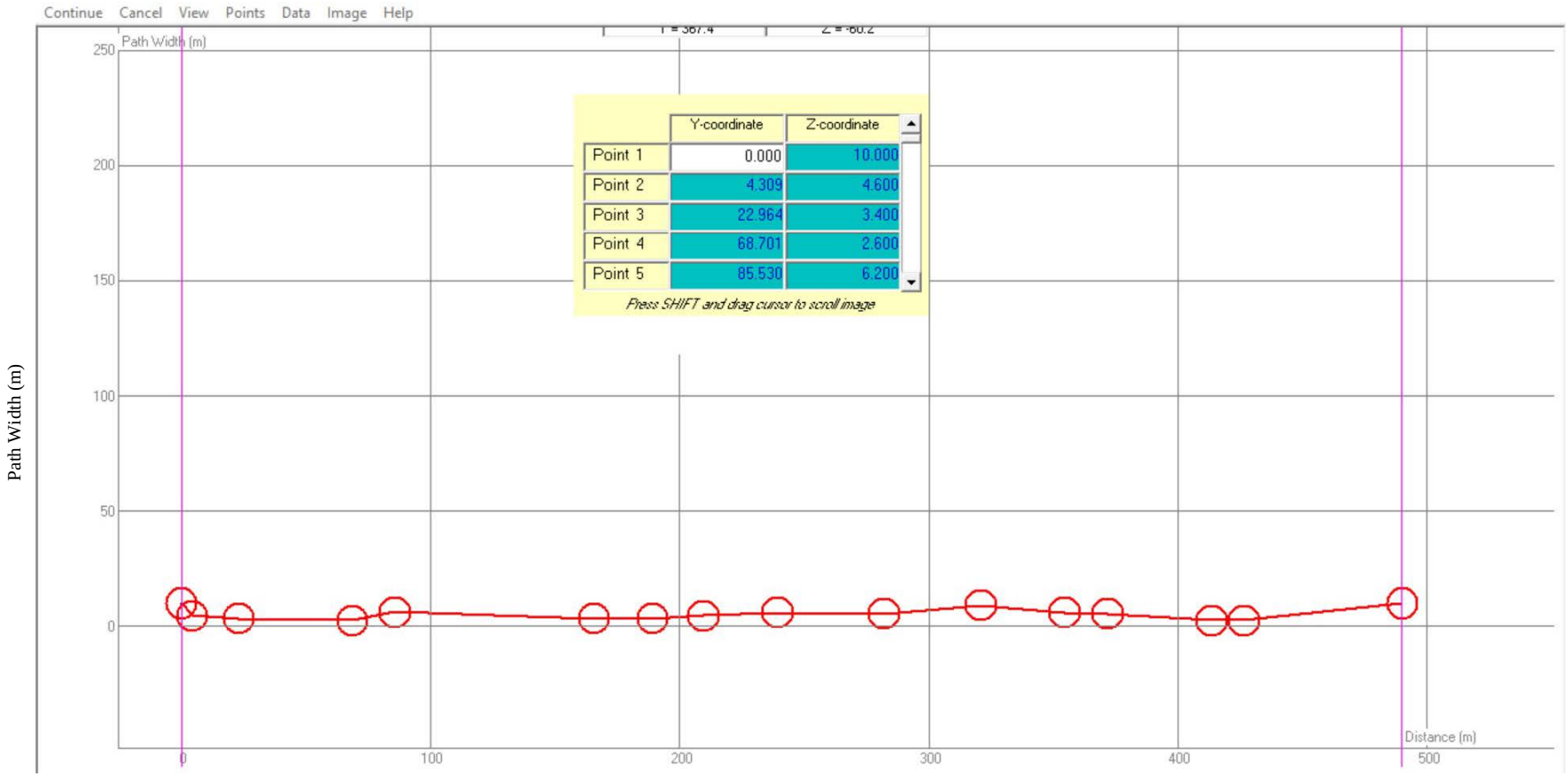
Design Source Volume = 40m^3

Figure D17

Section Profile – (pre-sliding)



Width Profile



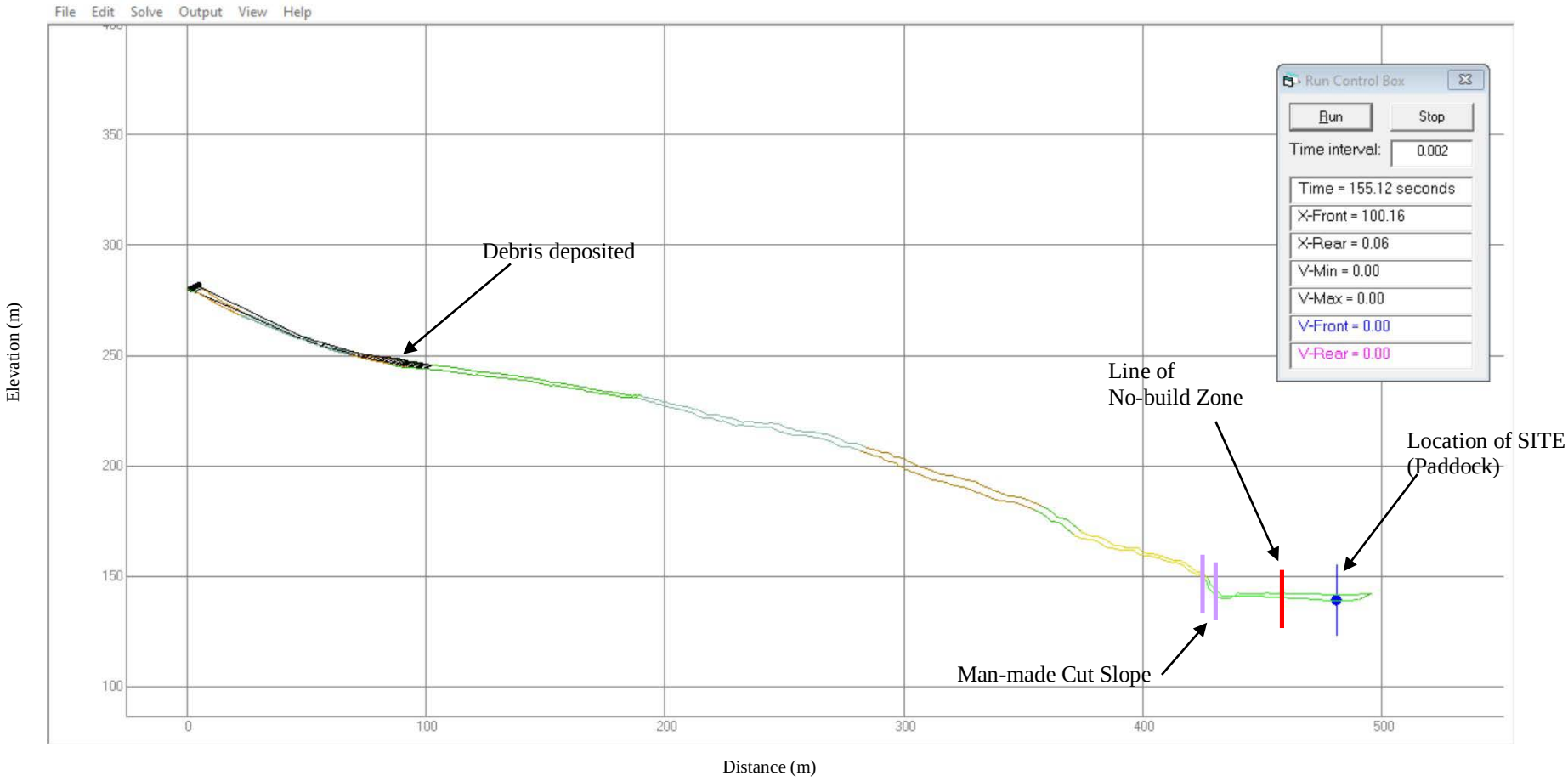
Path Width (m)

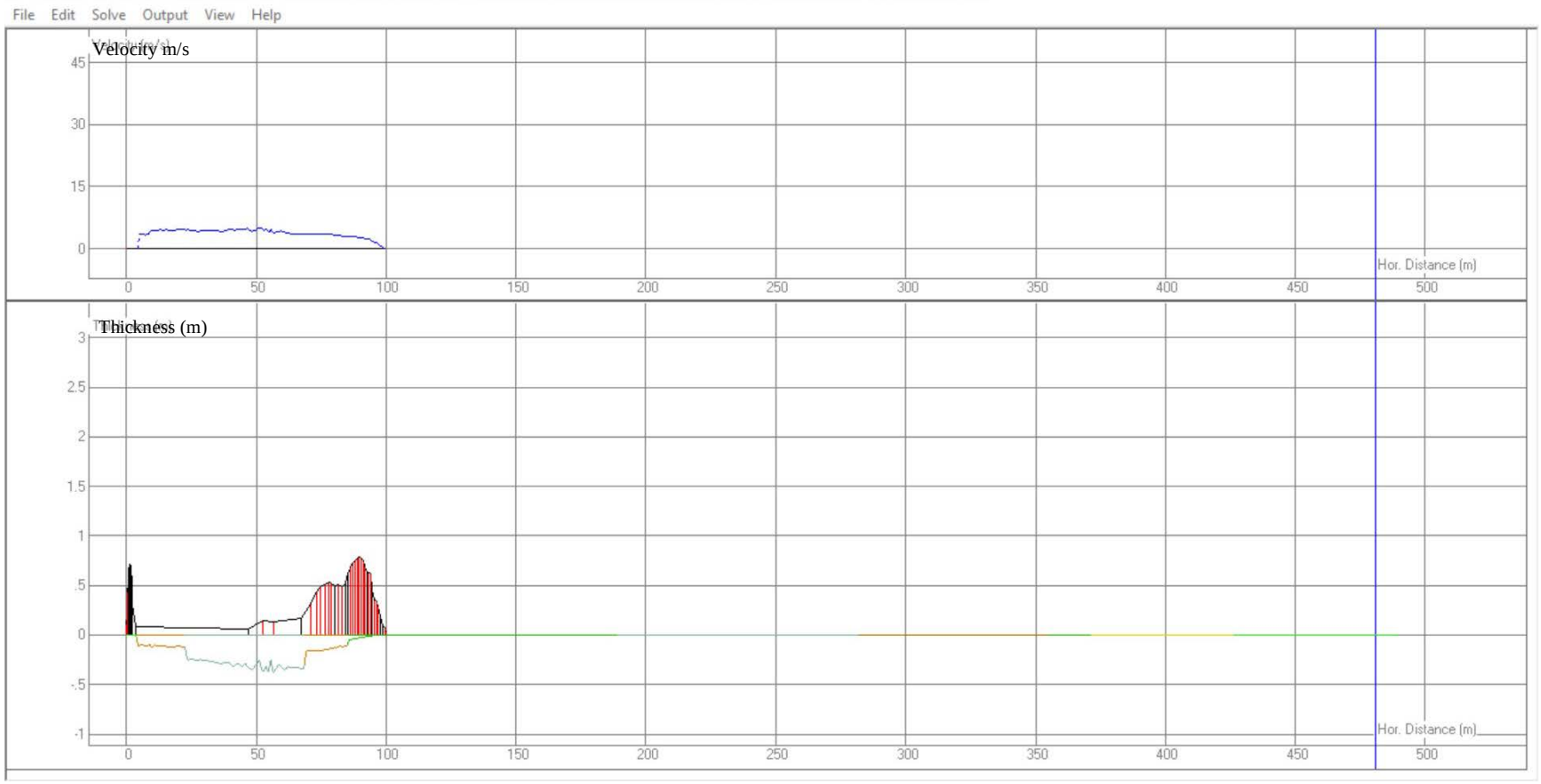
Distance (m)

Result of Debris Mobility Analysis

Source Volume (m^3)	Final Volume (m^3)	Travel Distance (m)	Debris Reached Proposed SITE Facility
40.58	106.83	95.63	No

Section Profile – (post-sliding)




File Edit Solve Output View Help
Velocity m/s
45
30
15
0
0 50 100 150 200 250 300 350 400 450 500
Hor. Distance (m)
Thickness (m)
3
2.5
2
1.5
1
.5
0
-.5
-1
0 50 100 150 200 250 300 350 400 450 500
Hor. Distance (m)

Distance (m)

No of Blocks = 50

Time step = 0.002 seconds

End at time = 0.00 seconds

Configuration = 3-dimensional

Boundary Block Geometry = Normal

Shape factor = 1.00

Maximum velocity = 5.06 at X = 51.48

Maximum front velocity = 5.06 at X =51.48

CENTRE OF GRAVITY: X-Source = 2.07

Z-Source = 279.82

X-Depos. = 71.77

Z-Depos. = 251.63

CG Ratio = 0.40

Travel angle = 22.02

FAHRBOSCHUNG = 20.03

FRONT DISPLACEMENT: X = 100.156 Z = 243.921

Curvilinear Displ.= 103.523

Horiz. Displ. = 95.63

SLIDE VOLUME: Initial = 40.58

Final = 106.83

AREA IN PLAN: Initial = 32.47

Final = 430.02

REAR DISPLACEMENT: X = 0.06 Z = 280.36

Curvilinear Displ.= 0.09

Horiz. Displ. = 0.06

Runout not completed, V-MAX = 0.00

Export Print Close Help

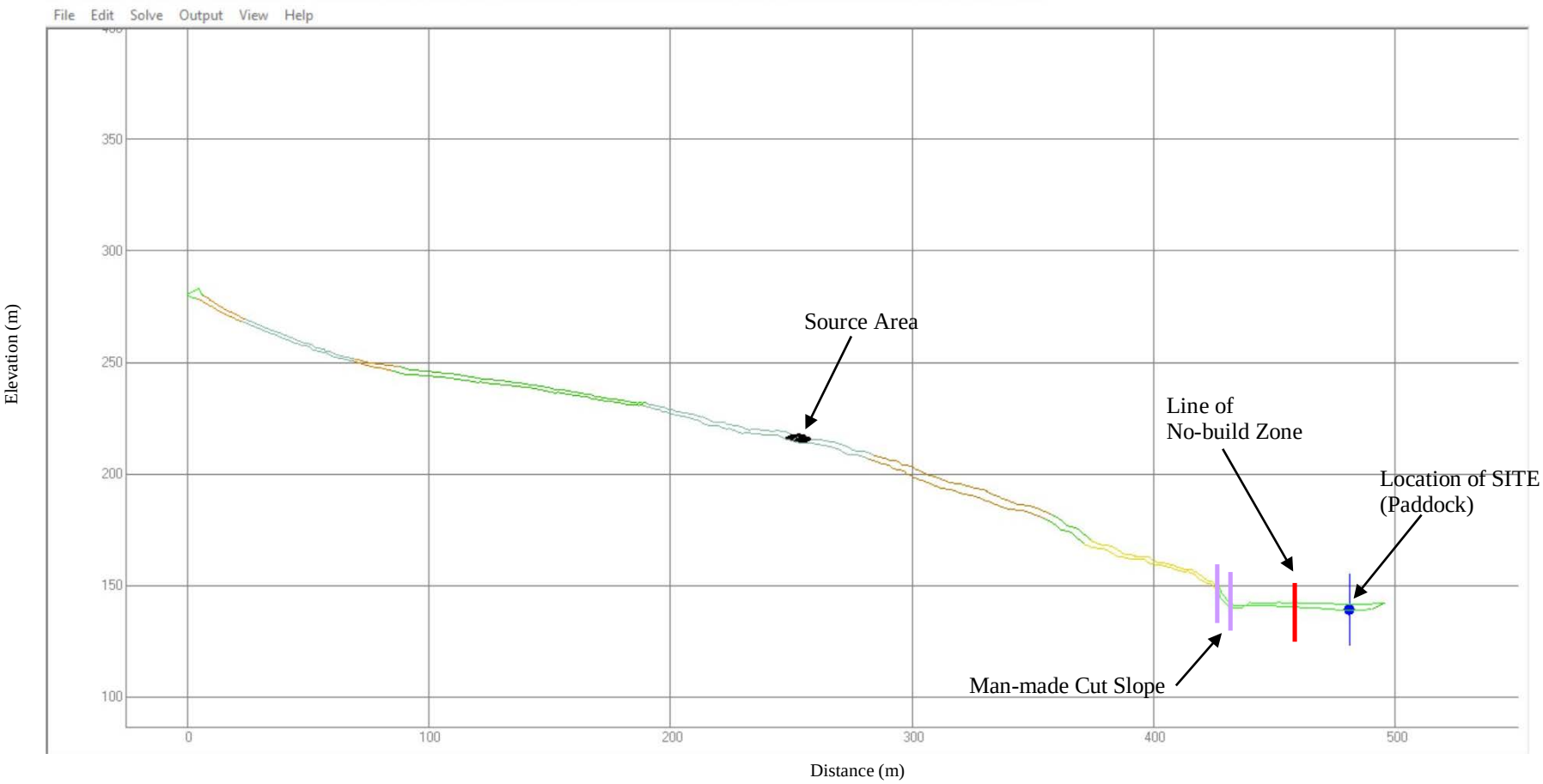
Debris Mobility Analysis for the Credible Runout Path RP10 (Case 2) within Catchment No. CD3

Landslide Type = CDF

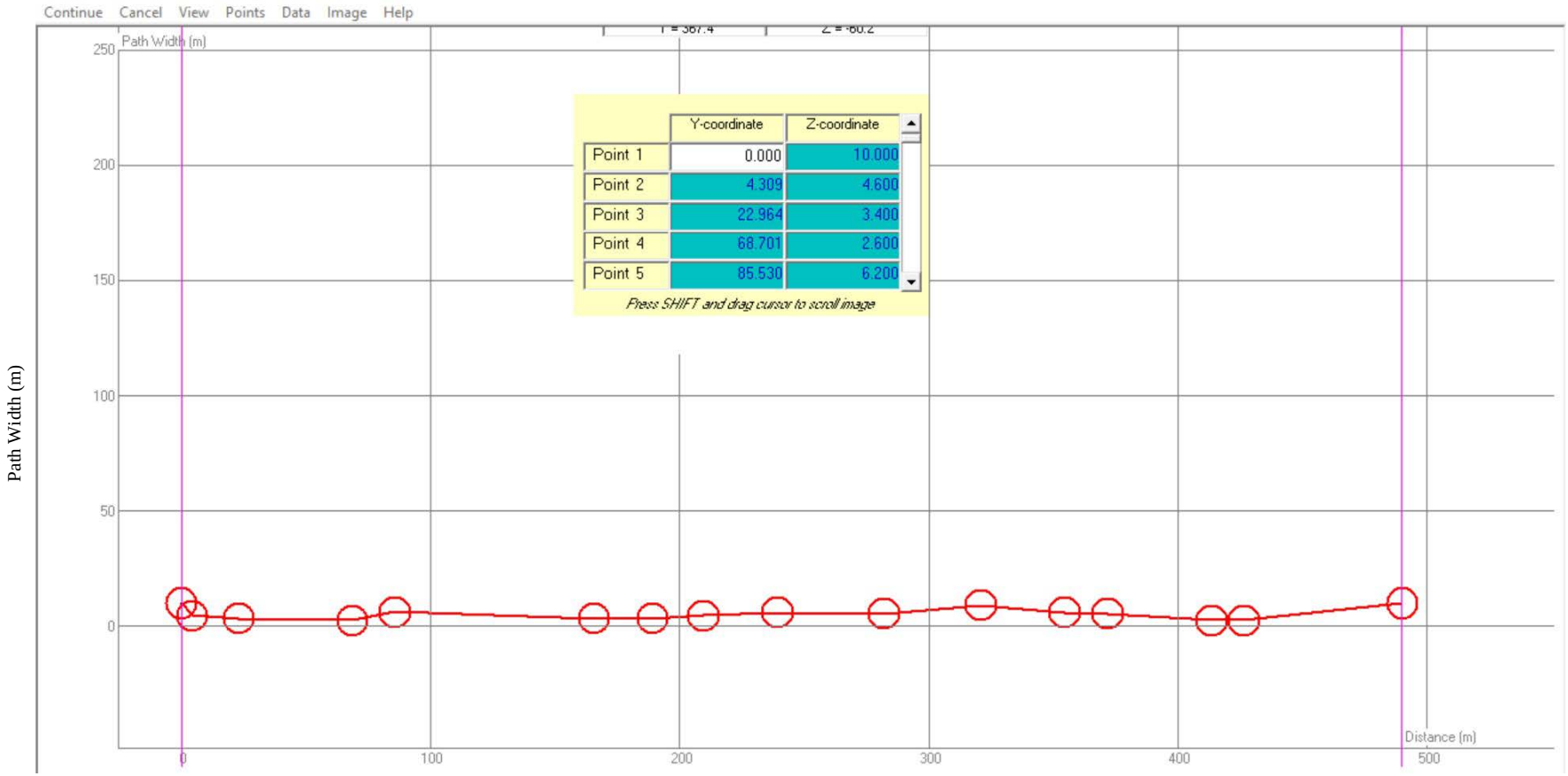
Design Source Volume = 40m^3

Figure D18

Section Profile – (pre-sliding)



Width Profile



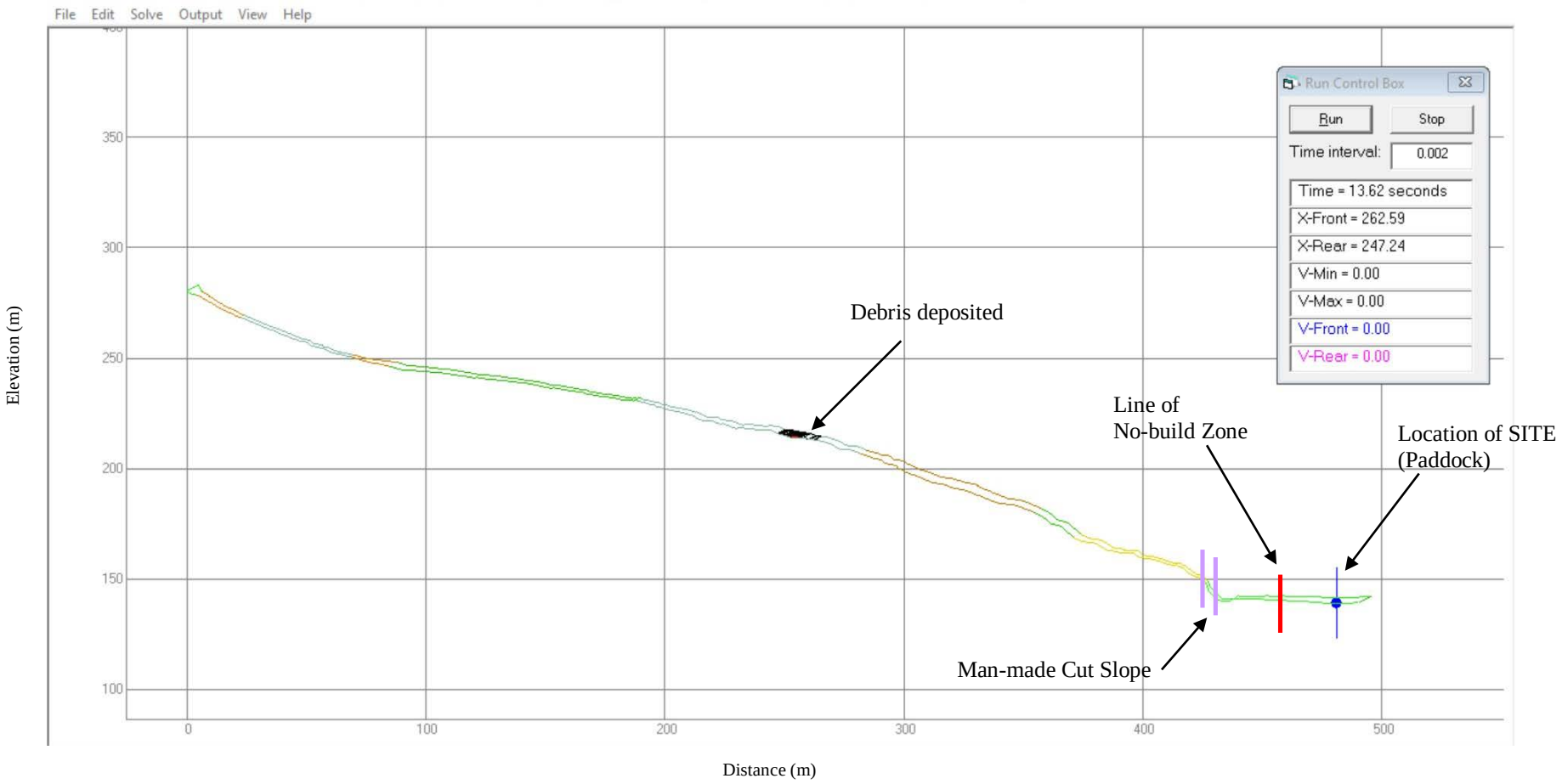
Path Width (m)

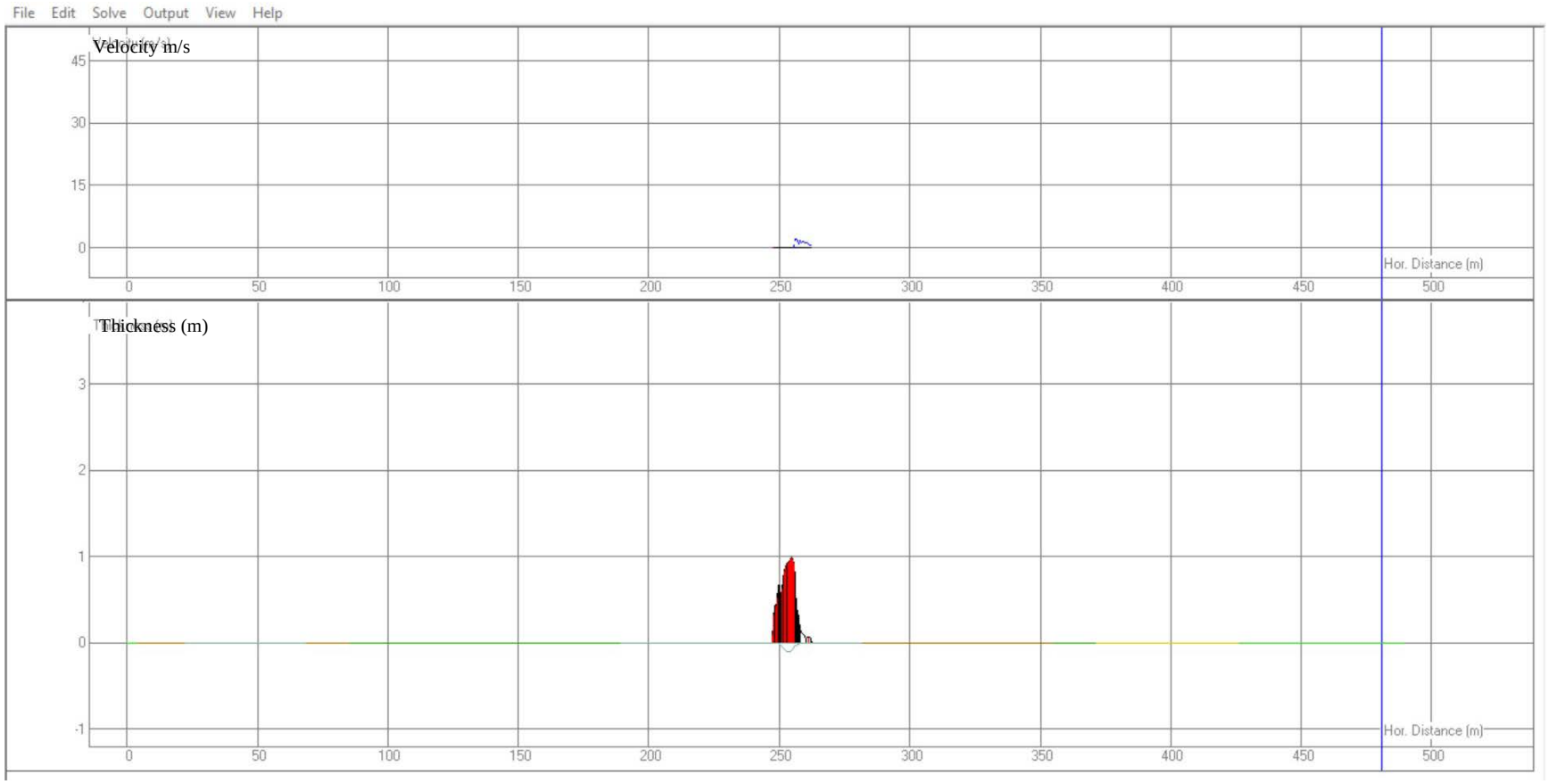
Distance (m)

Result of Debris Mobility Analysis

Source Volume (m^3)	Final Volume (m^3)	Travel Distance (m)	Debris Reached Proposed SITE Facility
40.14	43.68	7.07	No

Section Profile – (post-sliding)




File Edit Solve Output View Help
Velocity m/s
45
30
15
0
0 50 100 150 200 250 300 350 400 450 500
Hor. Distance (m)
Thickness (m)
3
2
1
0
-1
0 50 100 150 200 250 300 350 400 450 500
Hor. Distance (m)

Distance (m)

No of Blocks = 50

Time step = 0.002 seconds

End at time = 0.00 seconds

Configuration = 3-dimensional

Boundary Block Geometry = Normal

Shape factor = 1.00

Maximum velocity = 2.26 at X = 256.58

Maximum front velocity = 2.26 at X =256.58

CENTRE OF GRAVITY: X-Source = 251.59

Z-Source = 215.09

X-Depos. = 253.10

Z-Depos. = 214.71

CG Ratio = 0.25

Travel angle = 14.24

FAHRBOSCHUNG = 10.80

FRONT DISPLACEMENT: X = 262.593 Z = 213.002

Curvilinear Displ.= 7.192

Horiz. Displ. = 7.07

REAR DISPLACEMENT: X = 247.24 Z = 215.93

Curvilinear Displ.= 0.00

Horiz. Displ. = 0.00

SLIDE VOLUME: Initial = 40.14

Final = 43.68

AREA IN PLAN: Initial = 49.11

Final = 90.27

Runout time = 9.00

Export Print Close Help

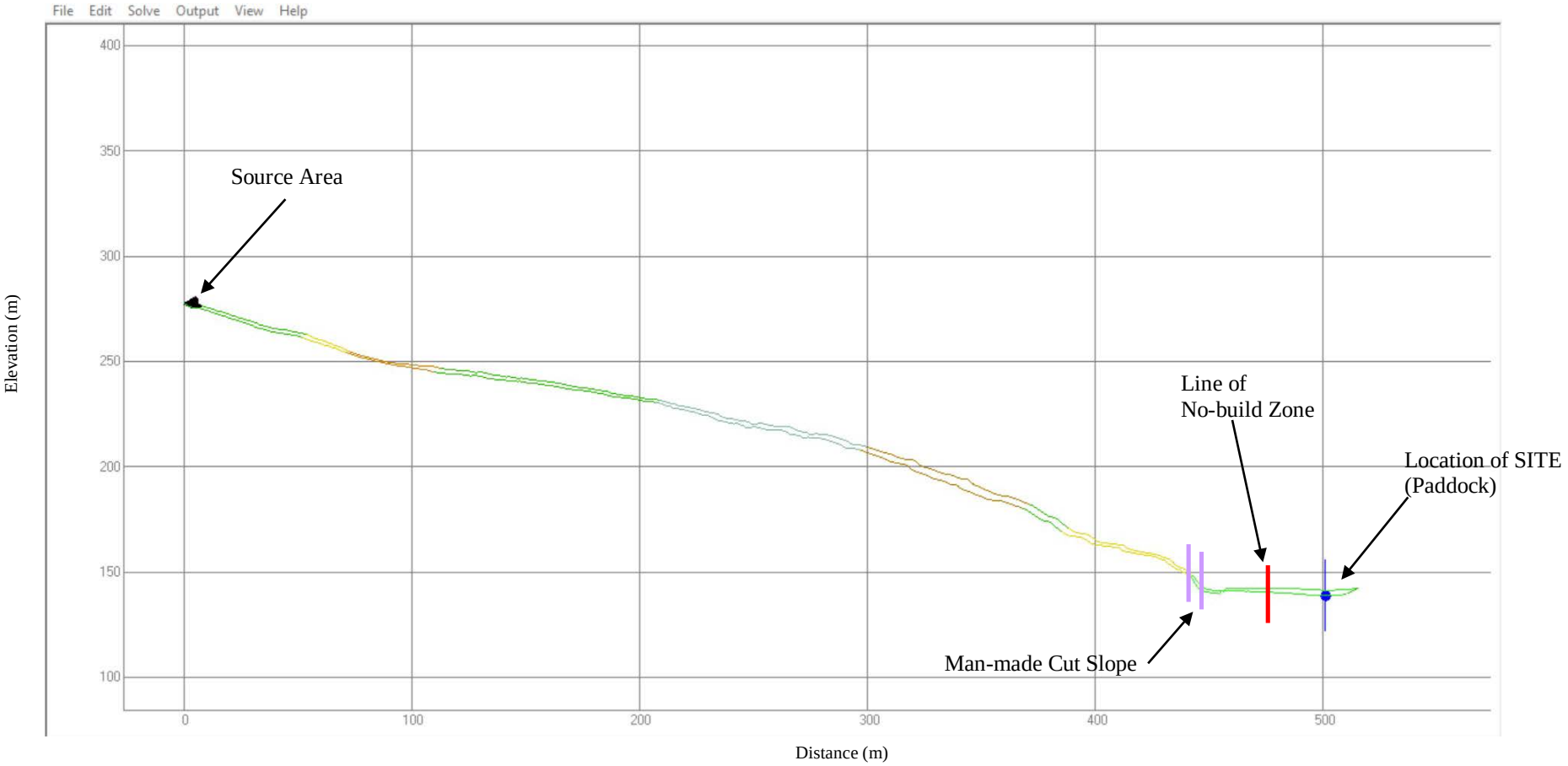
Debris Mobility Analysis for the Credible Runout Path RP11 (Case 1) within Catchment No. CD3

Landslide Type = CDF

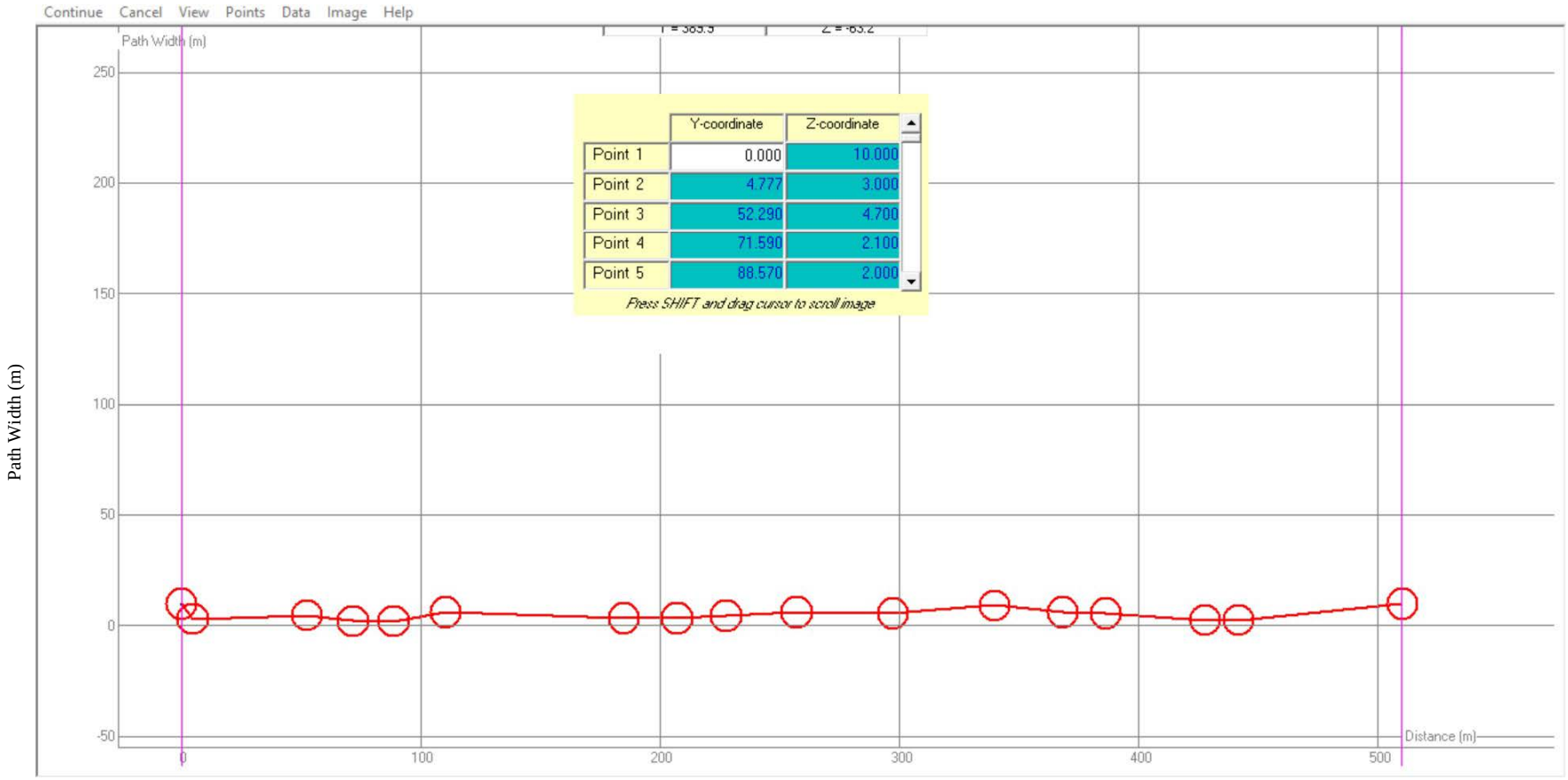
Design Source Volume = 40m^3

Figure D19

Section Profile – (pre-sliding)



Width Profile



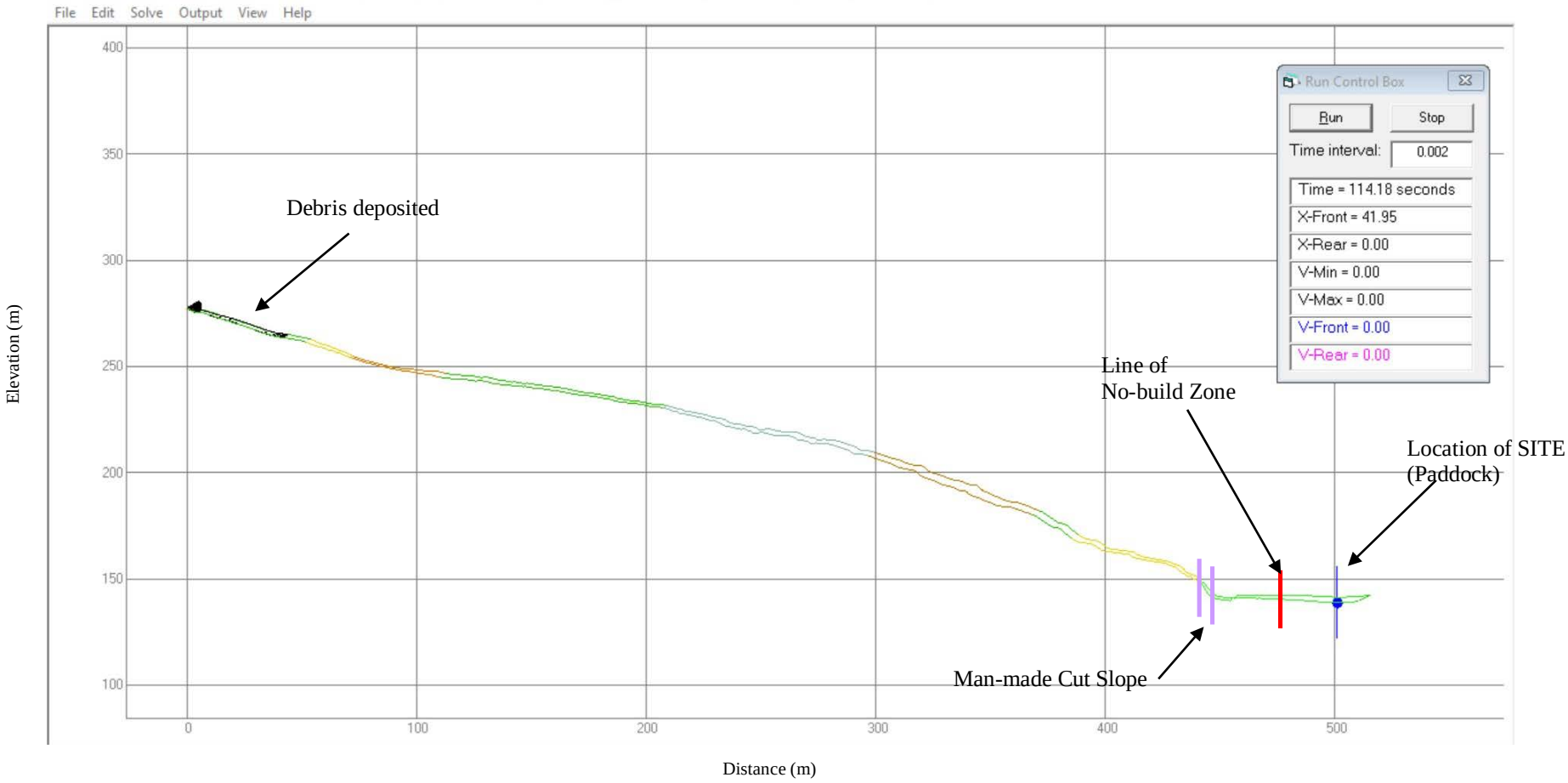
Path Width (m)

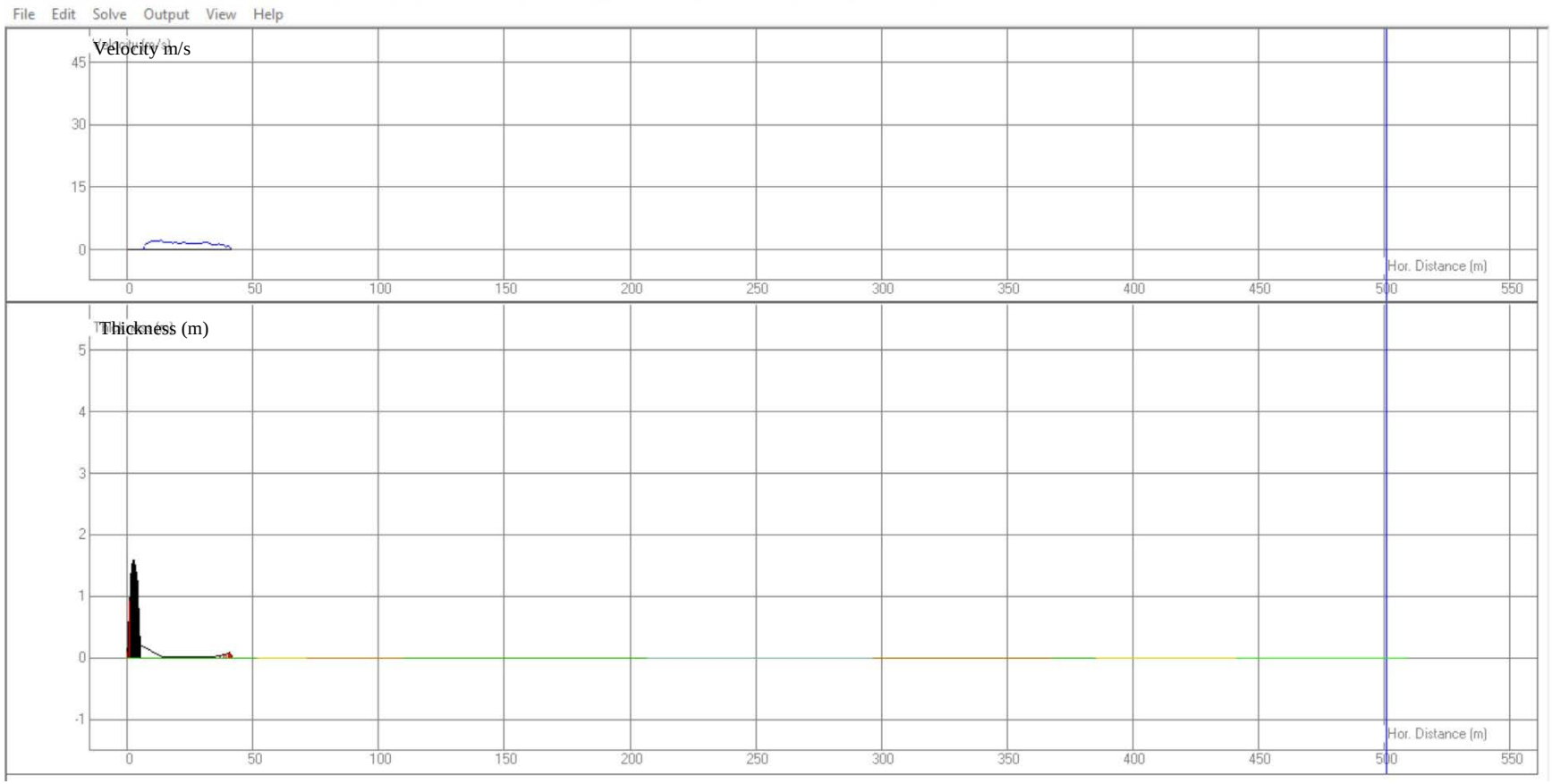
Distance (m)

Result of Debris Mobility Analysis

Source Volume (m^3)	Final Volume (m^3)	Travel Distance (m)	Debris Reached Proposed SITE Facility
40.50	41.00	35.35	No

Section Profile – (post-sliding)




File Edit Solve Output View Help
Velocity m/s
45
30
15
0
Hor. Distance (m)
0 50 100 150 200 250 300 350 400 450 500 550
Thickness (m)
5
4
3
2
1
0
-1
Hor. Distance (m)
0 50 100 150 200 250 300 350 400 450 500 550

Distance (m)

No of Blocks = 50

Time step = 0.002 seconds

End at time = 0.00 seconds

Configuration = 3-dimensional

Boundary Block Geometry = Normal

Shape factor = 1.00

Maximum velocity = 2.26 at X = 13.05

Maximum front velocity = 2.26 at X =13.41

CENTRE OF GRAVITY: X-Source = 2.64

Z-Source = 276.73

X-Depos. = 4.20

Z-Depos. = 276.19

CG Ratio = 0.35

Travel angle = 19.32

FAHRBOSCHUNG = 18.40

FRONT DISPLACEMENT: X = 41.953 Z = 263.732

Curvilinear Displ.= 37.459

Horiz. Displ. = 35.35

REAR DISPLACEMENT: X = 0.00 Z = 277.69

Curvilinear Displ.= 0.01

Horiz. Displ. = 0.00

SLIDE VOLUME: Initial = 40.50

Final = 41.00

AREA IN PLAN: Initial = 36.59

Final = 167.27

Runout not completed, V-MAX = 0.00

Export Print Close Help

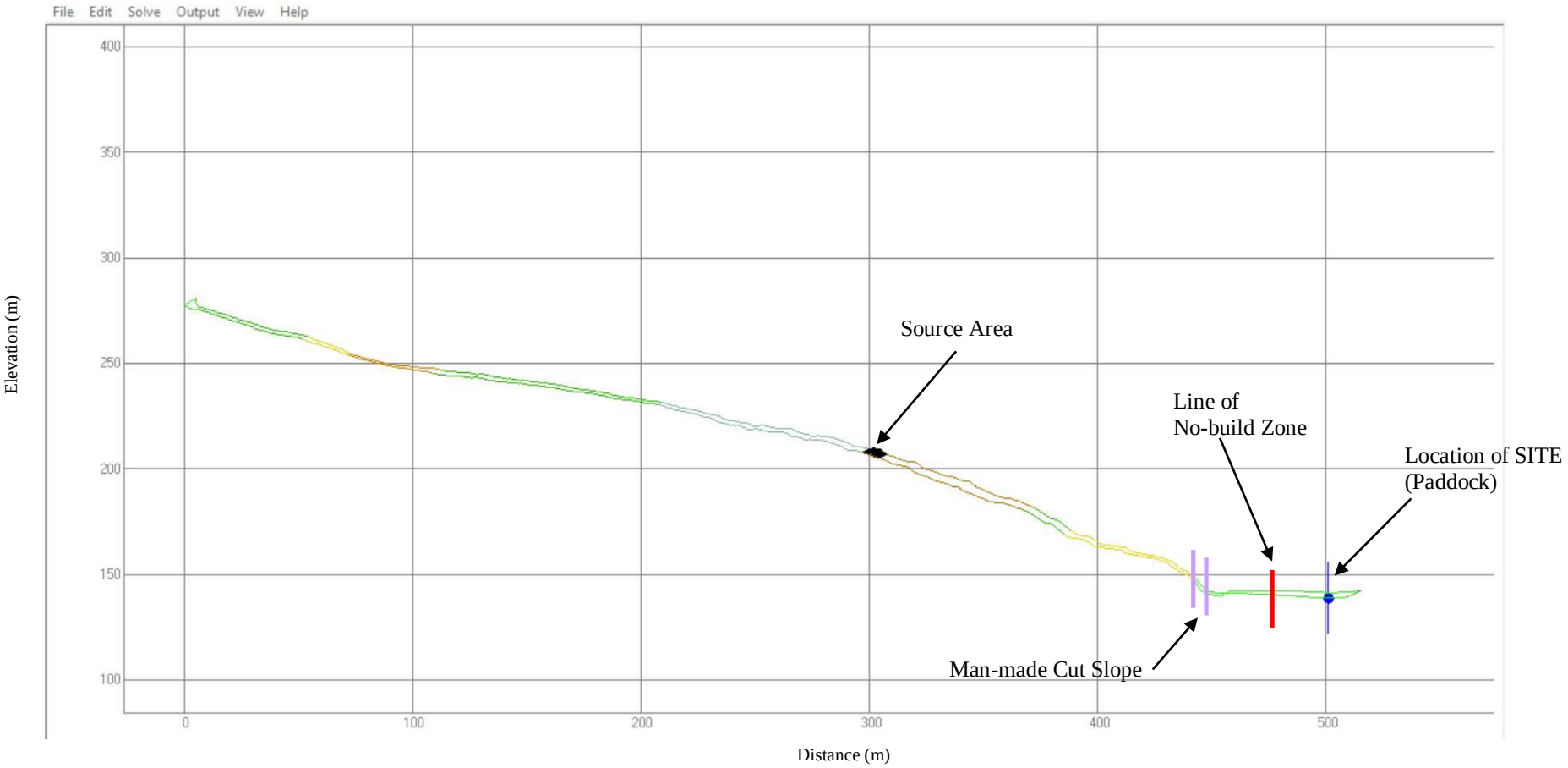
Debris Mobility Analysis for the Credible Runout Path RP11 (Case 2) within Catchment No. CD3

Landslide Type = CDF

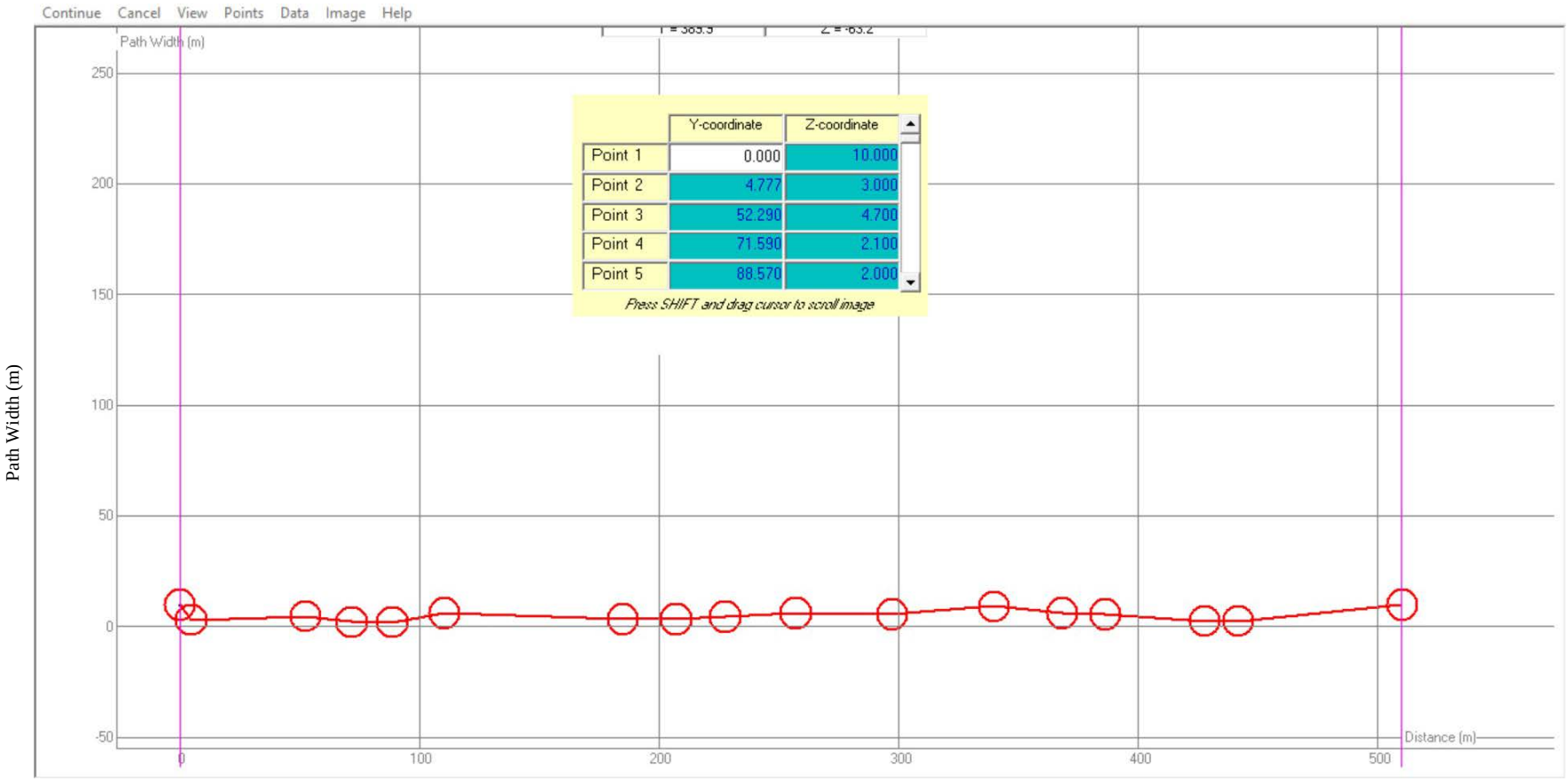
Design Source Volume = 40m^3

Figure D20

Section Profile – (pre-sliding)



Width Profile



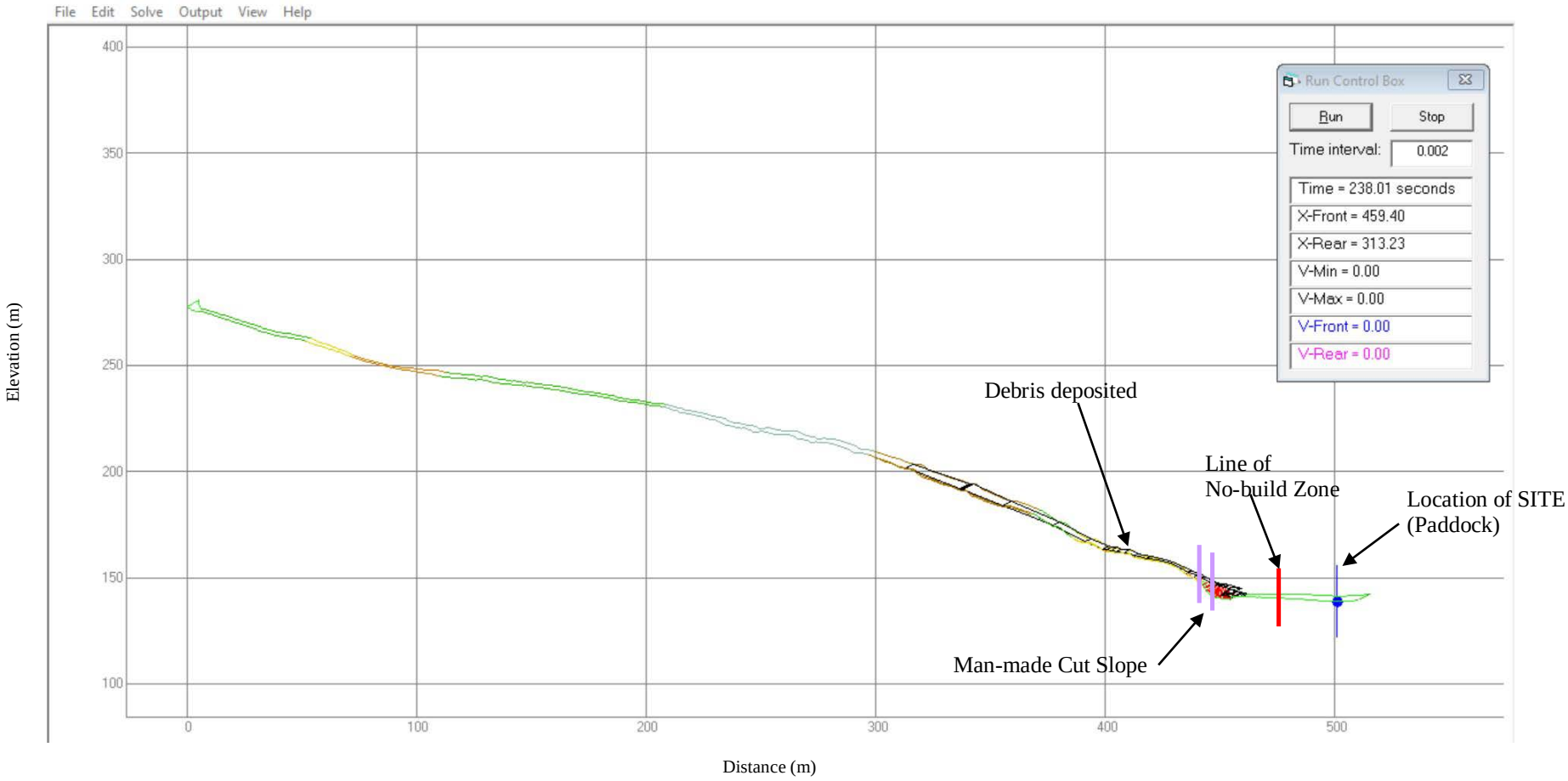
Path Width (m)

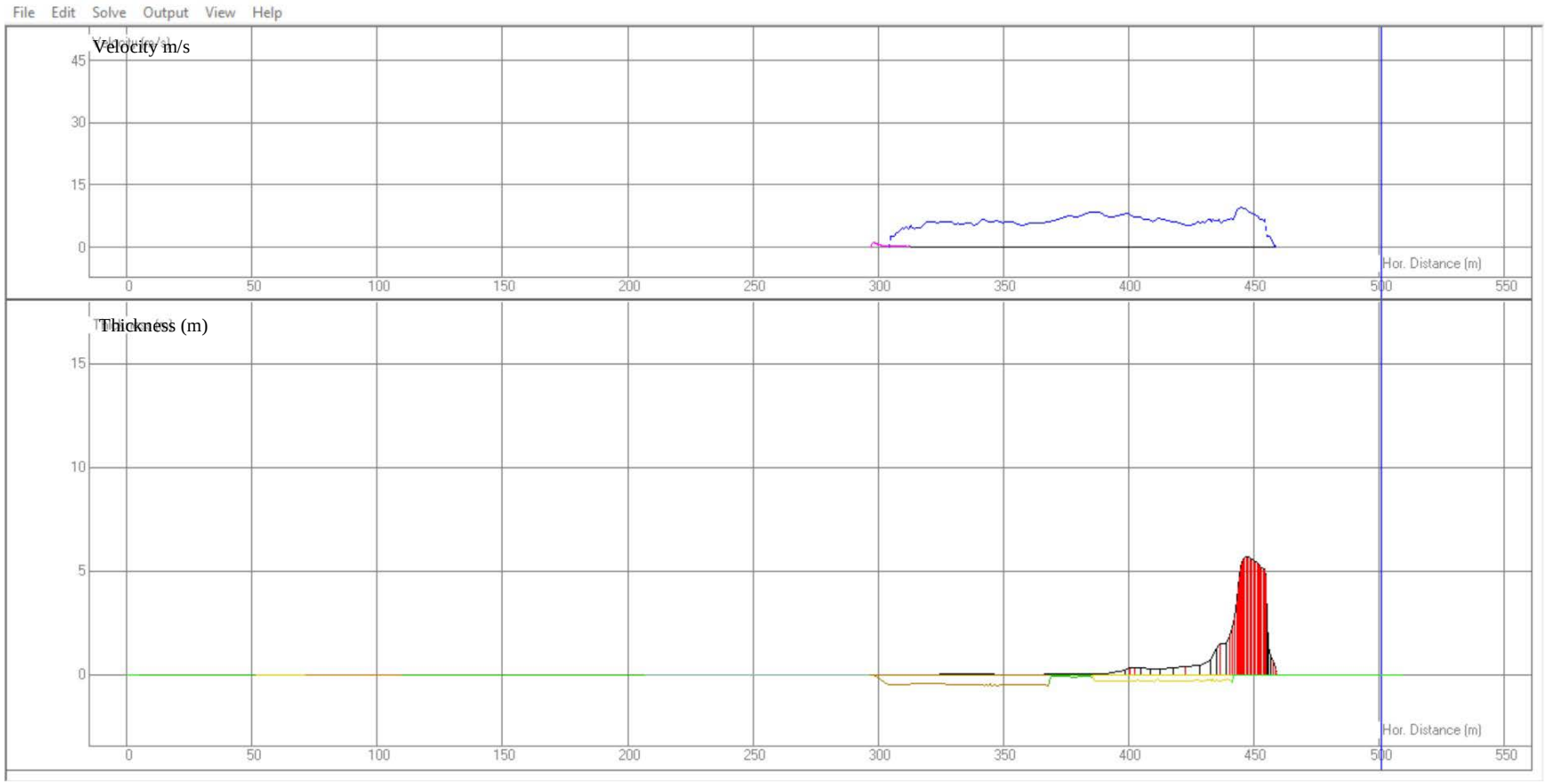
Distance (m)

Result of Debris Mobility Analysis

Source Volume (m^3)	Final Volume (m^3)	Travel Distance (m)	Debris Reached Proposed SITE Facility
40.10	382.83	154.81	No

Section Profile – (post-sliding)




File Edit Solve Output View Help
Velocity m/s
45
30
15
0
0 50 100 150 200 250 300 350 400 450 500 550
Hor. Distance (m)
Thickness (m)
15
10
5
0
0 50 100 150 200 250 300 350 400 450 500 550
Hor. Distance (m)

Distance (m)

No of Blocks = 50

Time step = 0.002 seconds

End at time = 0.00 seconds

Configuration = 3-dimensional

Boundary Block Geometry = Normal

Shape factor = 1.00

Maximum velocity = 9.57 at X = 445.08

Maximum front velocity = 9.57 at X =445.08

CENTRE OF GRAVITY: X-Source = 301.00

Z-Source = 206.85

X-Depos. = 443.46

Z-Depos. = 146.67

CG Ratio = 0.42

Travel angle = 22.90

FAHRBOSCHUNG = 22.37

FRONT DISPLACEMENT: X = 459.400 Z = 140.976

Curvilinear Displ.= 174.623

Horiz. Displ. = 154.81

REAR DISPLACEMENT: X = 313.23 Z = 201.66

Curvilinear Displ.= 17.20

Horiz. Displ. = 16.02

SLIDE VOLUME: Initial = 40.10

Final = 382.83

AREA IN PLAN: Initial = 42.97

Final = 798.64

Runout not completed, V-MAX = 0.00

Export Print Close Help

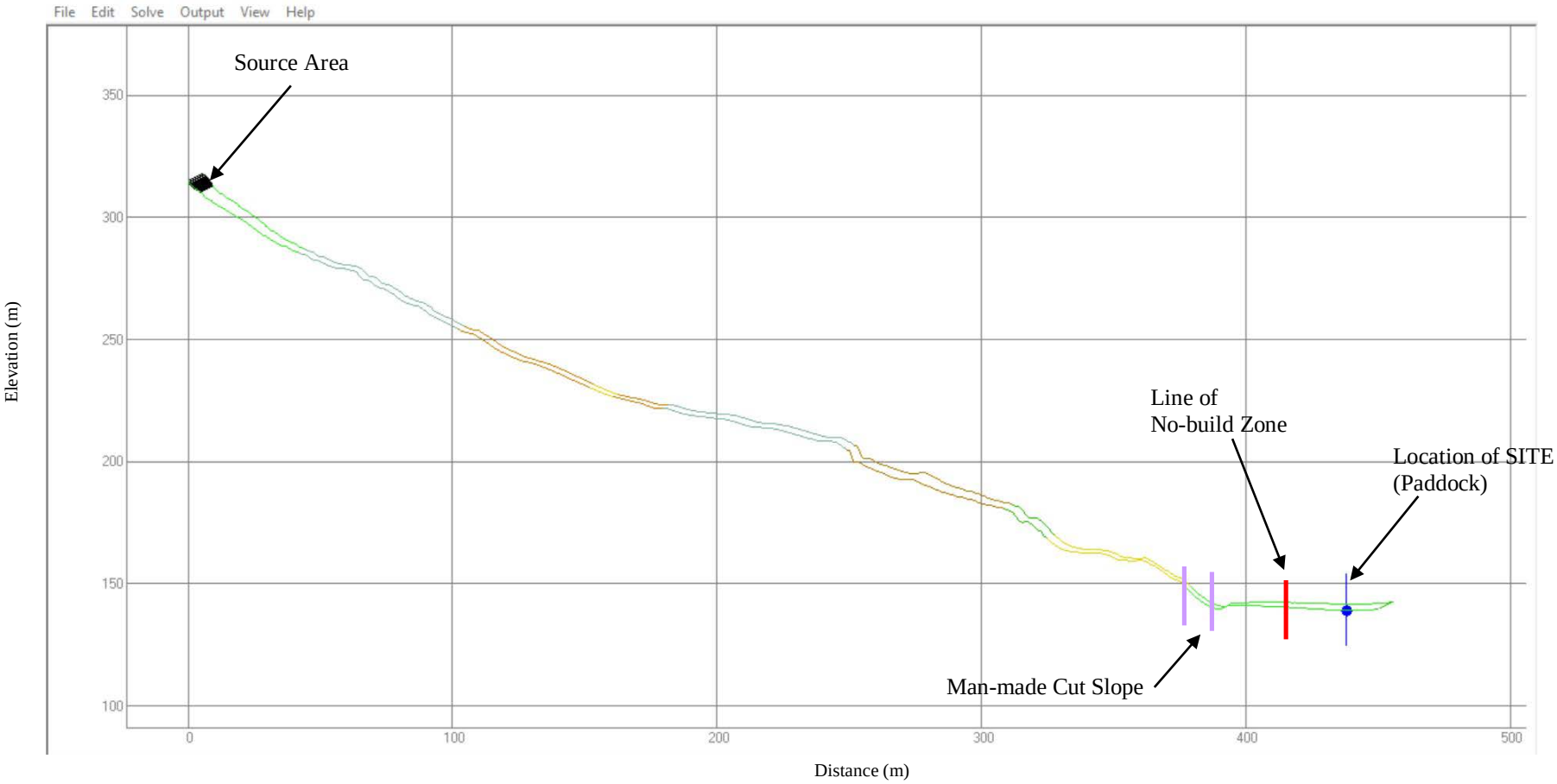
Debris Mobility Analysis for the Credible Runout Path RP12 (Case 1) within Catchment No. CD3

Landslide Type = CDF

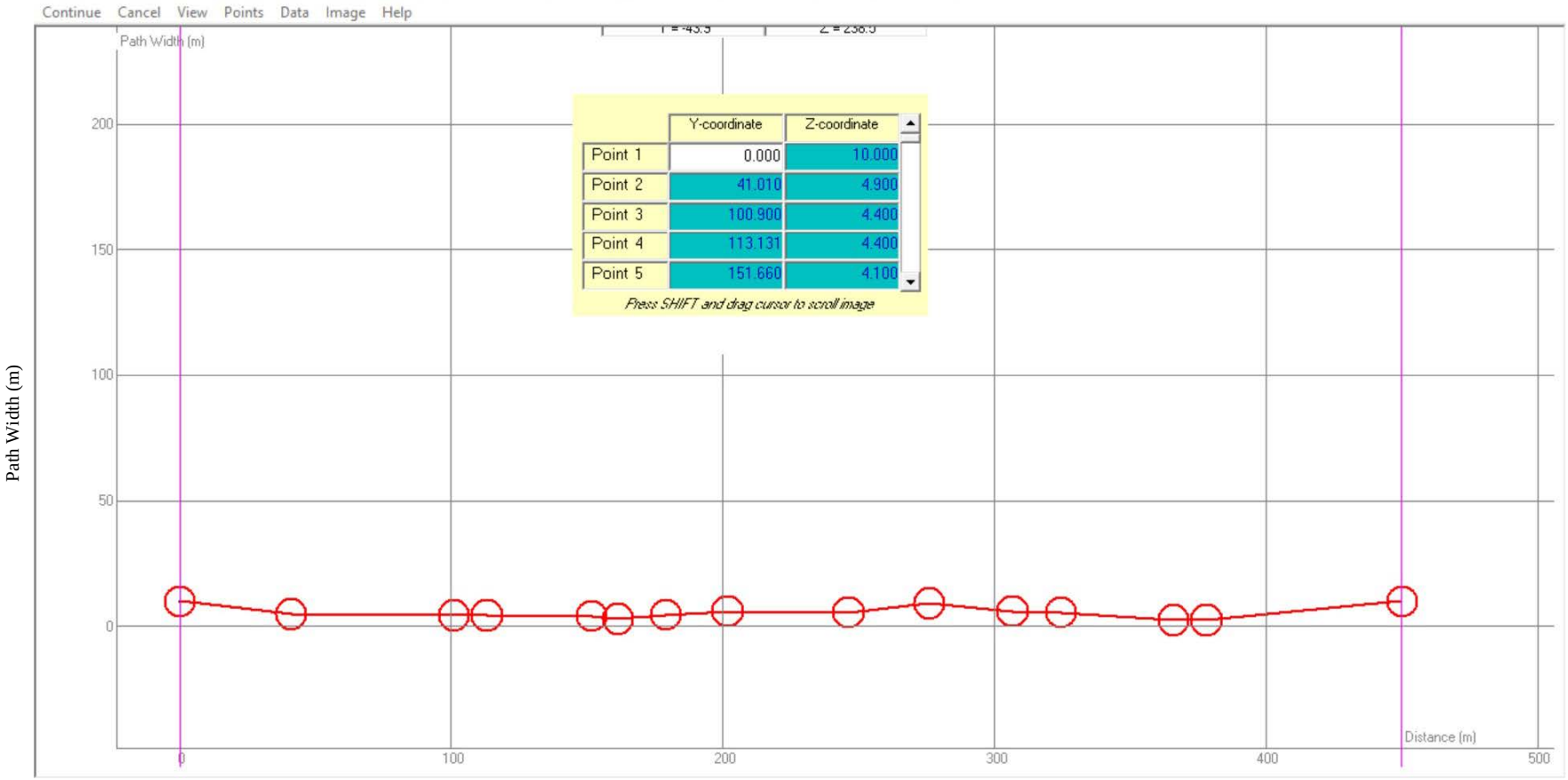
Design Source Volume = 40m^3

Figure D21

Section Profile – (pre-sliding)



Width Profile



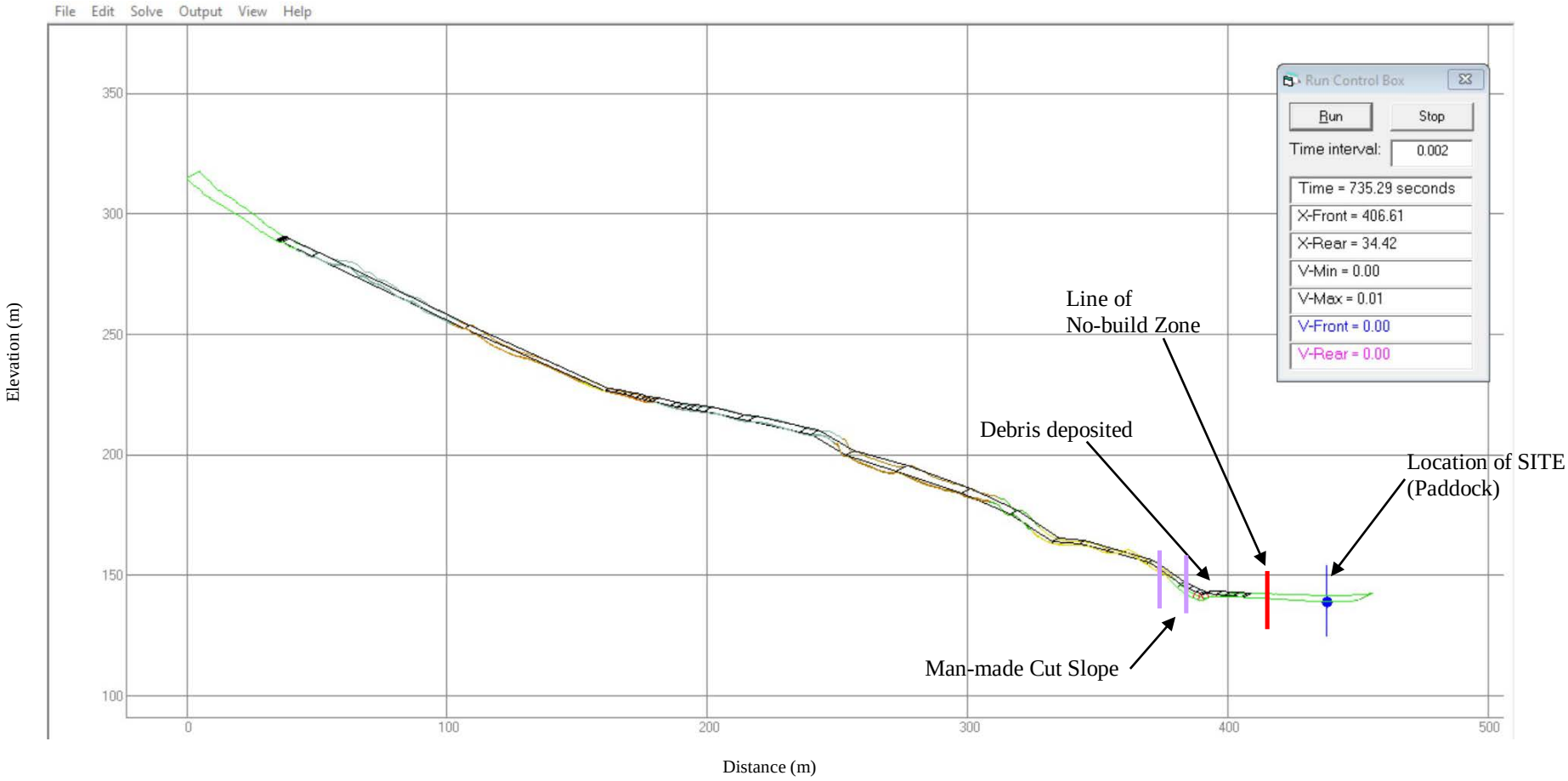
Path Width (m)

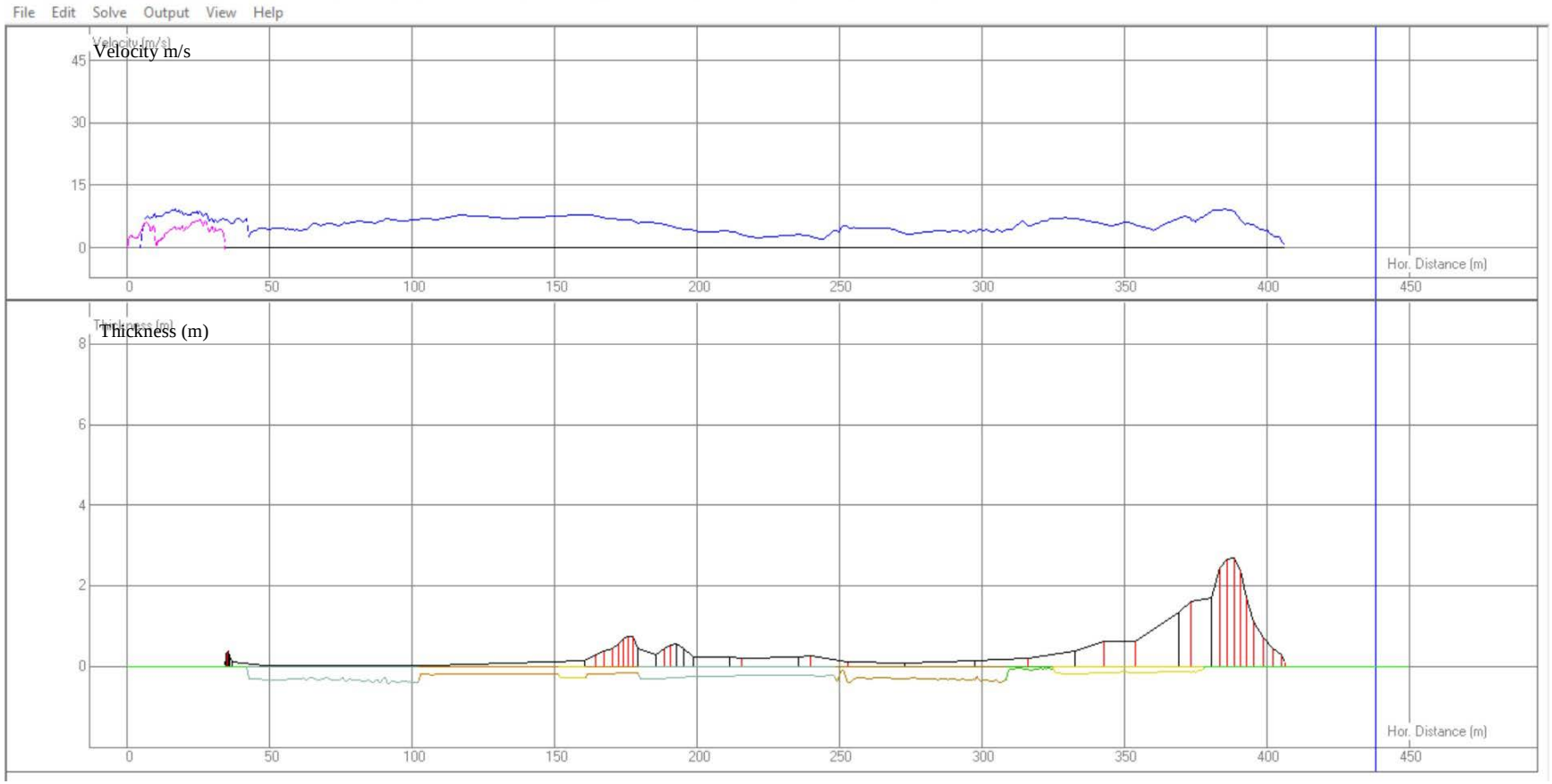
Distance (m)

Result of Debris Mobility Analysis

Source Volume (m^3)	Final Volume (m^3)	Travel Distance (m)	Debris Reached Proposed SITE Facility
40.07	517.11	402.06	No

Section Profile – (post-sliding)




File Edit Solve Output View Help
Velocity m/s
45
30
15
0
0 50 100 150 200 250 300 350 400 450
Hor. Distance (m)
Thickness (m)
8
6
4
2
0
0 50 100 150 200 250 300 350 400 450
Hor. Distance (m)

Distance (m)

No of Blocks = 50

Time step = 0.002 seconds

End at time = 0.00 seconds

Configuration = 3-dimensional

Boundary Block Geometry = Normal

Shape factor = 1.00

Maximum velocity = 9.40 at X = 16.87

Maximum front velocity = 9.40 at X =16.87

CENTRE OF GRAVITY: X-Source = 2.11

Z-Source = 312.96

X-Depos. = 315.92

Z-Depos. = 172.75

CG Ratio = 0.45

Travel angle = 24.08

FAHRBOSCHUNG = 23.18

FRONT DISPLACEMENT: X = 406.615 Z = 140.815

Curvilinear Displ.= 451.662

Horiz. Displ. = 402.06

REAR DISPLACEMENT: X = 34.42 Z = 288.96

Curvilinear Displ.= 43.77

Horiz. Displ. = 34.42

SLIDE VOLUME: Initial = 40.07

Final = 517.11

AREA IN PLAN: Initial = 44.23

Final = 1860.88

Runout not completed, V-MAX = 0.01

Export Print Close Help

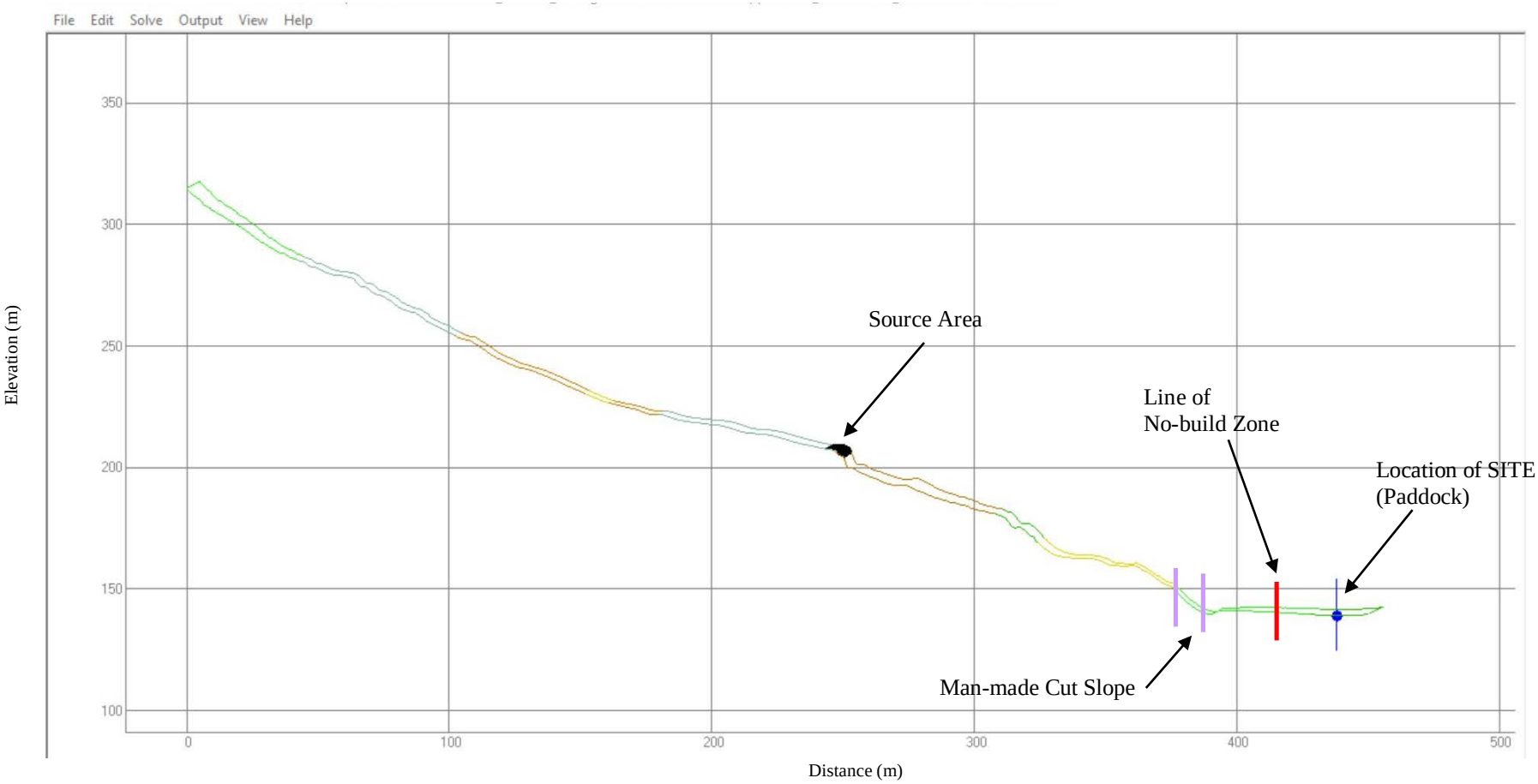
Debris Mobility Analysis for the Credible Runout Path RP12 (Case 2) within Catchment No. CD3

Landslide Type = CDF

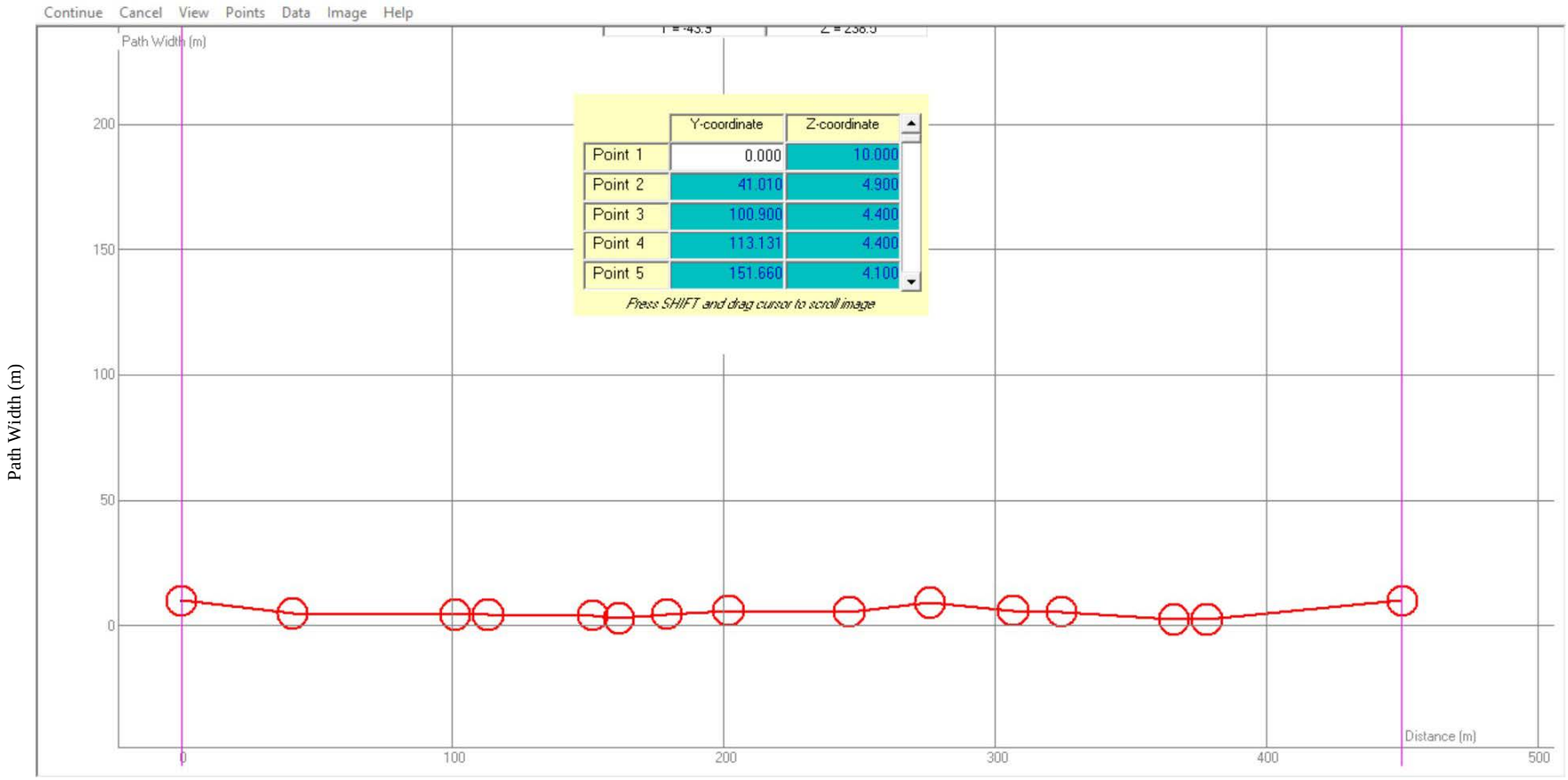
Design Source Volume = 40m^3

Figure D22

Section Profile – (pre-sliding)



Width Profile



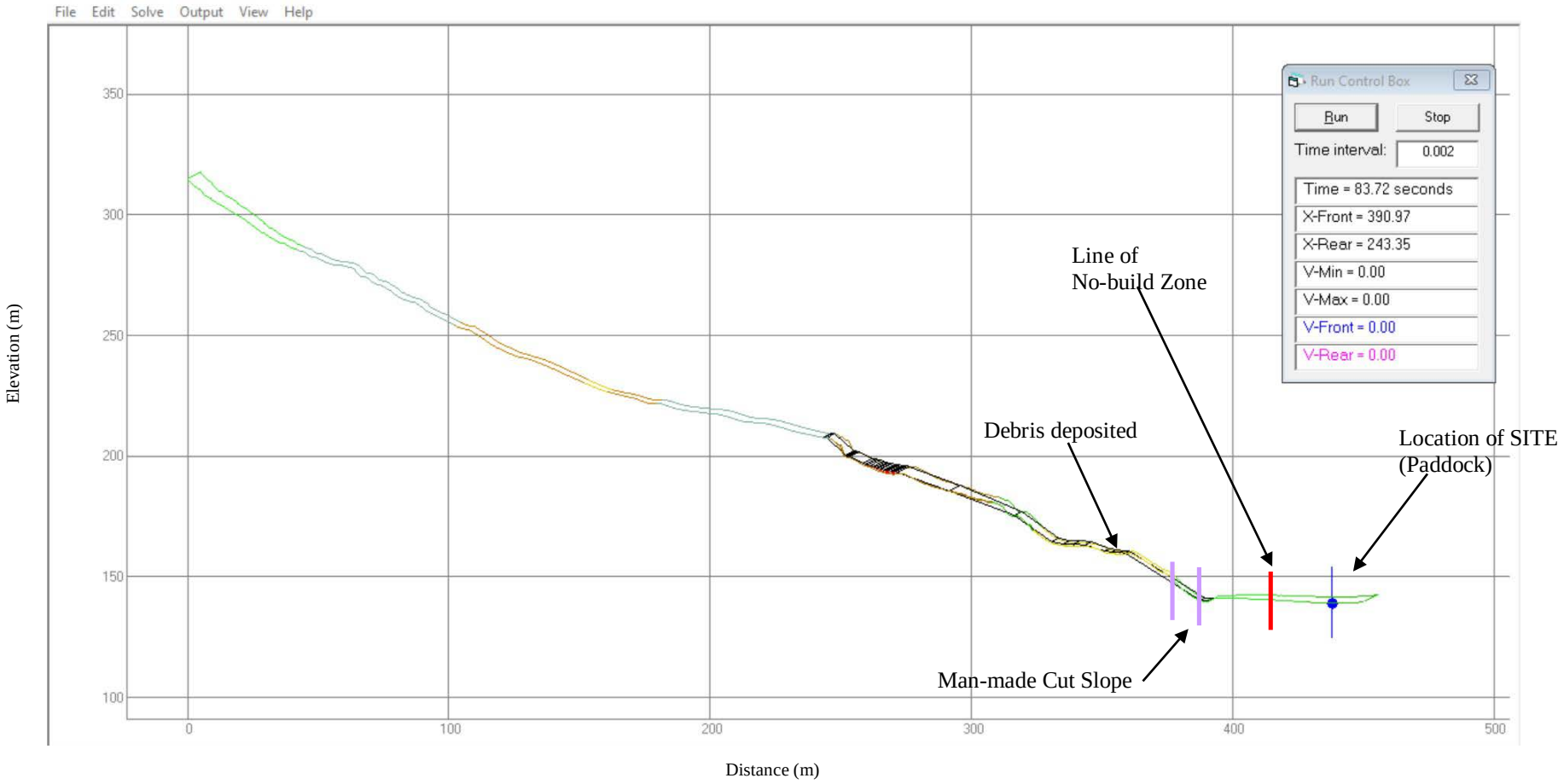
Path Width (m)

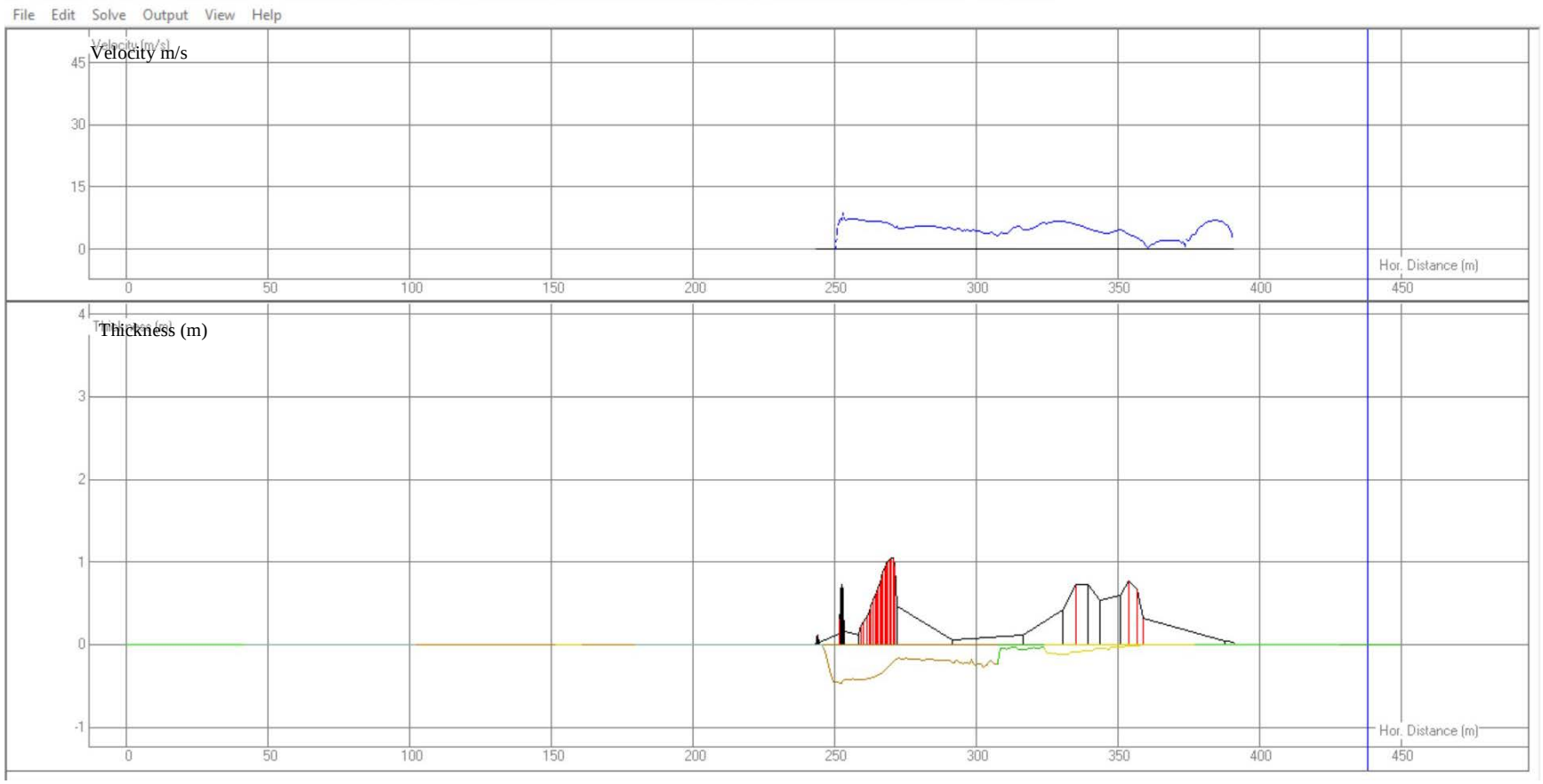
Distance (m)

Result of Debris Mobility Analysis

Source Volume (m^3)	Final Volume (m^3)	Travel Distance (m)	Debris Reached Proposed SITE Facility
40.34	196.99	140.64	No

Section Profile – (post-sliding)




File Edit Solve Output View Help
Velocity m/s
45
30
15
0
0 50 100 150 200 250 300 350 400 450
Hor. Distance (m)
Thickness (m)
4
3
2
1
0
-1
0 50 100 150 200 250 300 350 400 450
Hor. Distance (m)

Distance (m)

No of Blocks = 50

Time step = 0.002 seconds

End at time = 0.00 seconds

Configuration = 3-dimensional

Boundary Block Geometry = Normal

Shape factor = 1.00

Maximum velocity = 9.07 at X = 252.90

Maximum front velocity = 9.07 at X =252.90

CENTRE OF GRAVITY: X-Source = 248.01

Z-Source = 206.54

X-Depos. = 304.47

Z-Depos. = 178.54

CG Ratio = 0.50

Travel angle = 26.37

FAHRBOSCHUNG = 24.68

FRONT DISPLACEMENT: X = 390.970 Z = 139.886

Curvilinear Displ.= 162.243

Horiz. Displ. = 140.64

REAR DISPLACEMENT: X = 243.35 Z = 207.72

Curvilinear Displ.= 0.00

Horiz. Displ. = 0.00

SLIDE VOLUME: Initial = 40.34

Final = 196.99

AREA IN PLAN: Initial = 39.55

Final = 821.95

Runout not completed, V-MAX = 0.00

Export Print Close Help

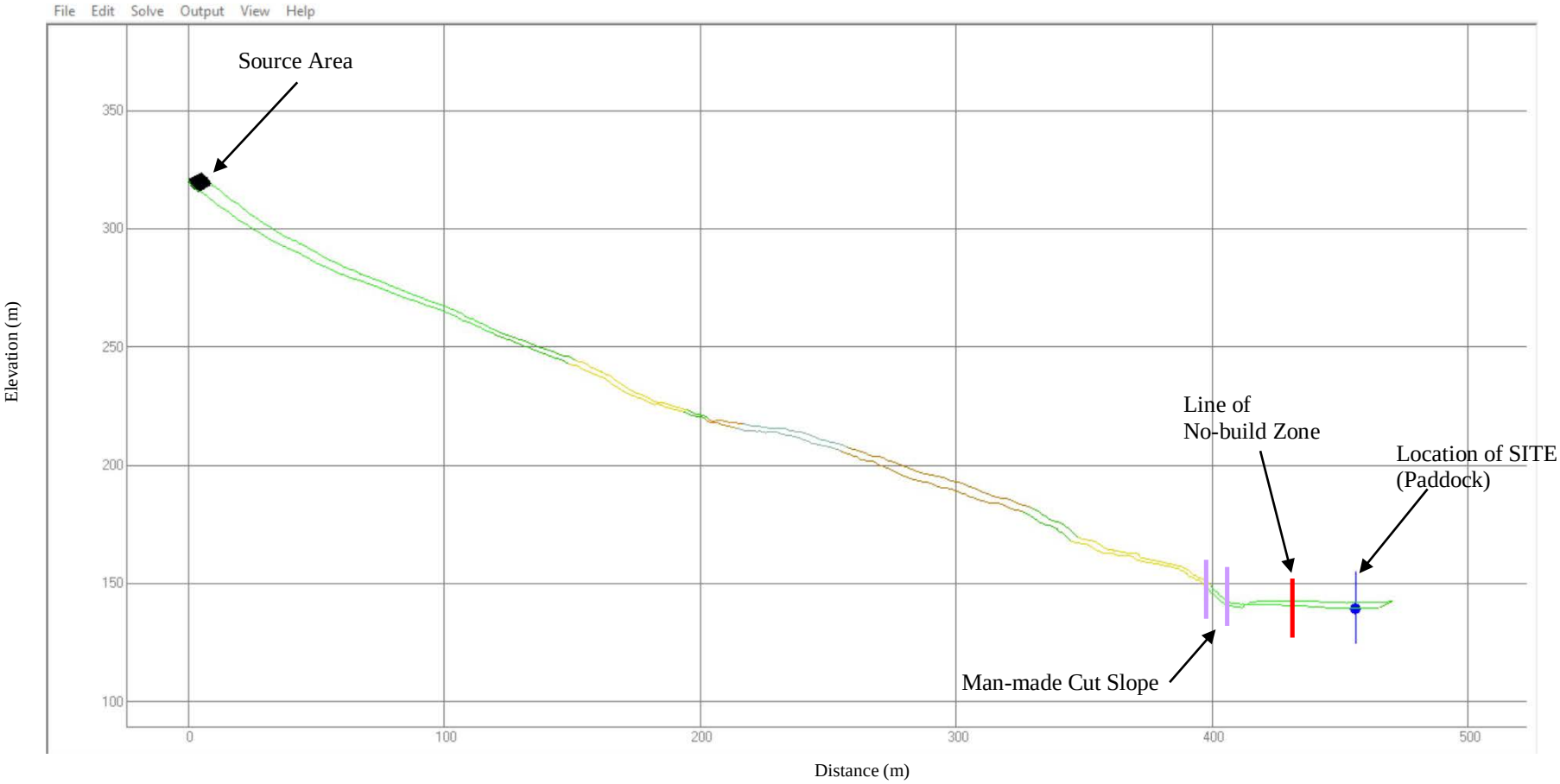
Debris Mobility Analysis for the Credible Runout Path RP13 (Case 1) within Catchment No. CD3

Landslide Type = CDF

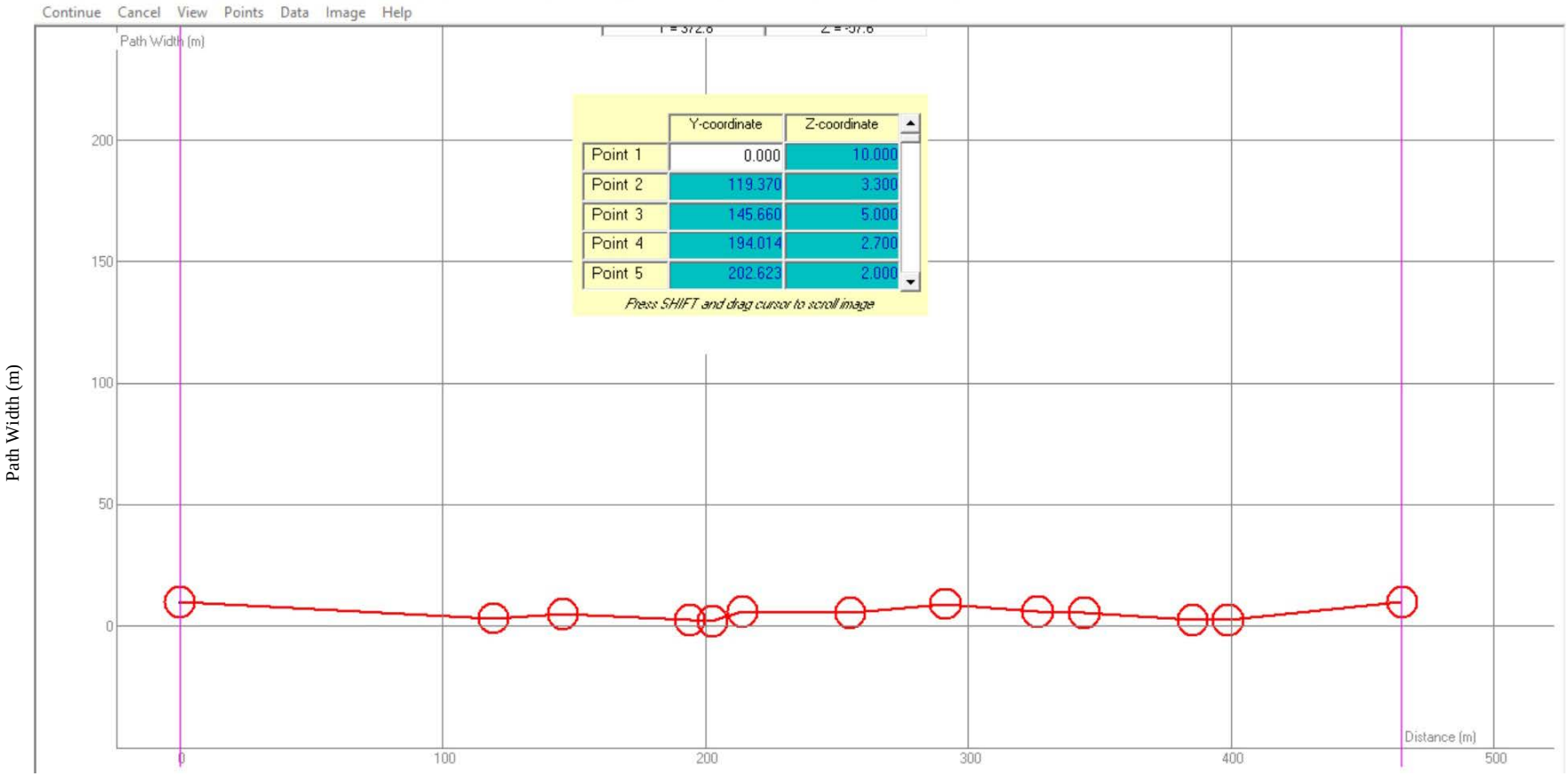
Design Source Volume = 40m^3

Figure D23

Section Profile – (pre-sliding)



Width Profile



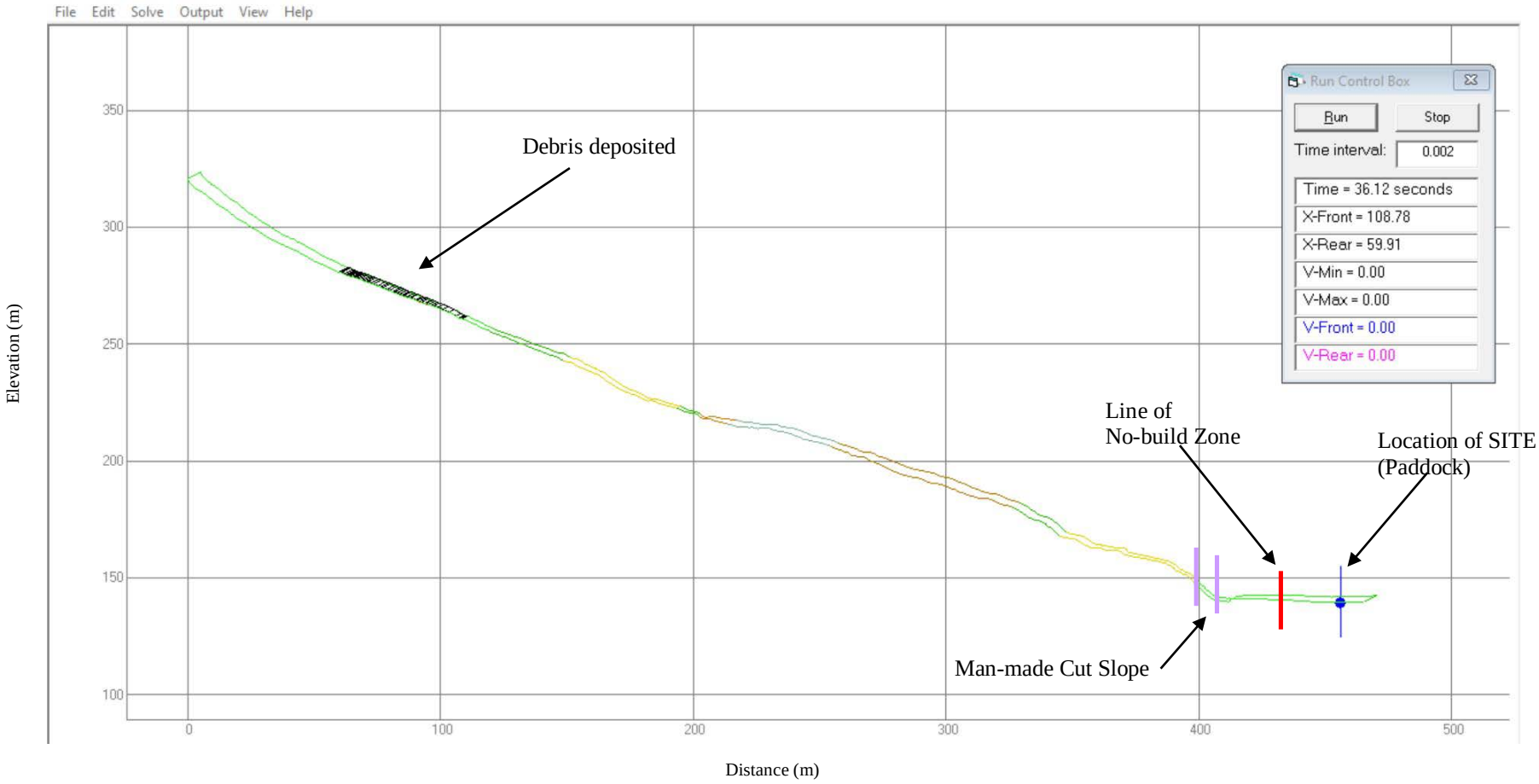
Path Width (m)

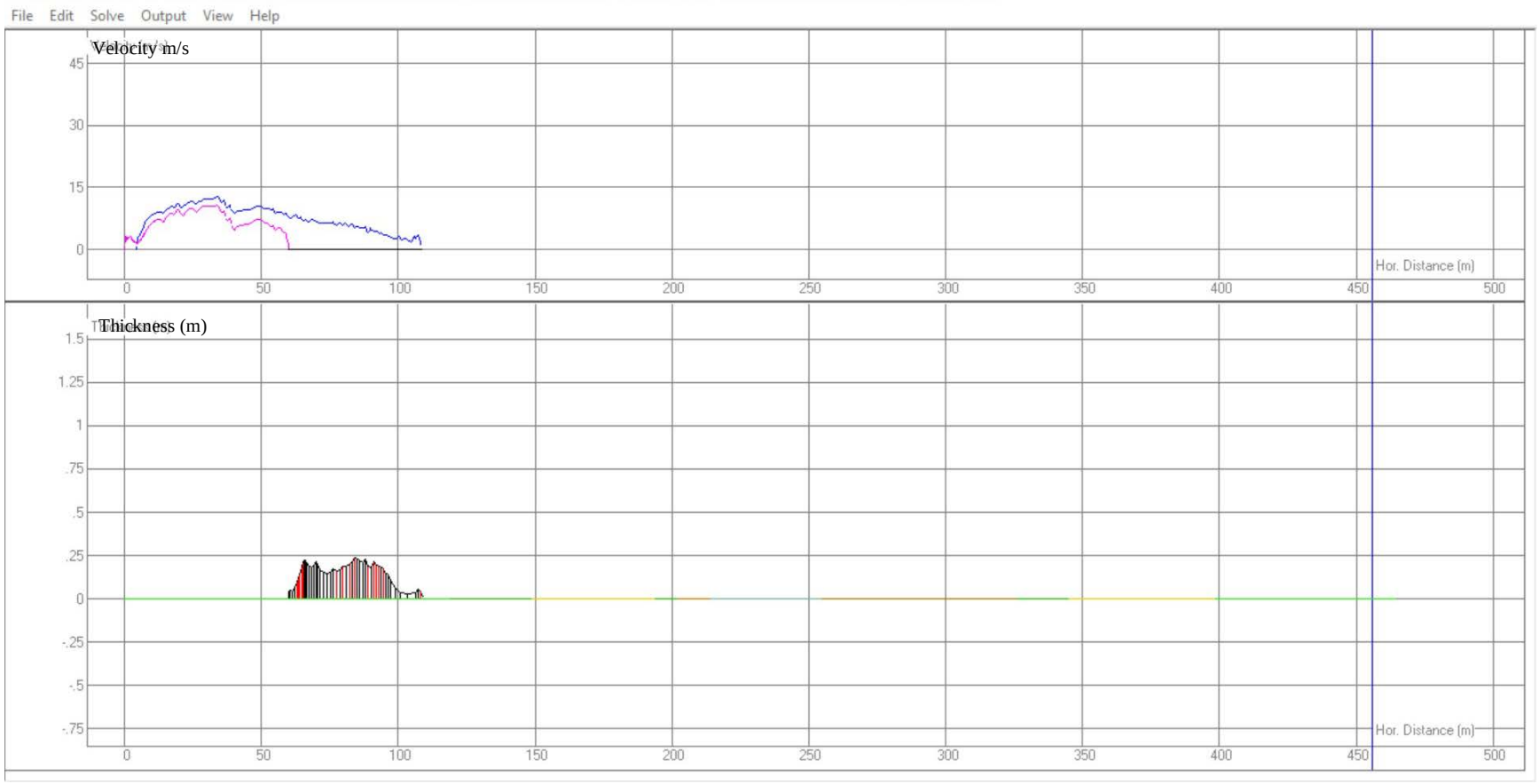
Distance (m)

Result of Debris Mobility Analysis

Source Volume (m^3)	Final Volume (m^3)	Travel Distance (m)	Debris Reached Proposed SITE Facility
40.51	40.51	104.65	No

Section Profile – (post-sliding)




File Edit Solve Output View Help
Velocity m/s
45
30
15
0
0 50 100 150 200 250 300 350 400 450 500
Hor. Distance (m)
Thickness (m)
1.5
1.25
1
.75
.5
.25
0
-.25
-.5
-.75
0 50 100 150 200 250 300 350 400 450 500
Hor. Distance (m)

Distance (m)

No of Blocks = 50

Time step = 0.002 seconds

End at time = 0.00 seconds

Configuration = 3-dimensional

Boundary Block Geometry = Normal

Shape factor = 1.00

Maximum velocity = 12.69 at X = 33.82

Maximum front velocity = 12.69 at X =33.91

CENTRE OF GRAVITY: X-Source = 1.97

Z-Source = 318.32

X-Depos. = 80.01

Z-Depos. = 272.96

CG Ratio = 0.58

Travel angle = 30.16

FAHRBOSCHUNG = 28.83

FRONT DISPLACEMENT: X = 108.783 Z = 260.965

Curvilinear Displ.= 119.717

Horiz. Displ. = 104.65

REAR DISPLACEMENT: X = 59.91 Z = 280.81

Curvilinear Displ.= 73.04

Horiz. Displ. = 59.91

SLIDE VOLUME: Initial = 40.51

Final = 40.51

AREA IN PLAN: Initial = 40.82

Final = 257.34

Runout not completed, V-MAX = 0.00

Export Print Close Help

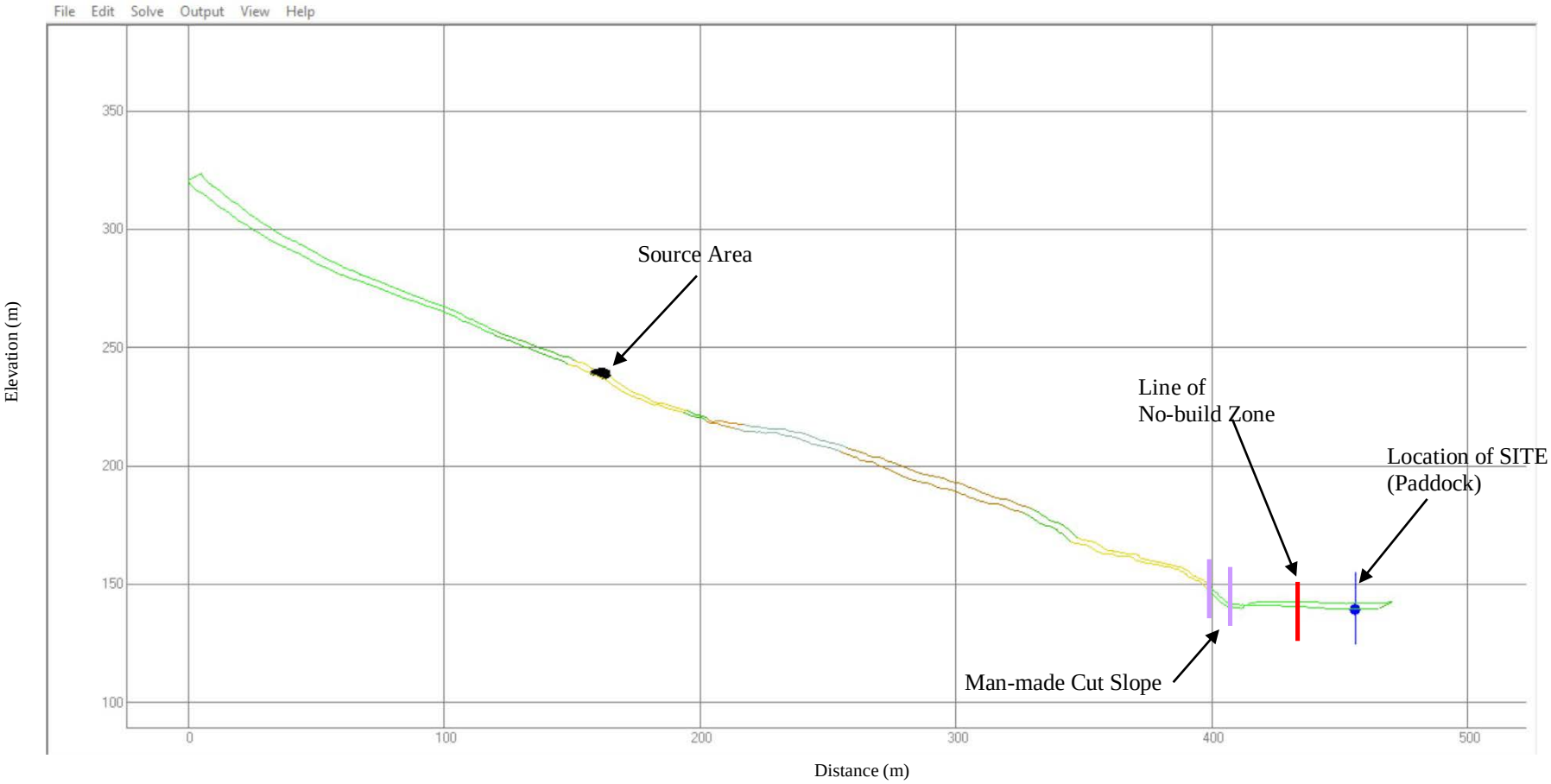
Debris Mobility Analysis for the Credible Runout Path RP13 (Case 2) within Catchment No. CD3

Landslide Type = CDF

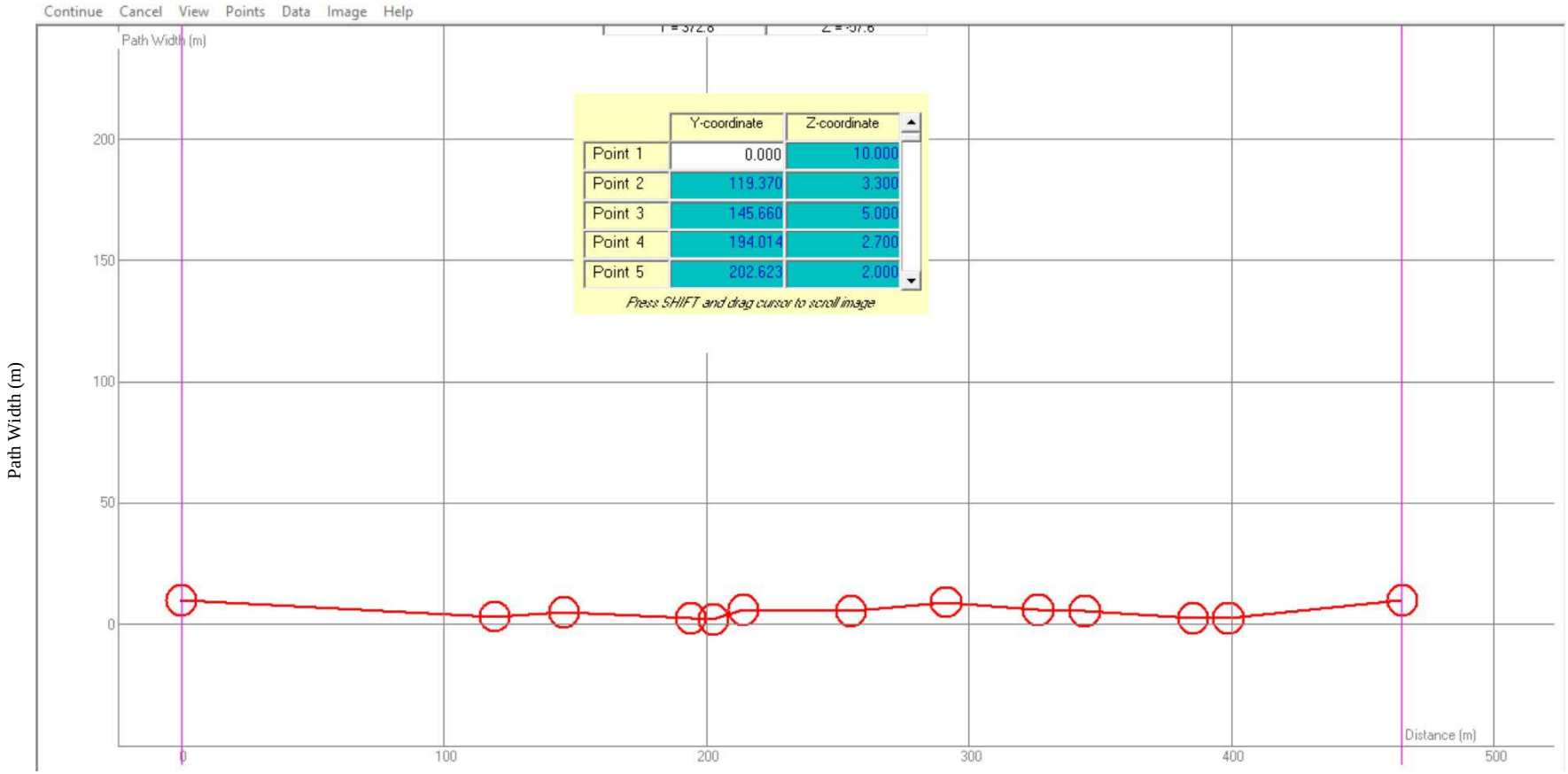
Design Source Volume = 40m^3

Figure D24

Section Profile – (pre-sliding)



Width Profile



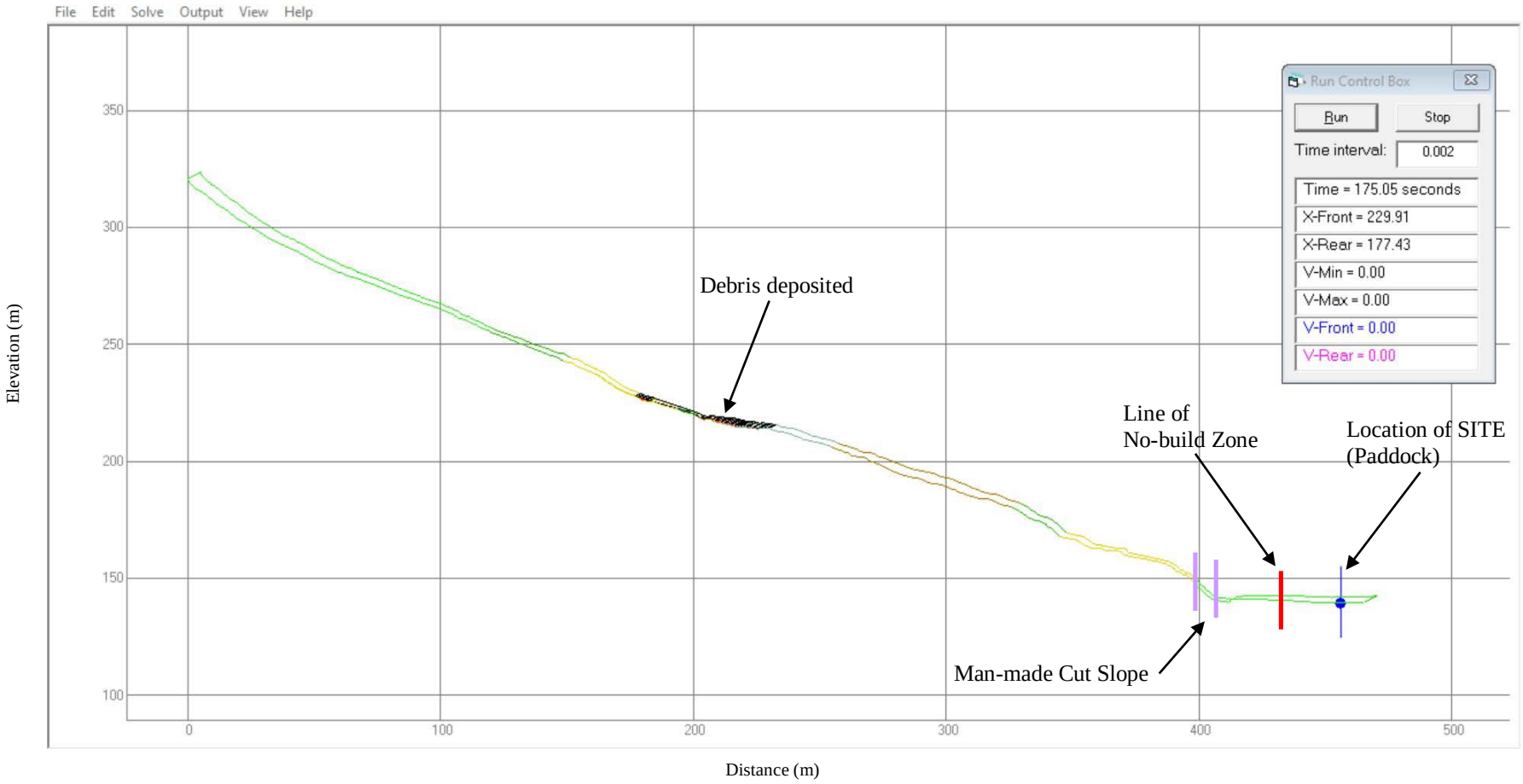
Path Width (m)

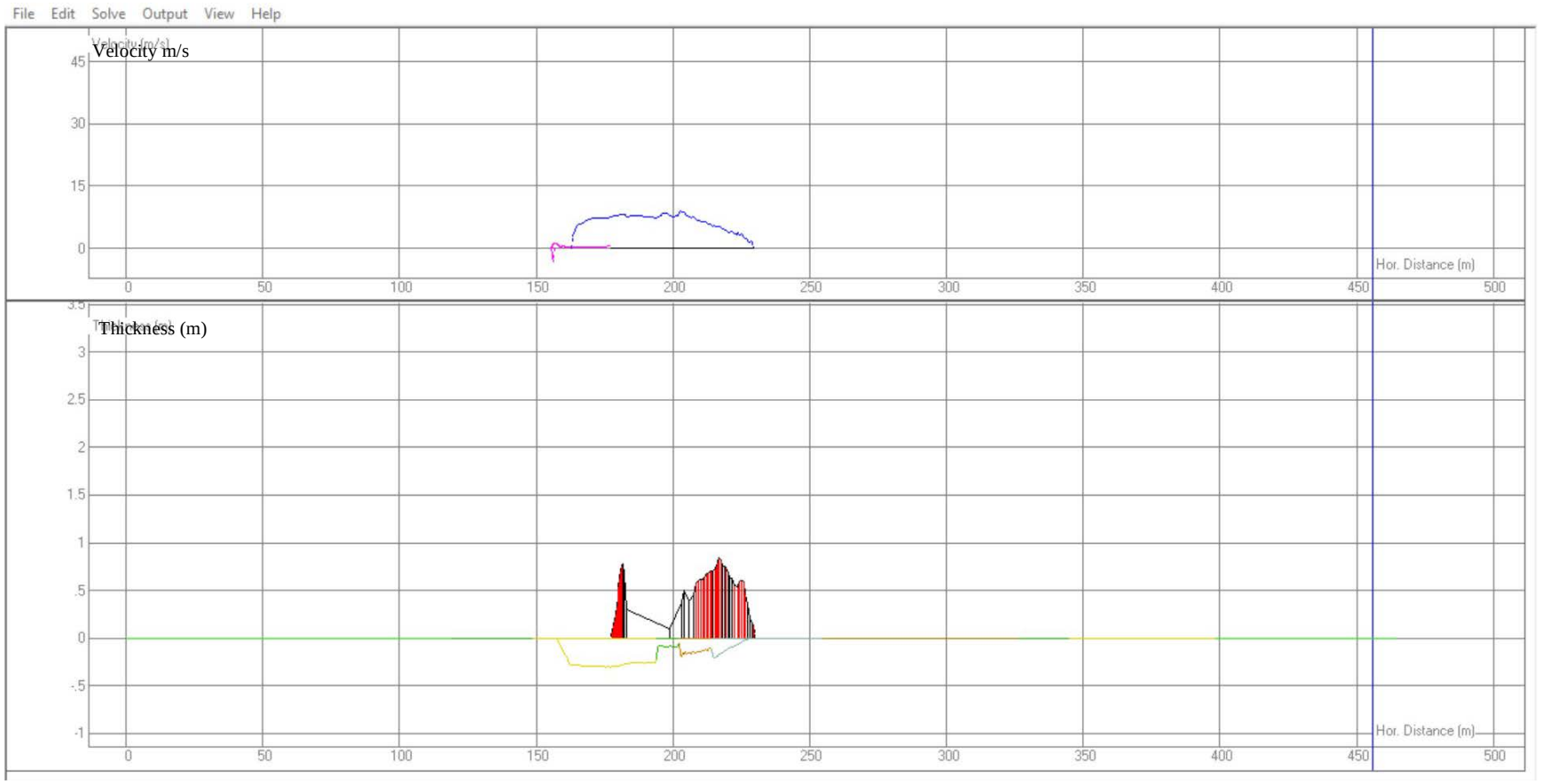
Distance (m)

Result of Debris Mobility Analysis

Source Volume (m^3)	Final Volume (m^3)	Travel Distance (m)	Debris Reached Proposed SITE Facility
40.81	96.65	67.08	No

Section Profile – (post-sliding)




File Edit Solve Output View Help
Velocity m/s
45
30
15
0
Hor. Distance (m)
0 50 100 150 200 250 300 350 400 450 500
Thickness (m)
3
2.5
2
1.5
1
.5
0
-.5
-1
Hor. Distance (m)
0 50 100 150 200 250 300 350 400 450 500

Distance (m)

No of Blocks = 50

Time step = 0.002 seconds

End at time = 0.00 seconds

Configuration = 3-dimensional

Boundary Block Geometry = Normal

Shape factor = 1.00

Maximum velocity = 9.00 at X = 202.90

Maximum front velocity = 9.00 at X =202.90

CENTRE OF GRAVITY: X-Source = 160.25

Z-Source = 238.69

X-Depos. = 212.86

Z-Depos. = 216.83

CG Ratio = 0.42

Travel angle = 22.56

FAHRBOSCHUNG = 19.14

FRONT DISPLACEMENT: X = 229.914 Z = 213.939

Curvilinear Displ.= 73.079

Horiz. Displ. = 67.08

REAR DISPLACEMENT: X = 177.43 Z = 227.89

Curvilinear Displ.= 23.89

Horiz. Displ. = 20.75

SLIDE VOLUME: Initial = 40.81

Final = 96.65

AREA IN PLAN: Initial = 26.64

Final = 212.26

Runout not completed, V-MAX = 0.00

Export Print Close Help

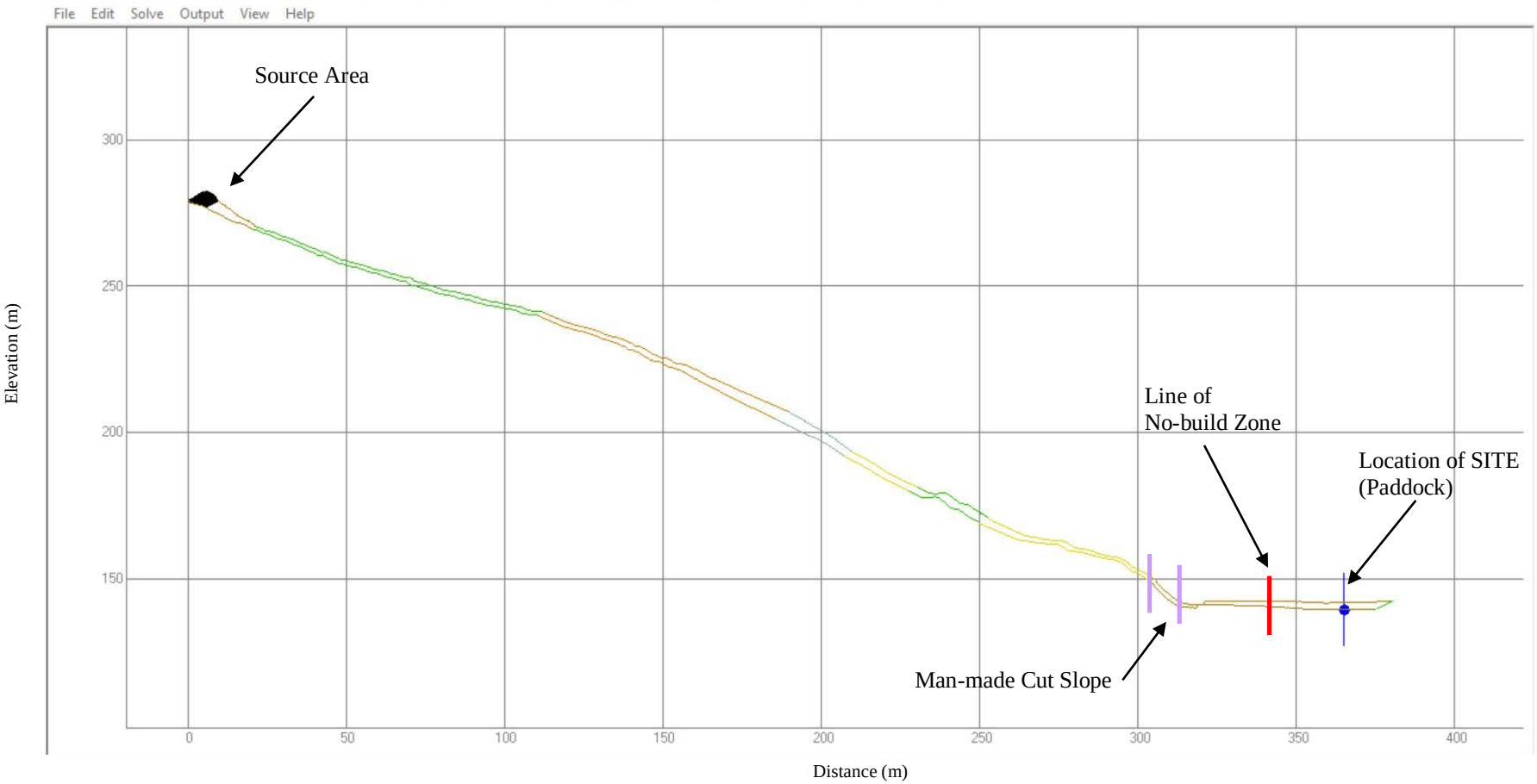
Debris Mobility Analysis for the Credible Runout Path RP14 (Case 1) within Catchment No. CD3

Landslide Type = CDF

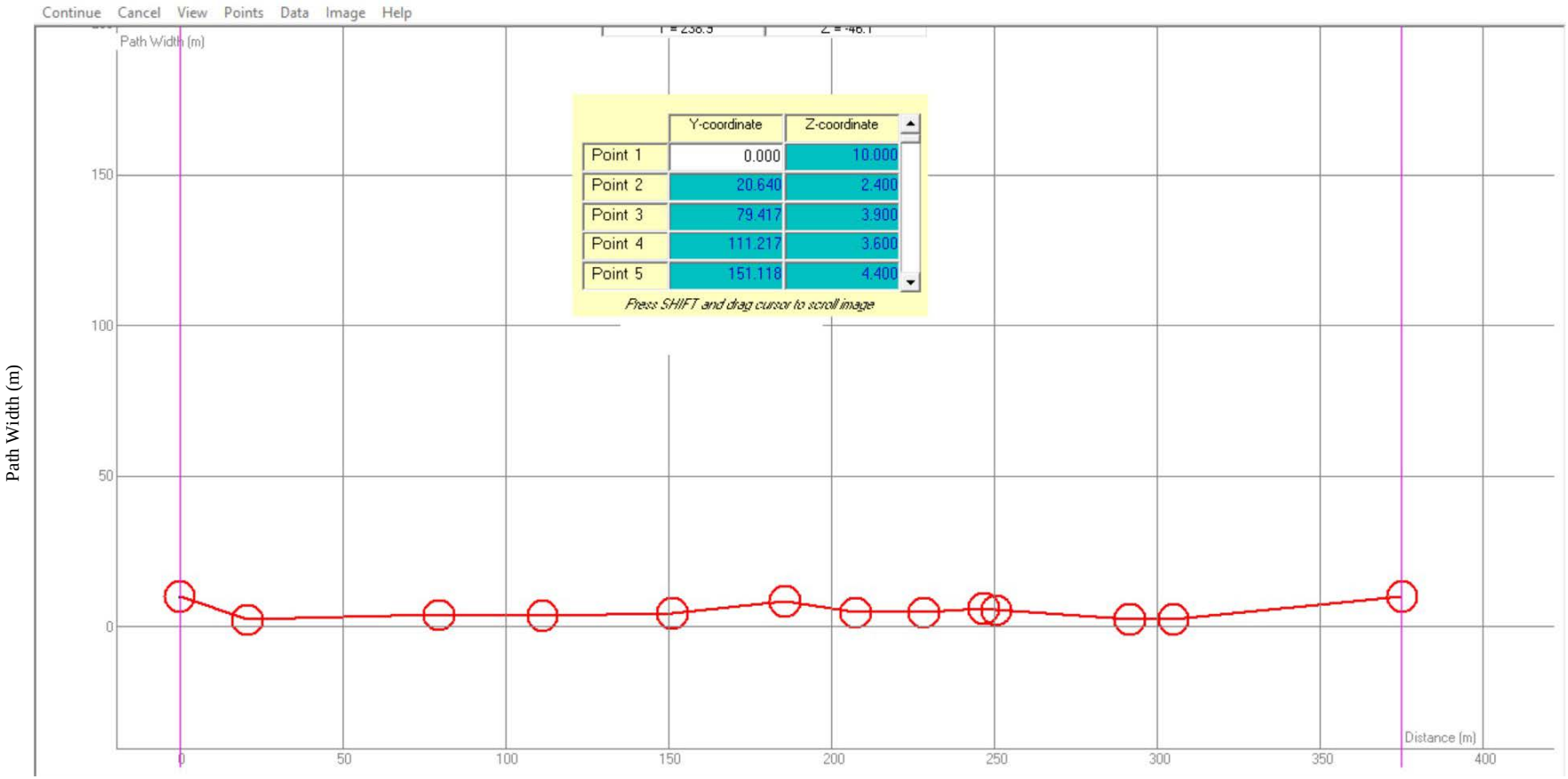
Design Source Volume = 40m^3

Figure D25

Section Profile – (pre-sliding)



Width Profile



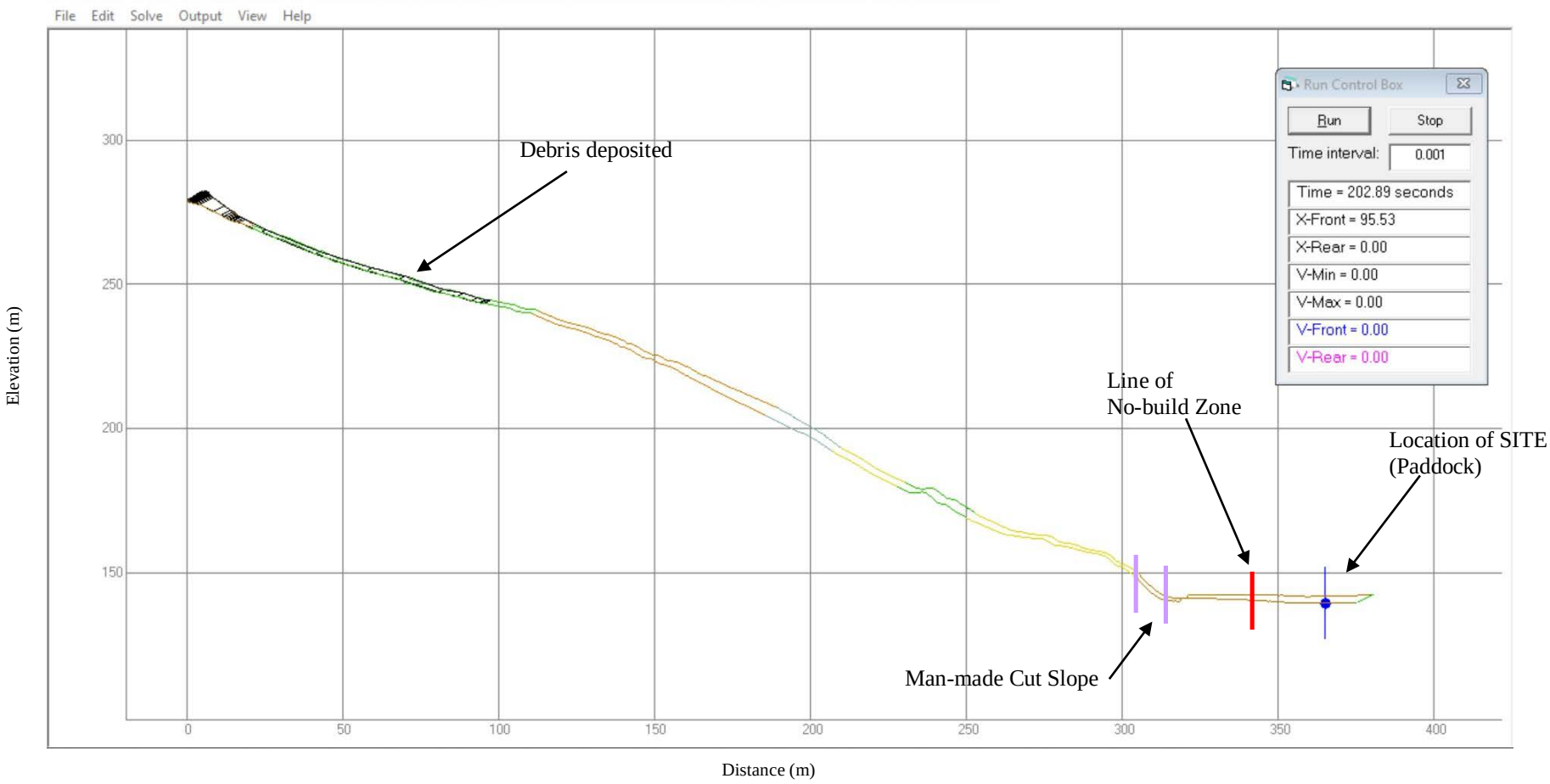
Path Width (m)

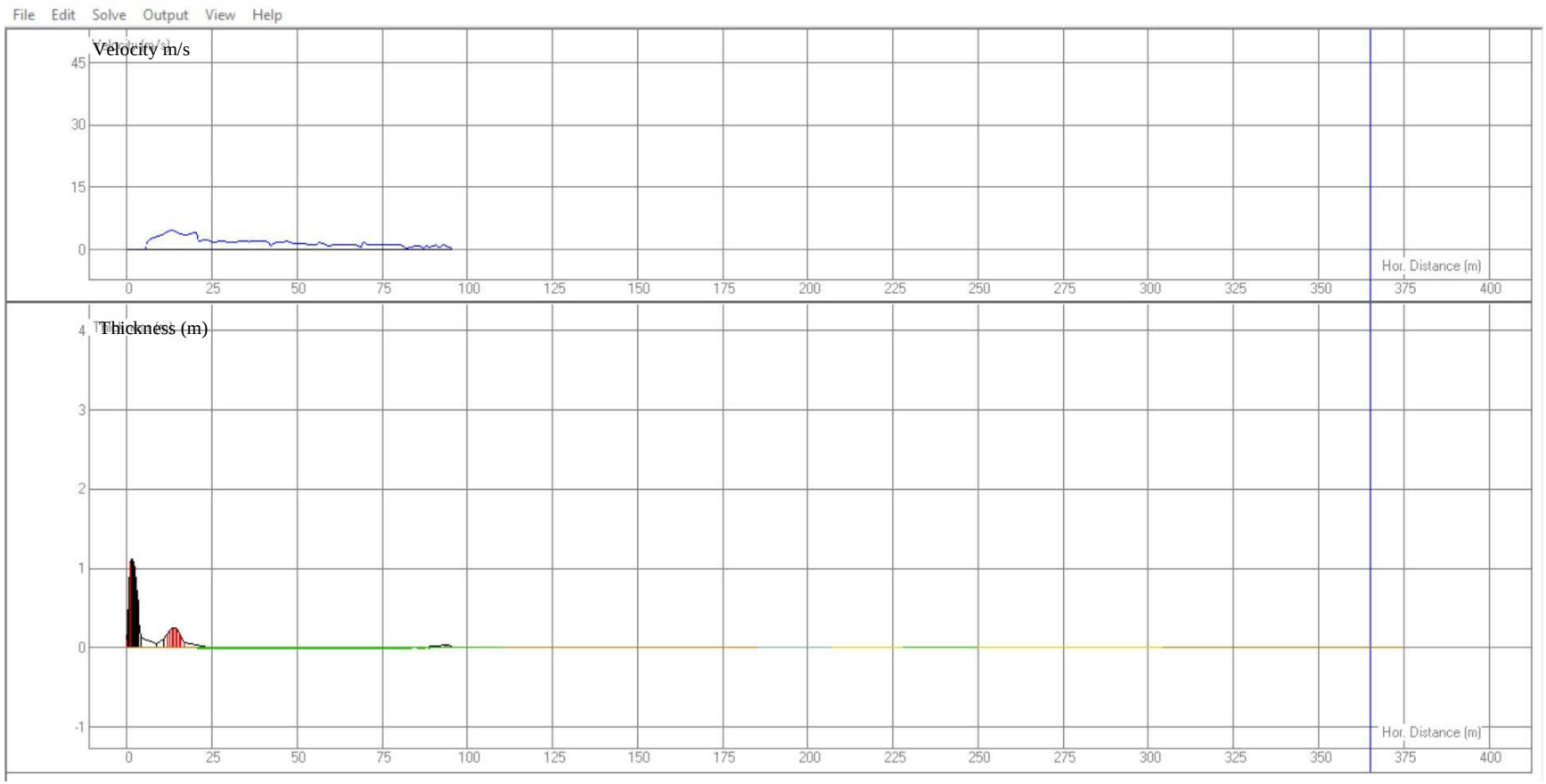
Distance (m)

Result of Debris Mobility Analysis

Source Volume (m^3)	Final Volume (m^3)	Travel Distance (m)	Debris Reached Proposed SITE Facility
40.88	41.54	89.85	No

Section Profile – (post-sliding)




File Edit Solve Output View Help
Velocity m/s
45
30
15
0
Hor. Distance (m)
0 25 50 75 100 125 150 175 200 225 250 275 300 325 350 375 400
Thickness (m)
4
3
2
1
0
-1
Hor. Distance (m)
0 25 50 75 100 125 150 175 200 225 250 275 300 325 350 375 400

Distance (m)

No of Blocks = 50

Time step = 0.001 seconds

End at time = 0.00 seconds

Configuration = 3-dimensional

Boundary Block Geometry = Normal

Shape factor = 1.00

Maximum velocity = 4.59 at X = 13.36

Maximum front velocity = 4.59 at X =13.36

CENTRE OF GRAVITY: X-Source = 2.45

Z-Source = 278.61

X-Depos. = 7.62

Z-Depos. = 276.19

CG Ratio = 0.47

Travel angle = 25.01

FAHRBOSCHUNG = 20.60

FRONT DISPLACEMENT: X = 95.534 Z = 243.425

Curvilinear Displ.= 97.027

Horiz. Displ. = 89.85

REAR DISPLACEMENT: X = 0.00 Z = 279.33

Curvilinear Displ.= 0.00

Horiz. Displ. = 0.00

SLIDE VOLUME: Initial = 40.88

Final = 41.54

AREA IN PLAN: Initial = 50.91

Final = 377.14

Runout not completed, V-MAX = 0.00

Export Print Close Help

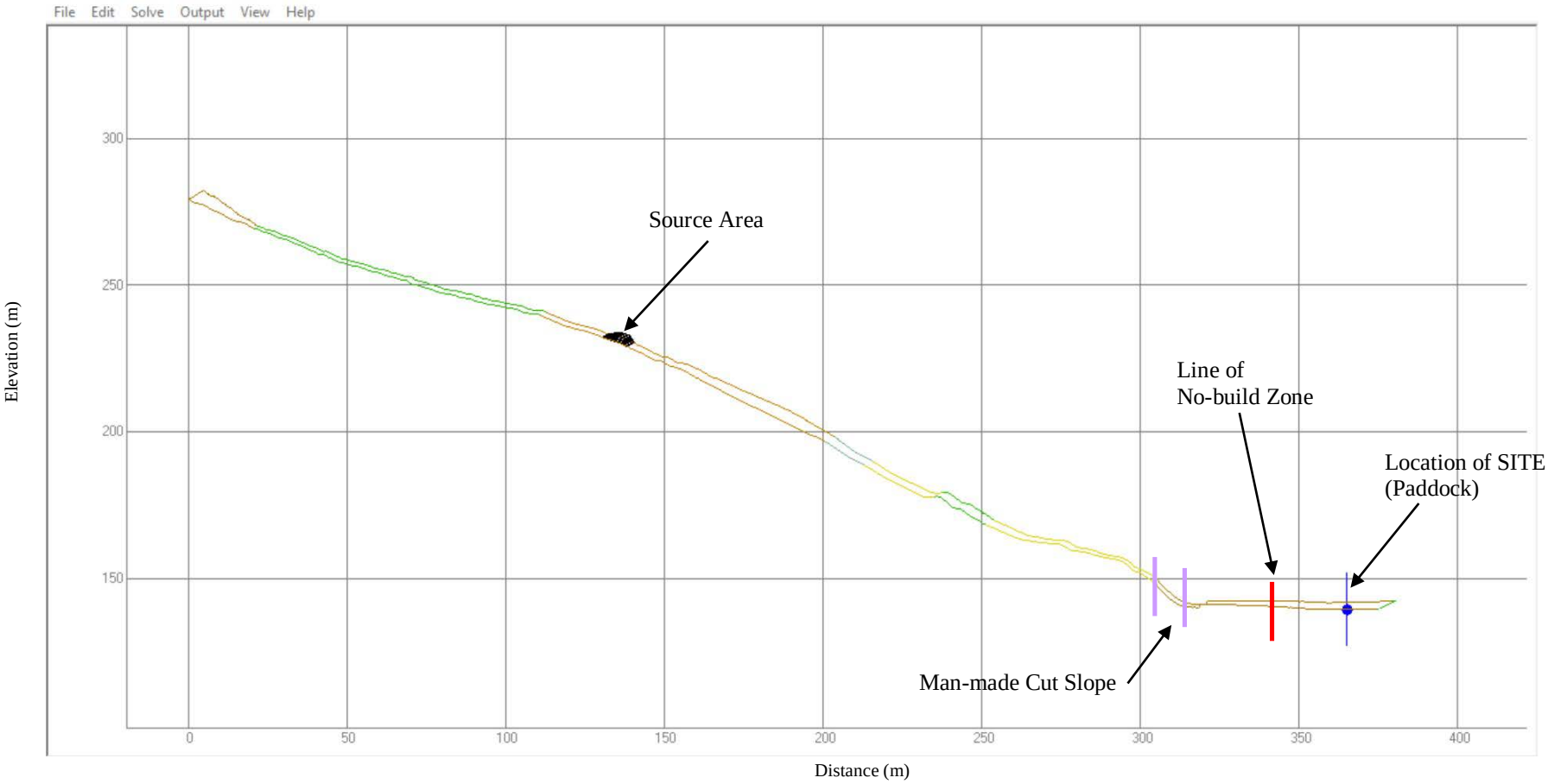
Debris Mobility Analysis for the Credible Runout Path RP14 (Case 2) within Catchment No. CD3

Landslide Type = CDF

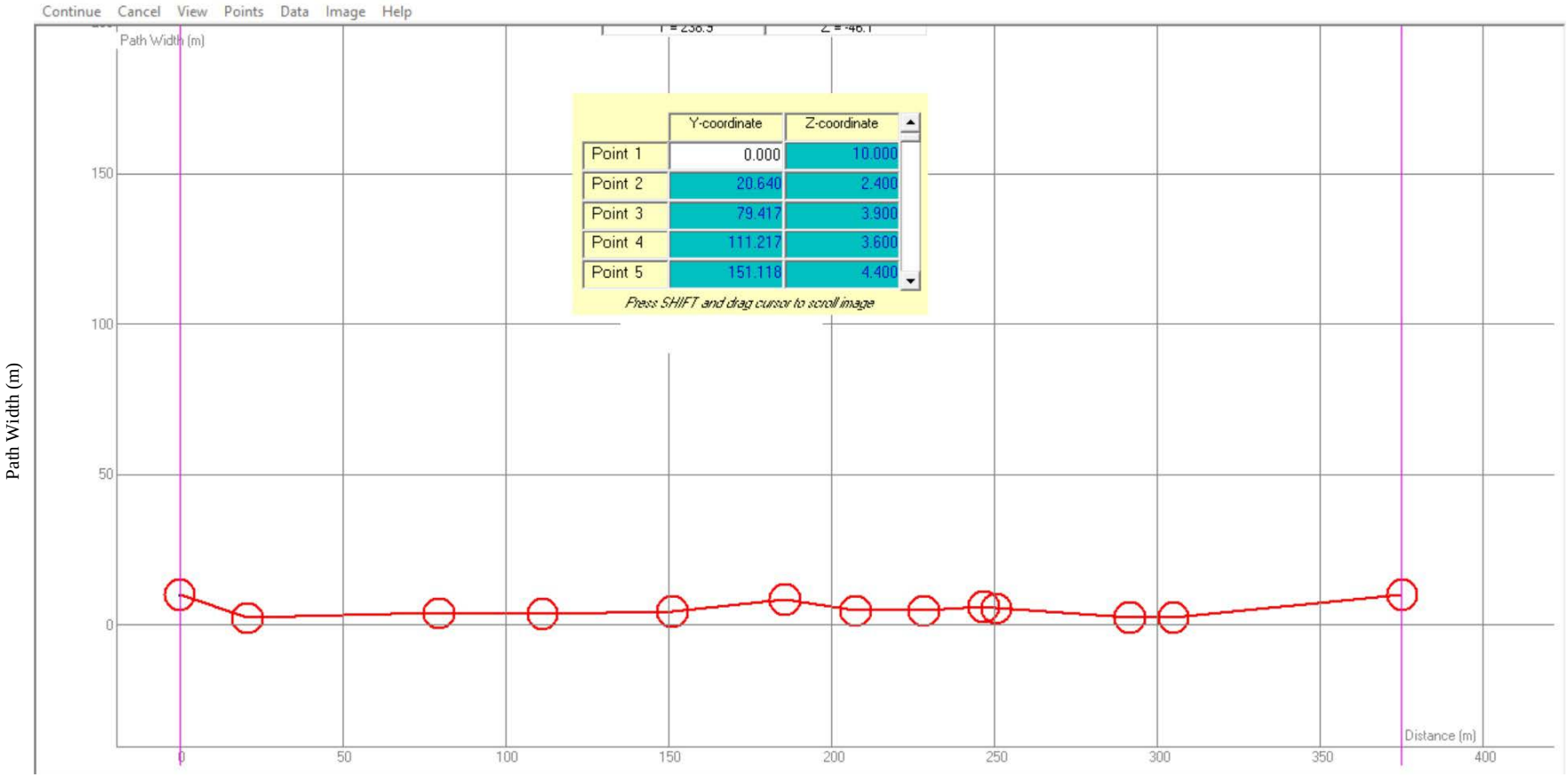
Design Source Volume = 40m^3

Figure D26

Section Profile – (pre-sliding)



Width Profile



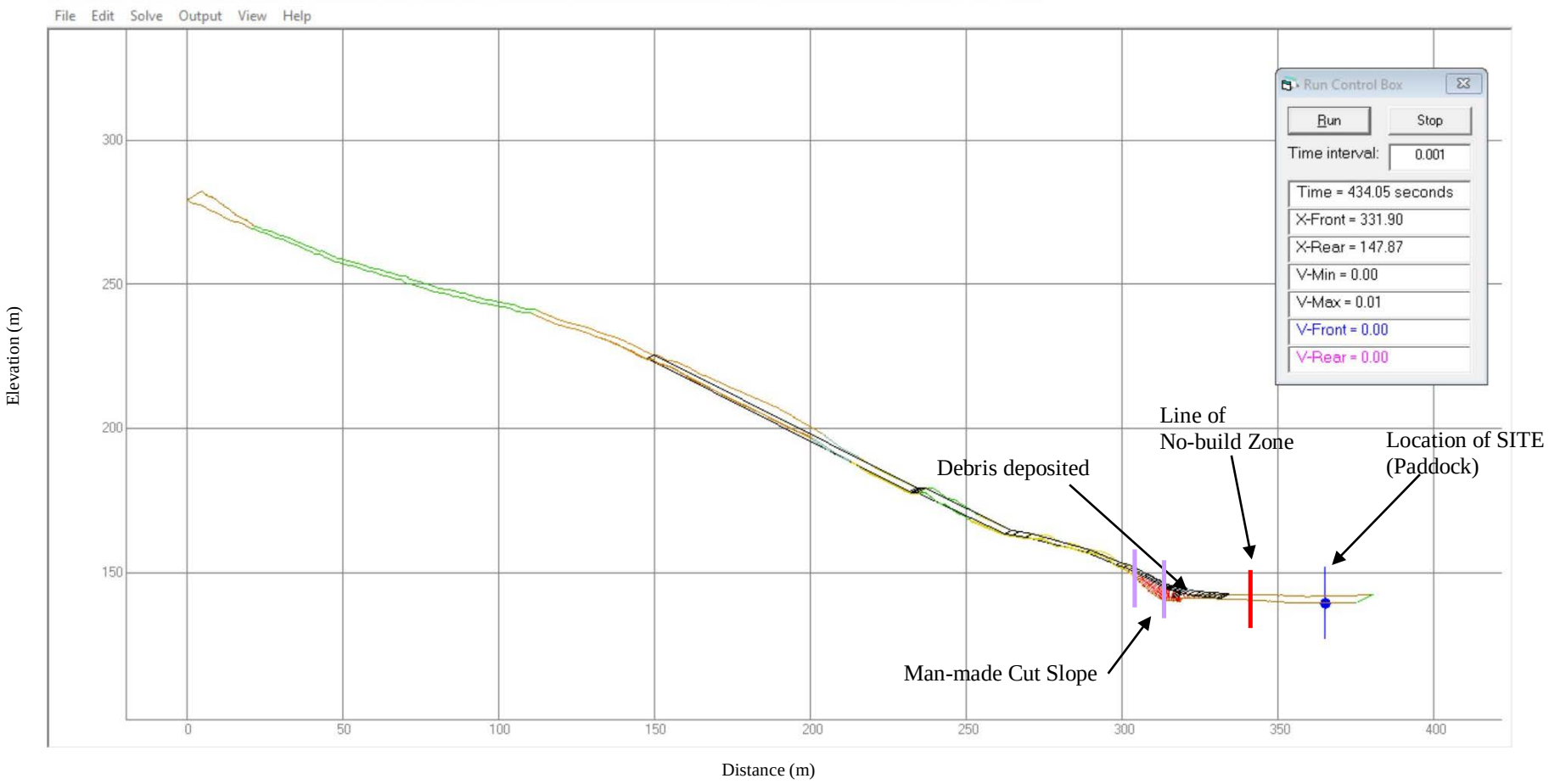
Path Width (m)

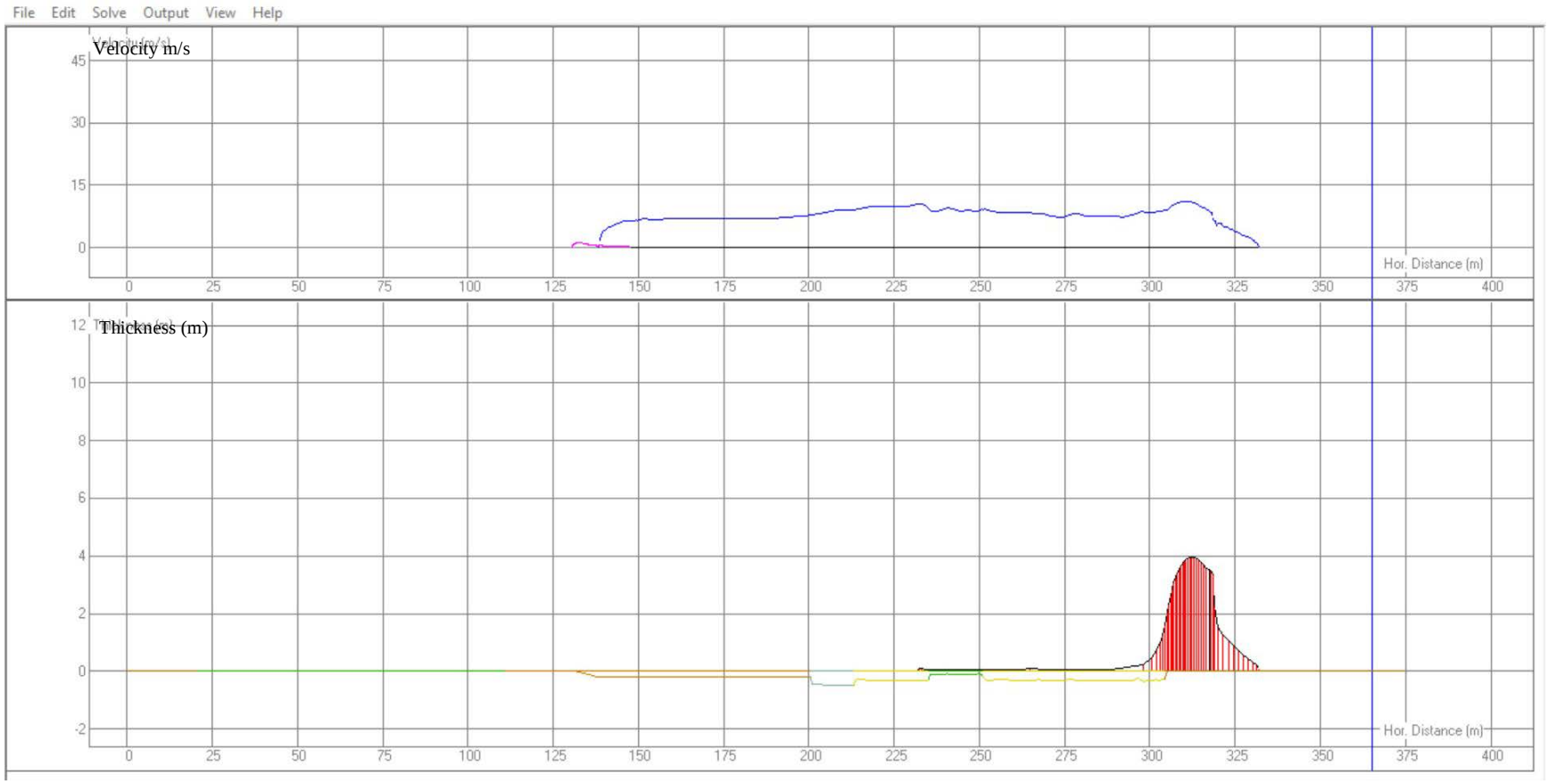
Distance (m)

Result of Debris Mobility Analysis

Source Volume (m^3)	Final Volume (m^3)	Travel Distance (m)	Debris Reached Proposed SITE Facility
40.17	272.87	193.52	No

Section Profile – (post-sliding)




File Edit Solve Output View Help
Velocity m/s
45
30
15
0
0 25 50 75 100 125 150 175 200 225 250 275 300 325 350 375 400
Hor. Distance (m)
Thickness (m)
12
10
8
6
4
2
0
-2
0 25 50 75 100 125 150 175 200 225 250 275 300 325 350 375 400
Hor. Distance (m)

Distance (m)

No of Blocks = 50

Time step = 0.001 seconds

End at time = 0.00 seconds

Configuration = 3-dimensional

Boundary Block Geometry = Normal

Shape factor = 1.00

Maximum velocity = 11.11 at X = 310.51

Maximum front velocity = 11.11 at X =310.51

CENTRE OF GRAVITY: X-Source = 134.97

Z-Source = 231.31

X-Depos. = 313.24

Z-Depos. = 143.87

CG Ratio = 0.49

Travel angle = 26.13

FAHRBOSCHUNG = 24.38

FRONT DISPLACEMENT: X = 331.901 Z = 140.843

Curvilinear Displ.= 219.405

Horiz. Displ. = 193.52

REAR DISPLACEMENT: X = 147.87 Z = 224.13

Curvilinear Displ.= 19.20

Horiz. Displ. = 17.39

SLIDE VOLUME: Initial = 40.17

Final = 272.87

AREA IN PLAN: Initial = 32.13

Final = 784.47

Runout not completed, V-MAX = 0.01

Export Print Close Help

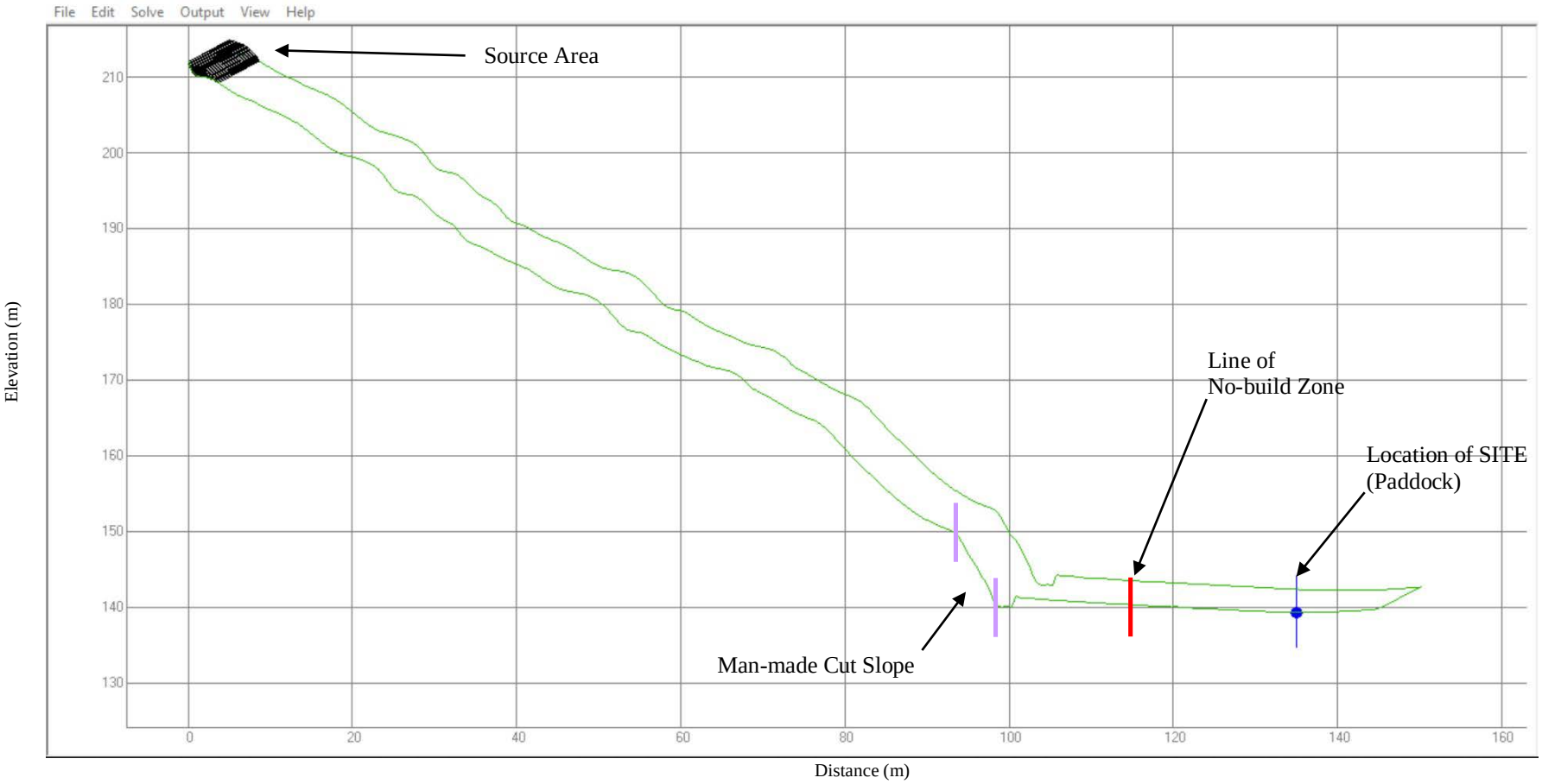
Debris Mobility Analysis for the Credible Runout Path RP15 within Catchment No. OH4

Landslide Type = OHL

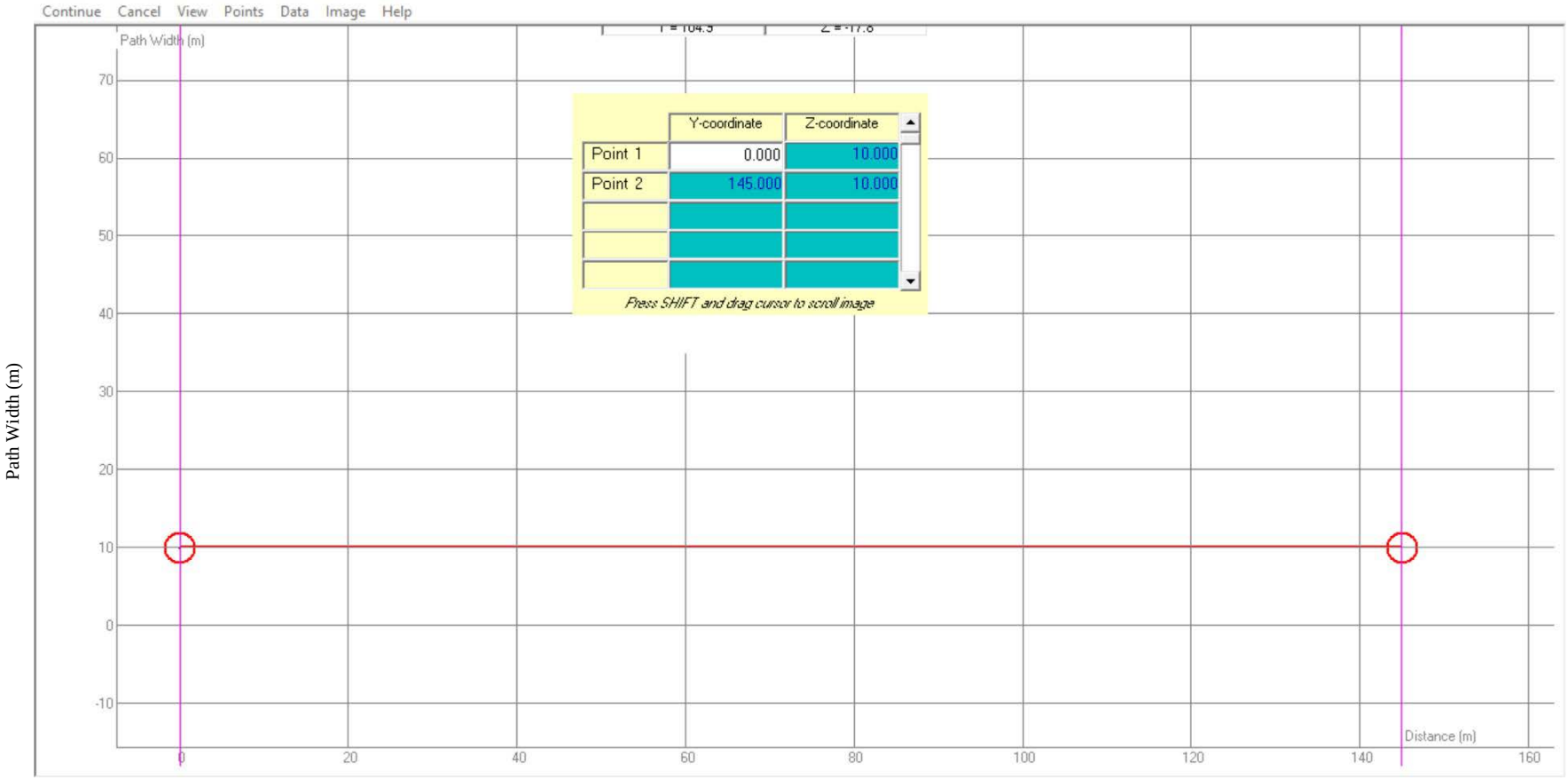
Design Source Volume = 40m^3

Figure D27

Section Profile – (pre-sliding)



Width Profile



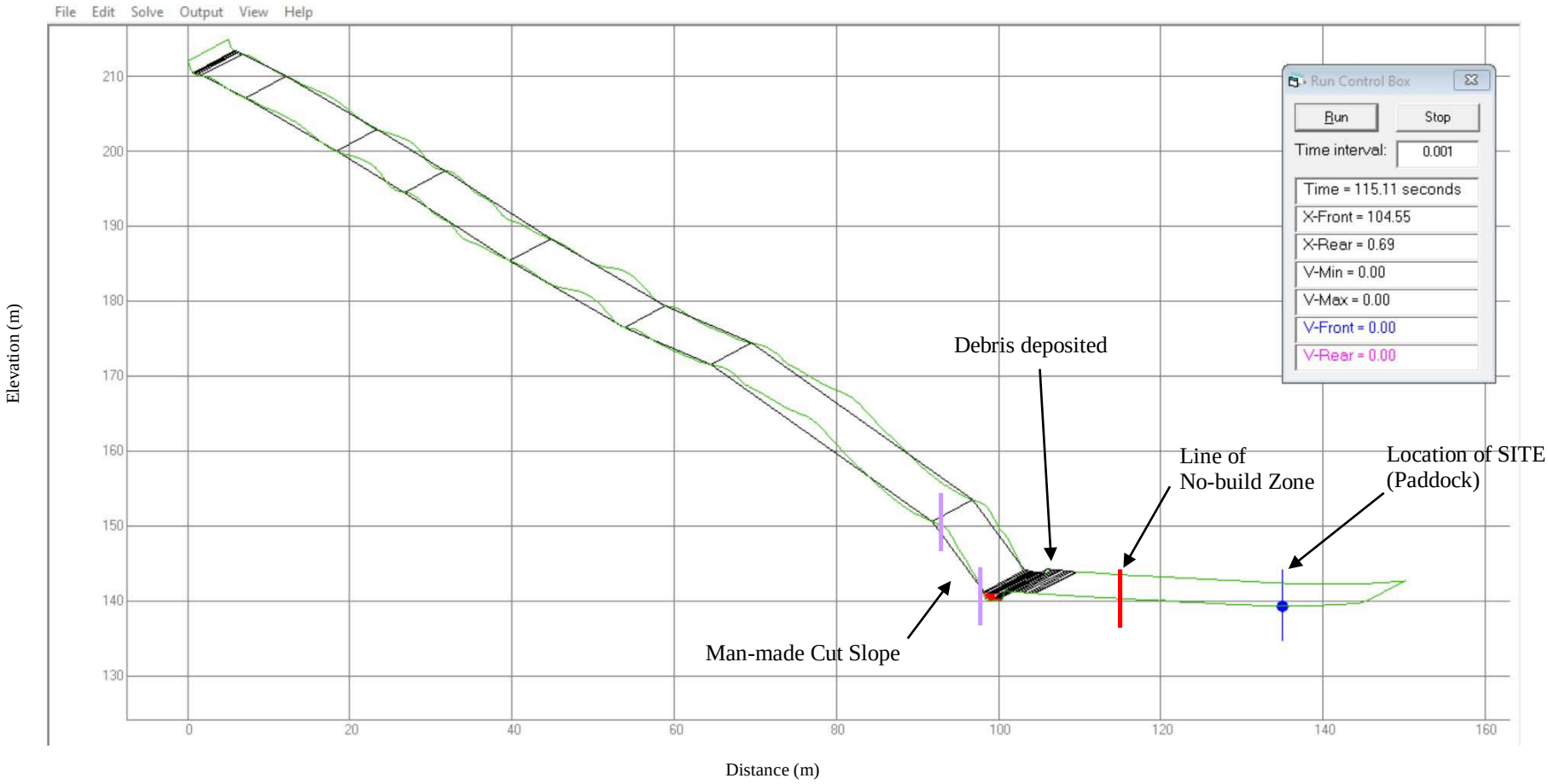
Path Width (m)

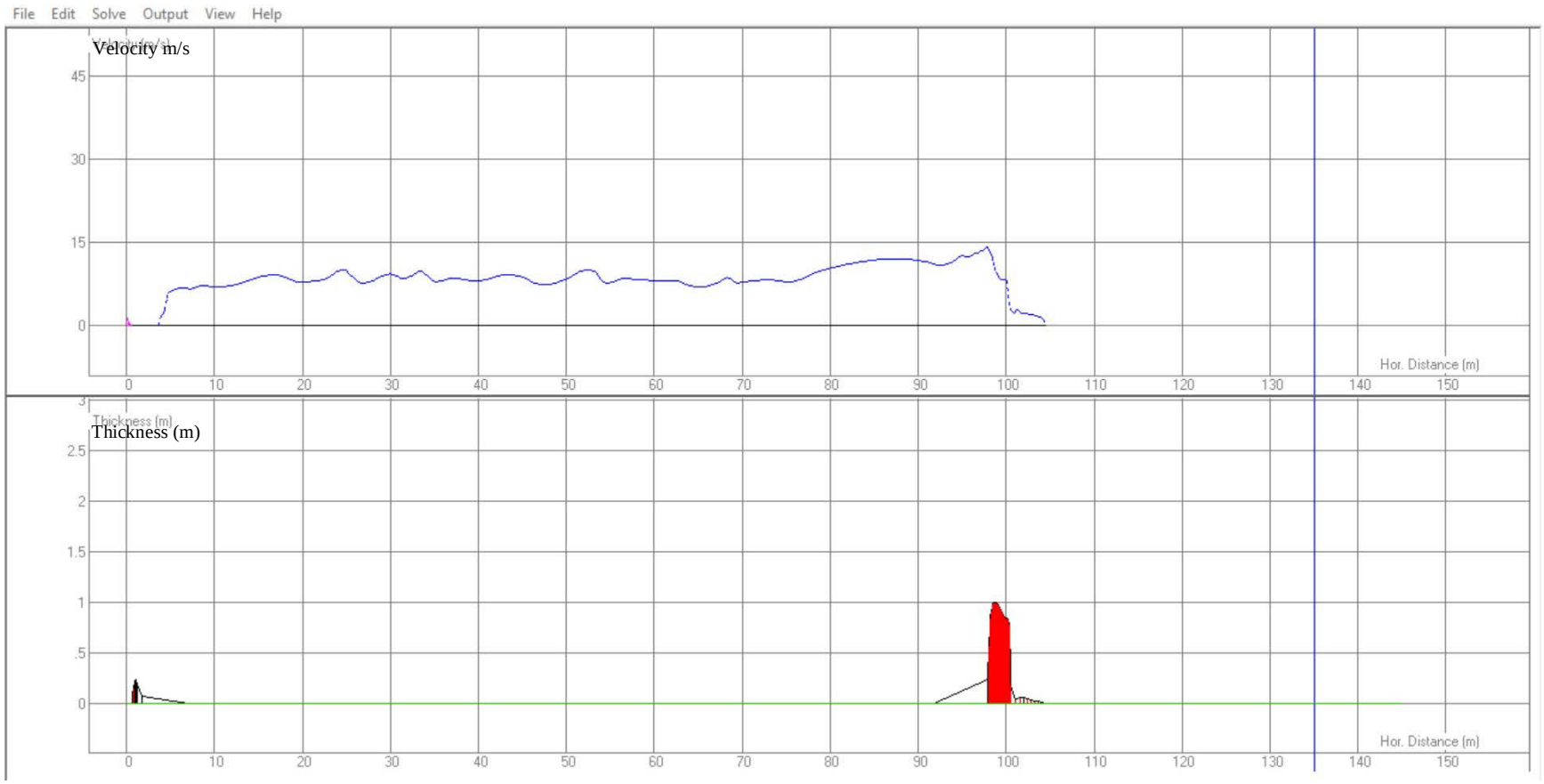
Distance (m)

Result of Debris Mobility Analysis

Source Volume (m^3)	Final Volume (m^3)	Travel Distance (m)	Debris Reached Proposed SITE Facility
40.67	40.67	100.87	No

Section Profile – (post-sliding)




File Edit Solve Output View Help
Velocity m/s
45
30
15
0
Hor. Distance (m)
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150
Thickness (m)
2.5
2
1.5
1
.5
0
Hor. Distance (m)
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150

Distance (m)

No of Blocks = 50

Time step = 0.001 seconds

End at time = 0.00 seconds

Configuration = 3-dimensional

Boundary Block Geometry = Normal

Shape factor = 1.00

Maximum velocity = 14.21 at X = 97.75

Maximum front velocity = 14.21 at X =97.75

CENTRE OF GRAVITY: X-Source = 1.53

Z-Source = 210.79

X-Depos. = 83.05

Z-Depos. = 152.84

CG Ratio = 0.71

Travel angle = 35.41

FAHRBOSCHUNG = 34.19

FRONT DISPLACEMENT: X = 104.552 Z = 140.976

Curvilinear Displ.= 127.706

Horiz. Displ. = 100.87

REAR DISPLACEMENT: X = 0.69 Z = 210.45

Curvilinear Displ.= 1.70

Horiz. Displ. = 0.69

SLIDE VOLUME: Initial = 40.67

Final = 40.67

AREA IN PLAN: Initial = 36.81

Final = 1038.62

Runout not completed, V-MAX = 0.00

Export Print Close Help

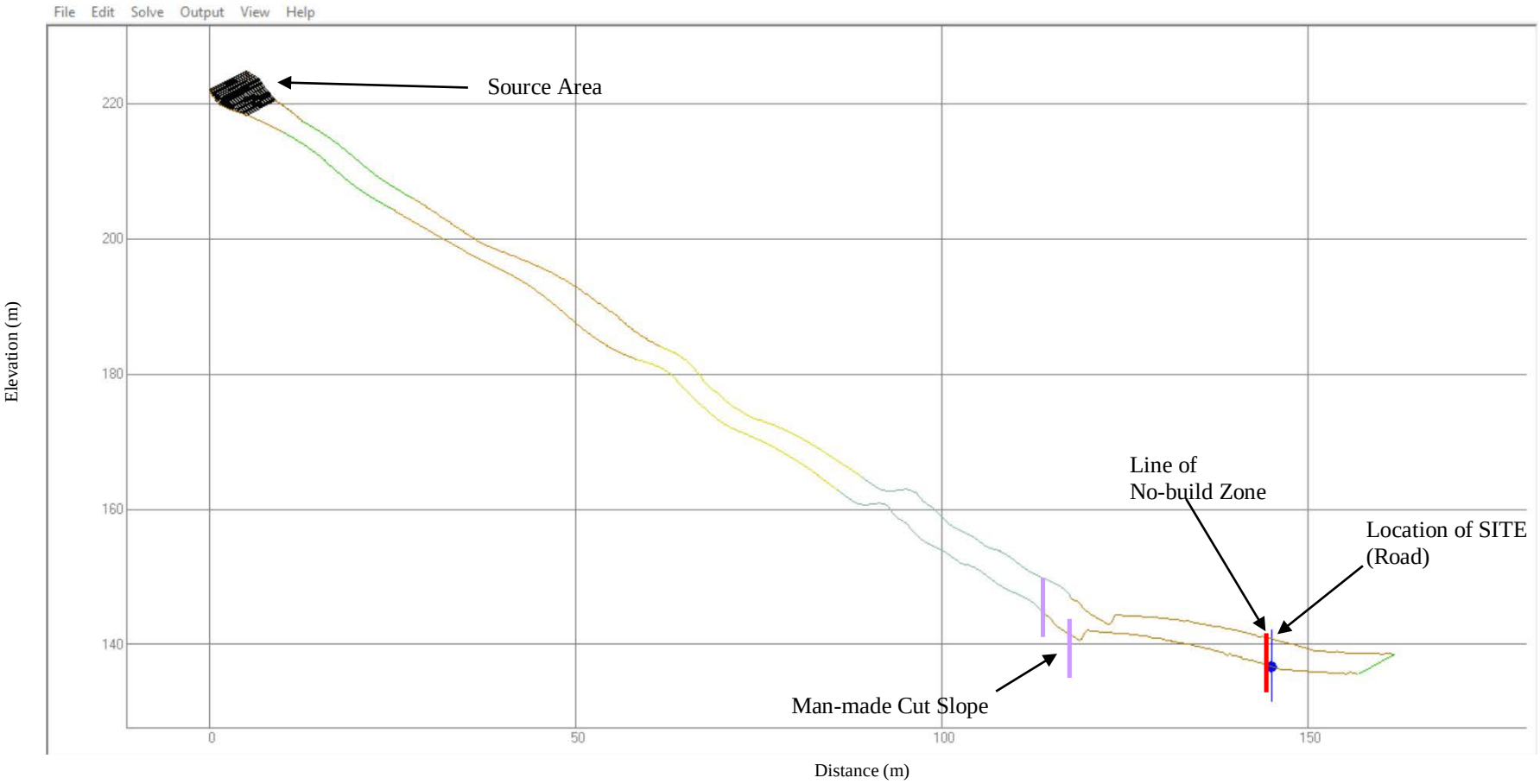
Debris Mobility Analysis for the Credible Runout Path RP16 within Catchment No. TD7

Landslide Type = DF

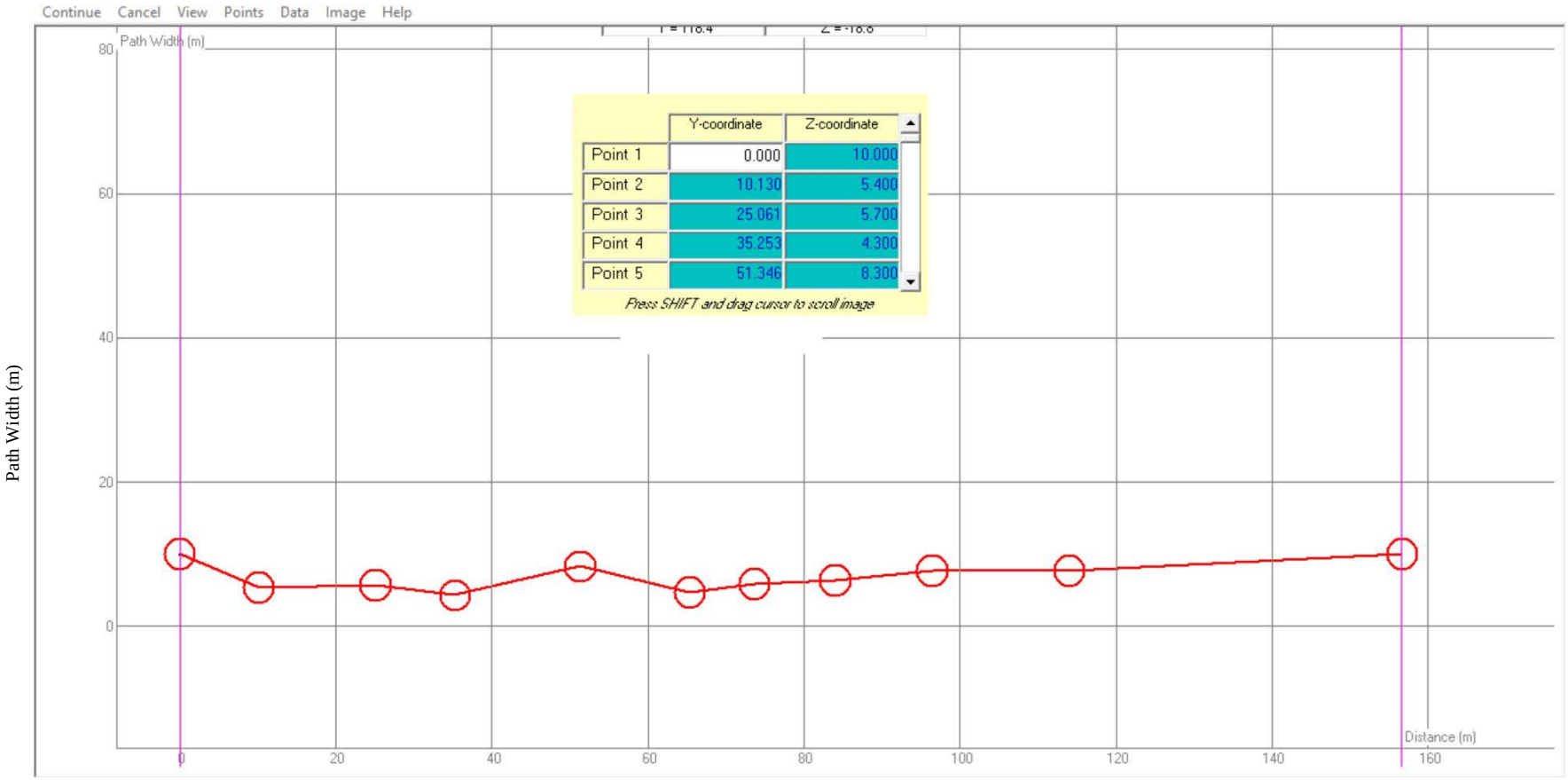
Design Source Volume = 40m^3

Figure D28

Section Profile – (pre-sliding)



Width Profile



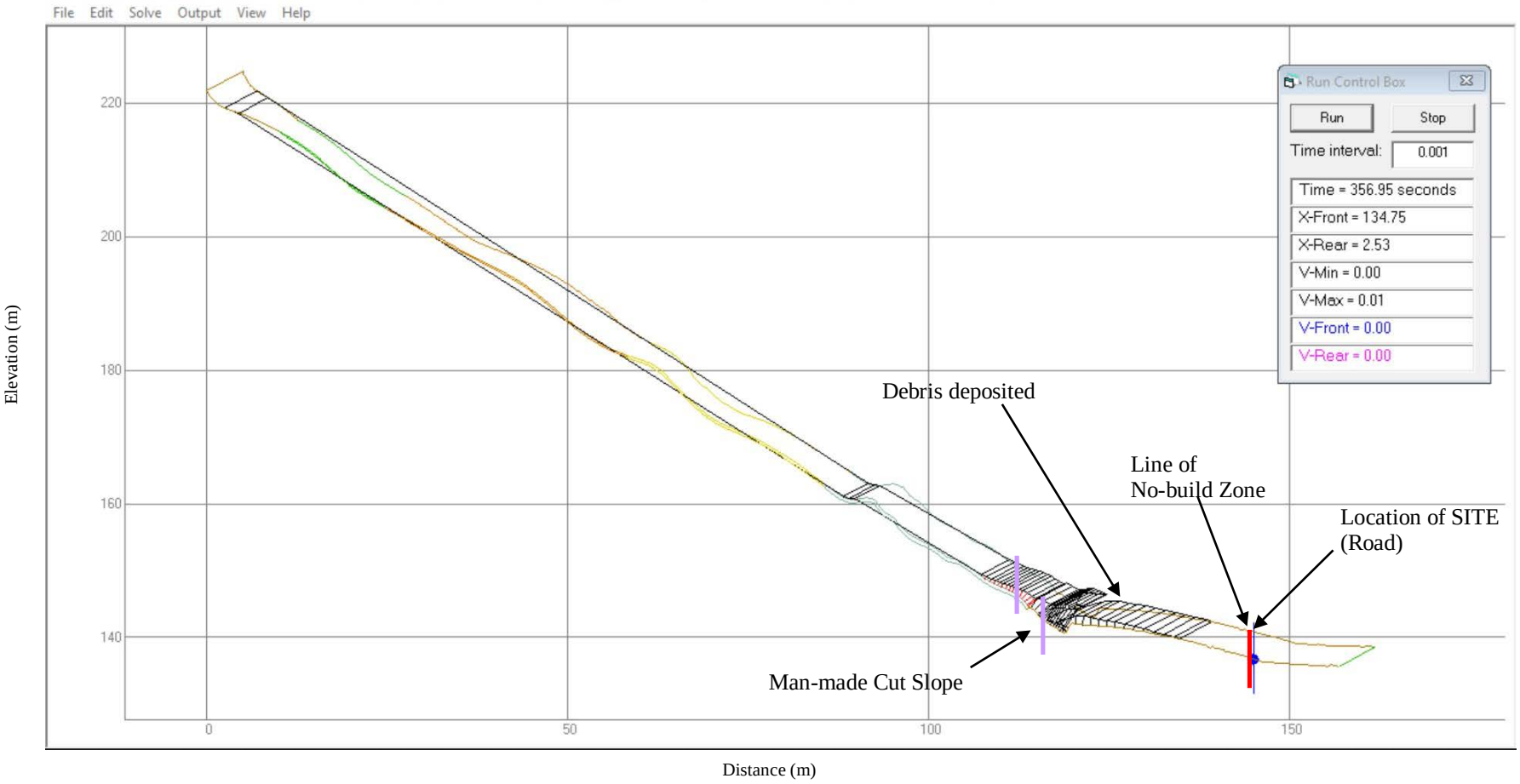
Path Width (m)

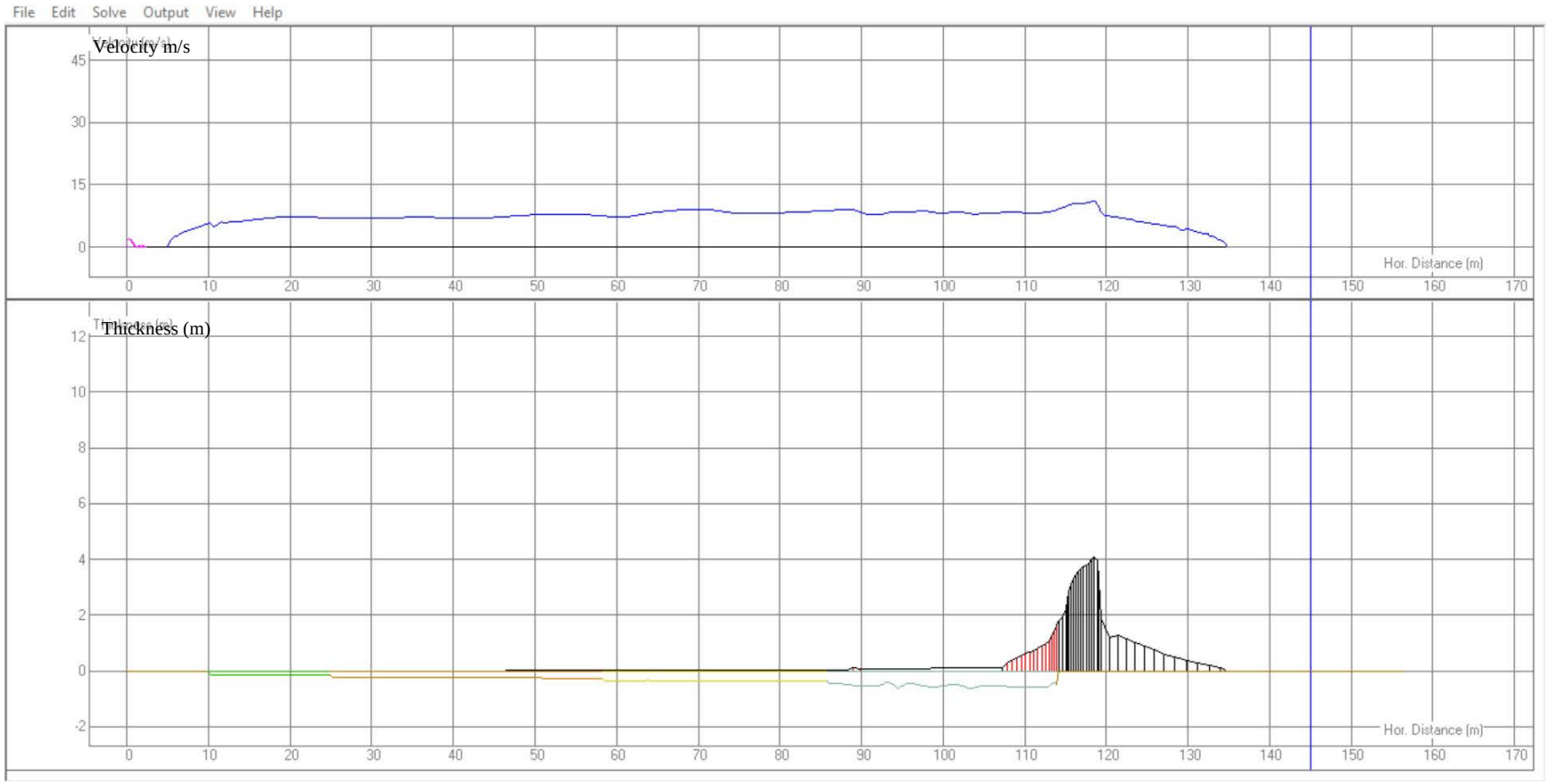
Distance (m)

Result of Debris Mobility Analysis

Source Volume (m^3)	Final Volume (m^3)	Travel Distance (m)	Debris Reached Proposed SITE Facility
40.28	321.11	129.70	No

Section Profile – (post-sliding)




File Edit Solve Output View Help
Velocity m/s
45
30
15
0
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170
Hor. Distance (m)
Thickness (m)
12
10
8
6
4
2
0
-2
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170
Hor. Distance (m)

Distance (m)

No of Blocks = 50

Time step = 0.001 seconds

End at time = 0.00 seconds

Configuration = 3-dimensional

Boundary Block Geometry = Normal

Shape factor = 1.00

Maximum velocity = 10.98 at X = 118.43

Maximum front velocity = 10.98 at X =118.43

CENTRE OF GRAVITY: X-Source = 2.13

Z-Source = 220.17

X-Depos. = 118.45

Z-Depos. = 143.60

CG Ratio = 0.66

Travel angle = 33.35

FAHRBOSCHUNG = 31.39

FRONT DISPLACEMENT: X = 134.754 Z = 139.753

Curvilinear Displ.= 156.573

Horiz. Displ. = 129.70

REAR DISPLACEMENT: X = 2.53 Z = 219.26

Curvilinear Displ.= 3.81

Horiz. Displ. = 2.53

SLIDE VOLUME: Initial = 40.28

Final = 321.11

AREA IN PLAN: Initial = 44.77

Final = 998.82

Runout not completed, V-MAX = 0.01

Export Print Close Help

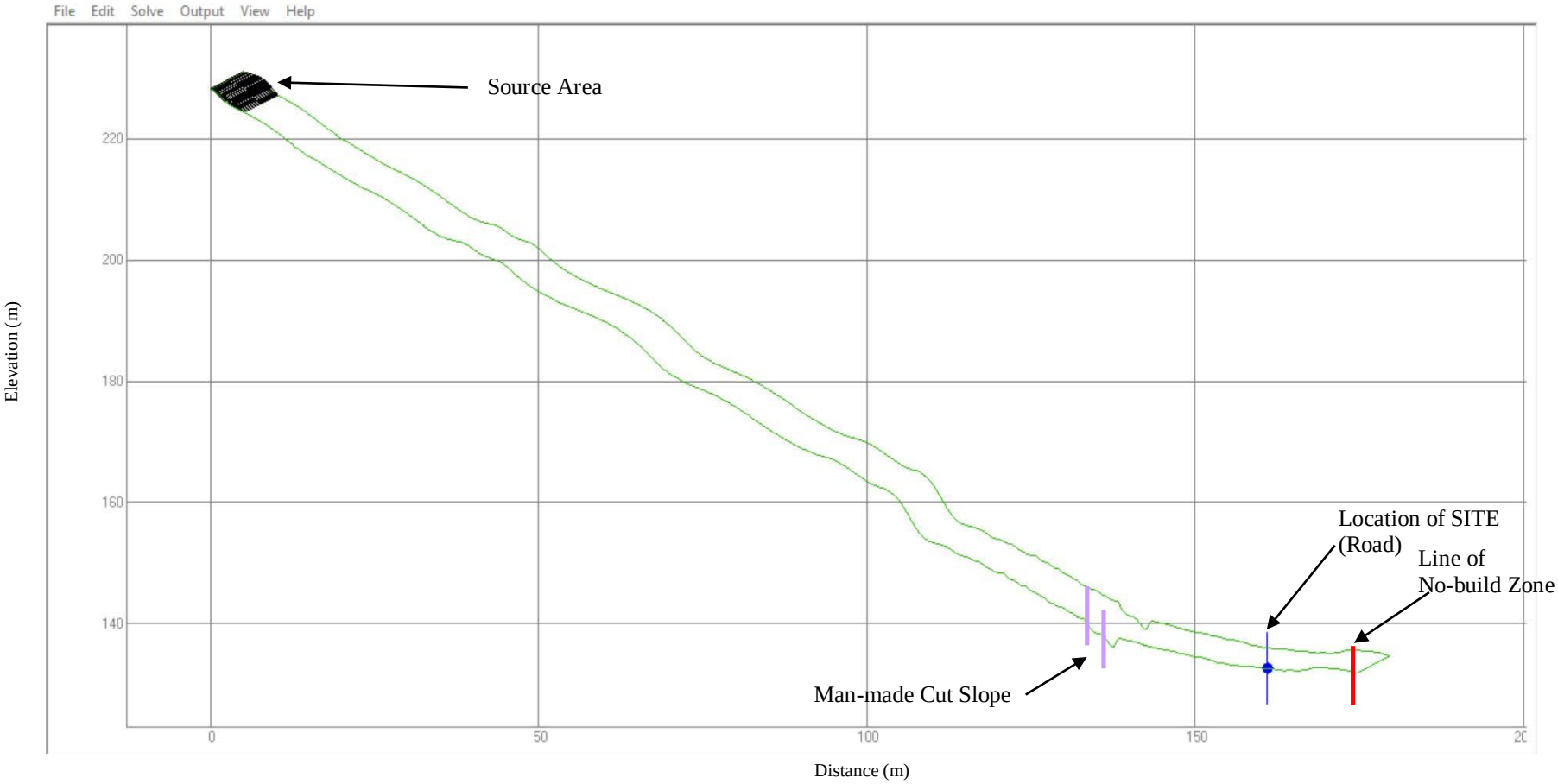
Debris Mobility Analysis for the Credible Runout Path RP17 within Catchment No. OH5

Landslide Type = OHL

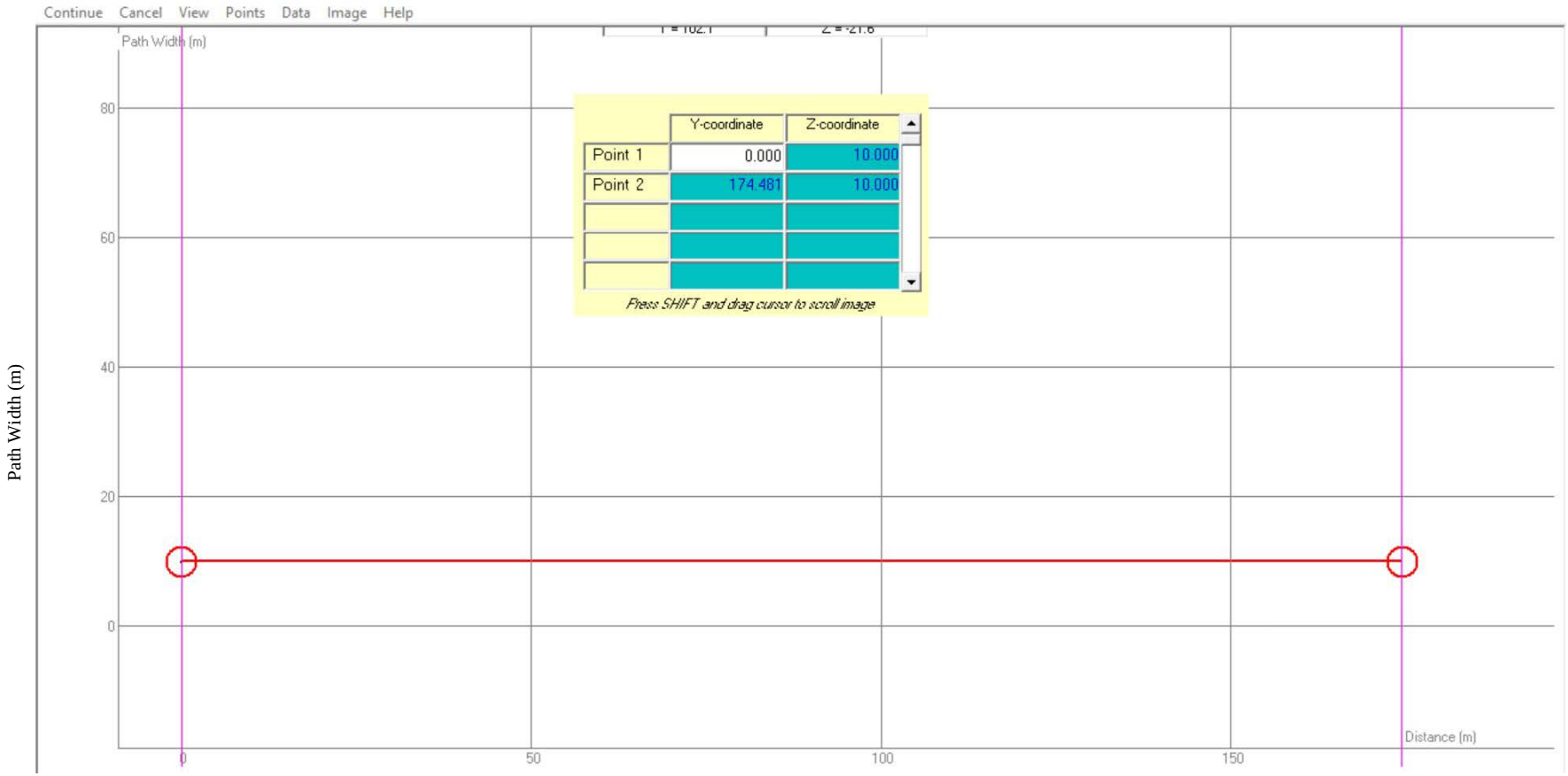
Design Source Volume = 40m^3

Figure D29

Section Profile – (pre-sliding)



Width Profile



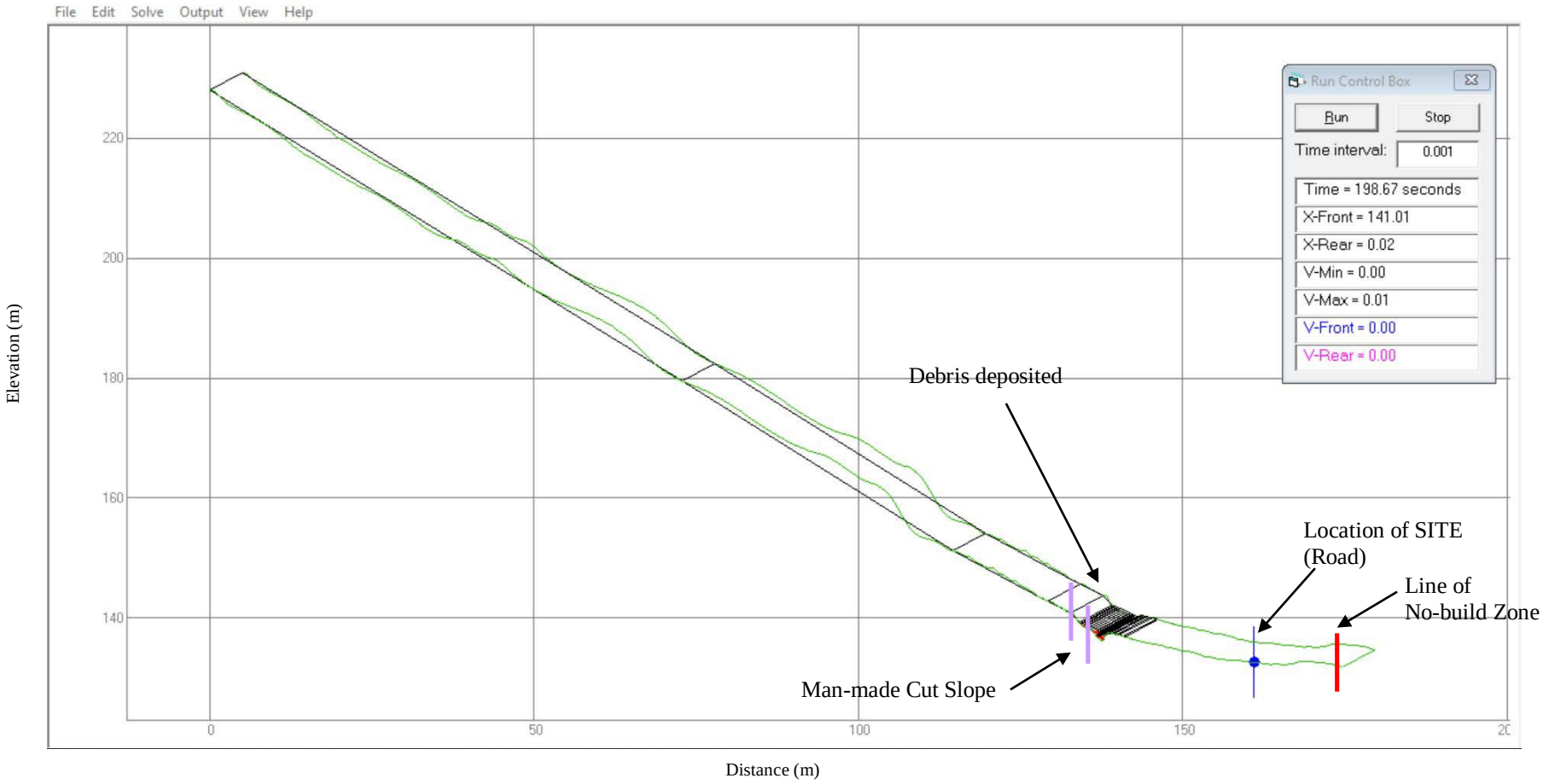
Path Width (m)

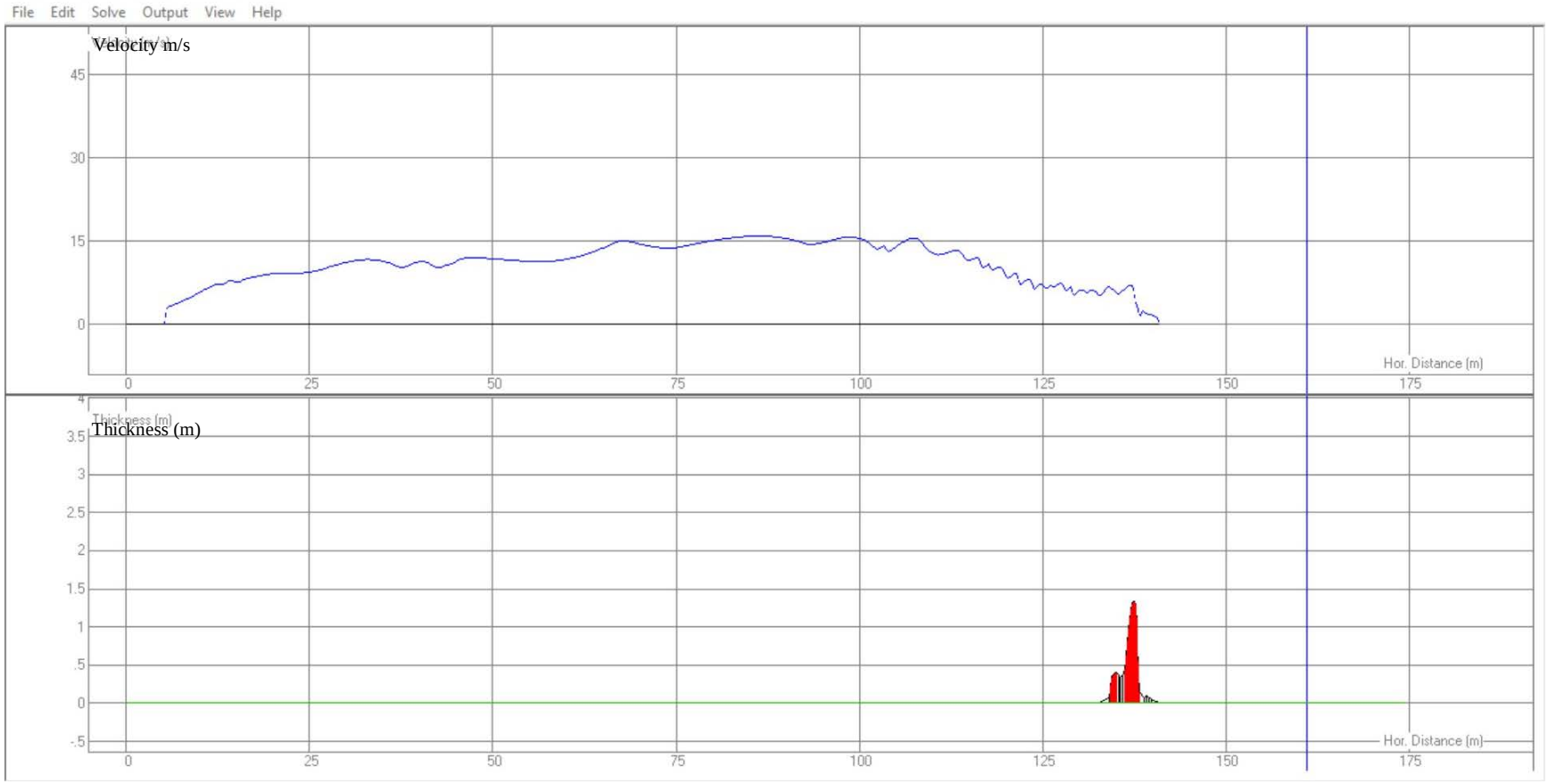
Distance (m)

Result of Debris Mobility Analysis

Source Volume (m^3)	Final Volume (m^3)	Travel Distance (m)	Debris Reached Proposed SITE Facility
40.89	40.89	135.74	No

Section Profile – (post-sliding)




File Edit Solve Output View Help
Velocity m/s
45
30
15
0
Hor. Distance (m)
0
25
50
75
100
125
150
175
Thickness (m)
3.5
3
2.5
2
1.5
1
.5
0
-.5
Hor. Distance (m)
0
25
50
75
100
125
150
175

Distance (m)

No of Blocks = 50

Time step = 0.001 seconds

End at time = 0.00 seconds

Configuration = 3-dimensional

Boundary Block Geometry = Normal

Shape factor = 1.00

Maximum velocity = 15.92 at X = 86.26

Maximum front velocity = 15.92 at X =86.26

CENTRE OF GRAVITY: X-Source = 2.86

Z-Source = 226.32

X-Depos. = 136.86

Z-Depos. = 137.43

CG Ratio = 0.66

Travel angle = 33.56

FAHRBOSCHUNG = 32.91

FRONT DISPLACEMENT: X = 141.011 Z = 136.877

Curvilinear Displ.= 166.178

Horiz. Displ. = 135.74

REAR DISPLACEMENT: X = 0.02 Z = 228.12

Curvilinear Displ.= 0.02

Horiz. Displ. = 0.02

SLIDE VOLUME: Initial = 40.89

Final = 40.89

AREA IN PLAN: Initial = 52.67

Final = 1409.93

Runout not completed, V-MAX = 0.01

Export Print Close Help

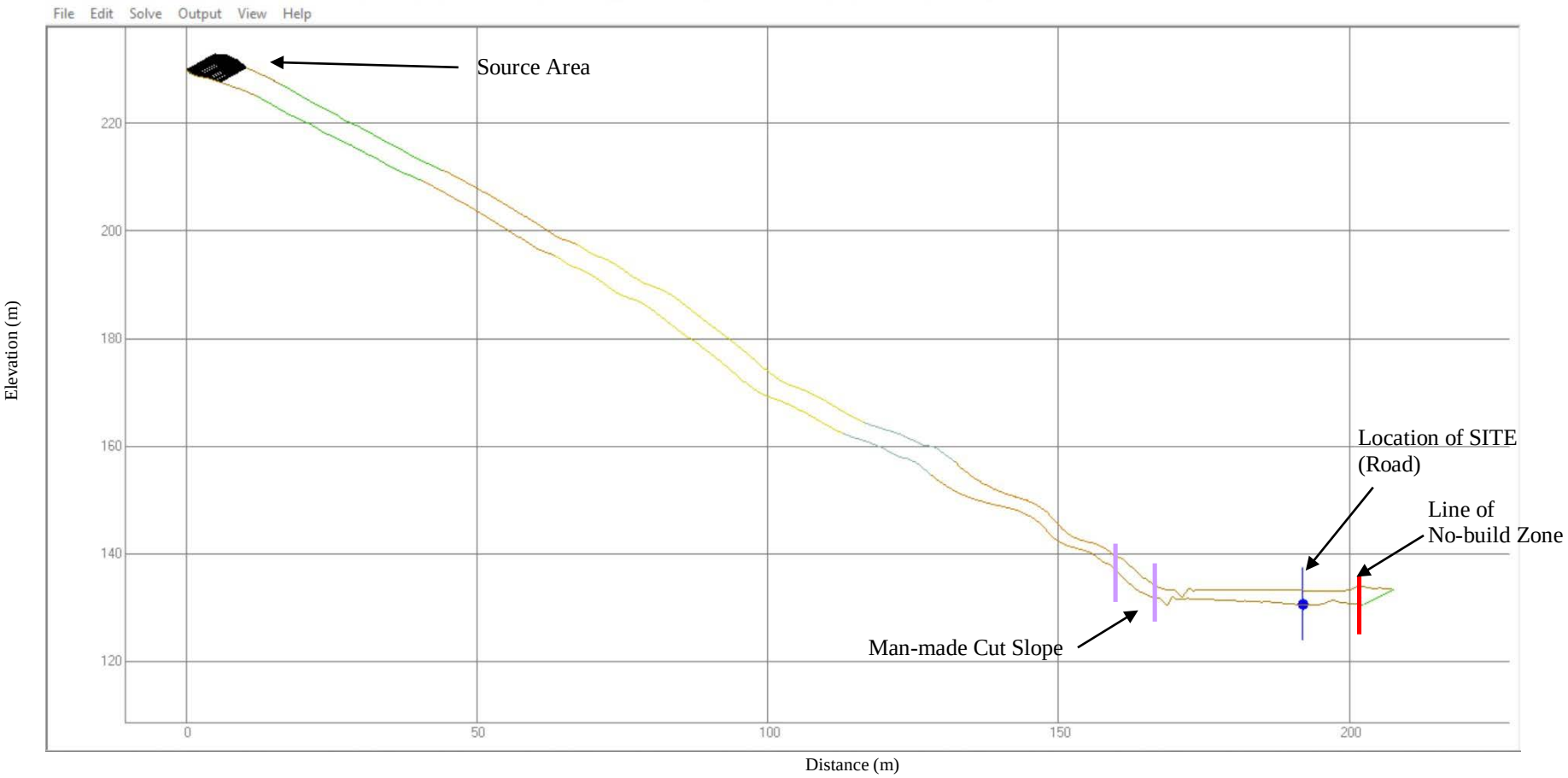
Debris Mobility Analysis for the Credible Runout Path RP18 within Catchment No. TD8

Landslide Type = DF

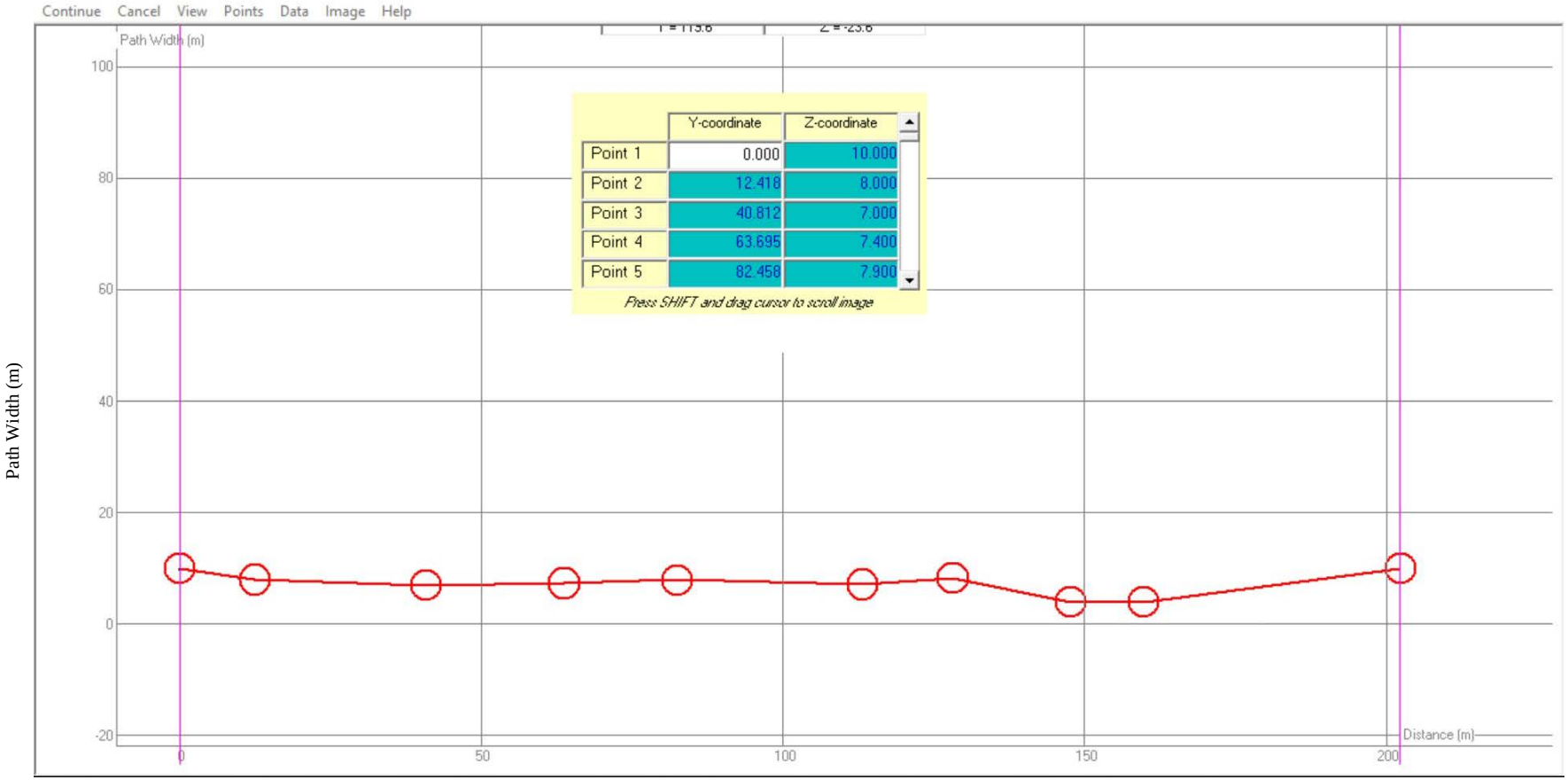
Design Source Volume = 40m^3

Figure D30

Section Profile – (pre-sliding)



Width Profile



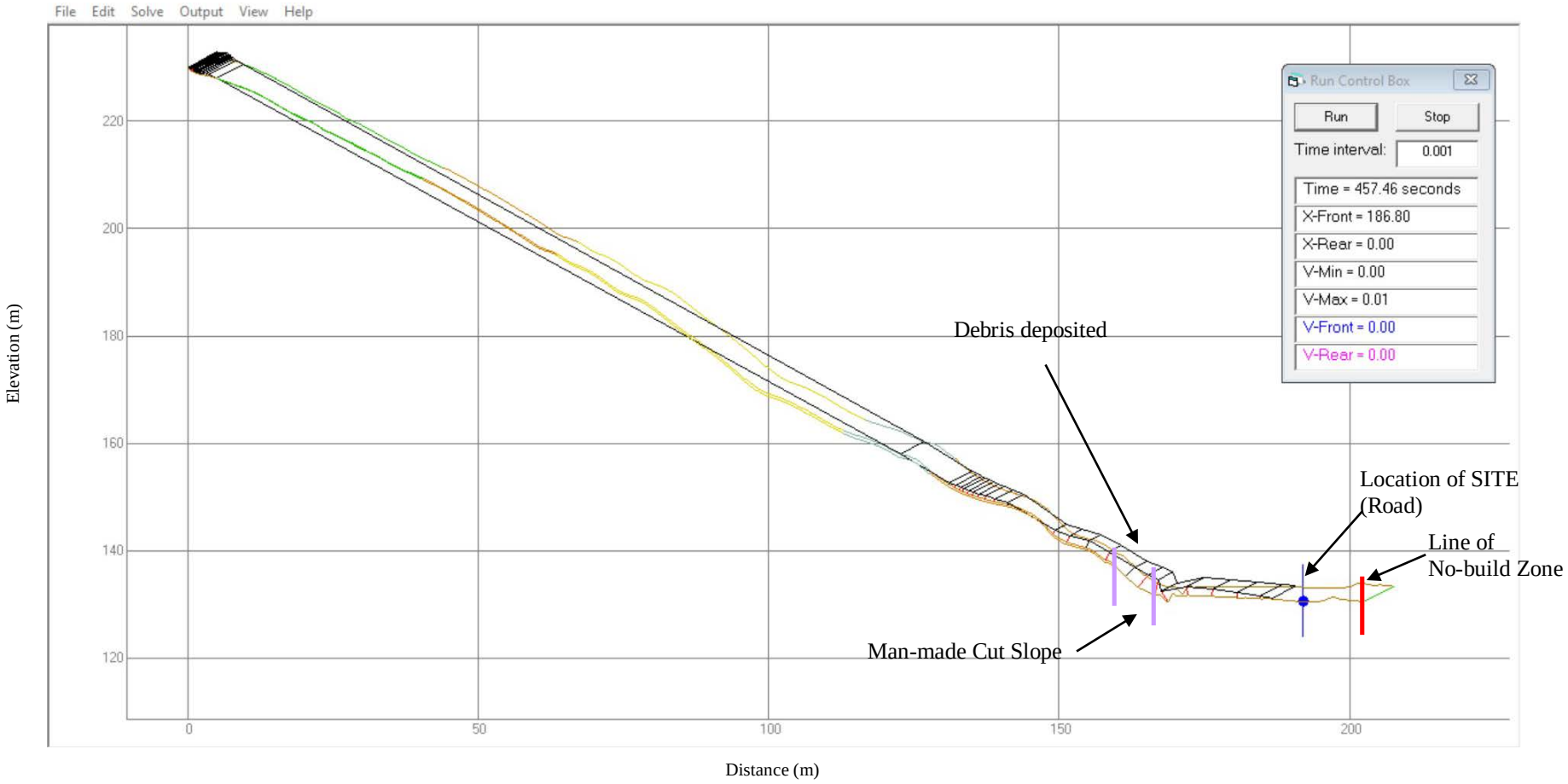
Path Width (m)

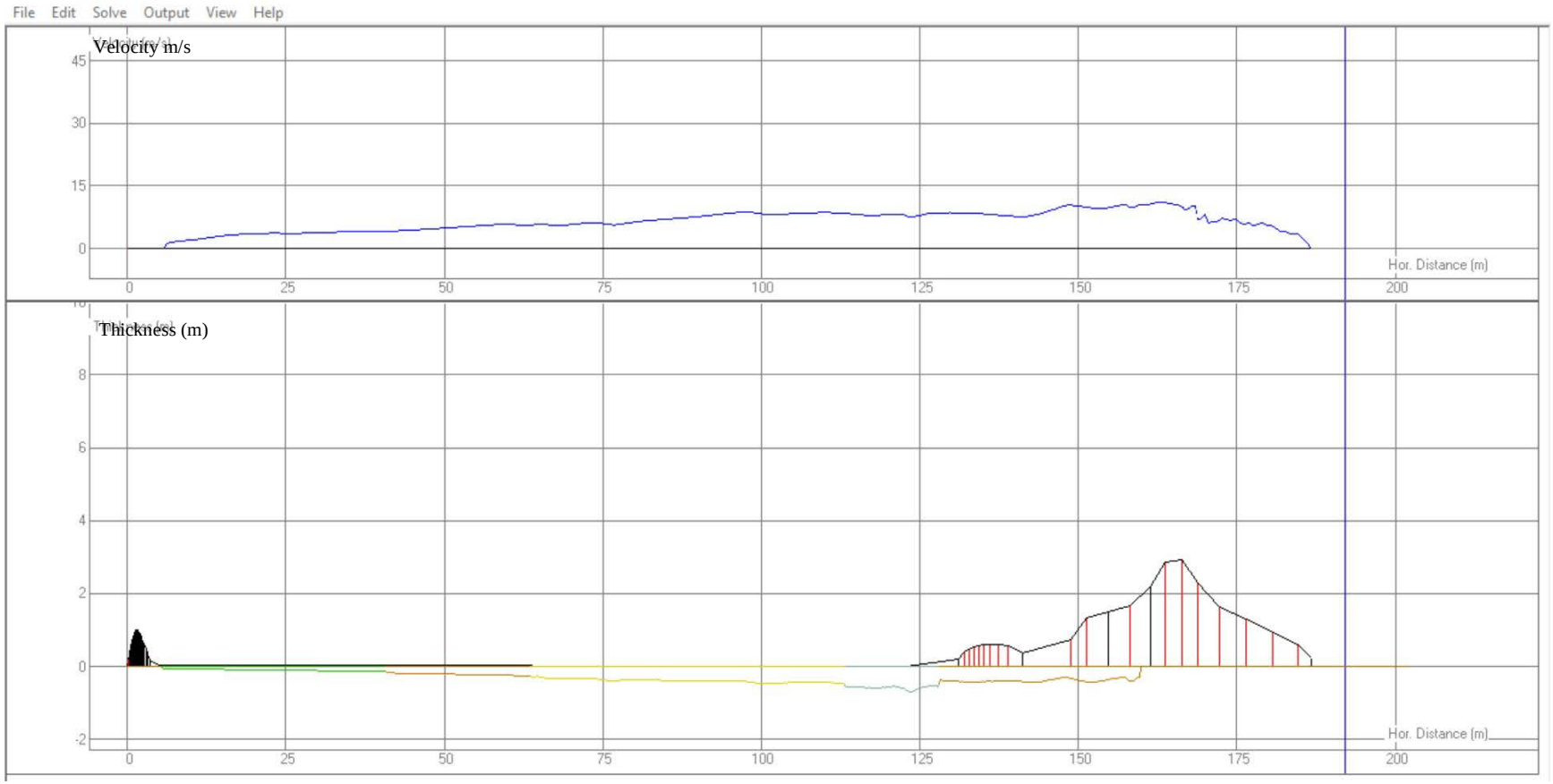
Distance (m)

Result of Debris Mobility Analysis

Source Volume (m^3)	Final Volume (m^3)	Travel Distance (m)	Debris Reached Proposed SITE Facility
40.61	434.97	180.95	No

Section Profile – (post-sliding)




File Edit Solve Output View Help
Velocity m/s
45
30
15
0
0 25 50 75 100 125 150 175 200
Hor. Distance (m)
Thickness (m)
8
6
4
2
0
-2
0 25 50 75 100 125 150 175 200
Hor. Distance (m)

Distance (m)

No of Blocks = 50

Time step = 0.001 seconds

End at time = 0.00 seconds

Configuration = 3-dimensional

Boundary Block Geometry = Normal

Shape factor = 1.00

Maximum velocity = 11.04 at X = 163.18

Maximum front velocity = 11.04 at X =163.18

CENTRE OF GRAVITY: X-Source = 2.64

Z-Source = 229.12

X-Depos. = 153.70

Z-Depos. = 142.24

CG Ratio = 0.58

Travel angle = 29.90

FAHRBOSCHUNG = 27.93

FRONT DISPLACEMENT: X = 186.801 Z = 130.973

Curvilinear Displ.= 210.886

Horiz. Displ. = 180.95

REAR DISPLACEMENT: X = 0.00 Z = 229.99

Curvilinear Displ.= 0.01

Horiz. Displ. = 0.00

SLIDE VOLUME: Initial = 40.61

Final = 434.97

AREA IN PLAN: Initial = 55.76

Final = 1423.61

Runout not completed, V-MAX = 0.01

Export Print Close Help

Appendix E

Unstable Boulders Extracted from the Boulder Survey Report

Boulder Investigation Sheet

Project Title: Engineering Study for Proposed New Public Riding School at Tseung Kwan O for the Hong Kong Jockey Club

Boulder No.: C120 Compiled by: SS, KG Checked by: AN Date: 02/12/2022

Boulder Characteristics						Boulder Setting Characteristics										(Use combinations as necessary)
Boulder Grouping	Visible Dimensions (m) (Multiple boulders: Maximum Dimensions)			Shape (Angularity)	Form	Support Type	Contact Condition	Local Slope Gradient Below Boulder (°)	Topography	Vegetation Type and Density Downslope	Nearest Proposed Facilities Downslope (Type/Distance) (m) (Paddock, stable blocks, changing room, etc.)	Risk Rating	Stability Rating	Potential Failure Mechanism	In-situ Preventive Works Required
	L1	L2	L3												
S	1	0.9	1.7	SR	ED	MS, DS, BS	3	30	CB	B, M	Public riding school, 50	H	M	R	R

Photo:



Upslope View



Cross-section View

Shape (Angularity)
A = Angular
SA = Sub-angular
SR = Sub-rounded
R = Rounded

Form
ED = Equidimensional
F = Flat
E = Elongated
FE = Flat and Elongated

Topography
PS = Planar Slope
VS = Valley Side Slope
S = Spur
LS = Landslide Scar
T = Terrace
CB = Channel Bed
F = Footslope
M = Man-made Slope
C = Cliff

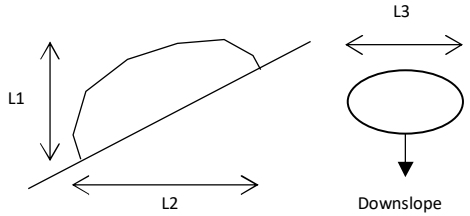
Grouping
S = Single
M = Multiple

Support Type
MS = Matrix Supported
R = Rock
DS = Dense Soil
LS = Loose Soil
Sh = Shotcrete
BS = Boulder Supported
VS = Vegetation Supported
U = Undermined
Other (please specify, e.g. Buttress)

Contact Condition
1 = Buried
2 = Lie firmly
3 = Lie firmly but with overhanging portion
4 = Lie loosely
5 = Lie loosely and with overhanging portion

Vegetation Type (25 m downslope of boulder)
MT = Mature Tree ≥ 100 mm trunk
YT = Young Tree < 100 mm trunk
B = Bushes
O = Other
N/A = No vegetation
Use combinations as necessary

Density of Vegetation
D = Dense (≥ 1/1 m^2))
M = Medium (1/25 m^2 – 1/1 m^2)
S = Sparse (< 1/25 m^2)



Preventive Works
S = Splitting
I = Infilling of Voids
M = Masonry Buttress
C = Concrete Buttress
SP = Surface Protection
D = Drainage Channel
R = Removal
RD = Rock Dowel
N/A = No Works Required

Risk Rating
L = Low: If movement occurred, it is highly unlikely that the boulder would reach the site area
H = High: If movement occurred, it is possible that the boulder would reach the site area

Stability Rating
L = Low: Active soil erosion removing support from around and/or beneath boulder, movement of boulder possible in the foreseeable future
M = Medium: Some vegetation present in the vicinity of the boulder with no active erosion evident
H = High: Dense vegetation with no active erosion evident in the vicinity of boulder, movement of boulder unlikely in the foreseeable future

Potential Failure Mechanism
R = Rolling: Removal of downhill support would enable boulder to roll forward
T = Toppling: Removal of downhill support would enable boulder to fall from steep slope
S = Sliding: Removal of downhill support would enable boulder to slide down from steep slope
N = Nil

Boulder Investigation Sheet

Project Title: Engineering Study for Proposed New Public Riding School at Tseung Kwan O for the Hong Kong Jockey Club

Boulder No.: C126 Compiled by: SS, KG Checked by: AN Date: 02/12/2022

Boulder Characteristics						Boulder Setting Characteristics										(Use combinations as necessary)
Boulder Grouping	Visible Dimensions (m) (Multiple boulders: Maximum Dimensions)			Shape (Angularity)	Form	Support Type	Contact Condition	Local Slope Gradient Below Boulder (°)	Topography	Vegetation Type and Density Downslope	Nearest Proposed Facilities Downslope (Type/Distance) (m) (Paddock, stable blocks, changing room, etc.)	Risk Rating	Stability Rating	Potential Failure Mechanism	In-situ Preventive Works Required
	L1	L2	L3												
S	0.8	0.8	1	SR	ED	MS, DS, U	3	35	S	B, YT, D	Public riding school, 20	H	L	R	R

Photo:



Upslope View



Cross-section View

Shape (Angularity)
A = Angular
SA = Sub-angular
SR = Sub-rounded
R = Rounded

Form
ED = Equidimensional
F = Flat
E = Elongated
FE = Flat and Elongated

Topography
PS = Planar Slope
VS = Valley Side Slope
S = Spur
LS = Landslide Scar
T = Terrace
CB = Channel Bed
F = Footslope
M = Man-made Slope
C = Cliff

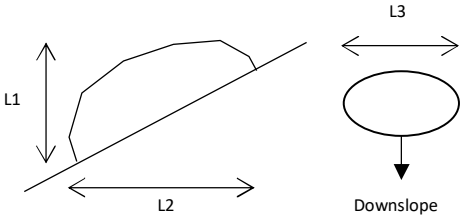
Grouping
S = Single
M = Multiple

Support Type
MS = Matrix Supported
R = Rock
DS = Dense Soil
LS = Loose Soil
Sh = Shotcrete
BS = Boulder Supported
VS = Vegetation Supported
U = Undermined
Other (please specify, e.g. Buttress)

Contact Condition
1 = Buried
2 = Lie firmly
3 = Lie firmly but with overhanging portion
4 = Lie loosely
5 = Lie loosely and with overhanging portion

Vegetation Type (25 m downslope of boulder)
MT = Mature Tree ≥ 100 mm trunk
YT = Young Tree < 100 mm trunk
B = Bushes
O = Other
N/A = No vegetation
Use combinations as necessary

Density of Vegetation
D = Dense (≥ 1/1 m^2))
M = Medium (1/25 m^2 – 1/1 m^2)
S = Sparse (< 1/25 m^2)



Preventive Works
S = Splitting
I = Infilling of Voids
M = Masonry Buttress
C = Concrete Buttress
SP = Surface Protection
D = Drainage Channel
R = Removal
RD = Rock Dowel
N/A = No Works Required

Risk Rating
L = Low: If movement occurred, it is highly unlikely that the boulder would reach the site area
H = High: If movement occurred, it is possible that the boulder would reach the site area

Stability Rating
L = Low: Active soil erosion removing support from around and/or beneath boulder, movement of boulder possible in the foreseeable future
M = Medium: Some vegetation present in the vicinity of the boulder with no active erosion evident
H = High: Dense vegetation with no active erosion evident in the vicinity of boulder, movement of boulder unlikely in the foreseeable future

Potential Failure Mechanism
R = Rolling: Removal of downhill support would enable boulder to roll forward
T = Toppling: Removal of downhill support would enable boulder to fall from steep slope
S = Sliding: Removal of downhill support would enable boulder to slide down from steep slope
N = Nil

Boulder Investigation Sheet

Project Title: Engineering Study for Proposed New Public Riding School at Tseung Kwan O for the Hong Kong Jockey Club

Boulder No.: C127 Compiled by: SS, KG Checked by: AN Date: 02/12/2022

Boulder Characteristics						Boulder Setting Characteristics										(Use combinations as necessary)
Boulder Grouping	Visible Dimensions (m) (Multiple boulders: Maximum Dimensions) L1	L2	L3	Shape (Angularity)	Form	Support Type	Contact Condition	Local Slope Gradient Below Boulder (°)	Topography	Vegetation Type and Density Downslope	Nearest Proposed Facilities Downslope (Type/Distance) (m) (Paddock, stable blocks, changing room, etc.)	Risk Rating	Stability Rating	Potential Failure Mechanism	In-situ Preventive Works Required
S	1	0.8	1.1	SR	ED	MS, BS, LS	3	35	S	B, YT, D	Public riding school, 30	H	M	R	R

Photo:



Upslope View



Cross-section View

Shape (Angularity)
A = Angular
SA = Sub-angular
SR = Sub-rounded
R = Rounded

Form
ED = Equidimensional
F = Flat
E = Elongated
FE = Flat and Elongated

Topography
PS = Planar Slope
VS = Valley Side Slope
S = Spur
LS = Landslide Scar
T = Terrace
CB = Channel Bed
F = Footslope
M = Man-made Slope
C = Cliff

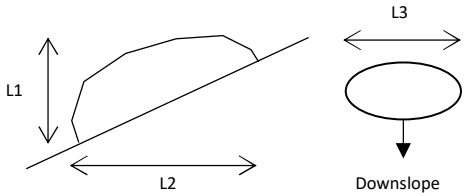
Grouping
S = Single
M = Multiple

Support Type
MS = Matrix Supported
R = Rock
DS = Dense Soil
LS = Loose Soil
Sh = Shotcrete
BS = Boulder Supported
VS = Vegetation Supported
U = Undermined
Other (please specify, e.g. Buttress)

Contact Condition
1 = Buried
2 = Lie firmly
3 = Lie firmly but with overhanging portion
4 = Lie loosely
5 = Lie loosely and with overhanging portion

Vegetation Type (25 m downslope of boulder)
MT = Mature Tree ≥ 100 mm trunk
YT = Young Tree < 100 mm trunk
B = Bushes
O = Other
N/A = No vegetation
Use combinations as necessary

Density of Vegetation
D = Dense (≥ 1/1 m^2))
M = Medium (1/25 m^2 – 1/1 m^2)
S = Sparse (< 1/25 m^2)



Preventive Works
S = Splitting
I = Infilling of Voids
M = Masonry Buttress
C = Concrete Buttress
SP = Surface Protection
D = Drainage Channel
R = Removal
RD = Rock Dowel
N/A = No Works Required

Risk Rating
L = Low: If movement occurred, it is highly unlikely that the boulder would reach the site area
H = High: If movement occurred, it is possible that the boulder would reach the site area

Stability Rating
L = Low: Active soil erosion removing support from around and/or beneath boulder, movement of boulder possible in the foreseeable future
M = Medium: Some vegetation present in the vicinity of the boulder with no active erosion evident
H = High: Dense vegetation with no active erosion evident in the vicinity of boulder, movement of boulder unlikely in the foreseeable future

Potential Failure Mechanism
R = Rolling: Removal of downhill support would enable boulder to roll forward
T = Toppling: Removal of downhill support would enable boulder to fall from steep slope
S = Sliding: Removal of downhill support would enable boulder to slide down from steep slope
N = Nil

Boulder Investigation Sheet

Project Title: Engineering Study for Proposed New Public Riding School at Tseung Kwan O for the Hong Kong Jockey Club

Boulder No.: C128 Compiled by: SS, KG Checked by: AN Date: 02/12/2022

Boulder Characteristics						Boulder Setting Characteristics										(Use combinations as necessary)
Boulder Grouping	Visible Dimensions (m) (Multiple boulders: Maximum Dimensions) L1	L2	L3	Shape (Angularity)	Form	Support Type	Contact Condition	Local Slope Gradient Below Boulder (°)	Topography	Vegetation Type and Density Downslope	Nearest Proposed Facilities Downslope (Type/Distance) (m) (Paddock, stable blocks, changing room, etc.)	Risk Rating	Stability Rating	Potential Failure Mechanism	In-situ Preventive Works Required
S	2	1.9	2.5	SR	ED	MS, R, DS	3	35	S	B, YT, D	Public riding school, 20	H	M	R	R

Photo:



Upslope View



Cross-section View

Shape (Angularity)
A = Angular
SA = Sub-angular
SR = Sub-rounded
R = Rounded

Form
ED = Equidimensional
F = Flat
E = Elongated
FE = Flat and Elongated

Topography
PS = Planar Slope
VS = Valley Side Slope
S = Spur
LS = Landslide Scar
T = Terrace
CB = Channel Bed
F = Footslope
M = Man-made Slope
C = Cliff

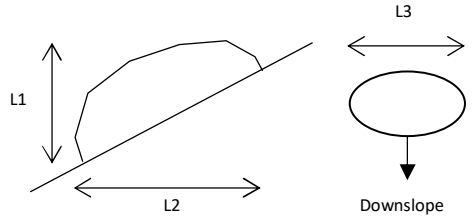
Grouping
S = Single
M = Multiple

Support Type
MS = Matrix Supported
R = Rock
DS = Dense Soil
LS = Loose Soil
Sh = Shotcrete
BS = Boulder Supported
VS = Vegetation Supported
U = Undermined
Other (please specify, e.g. Buttress)

Contact Condition
1 = Buried
2 = Lie firmly
3 = Lie firmly but with overhanging portion
4 = Lie loosely
5 = Lie loosely and with overhanging portion

Vegetation Type (25 m downslope of boulder)
MT = Mature Tree ≥ 100 mm trunk
YT = Young Tree < 100 mm trunk
B = Bushes
O = Other
N/A = No vegetation
Use combinations as necessary

Density of Vegetation
D = Dense (≥ 1/1 m^2))
M = Medium (1/25 m^2 – 1/1 m^2)
S = Sparse (< 1/25 m^2)



Preventive Works
S = Splitting
I = Infilling of Voids
M = Masonry Buttress
C = Concrete Buttress
SP = Surface Protection
D = Drainage Channel
R = Removal
RD = Rock Dowel
N/A = No Works Required

Risk Rating
L = Low: If movement occurred, it is highly unlikely that the boulder would reach the site area
H = High: If movement occurred, it is possible that the boulder would reach the site area

Stability Rating
L = Low: Active soil erosion removing support from around and/or beneath boulder, movement of boulder possible in the foreseeable future
M = Medium: Some vegetation present in the vicinity of the boulder with no active erosion evident
H = High: Dense vegetation with no active erosion evident in the vicinity of boulder, movement of boulder unlikely in the foreseeable future

Potential Failure Mechanism
R = Rolling: Removal of downhill support would enable boulder to roll forward
T = Toppling: Removal of downhill support would enable boulder to fall from steep slope
S = Sliding: Removal of downhill support would enable boulder to slide down from steep slope
N = Nil

Boulder Investigation Sheet

Project Title: Engineering Study for Proposed New Public Riding School at Tseung Kwan O for the Hong Kong Jockey Club

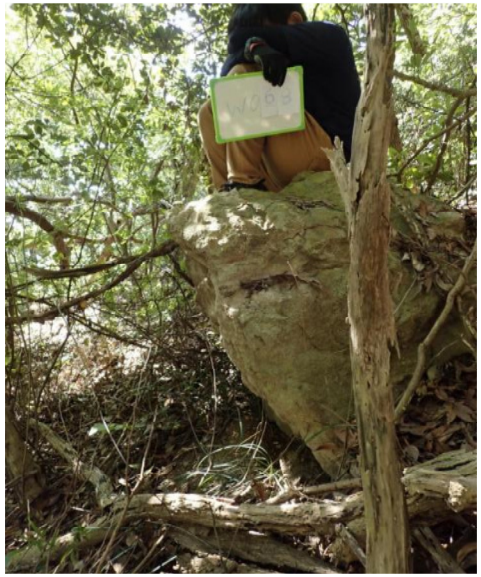
Boulder No.: W068 Compiled by: LS Checked by: AN Date: 10/11/2022

Boulder Characteristics						Boulder Setting Characteristics										(Use combinations as necessary)
Boulder Grouping	Visible Dimensions (m) (Multiple boulders: Maximum Dimensions) L1	L2	L3	Shape (Angularity)	Form	Support Type	Contact Condition	Local Slope Gradient Below Boulder (°)	Topography	Vegetation Type and Density Downslope	Nearest Proposed Facilities Downslope (Type/Distance) (m) (Paddock, stable blocks, changing room, etc.)	Risk Rating	Stability Rating	Potential Failure Mechanism	In-situ Preventive Works Required
S	1.3	1.2	0.9	SA	ED	MS, LS, U	3	30	PS	MT, YT, D	Public riding school, 40	H	L	R	R

Photo:



Upslope View



Cross-section View

Shape (Angularity)
A = Angular
SA = Sub-angular
SR = Sub-rounded
R = Rounded

Form
ED = Equidimensional
F = Flat
E = Elongated
FE = Flat and Elongated

Topography
PS = Planar Slope
VS = Valley Side Slope
S = Spur
LS = Landslide Scar
T = Terrace
CB = Channel Bed
F = Footslope
M = Man-made Slope
C = Cliff

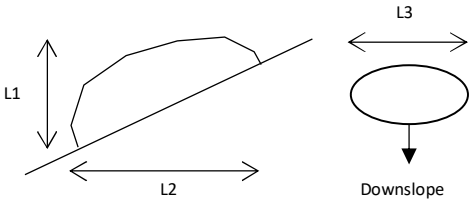
Grouping
S = Single
M = Multiple

Support Type
MS = Matrix Supported
R = Rock
DS = Dense Soil
LS = Loose Soil
Sh = Shotcrete
BS = Boulder Supported
VS = Vegetation Supported
U = Undermined
Other (please specify, e.g. Buttress)

Contact Condition
1 = Buried
2 = Lie firmly
3 = Lie firmly but with overhanging portion
4 = Lie loosely
5 = Lie loosely and with overhanging portion

Vegetation Type (25 m downslope of boulder)
MT = Mature Tree ≥ 100 mm trunk
YT = Young Tree < 100 mm trunk
B = Bushes
O = Other
N/A = No vegetation
Use combinations as necessary

Density of Vegetation
D = Dense (≥ 1/1 m²))
M = Medium (1/25 m² – 1/1 m²)
S = Sparse (< 1/25 m²)



Preventive Works
S = Splitting
I = Infilling of Voids
M = Masonry Buttress
C = Concrete Buttress
SP = Surface Protection
D = Drainage Channel
R = Removal
RD = Rock Dowel
N/A = No Works Required

Risk Rating
L = Low: If movement occurred, it is highly unlikely that the boulder would reach the site area
H = High: If movement occurred, it is possible that the boulder would reach the site area

Stability Rating
L = Low: Active soil erosion removing support from around and/or beneath boulder, movement of boulder possible in the foreseeable future
M = Medium: Some vegetation present in the vicinity of the boulder with no active erosion evident
H = High: Dense vegetation with no active erosion evident in the vicinity of boulder, movement of boulder unlikely in the foreseeable future

Potential Failure Mechanism
R = Rolling: Removal of downhill support would enable boulder to roll forward
T = Toppling: Removal of downhill support would enable boulder to fall from steep slope
S = Sliding: Removal of downhill support would enable boulder to slide down from steep slope
N = Nil

Boulder Investigation Sheet

Project Title: Engineering Study for Proposed New Public Riding School at Tseung Kwan O for the Hong Kong Jockey Club

Boulder No.: W075 Compiled by: LS Checked by: AN Date: 14/11/2022

Boulder Characteristics						Boulder Setting Characteristics									(Use combinations as necessary)
Boulder Grouping	Visible Dimensions (m) (Multiple boulders: Maximum Dimensions) L1	L2	L3	Shape (Angularity)	Form	Support Type	Contact Condition	Local Slope Gradient Below Boulder (°)	Topography	Vegetation Type and Density Downslope	Nearest Proposed Facilities Downslope (Type/Distance) (m) (Paddock, stable blocks, changing room, etc.)	Risk Rating	Stability Rating	Potential Failure Mechanism	In-situ Preventive Works Required
S	0.8	0.8	0.9	SA	ED	MS, DS, U	3	20	PS	YT, B, M	Public riding school, 30	H	M	R	R

Photo:



Upslope View



Cross-section View

Shape (Angularity)
A = Angular
SA = Sub-angular
SR = Sub-rounded
R = Rounded

Form
ED = Equidimensional
F = Flat
E = Elongated
FE = Flat and Elongated

Topography
PS = Planar Slope
VS = Valley Side Slope
S = Spur
LS = Landslide Scar
T = Terrace
CB = Channel Bed
F = Footslope
M = Man-made Slope
C = Cliff

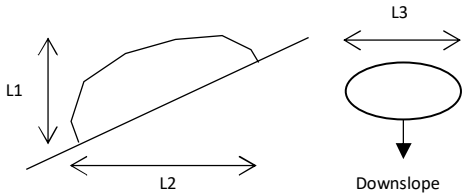
Grouping
S = Single
M = Multiple

Support Type
MS = Matrix Supported
R = Rock
DS = Dense Soil
LS = Loose Soil
Sh = Shotcrete
BS = Boulder Supported
VS = Vegetation Supported
U = Undermined
Other (please specify, e.g. Buttress)

Contact Condition
1 = Buried
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Vegetation Type (25 m downslope of boulder)
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O = Other
N/A = No vegetation
Use combinations as necessary

Density of Vegetation
D = Dense (≥ 1/1 m^2))
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Preventive Works
S = Splitting
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Risk Rating
L = Low: If movement occurred, it is highly unlikely that the boulder would reach the site area
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L = Low: Active soil erosion removing support from around and/or beneath boulder, movement of boulder possible in the foreseeable future
M = Medium: Some vegetation present in the vicinity of the boulder with no active erosion evident
H = High: Dense vegetation with no active erosion evident in the vicinity of boulder, movement of boulder unlikely in the foreseeable future

Potential Failure Mechanism
R = Rolling: Removal of downhill support would enable boulder to roll forward
T = Toppling: Removal of downhill support would enable boulder to fall from steep slope
S = Sliding: Removal of downhill support would enable boulder to slide down from steep slope
N = Nil

Appendix F

Boulder Fall Modelling

F1. Introduction

This appendix presents the results of boulder fall analysis for the Study Area preformed by a computer program Colorado Rock Fall Simulation Program (CRSP) Version 4 developed jointly by the Colorado Department of Transport, the Colorado Geological Survey and the Colorado School of Mines. This is a windows based program to assess the velocities and energies of boulders, which have sufficient mobility to affect the facilities located below the Study Area.

F2. Boulder Fall Analysis for the Study Area

Based on the field observation, four potential unstable boulders are identified at the lower portion of Catchment Nos. OH4 and TD7 (Figure F1). The predicted trajectories for these boulders are simulated by the steepest paths generated based on 1:1000 topographic data using the software ArcGIS version 10.3.1. Boulder fall parameters used in the study were based on published data in Chau et al. (1996).

a. Input Parameters:

The behavior of boulders is influenced by slope geometry, slope material properties, rock block geometry and boulder material properties (Table F1). These parameters are estimated from field mapping and with reference to Chau et al, 1996.

Table F1 – Parameters determining behavior of boulder fall

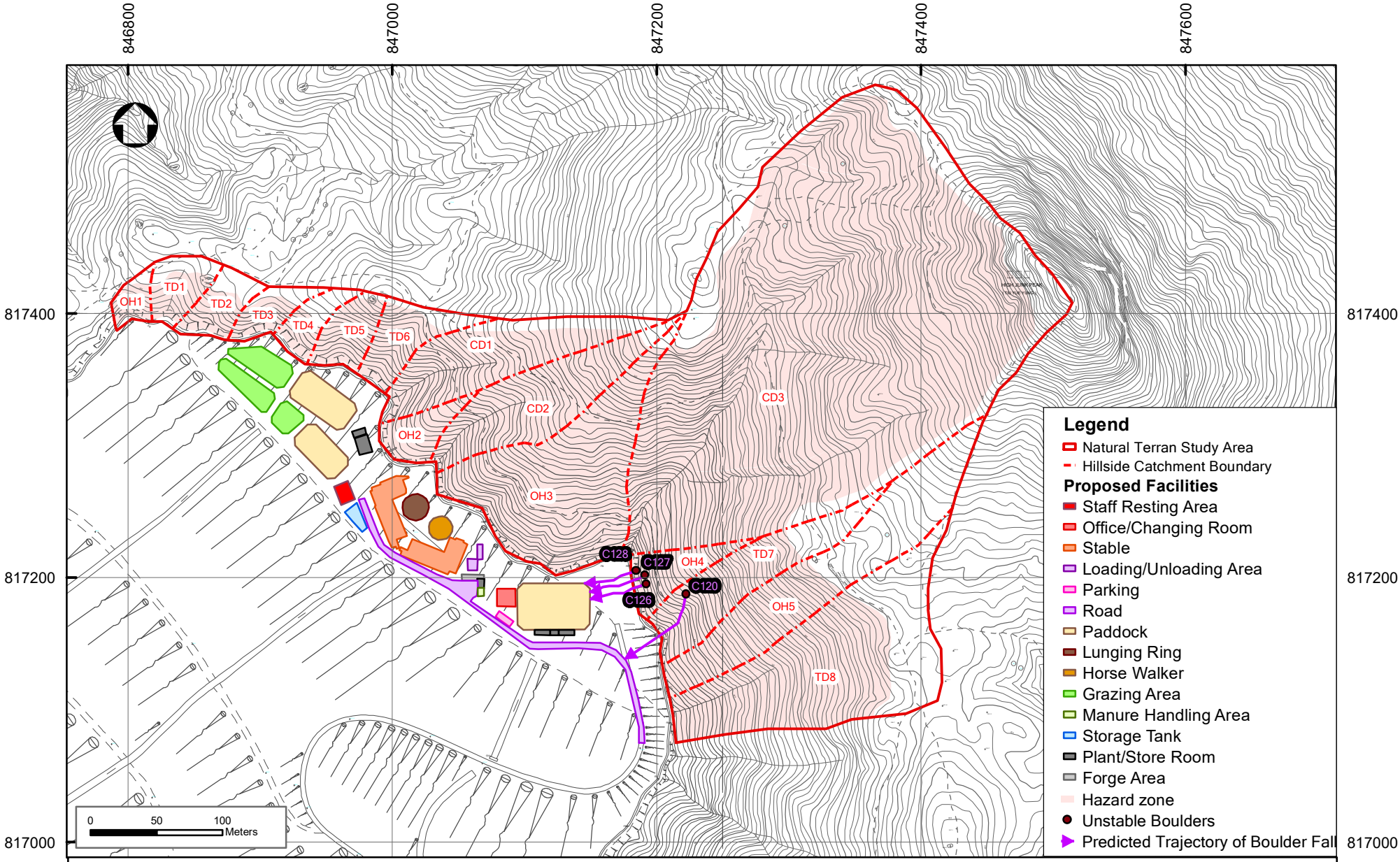
Factors	**Parameters**
Slope Geometry	*Slope inclination*
	Slope length
	Surface roughness
	Lateral variability
Slope Material Properties	*Slope coefficients*
	Rock coefficients
Rock Geometry	*Rock size*
	Rock Shape
Rock Material Properties	*Rock Durability*
	Rock mass

b. Summary of Findings:

The results of analysis are shown in Figures F2 to F5 and summarized in Table F2. Mobility analysis demonstrated that C120, C126, C127 and C128 cannot reach the proposed facilities.

Table F2 – Results of Analysis

Boulder No.	Catchment No.	% of Boulder Passing Analysis Point 1 (AP1, location of proposed facility)	Max. velocity at AP1 (m/s)	Max. bounce height at AP1 (m)	Max. energy at analysis point at AP1 (kJ)
C120	TD7	0	-	-	-
C126	OH4	0	-	-	-
C127	OH4	0	-	-	-
C128	OH4	0	-	-	-



PROJECT: Natural Terrain Hazard Study for the Proposed Development of New Public Riding School at the Restored Landfill Site (TKOL II/III) in Tseung Kwan O

TITLE: Predicted Trajectory of Boulder Fall	SCALE: 1 :4000	Modern Consulting Engineers Limited In association with CALVINT GEO-SERVICES LIMITED	FIGURE NO : FIGURE F1

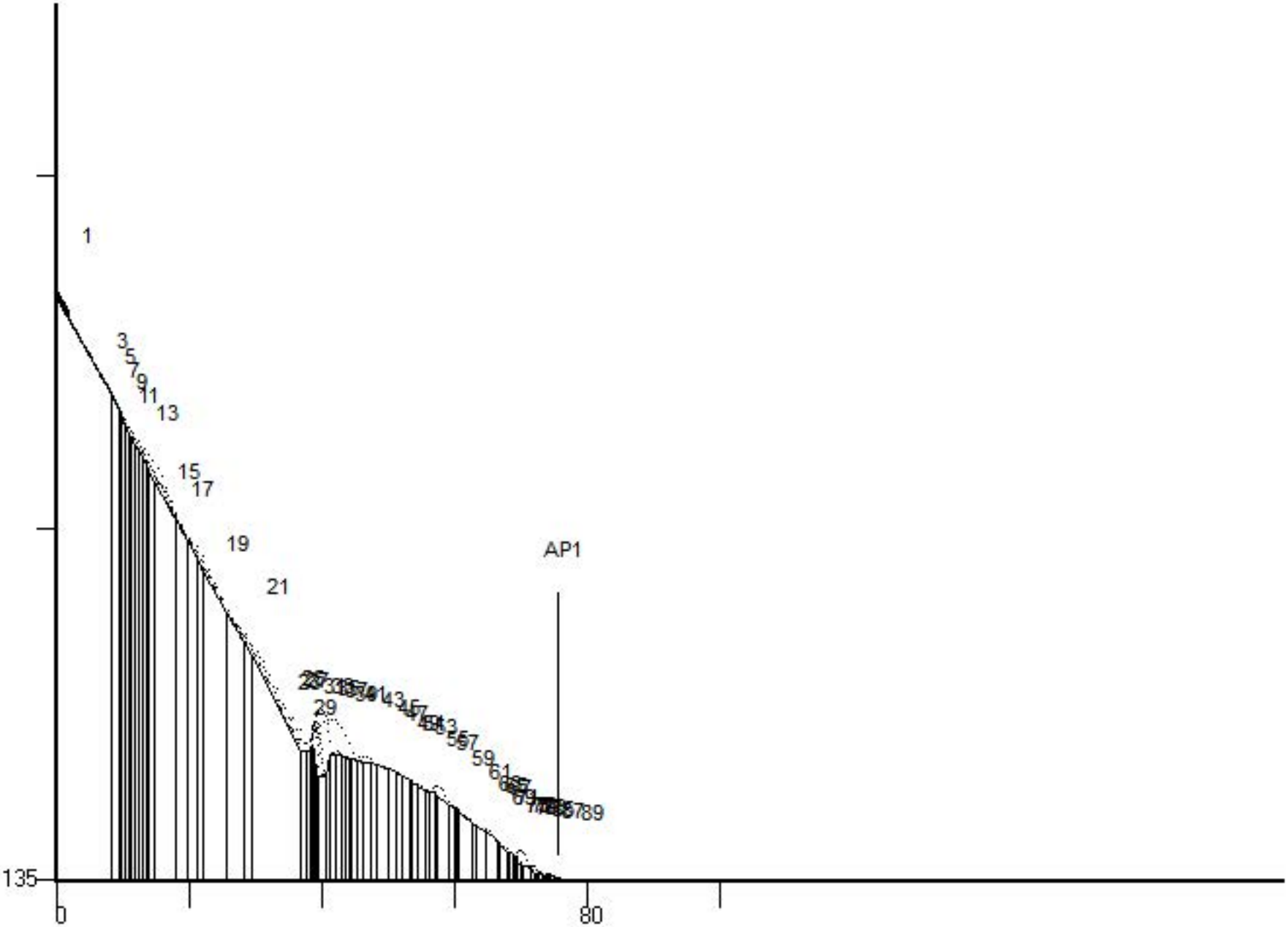


Figure F2 - Boulder Fall Modelling (C120)

CRSP Input File -C:\Users\Tseung Kwan O Landfill NTHS\After comments\Boulder Fall Anaysis\C120\C120.doc

Input File Specifications

Units of Measure: Metric
Total Number of Cells: 89
Analysis Point 1 X-Coordinate: 75.51
Analysis Point 2 X-Coordinate:
Analysis Point 3 X-Coordinate:
Initial Y-Top Starting Zone Coordinate: 168
Initial Y-Base Starting Zone Coordinate: 167

Remarks:

Cell Data

Cell No.	S.R.	Tang. C.	Norm. C.	Begin X	Begin Y	End X	End Y
1	0.1	0.567	0.393	0	168	8.067	162.57
2	0.1	0.567	0.393	8.067	162.57	9.255	161.7
3	0.1	0.567	0.393	9.255	161.7	9.706	161.15
4	0.1	0.567	0.393	9.706	161.15	10.241	160.79
5	0.1	0.567	0.393	10.241	160.79	10.684	160.44
6	0.1	0.567	0.393	10.684	160.44	10.986	160.1
7	0.1	0.567	0.393	10.986	160.1	11.548	159.71
8	0.1	0.567	0.393	11.548	159.71	12.18	159.44
9	0.1	0.567	0.393	12.18	159.44	12.67	159.01
10	0.1	0.567	0.393	12.67	159.01	13.284	158.6
11	0.1	0.567	0.393	13.284	158.6	13.798	158.25
12	0.1	0.567	0.393	13.798	158.25	14.599	157.66
13	0.1	0.567	0.393	14.599	157.66	17.673	155.47
14	0.1	0.567	0.393	17.673	155.47	19.446	154.3
15	0.1	0.567	0.393	19.446	154.3	19.629	154.31
16	0.1	0.567	0.393	19.629	154.31	20.952	153.28
17	0.1	0.567	0.393	20.952	153.28	21.881	152.56
18	0.1	0.567	0.393	21.881	152.56	25.425	150.13

19	0.1	0.567	0.393	25.425	150.13	28.027
148.55						
20	0.1	0.567	0.393	28.027	148.55	29.218
147.76						
21	0.1	0.567	0.393	29.218	147.76	36.725
142.33						
22	0.1	0.567	0.393	36.725	142.33	37.387
142.27						
23	0.1	0.567	0.393	37.387	142.27	37.966
142.29						
24	0.1	0.567	0.393	37.966	142.29	38.167
142.52						
25	0.1	0.567	0.393	38.167	142.52	38.404
142.63						
26	0.1	0.567	0.393	38.404	142.63	38.625
142.44						
27	0.1	0.567	0.393	38.625	142.44	38.983
140.8						
28	0.1	0.567	0.393	38.983	140.8	39.243
140.83						
29	0.1	0.567	0.393	39.243	140.83	40.545
140.84						
30	0.1	0.567	0.393	40.545	140.84	41.01
142.06						
31	0.1	0.567	0.393	41.01	142.06	41.792
142.08						
32	0.1	0.567	0.393	41.792	142.08	42.681
142.08						
33	0.1	0.567	0.393	42.681	142.08	42.868
141.99						
34	0.1	0.567	0.393	42.868	141.99	43.273
141.95						
35	0.1	0.567	0.393	43.273	141.95	43.96
141.83						
36	0.1	0.567	0.393	43.96	141.83	44.335
141.88						
37	0.1	0.567	0.393	44.335	141.88	45.303
141.78						
38	0.1	0.567	0.393	45.303	141.78	45.953
141.63						
39	0.1	0.567	0.393	45.953	141.63	46.187
141.61						
40	0.1	0.567	0.393	46.187	141.61	47.232
141.6						
41	0.1	0.567	0.393	47.232	141.6	48.188
141.48						
42	0.1	0.567	0.393	48.188	141.48	49.846
141.27						
43	0.1	0.567	0.393	49.846	141.27	50.948
141.07						
44	0.1	0.567	0.393	50.948	141.07	52.025
140.9						
45	0.1	0.567	0.393	52.025	140.9	53.171
140.6						
46	0.1	0.567	0.393	53.171	140.6	53.381
140.54						
47	0.1	0.567	0.393	53.381	140.54	54.266
140.34						

48	0.1	0.567	0.393	54.266	140.34	55.564
140.03						
49	0.1	0.567	0.393	55.564	140.03	55.933
140						
50	0.1	0.567	0.393	55.933	140	56.19
140.03						
51	0.1	0.567	0.393	56.19	140.03	56.8
140						
52	0.1	0.567	0.393	56.8	140	57.297
139.74						
53	0.1	0.567	0.393	57.297	139.74	58.974
139.23						
54	0.1	0.567	0.393	58.974	139.23	59.989
139.04						
55	0.1	0.567	0.393	59.989	139.04	60.258
138.93						
56	0.1	0.567	0.393	60.258	138.93	60.413
138.87						
57	0.1	0.567	0.393	60.413	138.87	62.593
138.23						
58	0.1	0.567	0.393	62.593	138.23	63.19
138.03						
59	0.1	0.567	0.393	63.19	138.03	64.566
137.74						
60	0.1	0.567	0.393	64.566	137.74	66.229
137.16						
61	0.1	0.567	0.393	66.229	137.16	66.548
137.03						
62	0.1	0.567	0.393	66.548	137.03	67.866
136.59						
63	0.1	0.567	0.393	67.866	136.59	68.154
136.54						
64	0.1	0.567	0.393	68.154	136.54	68.77
136.41						
65	0.1	0.567	0.393	68.77	136.41	68.922
136.29						
66	0.1	0.567	0.393	68.922	136.29	69.177
136.35						
67	0.1	0.567	0.393	69.177	136.35	69.433
136.04						
68	0.1	0.567	0.393	69.433	136.04	69.878
135.79						
69	0.1	0.567	0.393	69.878	135.79	69.957
135.94						
70	0.1	0.567	0.393	69.957	135.94	70.074
135.72						
71	0.1	0.567	0.393	70.074	135.72	71.264
135.61						
72	0.1	0.567	0.393	71.264	135.61	71.89
135.32						
73	0.1	0.567	0.393	71.89	135.32	71.997
135.24						
74	0.1	0.567	0.393	71.997	135.24	72.101
135.34						
75	0.1	0.567	0.393	72.101	135.34	72.242
135.28						
76	0.1	0.567	0.393	72.242	135.28	72.559
135.31						

77	0.1	0.567	0.393	72.559	135.31	73.255
135.28						
78	0.1	0.567	0.393	73.255	135.28	73.489
135.26						
79	0.1	0.567	0.393	73.489	135.26	73.691
135.36						
80	0.1	0.567	0.393	73.691	135.36	74.069
135.33						
81	0.1	0.567	0.393	74.069	135.33	74.211
135.36						
82	0.1	0.567	0.393	74.211	135.36	74.402
135.23						
83	0.1	0.567	0.393	74.402	135.23	75.006
135.17						
84	0.1	0.567	0.393	75.006	135.17	75.259
135.15						
85	0.1	0.567	0.393	75.259	135.15	76.579
135.04						
86	0.1	0.567	0.393	76.579	135.04	76.945
135.02						
87	0.1	0.567	0.393	76.945	135.02	78.091
134.93						
88	0.1	0.567	0.393	78.091	134.93	79.87
134.92						
89	0.1	0.567	0.393	79.87	134.92	81.048
134.94						

CRSP Simulation Specifications: Used with C:\Users\Tseung Kwan O Landfill NTHS\After comments\Boulder Fall Anaysis\C120\C120.doc

Total Number of Rocks Simulated: 100
Starting Velocity in X-Direction: 0.3 m/sec
Starting Velocity in Y-Direction: -0.3 m/sec
Starting Cell Number: 1
Ending Cell Number: 89
Rock Density: 2646 kg/m^3
Rock Shape: Discoidal
Diameter: 0.9 m
Thickness: 1.7 m

CRSP Analysis Point 1 Data - C:\Users\Tseung Kwan O Landfill NTHS\After comments\Boulder Fall Anaysis\C120\C120.doc

Analysis Point 1: X = 75.51, Y = 135

NO ROCKS PAST ANALSYSIS POINT 1

CRSP Data Collected at End of Each Cell - C:\Users\Tseung Kwan O Landfill NTHS\After comments\Boulder Fall Anaysis\C120\C120.doc

Velocity Units: m/sec Bounce Height Units: m

Cell #	Max. Vel.	Avg. Vel.	S.D. Vel.	Max. Bounce Ht.	Avg. Bounce Ht.
1	7	7	.31	0	0
2	8	7	.4	0	0
3	8	8	.47	0	0
4	9	8	.53	0	0
5	9	8	.67	0	0
6	9	8	.78	0	0
7	9	8	.56	1	0
8	9	8	.64	0	0
9	9	8	.78	1	0
10	10	9	1.13	1	0
11	10	9	1.12	1	0
12	10	9	.61	1	0
13	11	10	.88	0	0
14	10	10	.25	0	0
15	10	10	.25	0	0
16	11	11	.22	1	0
17	12	11	.81	1	0
18	14	12	.9	1	0
19	12	11	.39	1	0
20	12	12	.45	1	0
21	14	13	.57	1	0
22	14	13	1.46	1	0
23	14	11	1.65	0	0
24	10	6	2.45	0	0
25	7	4	2.01	1	0
26	7	4	2.43	1	1
27	7	3	2.05	4	2
28	6	4	1.83	4	2
29	6	4	0	3	2
30	6	6	0	2	1
31	6	5	0	2	1
32	6	5	0	2	0
33	6	5	0	2	0
34	7	5	0	1	0
35	7	5	0	1	0
36	8	6	0	1	0
37	6	4	0	0	0
38	6	5	0	0	0
39	6	4	0	0	0
40	6	6	0	0	0
41	6	6	0	0	0
42	6	6	0	0	-1
43	6	6	0	0	-1
44	6	6	0	0	0
45	6	6	0	0	0
46	6	6	0	0	0
47	5	5	0	0	0
48	6	6	0	0	0

49	6	6	0	0	-1
50	5	5	0	0	0
51	4	4	0	0	0
52	4	4	0	1	0
53	6	6	0	0	0
54	5	5	0	0	0
55	5	5	0	0	0
56	5	5	0	0	0
57	5	5	0	0	0
58	5	5	0	0	0
59	5	5	0	0	0
60	6	6	0	0	-1
61	5	5	0	0	0
62	5	5	0	0	0
63	6	6	0	0	0
64	6	6	0	0	-1
65	6	6	0	0	0
66	4	4	0	0	0
67	3	3	0	1	0
68	3	3	0	1	0
69	3	3	0	1	0
70	3	3	0	1	0
71	3	3	0	0	0
72	2	2	0	0	0
73	3	3	0	0	0
74	3	3	0	0	0
75	3	3	0	0	0
76	2	2	0	0	0
77	No rocks	past end of cell			
78	No rocks	past end of cell			
79	No rocks	past end of cell			
80	No rocks	past end of cell			
81	No rocks	past end of cell			
82	No rocks	past end of cell			
83	No rocks	past end of cell			
84	No rocks	past end of cell			
85	No rocks	past end of cell			
86	No rocks	past end of cell			
87	No rocks	past end of cell			
88	No rocks	past end of cell			
89	No rocks	past end of cell			

CRSP Rocks Stopped Data - C:\Users\Tseung Kwan O Landfill NTHS\After comments\Boulder Fall Anaysis\C120\C120.doc

X Interval	Rocks Stopped
0 To 10 m	94
10 To 20 m	0
20 To 30 m	0
30 To 40 m	2
40 To 50 m	3
50 To 60 m	0
60 To 70 m	0
70 To 80 m	1
80 To 81.048 m	0

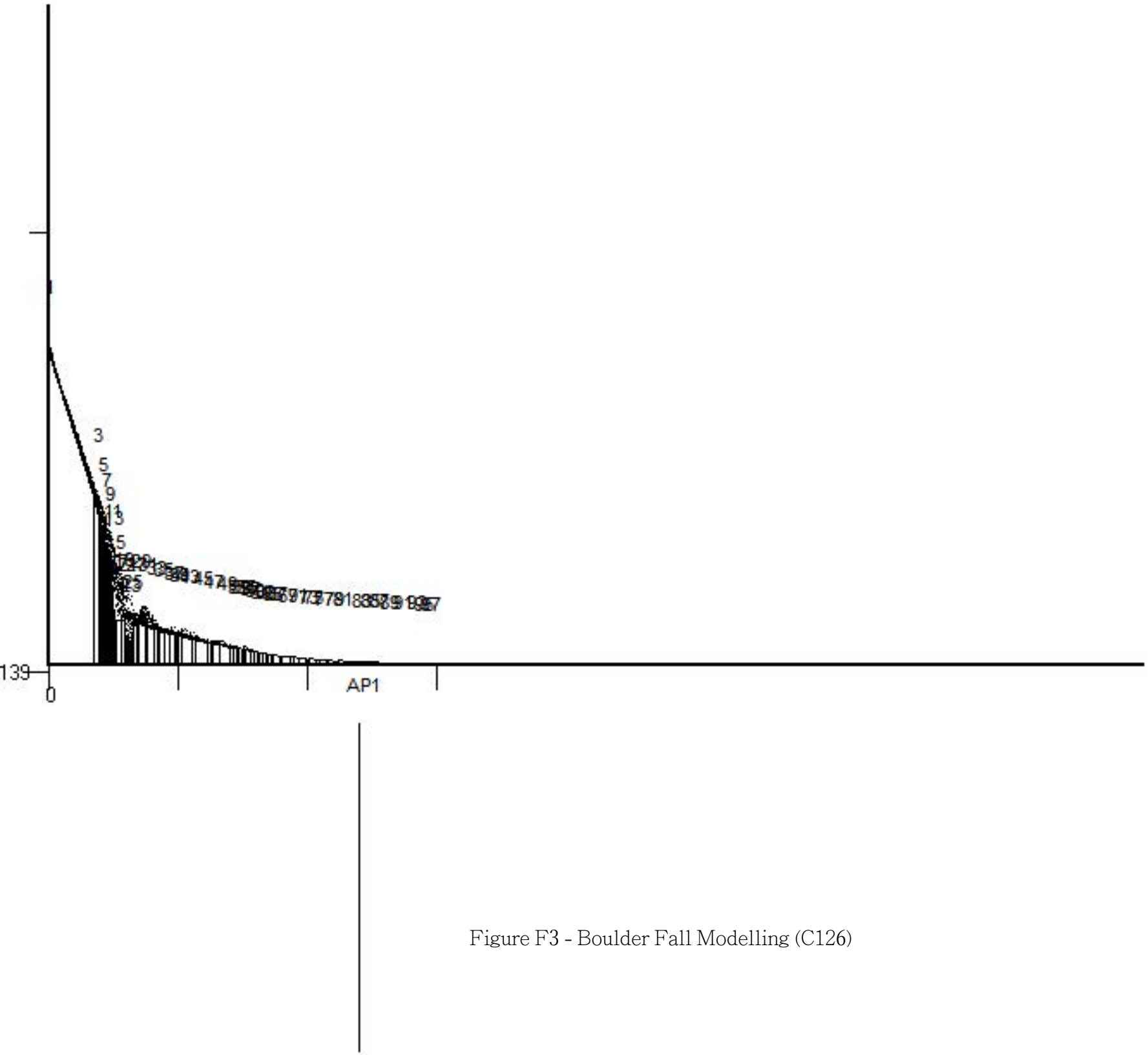


Figure F3 - Boulder Fall Modelling (C126)

CRSP Input File -C:\Users\ Tseung Kwan O Landfill NTHS\After comments\Boulder Fall Anaysis\C126\C126.doc

Input File Specifications

Units of Measure: Metric
Total Number of Cells: 97
Analysis Point 1 X-Coordinate: 48.07
Analysis Point 2 X-Coordinate:
Analysis Point 3 X-Coordinate: 0
Initial Y-Top Starting Zone Coordinate: 154
Initial Y-Base Starting Zone Coordinate: 153

Remarks:

Cell Data

Cell No.	S.R.	Tang. C.	Norm. C.	Begin X	Begin Y	End X	End Y
1	.1	.567	.393	0	154	.14	153.53
2	.1	.567	.393	.14	153.53	7.102	147
3	.1	.567	.393	7.102	147	7.832	146.12
4	.1	.567	.393	7.832	146.12	7.972	145.67
5	.1	.567	.393	7.972	145.67	8.392	145.32
6	.1	.567	.393	8.392	145.32	8.6	144.96
7	.1	.567	.393	8.6	144.96	8.882	144.62
8	.1	.567	.393	8.882	144.62	9.154	144.39
9	.1	.567	.393	9.154	144.39	9.479	144.01
10	.1	.567	.393	9.479	144.01	9.576	143.6
11	.1	.567	.393	9.576	143.6	9.698	143.22
12	.1	.567	.393	9.698	143.22	9.747	143.26
13	.1	.567	.393	9.747	143.26	9.921	142.73
14	.1	.567	.393	9.921	142.73	10.086	142.13
15	.1	.567	.393	10.086	142.13	10.235	141.57
16	.1	.567	.393	10.235	141.57	10.541	141.32
17	.1	.567	.393	10.541	141.32	10.549	141.34
18	.1	.567	.393	10.549	141.34	11.288	141.36

19	.1	.567	.393	11.288	141.36	11.72
141.37						
20	.1	.567	.393	11.72	141.37	11.894
141.1						
21	.1	.567	.393	11.894	141.1	12.011
140.24						
22	.1	.567	.393	12.011	140.24	12.443
140.17						
23	.1	.567	.393	12.443	140.17	12.65
140.34						
24	.1	.567	.393	12.65	140.34	12.718
140.35						
25	.1	.567	.393	12.718	140.35	12.933
140.24						
26	.1	.567	.393	12.933	140.24	13.108
141.15						
27	.1	.567	.393	13.108	141.15	13.712
141.2						
28	.1	.567	.393	13.712	141.2	13.966
141.33						
29	.1	.567	.393	13.966	141.33	14.084
141.2						
30	.1	.567	.393	14.084	141.2	15.041
141.11						
31	.1	.567	.393	15.041	141.11	15.263
141.06						
32	.1	.567	.393	15.263	141.06	16.251
140.97						
33	.1	.567	.393	16.251	140.97	16.892
140.93						
34	.1	.567	.393	16.892	140.93	17.226
140.86						
35	.1	.567	.393	17.226	140.86	17.888
140.81						
36	.1	.567	.393	17.888	140.81	18.786
140.75						
37	.1	.567	.393	18.786	140.75	19.471
140.71						
38	.1	.567	.393	19.471	140.71	19.715
140.65						
39	.1	.567	.393	19.715	140.65	20.093
140.68						
40	.1	.567	.393	20.093	140.68	20.134
140.68						
41	.1	.567	.393	20.134	140.68	20.537
140.64						
42	.1	.567	.393	20.537	140.64	20.632
140.61						
43	.1	.567	.393	20.632	140.61	22.263
140.53						
44	.1	.567	.393	22.263	140.53	22.702
140.5						
45	.1	.567	.393	22.702	140.5	24.509
140.35						
46	.1	.567	.393	24.509	140.35	25.288
140.32						
47	.1	.567	.393	25.288	140.32	25.467
140.29						

48	.1	.567	.393	25.467	140.29	26.628
140.26						
49	.1	.567	.393	26.628	140.26	28.196
140.15						
50	.1	.567	.393	28.196	140.15	28.638
140.13						
51	.1	.567	.393	28.638	140.13	29.289
140.06						
52	.1	.567	.393	29.289	140.06	29.444
140.09						
53	.1	.567	.393	29.444	140.09	29.847
140.04						
54	.1	.567	.393	29.847	140.04	30.297
140.08						
55	.1	.567	.393	30.297	140.08	30.389
140.01						
56	.1	.567	.393	30.389	140.01	30.632
140.02						
57	.1	.567	.393	30.632	140.02	31.262
139.98						
58	.1	.567	.393	31.262	139.98	31.405
139.99						
59	.1	.567	.393	31.405	139.99	31.752
139.94						
60	.1	.567	.393	31.752	139.94	32.503
139.88						
61	.1	.567	.393	32.503	139.88	32.538
139.9						
62	.1	.567	.393	32.538	139.9	33.1
139.88						
63	.1	.567	.393	33.1	139.88	33.633
139.85						
64	.1	.567	.393	33.633	139.85	34.067
139.83						
65	.1	.567	.393	34.067	139.83	34.507
139.78						
66	.1	.567	.393	34.507	139.78	34.815
139.77						
67	.1	.567	.393	34.815	139.77	35.793
139.75						
68	.1	.567	.393	35.793	139.75	36.084
139.73						
69	.1	.567	.393	36.084	139.73	37.336
139.7						
70	.1	.567	.393	37.336	139.7	38.099
139.69						
71	.1	.567	.393	38.099	139.69	38.897
139.62						
72	.1	.567	.393	38.897	139.62	39.745
139.62						
73	.1	.567	.393	39.745	139.62	40.102
139.6						
74	.1	.567	.393	40.102	139.6	40.414
139.62						
75	.1	.567	.393	40.414	139.62	41.368
139.6						
76	.1	.567	.393	41.368	139.6	42.048
139.57						

77	.1	.567	.393	42.048	139.57	42.969	139.57
78	.1	.567	.393	42.969	139.57	43.179	139.55
79	.1	.567	.393	43.179	139.55	44.774	139.52
80	.1	.567	.393	44.774	139.52	44.799	139.55
81	.1	.567	.393	44.799	139.55	46.007	139.5
82	.1	.567	.393	46.007	139.5	47.973	139.49
83	.1	.567	.393	47.973	139.49	48.315	139.48
84	.1	.567	.393	48.315	139.48	49.305	139.45
85	.1	.567	.393	49.305	139.45	50.109	139.48
86	.1	.567	.393	50.109	139.48	50.983	139.48
87	.1	.567	.393	50.983	139.48	51.031	139.43
88	.1	.567	.393	51.031	139.43	52.15	139.42
89	.1	.567	.393	52.15	139.42	52.767	139.36
90	.1	.567	.393	52.767	139.36	54.347	139.38
91	.1	.567	.393	54.347	139.38	55.05	139.37
92	.1	.567	.393	55.05	139.37	56.473	139.38
93	.1	.567	.393	56.473	139.38	56.997	139.37
94	.1	.567	.393	56.997	139.37	57.467	139.36
95	.1	.567	.393	57.467	139.36	58.054	139.36
96	.1	.567	.393	58.054	139.36	58.61	139.36
97	.1	.567	.393	58.61	139.36	59.072	139.34

CRSP Simulation Specifications: Used with C:\Users\Tseung Kwan O Landfill NTHS\After comments\Boulder Fall Anaysis\C126\C126.doc

Total Number of Rocks Simulated: 100
Starting Velocity in X-Direction: 0.3 m/sec
Starting Velocity in Y-Direction: -0.3 m/sec
Starting Cell Number: 1
Ending Cell Number: 97
Rock Density: 2646 kg/m^3
Rock Shape: Discoidal
Diameter: 0.8 m
Thickness: 1 m

CRSP Analysis Point 1 Data - C:\Users\Tseung Kwan O Landfill NTHS\After comments\Boulder Fall Anaysis\C126\C126.doc

Analysis Point 1: X = 48.07, Y = 139

NO ROCKS PAST ANALSYSIS POINT 1

CRSP Data Collected at End of Each Cell - C:\Users\Tseung Kwan O Landfill NTHS\After comments\Boulder Fall Anaysis\C126\C126.doc

Velocity Units: m/sec Bounce Height Units: m

Cell #	Max. Vel.	Avg. Vel.	S.D. Vel.	Max. Bounce Ht.	Avg. Bounce Ht.
1	4	2	1.05	0	0
2	9	8	.59	1	0
3	10	9	.64	1	0
4	10	9	.65	1	0
5	11	9	.76	1	0
6	11	10	.77	1	0
7	12	10	.79	2	0
8	12	10	.94	2	0
9	12	10	.98	2	0
10	12	10	1.01	2	0
11	12	10	1.05	2	1
12	12	10	1.06	2	0
13	13	10	1.11	2	1
14	13	11	1.16	3	1
15	13	11	1.2	3	2
16	13	11	1.28	3	1
17	13	11	1.29	3	1
18	13	10	3.14	3	0
19	13	8	3.46	2	0
20	13	8	3.6	2	0
21	14	8	3.69	3	1
22	14	9	3.93	3	1
23	14	8	3.76	2	1
24	14	8	3.75	2	1
25	14	8	3.48	2	1
26	12	6	2.73	1	0
27	12	6	2.25	0	0
28	7	4	1.36	0	0
29	7	4	1.47	0	0
30	7	4	1.22	1	0
31	7	4	1.15	1	0
32	7	4	1.27	1	0

33	7	4	1.35	0	0
34	7	4	1.29	0	0
35	8	4	1.21	0	0
36	7	4	1.03	0	0
37	6	4	1.11	0	0
38	6	4	1.07	0	0
39	6	4	1.06	0	0
40	6	4	1.07	0	0
41	6	4	1.11	0	0
42	6	4	1.09	0	0
43	6	4	.94	0	0
44	6	4	.82	0	0
45	5	4	.85	0	0
46	5	4	.69	0	0
47	5	4	.74	0	0
48	4	4	.49	0	0
49	4	3	.81	0	0
50	4	3	0	0	0
51	4	4	0	0	0
52	4	4	0	0	-1
53	4	4	0	0	0
54	4	3	0	0	0
55	4	3	0	0	0
56	4	3	0	0	0
57	3	3	0	0	0
58	4	3	0	0	0
59	3	3	0	0	0
60	3	3	0	0	0
61	3	3	0	0	-1
62	No rocks	past end of cell			
63	No rocks	past end of cell			
64	No rocks	past end of cell			
65	No rocks	past end of cell			
66	No rocks	past end of cell			
67	No rocks	past end of cell			
68	No rocks	past end of cell			
69	No rocks	past end of cell			
70	No rocks	past end of cell			
71	No rocks	past end of cell			
72	No rocks	past end of cell			
73	No rocks	past end of cell			
74	No rocks	past end of cell			
75	No rocks	past end of cell			
76	No rocks	past end of cell			
77	No rocks	past end of cell			
78	No rocks	past end of cell			
79	No rocks	past end of cell			
80	No rocks	past end of cell			
81	No rocks	past end of cell			
82	No rocks	past end of cell			
83	No rocks	past end of cell			
84	No rocks	past end of cell			
85	No rocks	past end of cell			
86	No rocks	past end of cell			
87	No rocks	past end of cell			
88	No rocks	past end of cell			
89	No rocks	past end of cell			
90	No rocks	past end of cell			

91	No rocks	past end of cell
92	No rocks	past end of cell
93	No rocks	past end of cell
94	No rocks	past end of cell
95	No rocks	past end of cell
96	No rocks	past end of cell
97	No rocks	past end of cell

CRSP Rocks Stopped Data - C:\Users\Tseung Kwan O Landfill NTHS\After comments\Boulder Fall Anaysis\C126\C126.doc

X Interval	Rocks Stopped
0 To 10 m	4
10 To 20 m	70
20 To 30 m	24
30 To 40 m	2
40 To 50 m	0
50 To 59.072 m	0

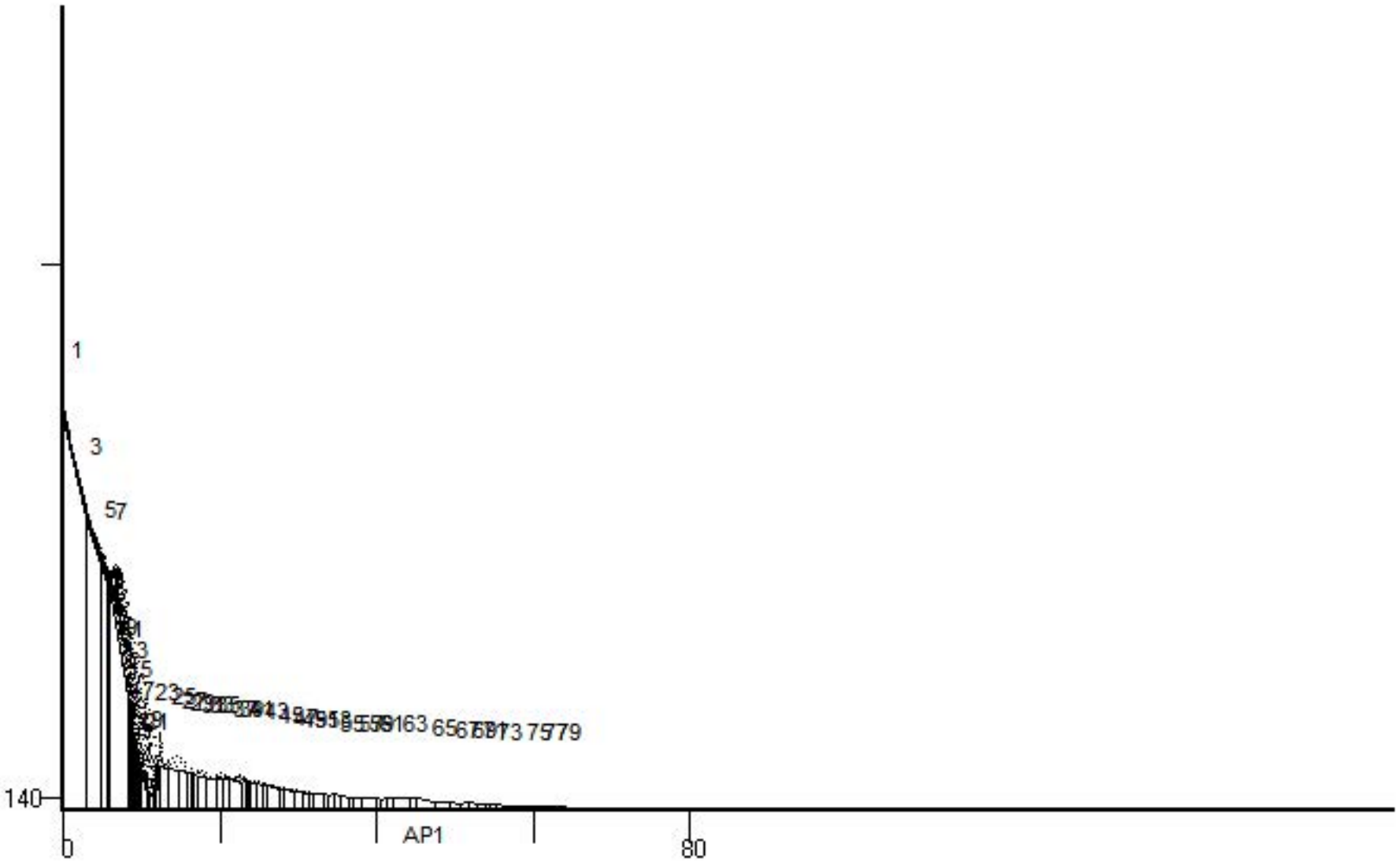


Figure F4 - Boulder Fall Modelling (C127)

CRSP Input File -C:\Users\Tseung Kwan O Landfill NTHS\After comments\Boulder Fall Anaysis\C127\C127.doc

Input File Specifications

Units of Measure: Metric
Total Number of Cells: 79
Analysis Point 1 X-Coordinate: 45.2
Analysis Point 2 X-Coordinate:
Analysis Point 3 X-Coordinate:
Initial Y-Top Starting Zone Coordinate: 154.2
Initial Y-Base Starting Zone Coordinate: 153.2

Remarks:

Cell Data

Cell No.	S.R.	Tang. C.	Norm. C.	Begin X	Begin Y	End X	End Y
1	0.1	0.567	0.393	0	154.2	2.853	150.58
2	0.1	0.567	0.393	2.853	150.58	2.993	150.39
3	0.1	0.567	0.393	2.993	150.39	4.82	148.72
4	0.1	0.567	0.393	4.82	148.72	5.698	148.02
5	0.1	0.567	0.393	5.698	148.02	5.847	147.86
6	0.1	0.567	0.393	5.847	147.86	5.984	147.94
7	0.1	0.567	0.393	5.984	147.94	8.166	143.83
8	0.1	0.567	0.393	8.166	143.83	8.438	143.62
9	0.1	0.567	0.393	8.438	143.62	8.441	143.73
10	0.1	0.567	0.393	8.441	143.73	8.481	143.53
11	0.1	0.567	0.393	8.481	143.53	8.724	143.35
12	0.1	0.567	0.393	8.724	143.35	8.935	142.79
13	0.1	0.567	0.393	8.935	142.79	9.104	142.27
14	0.1	0.567	0.393	9.104	142.27	9.36	142.05
15	0.1	0.567	0.393	9.36	142.05	9.474	141.55
16	0.1	0.567	0.393	9.474	141.55	9.757	141.28
17	0.1	0.567	0.393	9.757	141.28	9.967	141.11
18	0.1	0.567	0.393	9.967	141.11	10.736	140.2

19	0.1	0.567	0.393	10.736	140.2	11.064
140.07						
20	0.1	0.567	0.393	11.064	140.07	11.54
140.08						
21	0.1	0.567	0.393	11.54	140.08	11.633
140.03						
22	0.1	0.567	0.393	11.633	140.03	12.33
141.18						
23	0.1	0.567	0.393	12.33	141.18	13.476
141.11						
24	0.1	0.567	0.393	13.476	141.11	14.701
141.02						
25	0.1	0.567	0.393	14.701	141.02	15.646
140.96						
26	0.1	0.567	0.393	15.646	140.96	16.29
140.91						
27	0.1	0.567	0.393	16.29	140.91	16.714
140.86						
28	0.1	0.567	0.393	16.714	140.86	17.108
140.81						
29	0.1	0.567	0.393	17.108	140.81	18.07
140.76						
30	0.1	0.567	0.393	18.07	140.76	18.298
140.74						
31	0.1	0.567	0.393	18.298	140.74	19.485
140.71						
32	0.1	0.567	0.393	19.485	140.71	19.517
140.72						
33	0.1	0.567	0.393	19.517	140.72	20.224
140.72						
34	0.1	0.567	0.393	20.224	140.72	20.356
140.72						
35	0.1	0.567	0.393	20.356	140.72	21.046
140.68						
36	0.1	0.567	0.393	21.046	140.68	22.764
140.6						
37	0.1	0.567	0.393	22.764	140.6	23.164
140.61						
38	0.1	0.567	0.393	23.164	140.61	23.526
140.58						
39	0.1	0.567	0.393	23.526	140.58	23.937
140.56						
40	0.1	0.567	0.393	23.937	140.56	24.715
140.53						
41	0.1	0.567	0.393	24.715	140.53	25.469
140.52						
42	0.1	0.567	0.393	25.469	140.52	26.062
140.47						
43	0.1	0.567	0.393	26.062	140.47	27.696
140.35						
44	0.1	0.567	0.393	27.696	140.35	28.245
140.32						
45	0.1	0.567	0.393	28.245	140.32	29.438
140.25						
46	0.1	0.567	0.393	29.438	140.25	30.578
140.22						
47	0.1	0.567	0.393	30.578	140.22	30.586
140.19						

48	0.1	0.567	0.393	30.586	140.19	31.447	140.17
49	0.1	0.567	0.393	31.447	140.17	31.956	140.16
50	0.1	0.567	0.393	31.956	140.16	33.144	140.16
51	0.1	0.567	0.393	33.144	140.16	33.665	140.11
52	0.1	0.567	0.393	33.665	140.11	34.574	140.15
53	0.1	0.567	0.393	34.574	140.15	35.362	140.11
54	0.1	0.567	0.393	35.362	140.11	36.295	140.05
55	0.1	0.567	0.393	36.295	140.05	37.05	140.05
56	0.1	0.567	0.393	37.05	140.05	38.097	140.01
57	0.1	0.567	0.393	38.097	140.01	39.813	139.99
58	0.1	0.567	0.393	39.813	139.99	39.944	140
59	0.1	0.567	0.393	39.944	140	40.577	139.96
60	0.1	0.567	0.393	40.577	139.96	41.245	140.01
61	0.1	0.567	0.393	41.245	140.01	42.192	140.02
62	0.1	0.567	0.393	42.192	140.02	44.171	139.98
63	0.1	0.567	0.393	44.171	139.98	45.022	139.99
64	0.1	0.567	0.393	45.022	139.99	47.488	139.83
65	0.1	0.567	0.393	47.488	139.83	49.362	139.82
66	0.1	0.567	0.393	49.362	139.82	50.737	139.79
67	0.1	0.567	0.393	50.737	139.79	51.648	139.82
68	0.1	0.567	0.393	51.648	139.82	52.881	139.8
69	0.1	0.567	0.393	52.881	139.8	53.867	139.78
70	0.1	0.567	0.393	53.867	139.78	54.469	139.77
71	0.1	0.567	0.393	54.469	139.77	55.151	139.78
72	0.1	0.567	0.393	55.151	139.78	56.345	139.67
73	0.1	0.567	0.393	56.345	139.67	57.209	139.7
74	0.1	0.567	0.393	57.209	139.7	59.931	139.68
75	0.1	0.567	0.393	59.931	139.68	60.792	139.7
76	0.1	0.567	0.393	60.792	139.7	62.359	139.68

77	0.1	0.567	0.393	62.359	139.68	62.76
139.69						
78	0.1	0.567	0.393	62.76	139.69	63.674
139.68						
79	0.1	0.567	0.393	63.674	139.68	64.743
139.57						

CRSP Simulation Specifications: Used with C:\Users\Tseung Kwan O Landfill NTHS\After comments\Boulder Fall Anaysis\C127\C127.doc

Total Number of Rocks Simulated: 100
Starting Velocity in X-Direction: 0.3 m/sec
Starting Velocity in Y-Direction: -0.3 m/sec
Starting Cell Number: 1
Ending Cell Number: 79
Rock Density: 2646 kg/m^3
Rock Shape: Discoidal
Diameter: 0.8 m
Thickness: 1.1 m

CRSP Analysis Point 1 Data - C:\Users\Tseung Kwan O Landfill NTHS\After comments\Boulder Fall Anaysis\C127\C127.doc

Analysis Point 1: X = 45.2, Y = 140

NO ROCKS PAST ANALSYSIS POINT 1

CRSP Data Collected at End of Each Cell - C:\Users\Esther\Desktop\Freelance\# NTHS\005_Modern_Tseung Kwan O Landfill NTHS\After comments\Boulder Fall Anaysis\C127\C127.doc

Velocity Units: m/sec Bounce Height Units: m

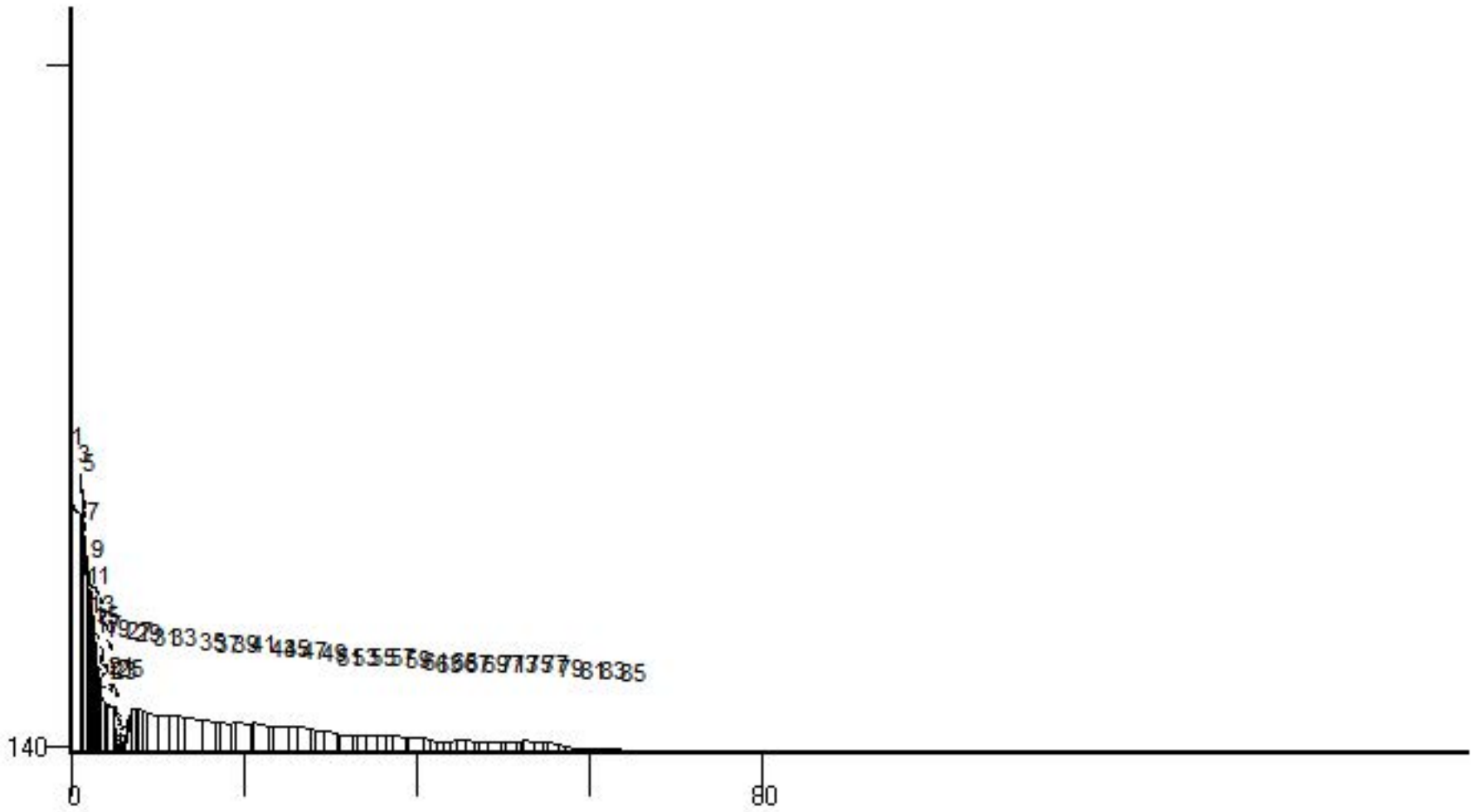
Cell #	Max. Vel.	Avg. Vel.	S.D. Vel.	Max. Bounce Ht.	Avg. Bounce Ht.
1	7	6	.49	0	0
2	8	6	.52	0	0
3	8	7	.4	1	0
4	9	8	.6	1	0
5	9	8	.62	1	0
6	9	6	2.1	0	0
7	12	9	1.77	4	1
8	12	9	1.87	3	1
9	12	10	1.74	3	1

10	12	10	1.73	3	1
11	13	10	1.88	3	1
12	13	10	1.9	3	1
13	13	10	1.92	3	1
14	14	11	2.11	3	1
15	14	11	2.13	4	1
16	14	11	2.32	4	1
17	14	11	2.46	4	1
18	15	11	2.46	4	1
19	15	10	2.54	3	0
20	14	9	3.1	2	0
21	14	9	3.17	2	0
22	13	6	5.31	1	0
23	7	5	0	0	0
24	7	7	0	1	0
25	7	7	0	0	0
26	8	7	0	0	0
27	7	7	0	0	0
28	7	6	0	0	0
29	7	6	0	0	0
30	7	6	0	0	0
31	6	6	0	0	0
32	6	6	0	0	0
33	6	6	0	0	0
34	6	6	0	0	0
35	6	5	0	0	0
36	5	5	0	0	0
37	5	5	0	0	0
38	5	5	0	0	0
39	6	5	0	0	-1
40	5	4	0	0	0
41	5	4	0	0	0
42	5	4	0	0	0
43	4	4	0	0	0
44	4	4	0	0	0
45	4	4	0	0	0
46	3	3	0	0	0
47	3	3	0	0	0
48	3	3	0	0	0
49	3	3	0	0	-1
50	No rocks	past end of cell			
51	No rocks	past end of cell			
52	No rocks	past end of cell			
53	No rocks	past end of cell			
54	No rocks	past end of cell			
55	No rocks	past end of cell			
56	No rocks	past end of cell			
57	No rocks	past end of cell			
58	No rocks	past end of cell			
59	No rocks	past end of cell			
60	No rocks	past end of cell			
61	No rocks	past end of cell			
62	No rocks	past end of cell			
63	No rocks	past end of cell			
64	No rocks	past end of cell			
65	No rocks	past end of cell			
66	No rocks	past end of cell			
67	No rocks	past end of cell			

68	No rocks	past end of cell
69	No rocks	past end of cell
70	No rocks	past end of cell
71	No rocks	past end of cell
72	No rocks	past end of cell
73	No rocks	past end of cell
74	No rocks	past end of cell
75	No rocks	past end of cell
76	No rocks	past end of cell
77	No rocks	past end of cell
78	No rocks	past end of cell
79	No rocks	past end of cell

CRSP Rocks Stopped Data – C:\Users\Tseung Kwan O Landfill NTHS\After comments\Boulder Fall Anaysis\C127\C127.doc

X Interval	Rocks Stopped
0 To 10 m	15
10 To 20 m	82
20 To 30 m	1
30 To 40 m	2
40 To 50 m	0
50 To 60 m	0
60 To 64.743 m	0



AP1

Figure F5 - Boulder Fall Modelling (C128)

CRSP Input File -C:\Users\Tseung Kwan O Landfill NTHS\After comments\Boulder Fall Anaysis\C128\C128.doc

Input File Specifications

Units of Measure: Metric
Total Number of Cells: 85
Analysis Point 1 X-Coordinate: 41.3
Analysis Point 2 X-Coordinate:
Analysis Point 3 X-Coordinate:
Initial Y-Top Starting Zone Coordinate: 147
Initial Y-Base Starting Zone Coordinate: 146

Remarks:

Cell Data

Cell No.	S.R.	Tang. C.	Norm. C.	Begin X	Begin Y	End X	End Y
1	0.1	0.567	0.393	0	147	1.093	146.81
2	0.1	0.567	0.393	1.093	146.81	1.182	146.31
3	0.1	0.567	0.393	1.182	146.31	1.289	146.32
4	0.1	0.567	0.393	1.289	146.32	1.44	146.03
5	0.1	0.567	0.393	1.44	146.03	1.966	144.67
6	0.1	0.567	0.393	1.966	144.67	2.166	144.63
7	0.1	0.567	0.393	2.166	144.63	2.243	143.87
8	0.1	0.567	0.393	2.243	143.87	2.632	143.51
9	0.1	0.567	0.393	2.632	143.51	2.665	143.39
10	0.1	0.567	0.393	2.665	143.39	2.82	142.71
11	0.1	0.567	0.393	2.82	142.71	3.05	142.12
12	0.1	0.567	0.393	3.05	142.12	3.25	141.88
13	0.1	0.567	0.393	3.25	141.88	3.345	142
14	0.1	0.567	0.393	3.345	142	3.417	141.6
15	0.1	0.567	0.393	3.417	141.6	3.85	141.26
16	0.1	0.567	0.393	3.85	141.26	3.906	141.34
17	0.1	0.567	0.393	3.906	141.34	4.144	141.17
18	0.1	0.567	0.393	4.144	141.17	4.867	141.18

19	0.1	0.567	0.393	4.867	141.18	5.21	140.01
20	0.1	0.567	0.393	5.21	140.01	5.426	140.08
21	0.1	0.567	0.393	5.426	140.08	5.523	140.08
22	0.1	0.567	0.393	5.523	140.08	5.733	139.93
23	0.1	0.567	0.393	5.733	139.93	5.754	139.95
24	0.1	0.567	0.393	5.754	139.95	6.303	140
25	0.1	0.567	0.393	6.303	140	6.985	141.11
26	0.1	0.567	0.393	6.985	141.11	7.422	141.1
27	0.1	0.567	0.393	7.422	141.1	7.715	141.14
28	0.1	0.567	0.393	7.715	141.14	8.266	141.04
29	0.1	0.567	0.393	8.266	141.04	8.78	140.99
30	0.1	0.567	0.393	8.78	140.99	10.101	140.95
31	0.1	0.567	0.393	10.101	140.95	11.415	140.91
32	0.1	0.567	0.393	11.415	140.91	12.329	140.9
33	0.1	0.567	0.393	12.329	140.9	13.129	140.88
34	0.1	0.567	0.393	13.129	140.88	15.233	140.82
35	0.1	0.567	0.393	15.233	140.82	16.752	140.7
36	0.1	0.567	0.393	16.752	140.7	17.265	140.71
37	0.1	0.567	0.393	17.265	140.71	18.613	140.66
38	0.1	0.567	0.393	18.613	140.66	19.061	140.7
39	0.1	0.567	0.393	19.061	140.7	20.84	140.64
40	0.1	0.567	0.393	20.84	140.64	21.035	140.71
41	0.1	0.567	0.393	21.035	140.71	22.961	140.62
42	0.1	0.567	0.393	22.961	140.62	23.415	140.61
43	0.1	0.567	0.393	23.415	140.61	25.075	140.6
44	0.1	0.567	0.393	25.075	140.6	25.287	140.58
45	0.1	0.567	0.393	25.287	140.58	26.092	140.57
46	0.1	0.567	0.393	26.092	140.57	27.698	140.51
47	0.1	0.567	0.393	27.698	140.51	28.243	140.49

48	0.1	0.567	0.393	28.243	140.49	29.261
140.44						
49	0.1	0.567	0.393	29.261	140.44	30.875
140.38						
50	0.1	0.567	0.393	30.875	140.38	31.02
140.36						
51	0.1	0.567	0.393	31.02	140.36	32.657
140.36						
52	0.1	0.567	0.393	32.657	140.36	33.164
140.35						
53	0.1	0.567	0.393	33.164	140.35	34.091
140.35						
54	0.1	0.567	0.393	34.091	140.35	35.381
140.34						
55	0.1	0.567	0.393	35.381	140.34	36.372
140.33						
56	0.1	0.567	0.393	36.372	140.33	37.303
140.33						
57	0.1	0.567	0.393	37.303	140.33	38.81
140.25						
58	0.1	0.567	0.393	38.81	140.25	39.012
140.28						
59	0.1	0.567	0.393	39.012	140.28	40.796
140.25						
60	0.1	0.567	0.393	40.796	140.25	41.682
140.19						
61	0.1	0.567	0.393	41.682	140.19	42.385
140.16						
62	0.1	0.567	0.393	42.385	140.16	43.163
140.14						
63	0.1	0.567	0.393	43.163	140.14	43.95
140.16						
64	0.1	0.567	0.393	43.95	140.16	44.547
140.18						
65	0.1	0.567	0.393	44.547	140.18	45.793
140.18						
66	0.1	0.567	0.393	45.793	140.18	46.676
140.17						
67	0.1	0.567	0.393	46.676	140.17	47.169
140.16						
68	0.1	0.567	0.393	47.169	140.16	48.298
140.12						
69	0.1	0.567	0.393	48.298	140.12	49.703
140.12						
70	0.1	0.567	0.393	49.703	140.12	50.38
140.14						
71	0.1	0.567	0.393	50.38	140.14	51.535
140.16						
72	0.1	0.567	0.393	51.535	140.16	52.035
140.14						
73	0.1	0.567	0.393	52.035	140.14	52.231
140.2						
74	0.1	0.567	0.393	52.231	140.2	53.502
140.13						
75	0.1	0.567	0.393	53.502	140.13	54.735
140.12						
76	0.1	0.567	0.393	54.735	140.12	55.281
140.12						

77	0.1	0.567	0.393	55.281	140.12	56.401
140.07						
78	0.1	0.567	0.393	56.401	140.07	57.259
140.04						
79	0.1	0.567	0.393	57.259	140.04	58.11
139.98						
80	0.1	0.567	0.393	58.11	139.98	59.988
139.93						
81	0.1	0.567	0.393	59.988	139.93	60.229
139.93						
82	0.1	0.567	0.393	60.229	139.93	61.931
139.92						
83	0.1	0.567	0.393	61.931	139.92	63.1
139.92						
84	0.1	0.567	0.393	63.1	139.92	64.065
139.91						
85	0.1	0.567	0.393	64.065	139.91	65.27
139.84						

CRSP Simulation Specifications: Used with C:\Users\Tseung Kwan O Landfill NTHS\After comments\Boulder Fall Anaysis\C128\C128.doc

Total Number of Rocks Simulated: 100
Starting Velocity in X-Direction: 0.3 m/sec
Starting Velocity in Y-Direction: -0.3 m/sec
Starting Cell Number: 1
Ending Cell Number: 85
Rock Density: 2646 kg/m^3
Rock Shape: Discoidal
Diameter: 2.5 m
Thickness: 1.9 m

CRSP Analysis Point 1 Data - C:\Users\Tseung Kwan O Landfill NTHS\After comments\Boulder Fall Anaysis\C128\C128.doc

Analysis Point 1: X = 41.3, Y = 140

NO ROCKS PAST ANALSYSIS POINT 1

CRSP Data Collected at End of Each Cell - C:\Users\Esther\Desktop\Freelance\# NTHS\005_Modern_Tseung Kwan O Landfill NTHS\After comments\Boulder Fall Anaysis\C128\C128.doc

Velocity Units: m/sec Bounce Height Units: m

Cell #	Max. Vel.	Avg. Vel.	S.D. Vel.	Max. Bounce Ht.	Avg. Bounce Ht.
1	No rocks past end of cell				
2	3	2	.81	1	1
3	6	5	.56	0	0
4	5	3	1.12	1	0
5	6	6	.21	1	0
6	7	5	1.39	0	0
7	7	6	1.55	1	0
8	8	6	1.98	1	0
9	8	6	2.02	1	0
10	9	6	2.23	2	0
11	10	6	2.29	2	1
12	10	6	1.4	3	1
13	7	5	1.31	2	1
14	7	5	1.62	3	1
15	7	6	1.14	3	1
16	7	6	1.12	3	1
17	8	6	1.15	2	1
18	9	8	1.55	1	0
19	9	8	1.62	2	1
20	10	9	1.62	1	0
21	10	9	1.83	1	0
22	10	9	2	1	0
23	10	9	2.01	1	0
24	6	4	1.32	0	0
25	No rocks past end of cell				
26	No rocks past end of cell				
27	No rocks past end of cell				
28	No rocks past end of cell				
29	No rocks past end of cell				
30	No rocks past end of cell				
31	No rocks past end of cell				
32	No rocks past end of cell				
33	No rocks past end of cell				
34	No rocks past end of cell				
35	No rocks past end of cell				
36	No rocks past end of cell				
37	No rocks past end of cell				
38	No rocks past end of cell				
39	No rocks past end of cell				
40	No rocks past end of cell				
41	No rocks past end of cell				
42	No rocks past end of cell				
43	No rocks past end of cell				
44	No rocks past end of cell				
45	No rocks past end of cell				
46	No rocks past end of cell				
47	No rocks past end of cell				
48	No rocks past end of cell				
49	No rocks past end of cell				
50	No rocks past end of cell				
51	No rocks past end of cell				
52	No rocks past end of cell				
53	No rocks past end of cell				
54	No rocks past end of cell				
55	No rocks past end of cell				

56	No rocks	past end of cell
57	No rocks	past end of cell
58	No rocks	past end of cell
59	No rocks	past end of cell
60	No rocks	past end of cell
61	No rocks	past end of cell
62	No rocks	past end of cell
63	No rocks	past end of cell
64	No rocks	past end of cell
65	No rocks	past end of cell
66	No rocks	past end of cell
67	No rocks	past end of cell
68	No rocks	past end of cell
69	No rocks	past end of cell
70	No rocks	past end of cell
71	No rocks	past end of cell
72	No rocks	past end of cell
73	No rocks	past end of cell
74	No rocks	past end of cell
75	No rocks	past end of cell
76	No rocks	past end of cell
77	No rocks	past end of cell
78	No rocks	past end of cell
79	No rocks	past end of cell
80	No rocks	past end of cell
81	No rocks	past end of cell
82	No rocks	past end of cell
83	No rocks	past end of cell
84	No rocks	past end of cell
85	No rocks	past end of cell

CRSP Rocks Stopped Data - C:\Users\Tseung Kwan O Landfill NTHS\After comments\Boulder Fall Anaysis\C128\C128.doc

X Interval	Rocks Stopped
0 To 10 m	100
10 To 20 m	0
20 To 30 m	0
30 To 40 m	0
40 To 50 m	0
50 To 60 m	0
60 To 65.27 m	0

Appendix D

Detailed Aerial Photograph Interpretation Extracted from Previous NTHS Report 2023

Appendix B

Detailed Aerial Photograph Interpretations

B.1 DETAILED AERIAL PHOTOGRAPH INTERPRETATION

The following report comprises the detailed observations made from the examination of aerial photographs taken between 1924 and 2021. A list of aerial photographs examined in this study is presented in Table B1. The interpretations on geomorphology and man-made features are shown in Figure B1 to B21.

YEAR	**OBSERVATIONS**
1924 (Figure B1)	High altitude and poor resolution stereo pairs. The NTSA appears as southwest facing natural hillsides emerging from a northwest trending ridgeline below High Junk Peak. Due to the poor resolution of aerial photographs, the entire NTSA and the Site (proposed public riding school development area) appears as high reflectance, no detail observation can be examined.
1945 (Figure B2)	High altitude and fair resolution stereo pairs. The eastern and western boundary of the NTSA is bounded by indistinct rounded spurs. Several linear hollows, possibly ephemeral drainage lines DL1, DL2, DL3, DL4 and DL5 and their sub-ordinate drainage lines can be discerned within the NTSA. No perennial drainage line can be discerned within the NTSA. The area below the NTSA and the Site is extensively cultivated.
1956	Low altitude and fair resolution stereo pairs. No substantial change to the NTSA since 1945.
1963 (Figure B3, B4 & B5)	Low altitude and high resolution stereo pairs. The smooth surface of the NTSA indicates the NTSA is probably covered by in-situ materials without significant mass wasting process, possibly a thin layer veneer (< 2m thick) of hillslope colluvium blanket the majority of the hillsides within the NTSA. Valley colluvium is confined along the drainage lines. Small portion of intermittent rock outcrops can be discerned at the crest of the NTSA which located along the ridgeline at upper portion of Catchment Nos. CD3, OH5 and TD8. Rock cliff is present at the hillside behind the crest of the NTSA which facing northeast. <u>Ephemeral drainage lines:</u> Ten linear hollows, possibly ephemeral drainage lines DLl, DL2, DL3, DL4 and DL5 and sub-ordinate ephemeral drainage lines DL4.1, DL4.2, DL4.3,

YEAR	OBSERVATIONS

DL4.4 and DL4.5 are observed in Catchment Nos. TD1, CD1, CD2, CD3, TD7 and TD8. Drainage lines DL1, DL2, DL3 and DL5 are present at the lower half portion of Catchment Nos. TD1, CD1, CD2 and TD8 respectively. DL4 contains five sub-ordinate drainage lines, namely DL4.1, DL4.2, DL4.3, DL4.4 and DL4.5. Main drainage line DL4 flows from the top of Catchment No. CD3 towards the bottom of Catchment No. CD3; sub-ordinates drainage line DL4.1 is discerned approximately 20m away from the top of Catchment No. CD3, whilst DL4.2, DL4.3 and DL4.4 are apparent at the upper, middle and lower portion of Catchment No. CD3 respectively. DL4.5 is located along Catchment No. TD7. These five southwest trending drainage lines are running towards the toe of the NTSA. Sub-ordinate drainage lines DL4.1, DL4.2, DL4.3 and DL4.4 are generally west trending and flowing towards DL4 which finally converge towards the toe of the NTSA. Sub-ordinates DL4.5 is apparent as an individual southwest trending drainage line flowing towards the toe of the NTSA. However, DL4.5 was converging towards DL4 below the NTSA. DL1 and DL5 appeared to be subtle depression, whilst DL2 and DL3 is relatively incisive, DL4 is the most distinctive. This probably indicates more water concentrate along DL4 and therefore the erosion of DL4 is more active than the other four drainage lines. Some boulders, probably colluvial boulders are concentrated along DL4.

Topographic depressions:

Seven linear hollows were observed in Catchment Nos. TD2, TD3, TD4, TD5, TD6 and OH3. They are part of the head of ephemeral drainage lines or sub-drainage lines which located below the NTSA. Since they appeared as broad and subtle depressions, this indicate no significant water concentration and therefore the erosion activities are relatively small. These seven hollows within Catchment Nos. TD2, TD3, TD4, TD5, TD6 and OH3 can be regarded as minor topographic depressions.

Relict landslide scars within NTSA:

A break of slope and a concave depression is observed near the head of ephemeral sub-ordinate drainage line DL4.2, possibly instability (RL1) had taken place. The estimated landslide volume of RL1 is about $35m^3$. This location was possibly the ENTLI record no. 12SWA0004E. Another three concave depressions (RL2 to RL4) are discerned adjacent to RL1 which located at the crest of Catchment No. CD3. RL3 and RL4 are appeared as a spoon-shaped depression with distinct landslide trails whilst RL2 is a relatively subtle depression when compare with the other three landslides. RL3 and RL4 has an estimated failure volume of $29m^3$ and $18m^3$ respectively, whilst RL2 is about $24m^3$. However, RL2 may not be regarded as genuine landslide scar, further verification on site is required. RL2 and RL3 are possibly the locations of ENTLI record Nos. 12SWA0220E and 12SWA0005E respectively. RL4 does not recorded in the ENTLI.

Relict landslide scars to the east of NTSA:

Four broad and shallow concave depressions are observed adjacent to the upper portion of Catchment No. CD3, possibly four landslide incidents (RL5, RL6, RL7 and RL8) were occurred. RL5 is located at the NTSA boundary,

YEAR **OBSERVATIONS**

whilst another three depressions (RL6, RL7 and RL8) are apparent approximately 9m to 37m to the east of the upper portion of Catchment No. CD3. These four landslide scarps are very degraded which indicate probably were occurred for a long period of time. The estimated failure source volume of these four landslides is about 11m^3 to 37m^3. They are possibly registered as ENTLI Nos. 12SWA0341E, 12SWA0006E, 12SWA0007E and 12SWA0339E.

A distinct break of slope and depression is discerned on the bank of an ephemeral drainage line located outside the NTSA, which located approximately 20m to the south of the middle portion of Catchment No. TD8, probably represent a relict landslide scar, RL9. RL9 has a failure volume of about 30m^3 which is possibly the location of ENTLI No. 12SWA0273E.

Relict landslide scars below the NTSA:

Two concave depressions were apparent below the NTSA, probably two landslide events (RL10 and RL11) were occurred previously. RL10 is located approximately 52m below Catchment No. TD4 whilst RL11 is discerned 165m below Catchment No. OH2. RL10 apparent as a sharp break of slope, therefore the landslide scarp was distinct which indicated it has a relatively higher certainly and this relict landslide possibly happened in a more recently period of time. The depression of RL10 is relatively shallow and small in size, the failure volume estimated to be 16m^3. RL11 is observed at the head of a sub-ordinate drainage line. Its landslide source area appears more incisive than RL10. The estimated failure volume of RL11 is about 39m^3. RL10 and RL11 are possibly the locations of ENTLI Nos. 12SWA0198E and 12SWA0199E respectively.

Landslide scars adjacent to the Catchment OH1:

Ten concave depressions are evident in the adjacent catchment of Catchment No. OH1, which located approximately 170 to 345m to the west of the NTSA. They are probably relict landslides scars (RL12 to RL21). RL12 to RL15 are located on the bank of a drainage line which located outside the NTSA. They are hardly observed since broad and shallow depressions without obvious break of slope, therefore possibly have been degraded for a long period of time and the certainty of these landslide features are relatively low. The estimated failure volume is relatively small, about 10 m^3 to 30m^3. RL12 to RL15 are recorded as ENTLI Nos. 12SWA0195E, 12SWA0196E, 12SWA0197E and 12SWA0272E respectively. RL16 to RL21 are discerned on an open hillslope. They apparent as rounded scarps with very distinct linear-shaped landslide trails, therefore these six landslide features have a relatively higher certainty. Their failure source areas are relatively bigger and more incisive than RL12 to RL15, therefore RL16 to RL21 has a larger failure volume range between 30m^3 to 60m^3. The locations of RL16 to RL21 are registered as ENTLI Nos. 12SWA0017E, 12SWA0018E, 12SWA0194E, 12SWA0019E, 12SWA0021E and 12SWA0020E respectively.

Landslide scars adjacent to the Catchment TD8:

Eighteen concave depressions are apparent on the adjacent catchment of

YEAR **OBSERVATIONS**

Catchment No. TD8, which located approximately 190 to 670m to the south of the NTSA. They are probably relict landslides scars (RL22 to RL39). RL22 to RL29 are discerned immediately below the ridgeline. Their depression sizes are relatively broad, but most of them are located at the head of drainage lines, the suspected landslide scars are mostly rounded which is hardly to distinguish whether the depressions are related to the shape of the drainage lines or landslide failures, therefore the certainties are not too high. Geomorphologically, since these eight landslides were occurred on the over-steepened slopes immediately below the convex break of slope forming the boundary between the upper and lower landforms. These failures may be possibly part of the hillside retreat process. The estimated failure volumes of RL22 to RL29 are range in between $37m^3$ to $57m^3$. RL22 to RL29 are registered as ENTLI Nos. 12SWA0068E, 12SWA0069E, 12SWA0184E, 12SWA0183E, 12SWA0015E, 12SWA0179E, 12SWA0178E and 12SWA0016E respectively. Another ten landslides are evident in the lower portion of the catchment, namely RL30 to RL39. They have a smaller scale of depressions when compares to RL22 to RL29. Most of them are located on the bank of drainage lines or open hillslope which also apparent as sharper scars, therefore the certainty of RL30 to RL39 are relatively higher. The failure volumes of RL30 to RL39 are about $24m^3$ to $38m^3$. Locations of RL30 to RL39 are probably the location of ENTLI Nos. 12SWA0187E, 12SWA0188E, 12SWA0186E, 12SWA0185E, 12SWA0328E, 12SWA0182E, 12SWA0330E, 12SWA0329E, 12SWA0181E and 12SWA0180E respectively.

RL1 to RL39 are discerned in dark grey tone, therefore they may have been happened long period ago. Among these relict landslide scars, RL22, RL23 and RL24 are considered to have similar geological and geomorphological setting with the NTSA and their estimated failure volumes range from $37m^3$ to $39m^3$. All these landslide events are regarded as relict landslides. No recent landslide is present within or in the close vicinity of the NTSA.

A spot of high reflectance feature was existed at the upper portion of Catchment No. OH5, possibly grave.

Four high reflectance linear features were traversed within the NTSA, probably footpaths (FP1 to FP4). FP1 were present along the middle portion of Catchment No. CD3 downwards to the upper portion of Catchment Nos. TD7, OH5 and TD8. FP2 were discerned from the top of Catchment No. OH1 which run along the ridgeline across Catchment Nos. TD1, TD2, TD3, TD4, TD5, TD6, CD1, CD2, OH3 and finally CD3 adjoining FP1. FP3 was relatively less reflective, possibly lightly in use when compares to FP1 and FP2. It apparent at the top of Catchment No. TD6 then passed through Catchment Nos. CD1, OH2, CD2 and along the toe of Catchment Nos. OH3, CD3, OH4, TD7, OH5 and TD8. FP4 existed along the ridgeline which located at the crest of the NTSA.

The agricultural terraces and farmlands observed below the NTSA in year 1945 were still actively in use. Many cottages were constructed around the agricultural terraces and farmlands.

YEAR	OBSERVATIONS
	Morphologically, a convex change of slope is discerned immediately below the ridgeline which bounded the upper boundary of the NTSA. The convex change of slope is discerned at about +142mPD at Catchment No. OH1 and then extend up to about +234mPD at Catchment No. CD3. Another distinct convex change of slope is apparent at approximately +228mPD which located along the upper portion of Catchment Nos. TD7, OH5 and TD8. These convex changes of slope demarcate the upper and middle slope terrain. The upper slope terrain comprises of gentle slope with gradient less than 20° whilst the transportation middle slope terrain comprises of relatively steeper slope with gradient lies in between 25° to 35°.
1964	High altitude and high resolution stereo pairs. No observable significant change to the NTSA since 1963.
1967	High altitude and high resolution stereo pairs. Most of the NTSA was obscured by cloud. No observable significant change to the visible portion of the NTSA since 1963.
1973 (Figure B6)	High altitude and high resolution stereo pairs. No observable significant change to the NTSA since 1967. Two high reflectance concave depressions are discerned approximately 415m and 535m adjacent to Catchment No. TD8, bare soil without any vegetation is observed, probably recent landslides (RC1 and RC2) occurred recently. RC1 is located on a topographic depression whilst RC2 located on the bank of a drainage line, both of them appears as shallow depressions. The estimated failure volumes of RC1 and RC2 are about $20m^3$ and $25m^3$ respectively. These two locations are registered as ENTLI Nos. 12SWA0376E (RC1) and 12SWA0377E (RC2). A new footpath (FP5) is formed along the eastern boundary of the NTSA which traversed along the spurline from the top of Catchment No. CD3 downslope to the top of Catchment No. TD8 which adjoining FP1.
1974	Low altitude and high resolution stereo pairs. No significant changes could be observed since 1973.
1975 (Figure B7)	High altitude and high resolution stereo pairs.

YEAR	OBSERVATIONS
	No observable significant change to the NTSA since 1967.
	A very shallow depression is evident on an open hillslope at about 102m below Catchment No. OH1. It is highly reflective bare soil surface without any vegetation, possibly recent landslide RC3. The failure area is relatively small and therefore the estimated source volume is only about $10m^3$. This is probably the location of ENTLI No. 12SWA0378E.
	An elongated depression is apparent along a drainage line which located approximately 477m adjacent to Catchment No. TD8. It is highly reflective, bare soil is observed, probably a channelized debris flow (RC4) was occurred very recently due to no vegetation is present. The source area is narrow but long in shaped, and it is relatively incisive when compares to RC3. RC4 has an estimated failure volume of $40m^3$. This recent landslide event is registered as ENTLI No. 12SWA0380E.
1976	High altitude and high resolution stereo pairs.
	No significant changes could be observed since 1975.
1978	High altitude and high resolution stereo pairs.
	No significant changes could be observed since 1976.
1979	High altitude and high resolution stereo pairs.
	No significant changes could be observed since 1978.
1980	Low altitude and high resolution stereo pairs.
	No significant changes could be observed since 1979.
1981	High altitude and high resolution stereo pairs.
	No significant changes could be observed since 1980.
1982	High altitude and high resolution stereo pairs.
	No significant changes could be observed since 1981.
1983	Low altitude and high resolution stereo pairs.
	No significant changes could be observed since 1982.

YEAR	OBSERVATIONS
1984	High altitude and high resolution stereo pairs. No significant changes could be observed since 1983.
1985 (Figure B8 & B9)	Low altitude and high resolution stereo pairs. Part of the NTSA does not cover by these stereo pairs. Several tiny high reflectance features are present below Catchment Nos. TD2, OH2, OH3 and TD7. Bare soil is observed, sharp break of slopes are discerned within the bare soil features. This is possibly due to minor excavation by anthropogenic activities, the excavated soil were then dumped and pushed downslope which formed the soil trails. The boundary in between the excavated areas and the soil trails formed the convex break of slopes. These locations are possibly the trial pit locations of TP12, TP13, TP14, TP15 and TP16 under GIU No. 05553. The upper portion of Catchment Nos. TD7, OH5 and TD8 were appeared as lighter tone, bare soil is observed, possibly due to hill fire.
1986	Low altitude and high resolution stereo pairs. No observable significant change to the NTSA since 1985.
1987	Low altitude and high resolution stereo pairs. No observable significant change to the NTSA since 1986.
1988 (Figure B10)	Low altitude and high resolution stereo pairs. No observable significant change to the NTSA since 1987 except some vegetation grew on the slope surface. The agricultural terraces and cottages located below the NTSA were demolished. Site formation and reclamation works were commenced below the NTSA, probably the area was begun to use as landfill site.
1989 (Figure B11)	Low altitude and high resolution stereo pairs. Three highly reflective white spot features are discerned at the lower portion of Catchment Nos. TD5, OH2 and OH3. Bare soil is observed. The locations within Catchment Nos. OH2 and OH3 are possibly the Borehole locations of BH17 and BH18 under GIU No. 12800. The bare soil existed in Catchment No. TD5 appeared as rounded bare soil surface and thus likely created by anthropogenic activities, possibly this was an inspection pit for the proposed

YEAR	OBSERVATIONS
	ground investigation, but no ground investigation record could be found at that location, possible the proposed GI station has been deleted. The site formation works below the NTSA was ongoing, the area was continued to serve as landfill site.
1990 (Figure B12)	High altitude and high resolution single photograph. No observable significant change to the NTSA since 1989. A linear feature, probably catchwater is aligned along the toe of the NTSA. Formation of eight man-made cut slopes were commenced along the toe of the NTSA, probably in association with the alignment of the catchwater. They were registered as Feature Nos. 12SW-A/C178, 12SW-A/C182, 12SW-A/C183, 12SW-A/C184, 12SW-A/C185, 12SW-A/C186, 12SW-A/C187 and 12SW-A/C188. A cross-shaped features are apparent in the middle portion of Catchment No. OH3. It was located at the intersection of two footpaths, possibly a resting place or sign indicator for hikers.
1991	Low altitude and high resolution stereo pairs. Formation of feature Nos. 12SW-A/C178, 12SW-A/C182, 12SW-A/C183, 12SW-A/C184, 12SW-A/C185, 12SW-A/C186, 12SW-A/C187 and 12SW-A/C188 were ongoing. The area below the NTSA was continued to serve as landfill site.
1992 (Figure B13)	Low altitude and high resolution stereo pairs. A small patch of high reflectance bare soil is observed at the upper portion of Catchment No. CD3, possible a grave was constructed. Formation of feature Nos. 12SW-A/C178, 12SW-A/C182, 12SW-A/C183, 12SW-A/C184, 12SW-A/C185, 12SW-A/C186, 12SW-A/C187 and 12SW-A/C188 were completed. A cut slope was formed below Catchment Nos. TD7 and OH5, probably in association with the extension of the landfill site. This man-made slope was registered as Feature No. 12SW-A/C227. The area below the NTSA was continued to serve as landfill site.

YEAR	OBSERVATIONS
1993	Low altitude and high resolution stereo pairs. No observable significant change to the NTSA since 1992 except footpath FP1 was partially widened. The area below the NTSA was continued to serve as landfill site.
1994 (Figure B14)	Low altitude and high resolution stereo pairs. Entire footpath FP1 was being widened. The landfill site located below the NTSA is apparent as being filled up and the surface was smoothened. It was probably closed and no longer in use. The Site area is filled up as a platform.
1995 (Figure B15)	Low altitude and high resolution colour stereo pairs. No observable significant change to the NTSA since 1994. Eight man-made fill slopes were formed at the former landfill site which located below the NTSA. Man-made drainage channels are formed on the slope surfaces. They are registered as Feature Nos. 12SW-A/F67, 12SW-A/F68, 12SW-A/F69, 12SW-A/F70, 12SW-A/F72, 12SW-A/F73, 12SW-A/F74 and 12SW-A/F96.
1996 (Figure B16)	Low altitude and high resolution stereo pairs. Many linear features are apparent parallel to the contour lines in Catchment Nos. TD6, CD1, OH2, CD2, OH3 and CD3. A very thin layer of surface soil may be disturbed along these linear features by anthropogenic activities, possibly plantation.
1997 (Figure B17)	Low altitude and high resolution colour photograph. No observable significant change to the NTSA since 1996. The linear features observed in year 1996 were no longer observable.
1998	Low altitude and fair resolution colour photograph. Part of the NTSA was obscured by cloud. No observable significant change to the NTSA since 1997.
1999	Low altitude and high resolution colour stereo pairs.

YEAR	OBSERVATIONS
	No observable significant change to the NTSA since 1998.
2000	Low altitude and high resolution colour stereo pairs.
	No observable significant change to the NTSA since 1999.
2001	Low altitude and high resolution colour stereo pairs.
	No observable significant change to the NTSA since 2000 except some vegetation grew on the slope surface.
2002	Low altitude and high resolution colour stereo pairs.
	No observable significant change to the NTSA since 2001.
2003	Low altitude and fair resolution colour stereo pairs.
	No observable significant change to the NTSA since 2002.
2004 (Figure B18)	Low altitude and high resolution colour stereo photo.
	The upper portion of Catchment Nos. CD3, TD7, OH5 and TD8 are apparent as grey tone, possibly hill fire was occurred.
	A linear feature is discerned at the Site area, probably it is used as model aeroplane training field.
2005	Low altitude and high resolution colour stereo photo.
	No observable significant change to the NTSA since 2004.
2006	Low altitude and high resolution colour stereo pairs.
	No observable significant change to the NTSA since 2005 except denser vegetation grew on the slope surface.
2007	Low altitude and high resolution stereo pairs.
	No observable significant change to the NTSA since 2006 except denser vegetation grew on the slope surface.
2008	Low altitude and high resolution colour stereo pairs.
	No observable significant change to the NTSA since 2007 except denser

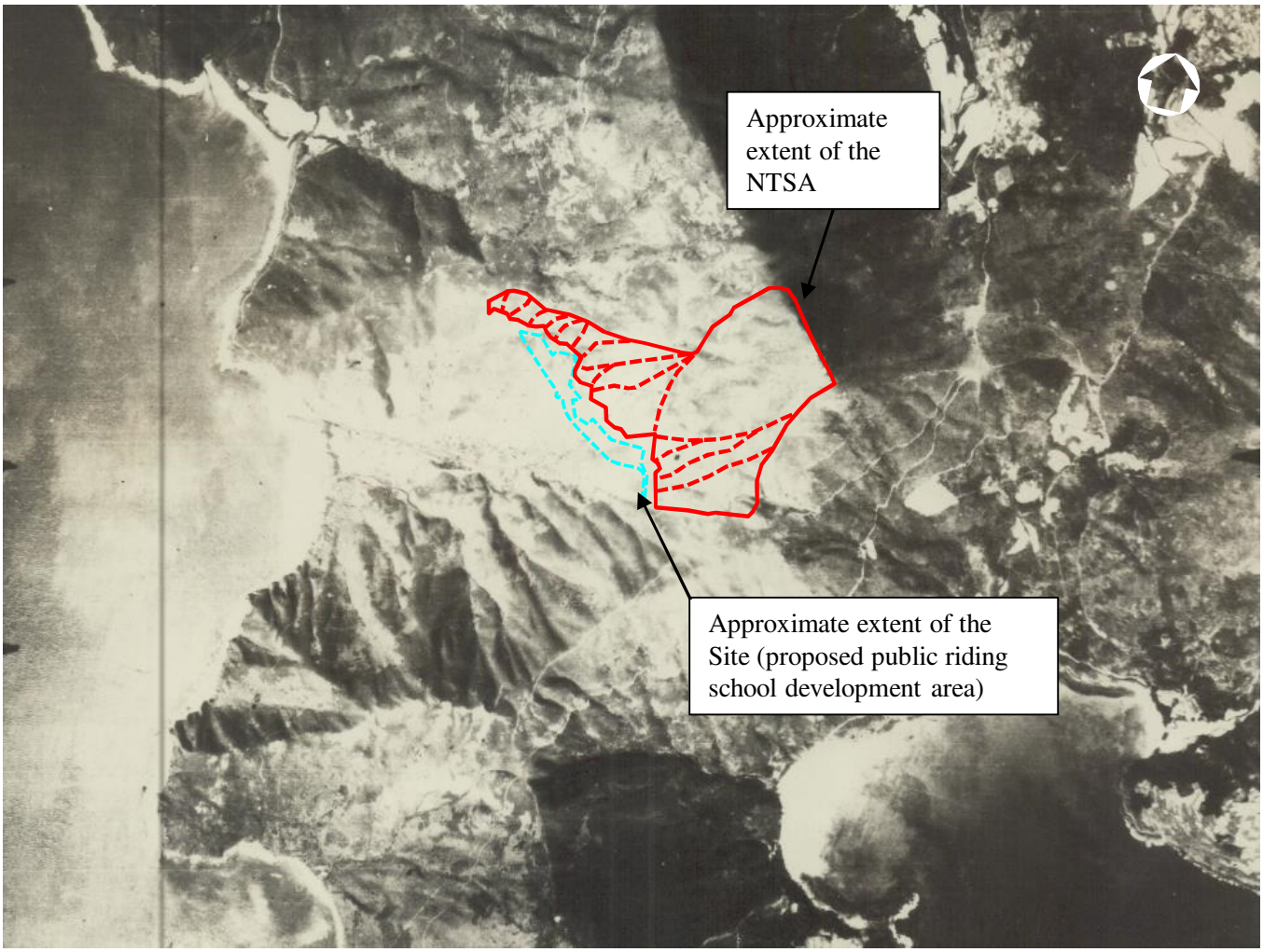
YEAR	OBSERVATIONS
	vegetation grew on the slope surface.
2009	Low altitude and high resolution colour stereo pairs.
	No observable significant change to the NTSA since 2008 except denser vegetation grew on the slope surface.
2010	Low altitude and high resolution colour stereo pairs.
	No observable significant change to the NTSA since 2009 except denser vegetation grew on the slope surface.
2011	Low altitude and high resolution colour stereo pairs.
	No observable significant change to the NTSA since 2010 except denser vegetation grew on the slope surface.
2012	Low altitude and high resolution colour stereo pairs.
	The stereo pairs only covered part of the NTSA. No observable significant change to the NTSA since 2011.
2013	Low altitude and high resolution colour stereo pairs.
	No observable significant change to the NTSA since 2012 except denser vegetation grew on the slope surface.
2014	Low altitude and high resolution colour stereo pairs.
	No observable significant change to the NTSA since 2013 except denser vegetation grew on the slope surface.
2015	Low altitude and high resolution colour stereo pairs.
	No observable significant change to the NTSA since 2014 except denser vegetation grew on the slope surface.
2016	Low altitude and high resolution colour stereo pairs.
	No observable significant change to the NTSA since 2015 except denser vegetation grew on the slope surface.
2017	Low altitude and high resolution colour stereo pairs.
	No observable significant change to the NTSA since 2016 except denser

YEAR	OBSERVATIONS
	vegetation grew on the slope surface.
2018 (Figure B19)	Low altitude and high resolution colour stereo pairs. No observable significant change to the NTSA since 2017 except vegetation clearance by anthropogenic activities at the upper portion of Catchment Nos. CD3 and OH5.
2019	Low altitude and high resolution colour stereo pairs. No observable significant change to the NTSA since 2018 except denser vegetation grew on the slope surface.
2020	Low altitude and high resolution colour stereo pairs. No observable significant change to the NTSA since 2019 except denser vegetation grew on the slope surface.
2021	Low altitude and high resolution colour stereo pairs. No observable significant change to the NTSA since 2020 except denser vegetation grew on the slope surface.

Table B1 – List of Photographs

Photo Year	Aerial Photo Reference No.	Flight Altitude (Feet)
1924	Y00031-2	12,500
1945	Y00433-4	20,000
1956	Y03253-4	-
1963	Y08354-5	3,900
1963	Y08392-3	3,900
1964	Y12906-7	12,500
1967	Y13343-4	6,250
1973	8037-8	12,500
1974	9304-5	4,000
1975	12055-6	12,500
1976	15928-9	12,500
1978	20763-4	12,500
1979	28028-9	10,000
1980	29753-5	4,000
1981	39036-7	10,000
1982	44514-5	10,000
1983	47499-501	4,000
1984	56489-90	11,000
1985	65987-8	4,000
1986	A04254-5	4,000
1987	A08668-9	4,000
1988	A12790-1	4,000
1989	A16793-4	4,000
1990	A24427-8	10,000
1991	A27706-7	4,000
1992	A32762-4	4,000
1993	A37382-3	4,000
1994	A39049-50	4,000
1995	CN10018-9	3,500
1996	A42220-1	4,000
1997	CN17110-1	4,000
1998	CN21383-4	4,000
1999	CN25165-6	4,000
2000	CN26669-70	4,000
2001	CW34867-8	4,000
2002	CW39242-3	3,000
2003	CW47869-70	4,000

Photo Year	Aerial Photo Reference No.	Flight Altitude (Feet)
2004	CW62910-1	4,000
2005	CW67596-7	4,000
2006	CS02206-8	6,000
2007	CS09051-2	6,000
2008	CS20259-60	6,000
2009	CS23448-9	6,000
2010	CS30143-4	6,000
2011	CW89762-4	3,000
2012	CW94555-6	2,000
2013	CS44655-7	6,000
2014	CS47084-6	6,000
2015	CS55027-9	6,000
2016	CS62116-7	6,000
2017	E027935-6C	6,900
2018	E046899-900C	6,900
2019	E079751-3C	6900
2020	E117651-3C	6,900
2021	E118313-5C	6,900



Photograph No.: Y00032 **Date of Photograph: 1924** **Altitude: 12,500'**

Legend:

Approximate Boundary of the NTSA

Catchment Boundary

Approximate Boundary of the Site (Proposed public riding school development area)

- The NTSA appears as southwest facing natural hillsides emerging from a northwest trending ridgeline below High Junk Peak.
- Due to the poor resolution of aerial photographs, the entire NTSA and the Site (proposed public riding school development area) appears as high reflectance, no detail observation can be examined.

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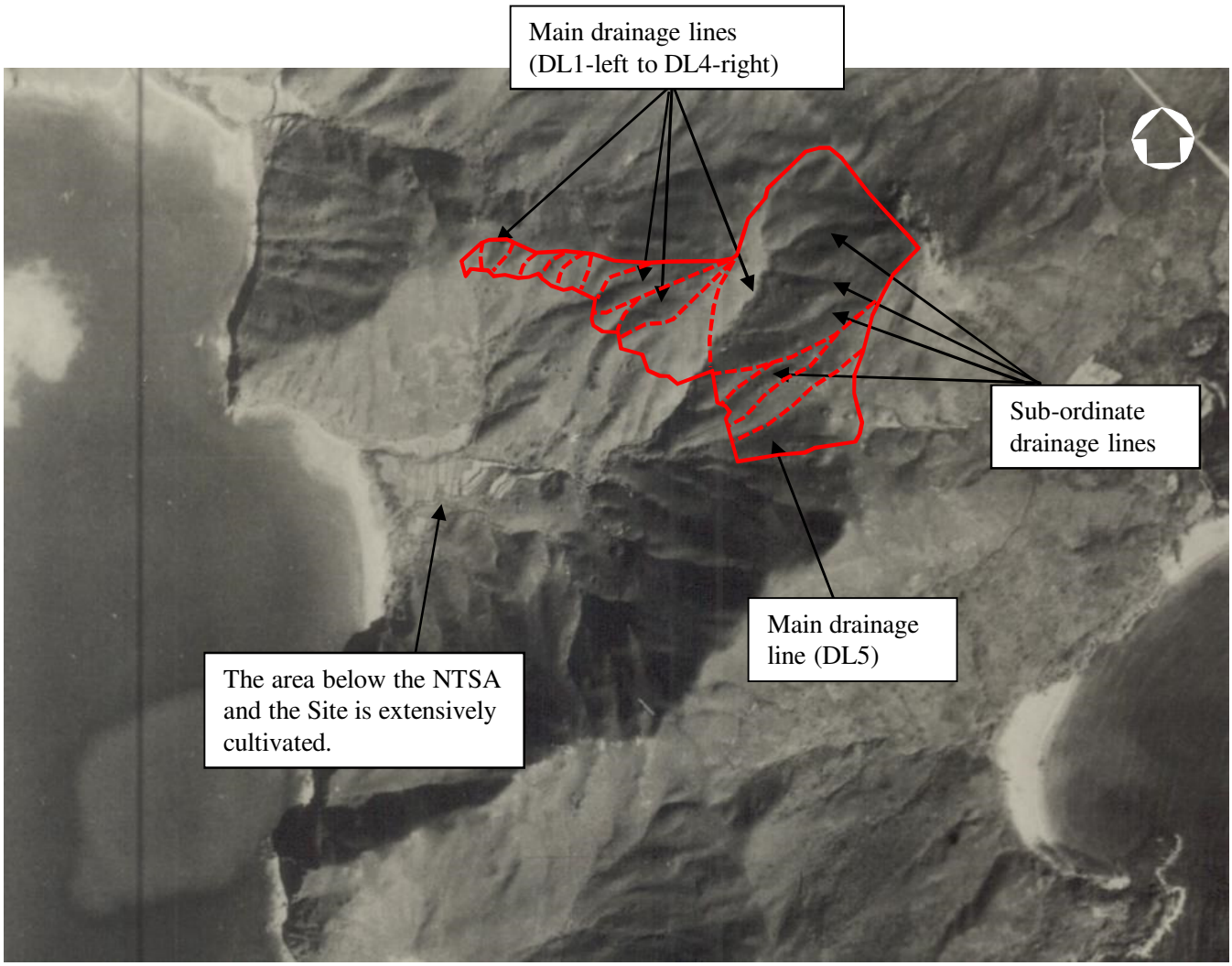
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FIGURE B1

Location
Landfill Site II/III, Tseung Kwan O

Scale NTS

Date 29 May 2022



Photograph No.: Y00433 **Date of Photograph: 11 Nov 1945** **Altitude: 20,000'**

Legend: Approximate Boundary of the NTSA Catchment Boundary

- The eastern and western boundary of the NTSA is bounded by indistinct rounded spurs.
- Several linear hollows, possibly ephemeral drainage lines DL1, DL2, DL3, DL4 and DL5 and their sub-ordinate drainage lines are observed within the NTSA.
- No perennial drainage line can be discerned within the NTSA.
- The area below the NTSA and the Site is extensively cultivated.

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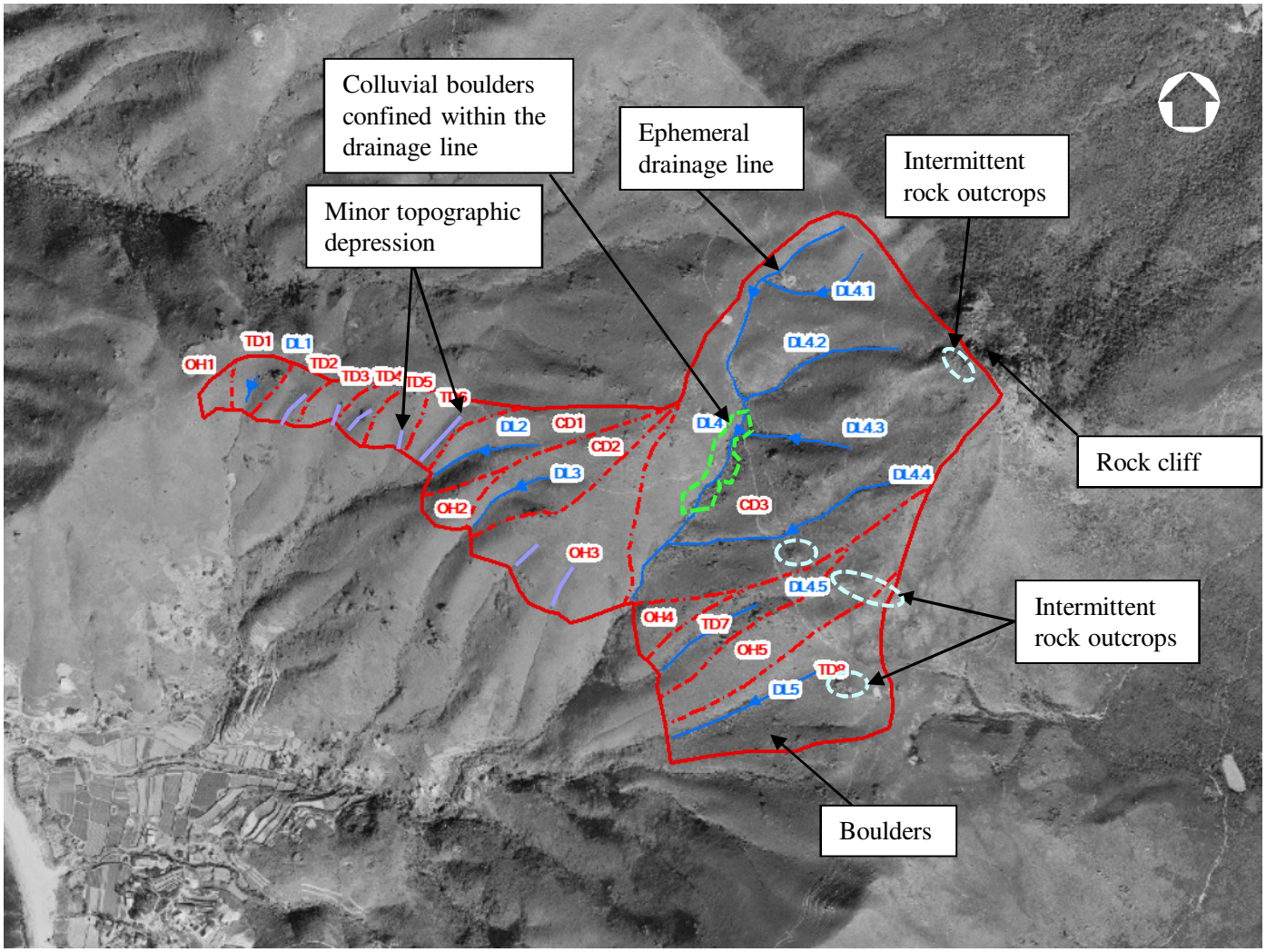
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FIGURE B2

Location
Landfill Site II/III, Tseung Kwan O

Scale NTS

Date 29 May 2022



Photograph No.: Y08354 **Date of Photograph: 17 Feb 1963** **Altitude: 3,900'**

Legend:

Approximate Boundary of the NTSA

Catchment Boundary

Intermittent rock outcrop

Colluvial boulders

Ephemeral drainage line

Minor topographic depression

- The smooth surface of the NTSA indicates the NTSA is probably covered by in-situ materials without significant mass wasting process, possibly a thin layer veneer (< 2m thick) of hillslope colluvium blanket the majority of the hillsides within the NTSA. Valley colluvium is confined along the drainage lines.
- Intermittent rock outcrops are discerned at the crest of the NTSA which located along the ridgeline at upper portion of Catchment Nos. CD3, OH5 and TD8. Some boulder fields were deposited at the middle portion of Catchment Nos. CD3.
- DL1 and DL5 appeared to be subtle depression, whilst DL2 and DL3 is relatively incisive, DL4 is the most distinctive. This probably indicates more water concentrate along DL4 and therefore the erosion of DL4 is more active than the other four drainage lines. Some boulders, probably colluvial boulders are concentrated along DL4.
- Morphologically, a convex change of slope is discerned immediately below the ridgeline which bounded the upper boundary of the NTSA. The convex change of slope is discerned at about +142mPD at Catchment No. OH1 and then extend up to about +234mPD at Catchment No. CD3. Another distinct convex change of slope is apparent at approximately +228mPD which located along the upper portion of Catchment Nos. TD7, OH5 and TD8. These convex changes of slope demarcate the upper and middle slope terrain. The upper slope terrain comprises of gentle slope with gradient less than 20° whilst the transportation middle slope terrain comprises of relatively steeper slope with gradient lies in between 25° to 35°.

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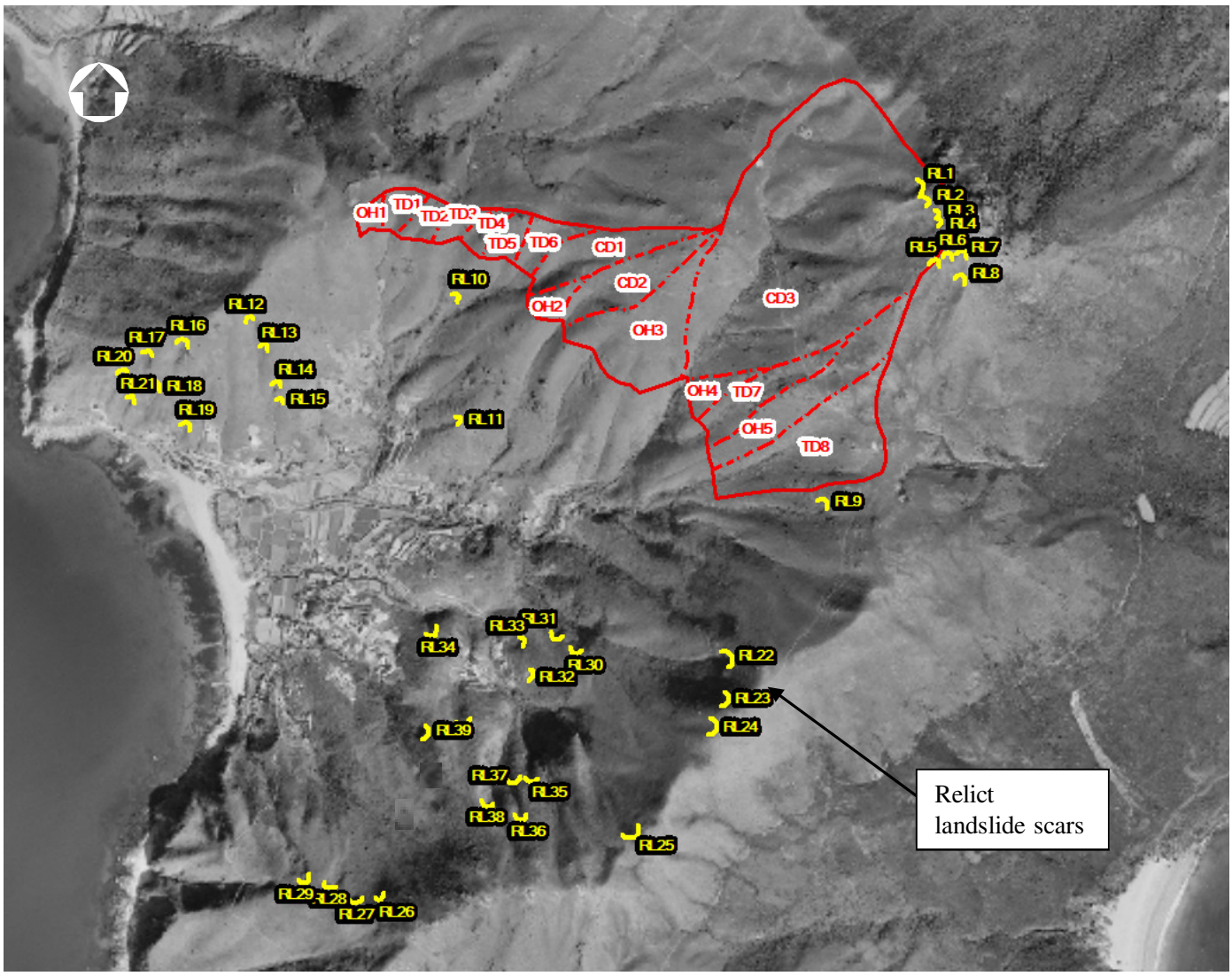
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FIGURE B3

Location
Landfill Site II/III, Tseung Kwan O

Scale NTS

Date 29 May 2022



Photograph No.: Y08354 **Date of Photograph: 17 Feb 1963** **Altitude: 3,900'**

Legend:

Approximate Boundary of the NTSA

Catchment Boundary

Relict landslide scar

- RL1 to RL39 are discerned in dark grey tone, therefore they probably occurred in a long period ago. All these landslide events are regarded as relict landslides.
- No recent landslide is discerned within or in the close vicinity of the NTSA.

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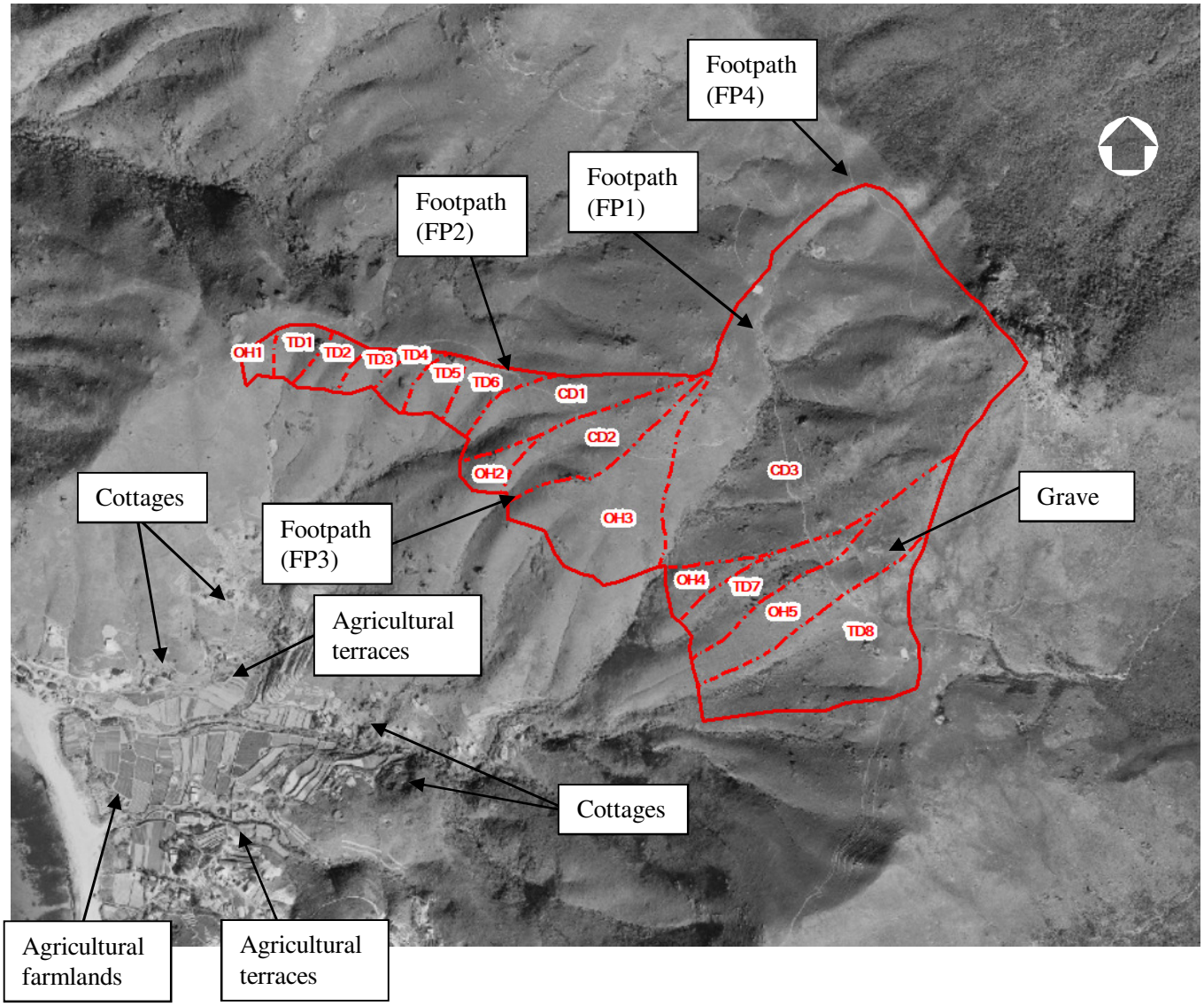
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FIGURE B4

Location
Landfill Site II/III, Tseung Kwan O

Scale NTS

Date 29 May 2022



Photograph No.: Y08354 **Date of Photograph: 17 Feb 1963** **Altitude: 3,900'**

Legend: Approximate Boundary of the NTSA — Catchment Boundary

- A spot of high reflectance feature was existed at the upper portion of Catchment No. OH5, possibly grave.
- Four high reflectance linear features were traversed within the NTSA, probably footpaths (FP1 to FP4). FP1 were present along the middle portion of Catchment No. CD3 downwards to the upper portion of Catchment Nos. TD7, OH5 and TD8. FP2 were discerned from the top of Catchment No. OH1 which run along the ridgeline across Catchment Nos. TD1, TD2, TD3, TD4, TD5, TD6, CD1, CD2, OH3 and finally CD3 adjoining FP1. FP3 was relatively less reflective, possibly lightly in use when compares to FP1 and FP2. It apparent at the top of Catchment No. TD6 then passed through Catchment Nos. CD1, OH2, CD2 and along the toe of Catchment Nos. OH3, CD3, OH4, TD7, OH5 and TD8. FP4 existed along the ridgeline which located at the crest of the NTSA.
- The agricultural terraces and farmlands observed below the NTSA in year 1945 were still actively in use.
- Many cottages were constructed around the agricultural terraces and farmlands.

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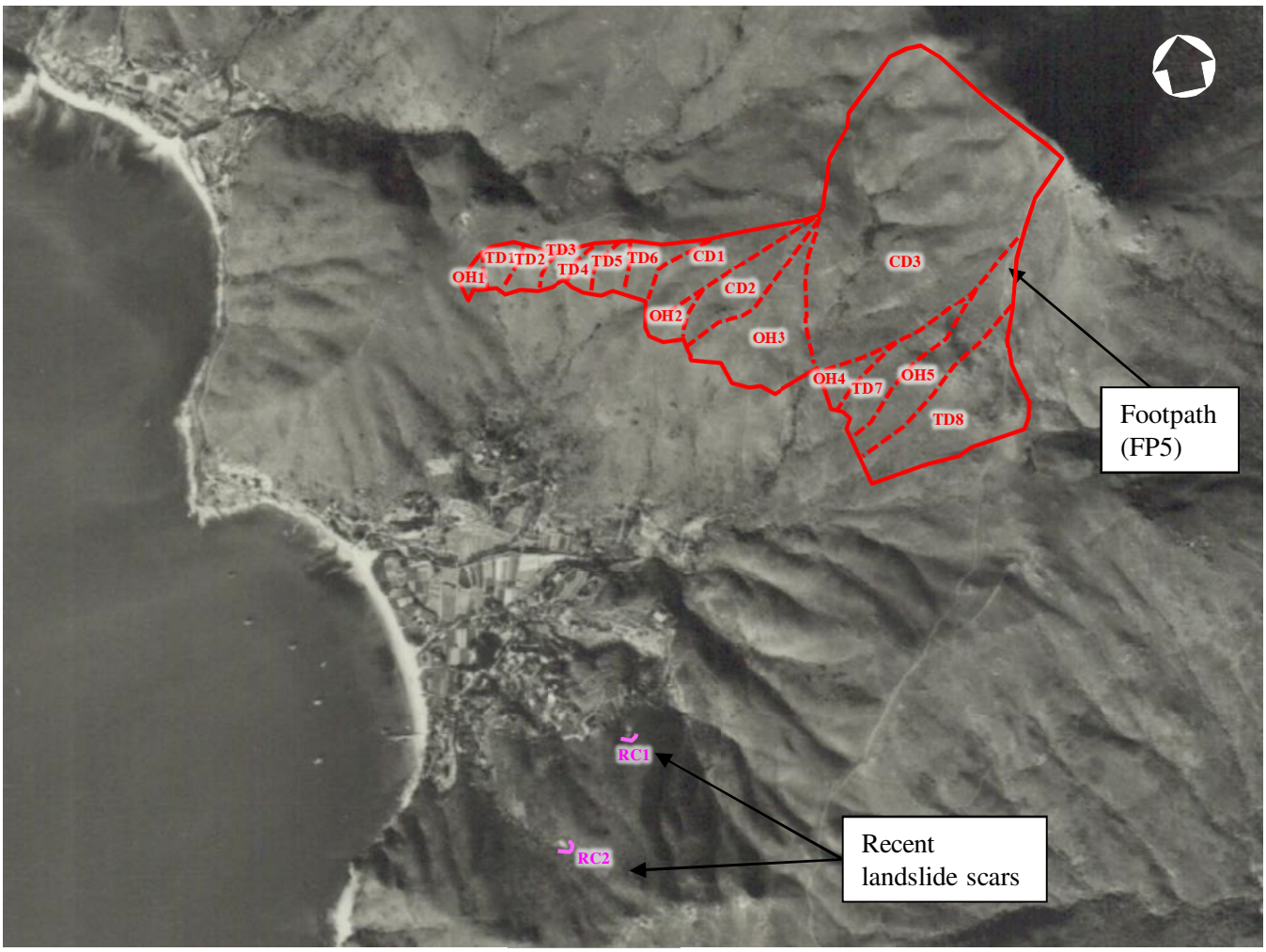
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FIGURE B5

Location
Landfill Site II/III, Tseung Kwan O

Scale NTS

Date 29 May 2022



Photograph No.: 8038 **Date of Photograph: 20 Dec 1973** **Altitude: 12,500'**

Legend:

Approximate Boundary of the NTSA

Catchment Boundary

Recent landslide scar

- Two high reflectance concave depressions are discerned approximately 415m and 535m adjacent to Catchment No. TD8, bare soil without any vegetation is observed, probably recent landslides (RC1 and RC2). RC1 is located on a topographic depression whilst RC2 located on the bank of a drainage line, both of them appears as shallow depressions. The estimated failure volumes of RC1 and RC2 are about 20m³ and 25m³ respectively. These two locations are registered as ENTLI Nos. 12SWA0376E (RC1) and 12SWA0377E (RC2).
- A new footpath (FP5) is formed along the eastern boundary of the NTSA which traversed along the spurline from the top of Catchment No. CD3 downslope to the top of Catchment No. TD8 which adjoining FP1.

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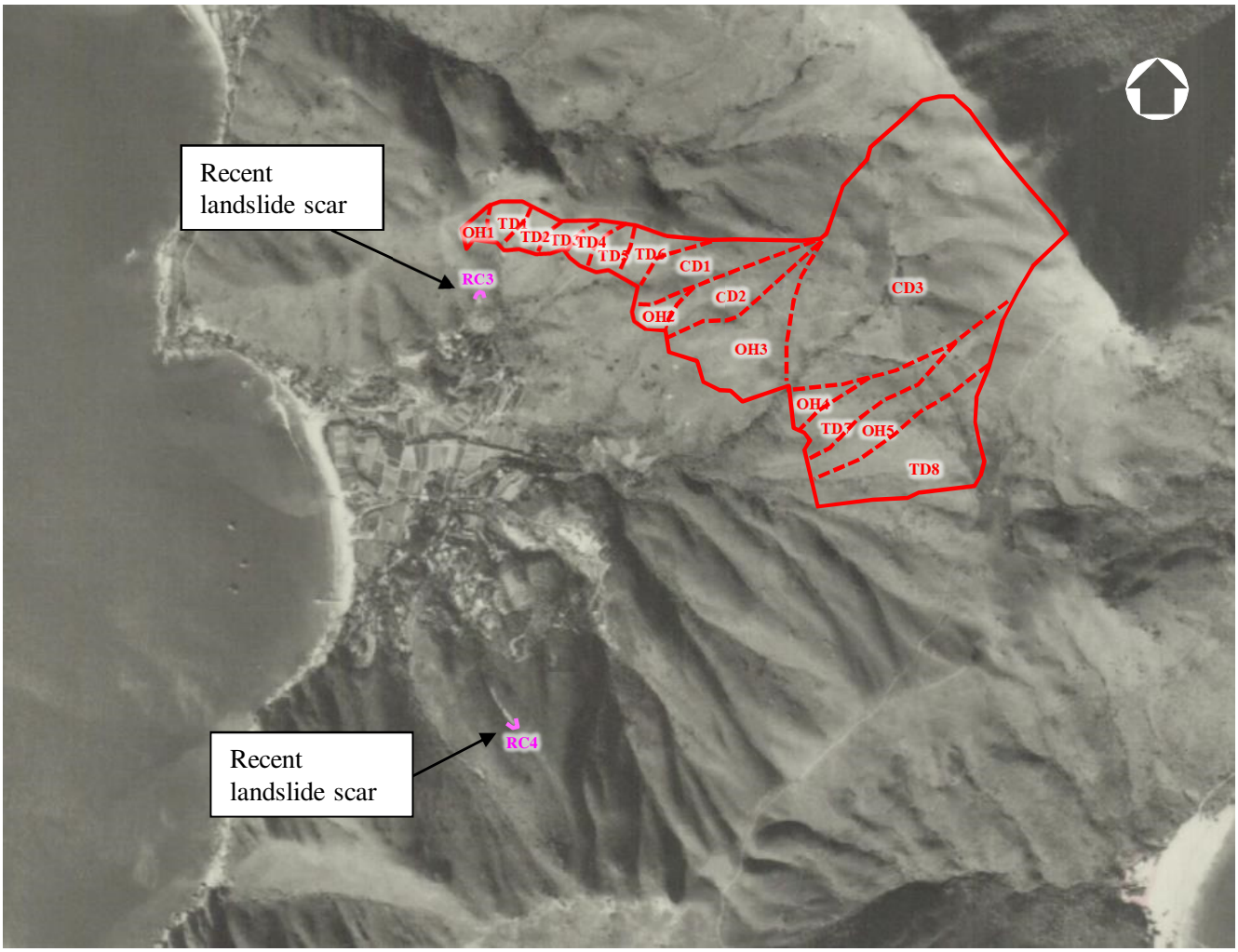
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FIGURE B6

Location
Landfill Site II/III, Tseung Kwan O

Scale NTS

Date 29 May 2022



Photograph No.: 12055 **Date of Photograph: 24 Dec 1975** **Altitude: 12,500'**

Legend: Approximate Boundary of the NTSA; Catchment Boundary; Recent landslide scar

- A very shallow depression is evident on an open hillslope at about 102m below Catchment No. OH1. It is highly reflective bare soil surface without any vegetation, possibly recent landslide RC3. The failure area is relatively small and therefore the estimated source volume is only about 10m³. This is probably the location of ENTLI No. 12SWA0378E.
- An elongated depression is apparent along a drainage line which located approximately 477m adjacent to Catchment No. TD8. It is highly reflective, bare soil is observed, probably a channelized debris flow (RC4) was occurred very recently due to no vegetation is present. The source area is narrow but long in shaped, and it is relatively incisive when compares to RC3. RC4 has an estimated failure source volume of 40m³. This recent landslide event is registered as ENTLI No. 12SWA0380E.

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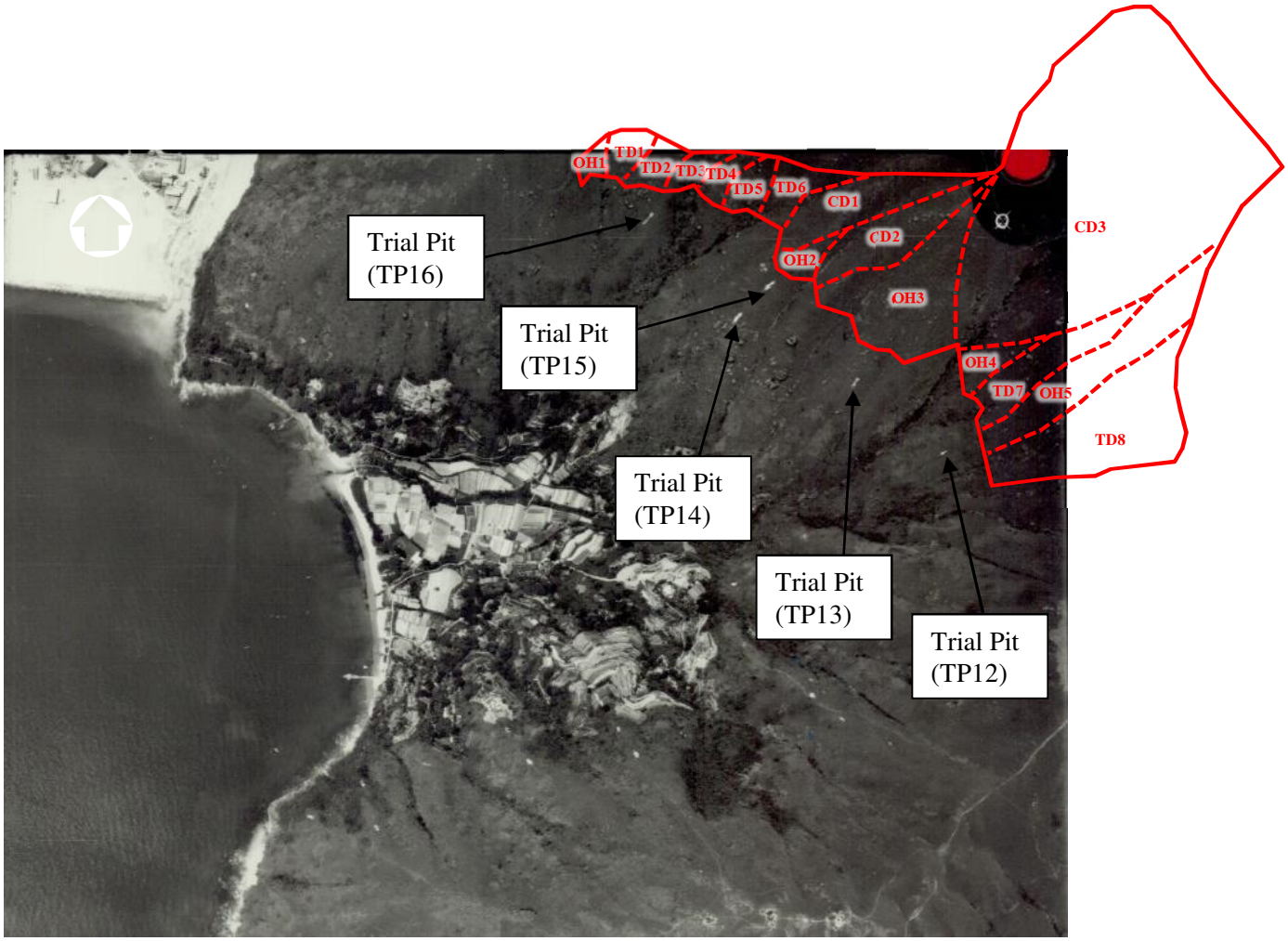
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FIGURE B7

Location: Landfill Site II/III, Tseung Kwan O

Scale: NTS

Date: 29 May 2022



Photograph No.: 65988 **Date of Photograph: 24 Apr 1985** **Altitude: 4,000'**

Legend: Approximate Boundary of the NTSA Catchment Boundary

- Several tiny high reflectance features are present below Catchment Nos. TD2, OH2, OH3 and TD7. Bare soil is observed, sharp break of slopes are discerned within the bare soil features. This is possibly due to minor excavation by anthropogenic activities, the excavated soil were then dumped and pushed downslope which formed the soil trails. The boundary in between the excavated areas and the soil trails formed the convex break of slopes. These locations are possibly the trial pit locations of TP12, TP13, TP14, TP15 and TP16 under GIU No. 05553.

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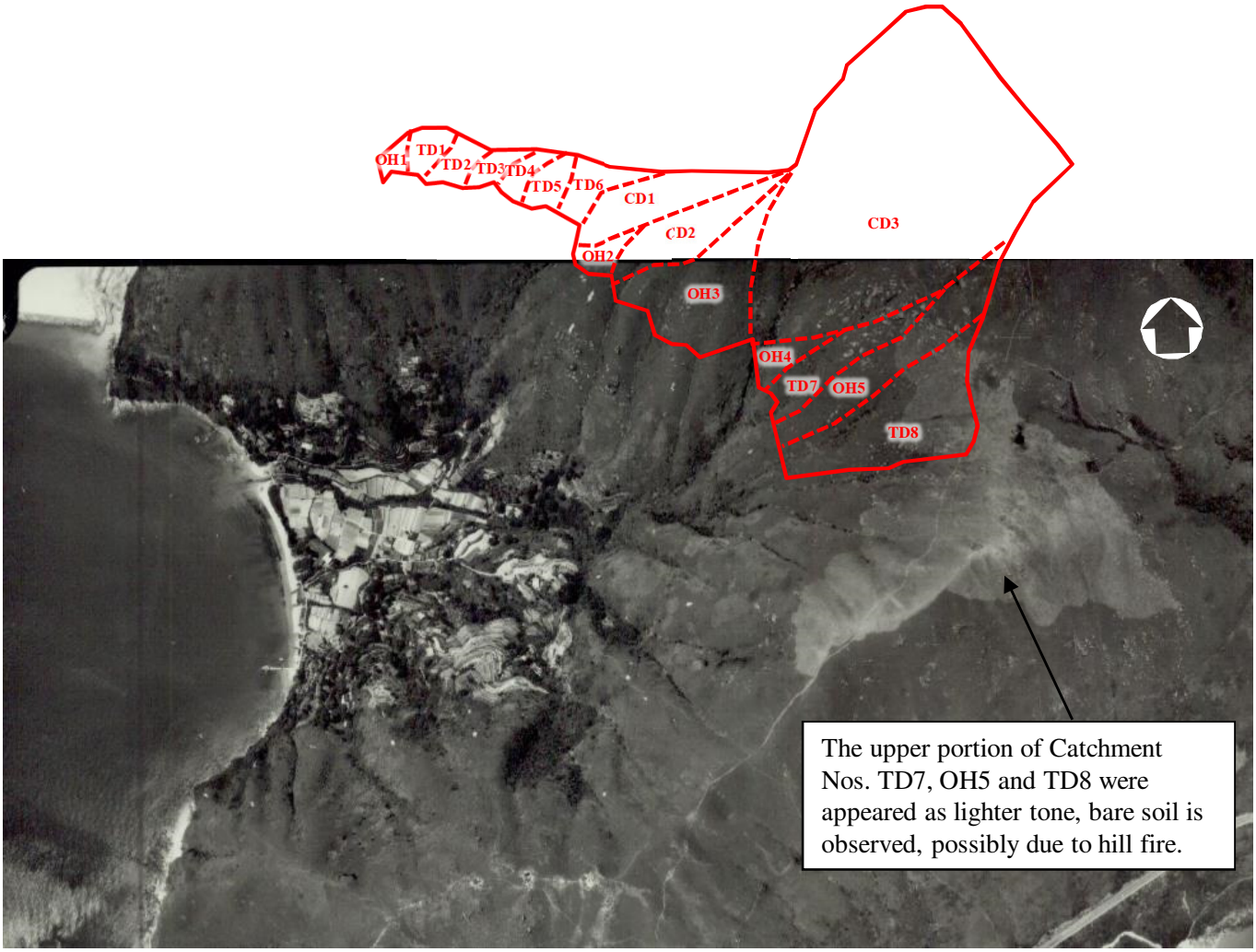
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FIGURE B18

Location
Landfill Site II/III, Tseung Kwan O

Scale NTS

Date 29 May 2022



Photograph No.: 65987 **Date of Photograph: 24 Apr 1985** **Altitude: 4,000'**

Legend: Approximate Boundary of the NTSA — Catchment Boundary

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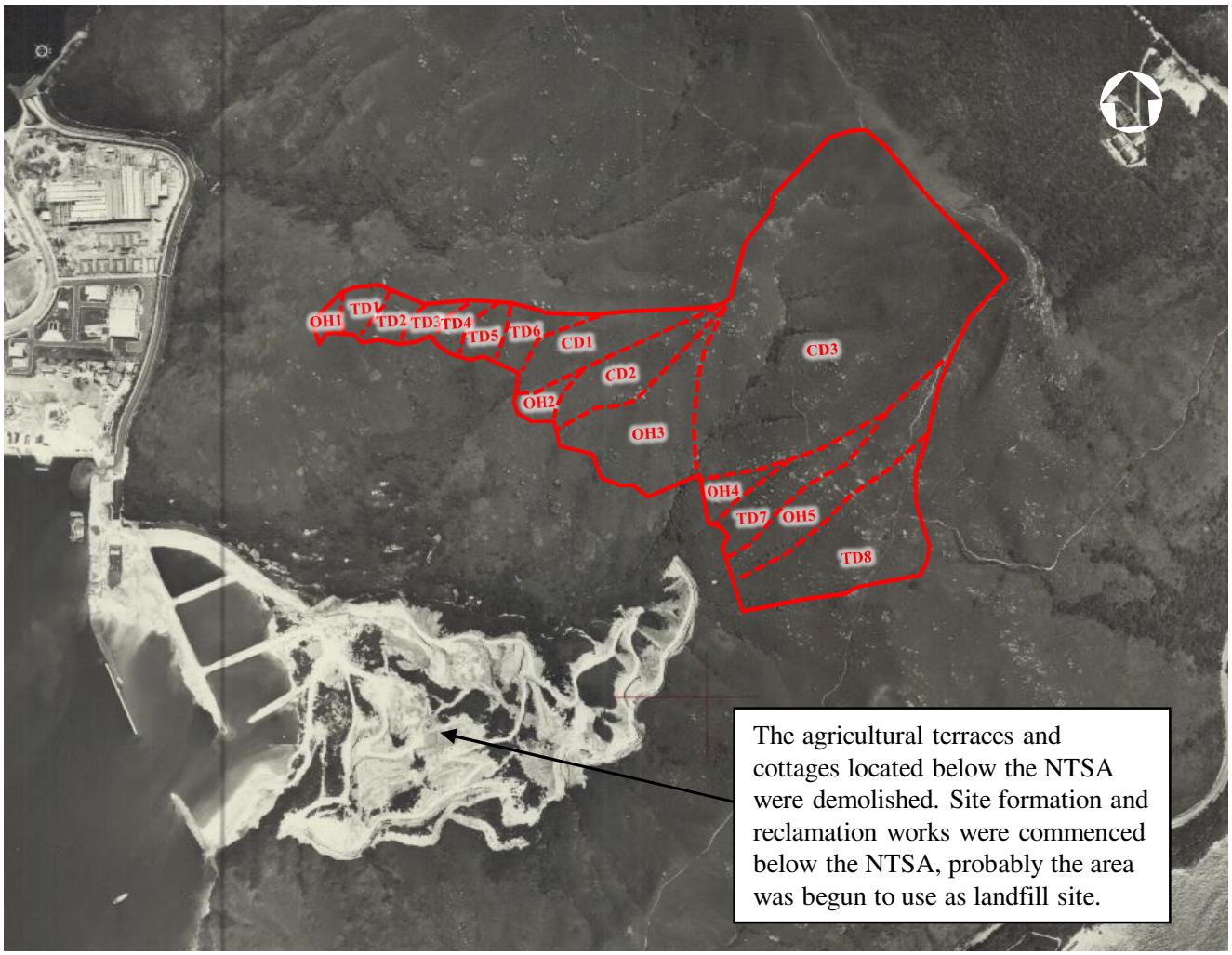
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FIGURE B9

Location
Landfill Site II/III, Tseung Kwan O

Scale NTS

Date 29 May 2022



Photograph No.: A12791 **Date of Photograph: 2 Jun 1988** **Altitude: 4,000'**

Legend: Approximate Boundary of the NTSA — — — Catchment Boundary

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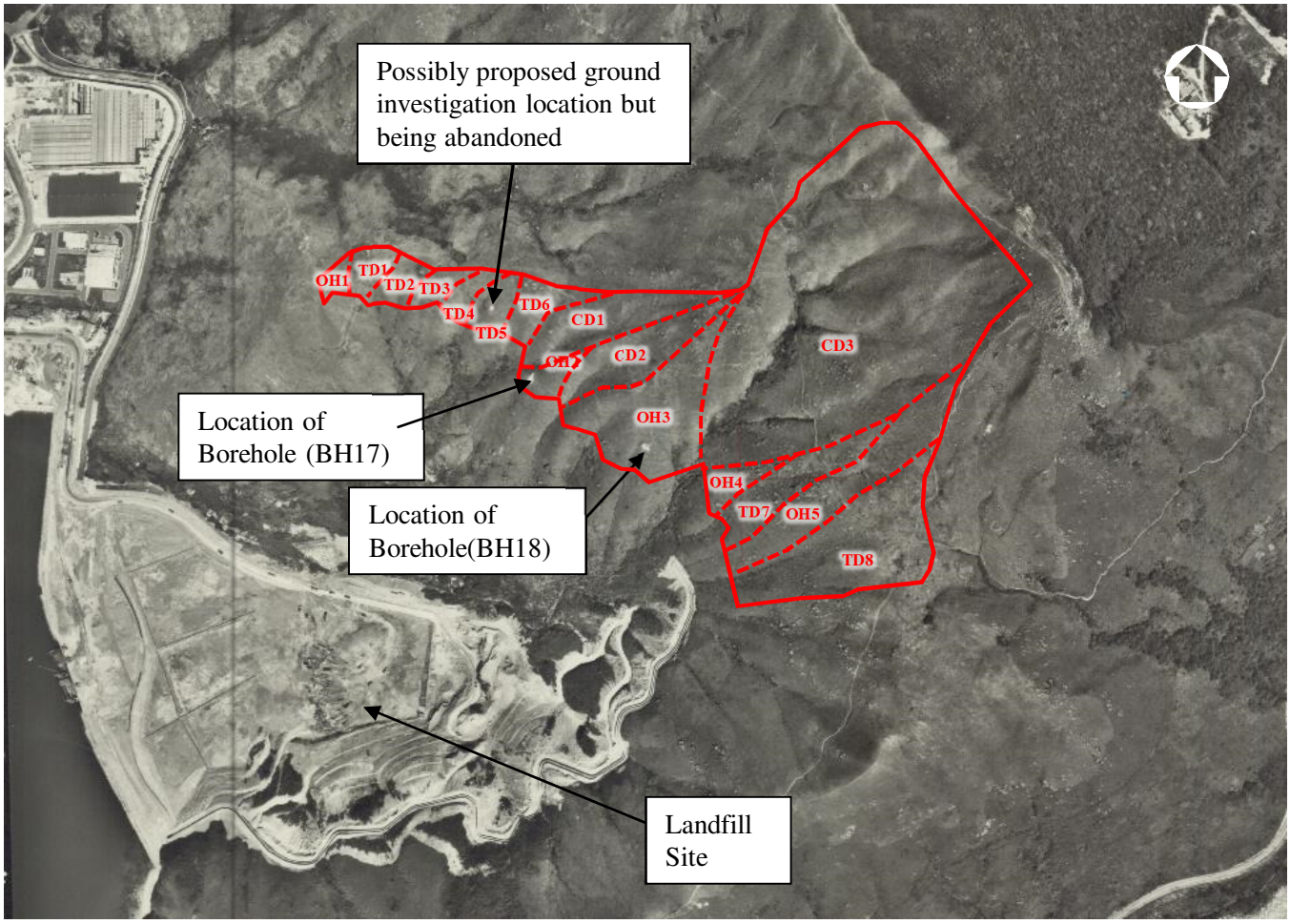
Project:
Natural Terrain Hazard Study for the Proposed Development of New Public Riding School at the Restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III)

FIGURE B10

Location
Landfill Site II/III, Tseung Kwan O

Scale NTS

Date 29 May 2022



Photograph No.: A16793 **Date of Photograph: 28 Mar 1989** **Altitude: 4,000'**

Legend: Approximate Boundary of the NTSA ---- Catchment Boundary

- The locations within Catchment Nos. OH2 and OH3 are possibly the Borehole locations of BH17 and BH18 under GIU No. 12800.
- The bare soil existed in Catchment No. TD5 appeared as rounded bare soil surface and thus likely created by anthropogenic activities, possibly this was a proposed ground investigation location but being abandoned, therefore no ground investigation record could be found.
- The site formation works below the NTSA was ongoing, the area was continued to serve as landfill site.

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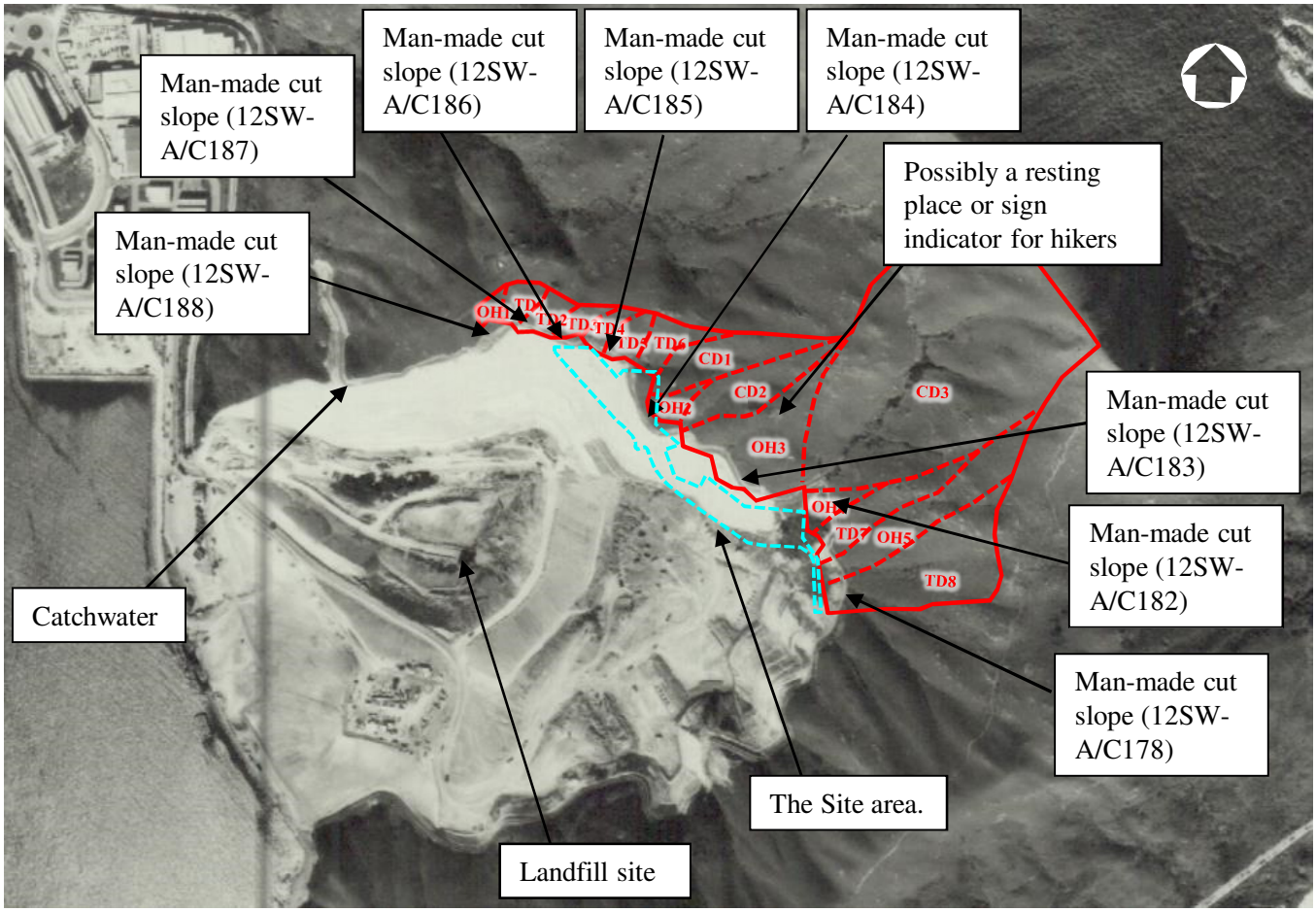
Project: Natural Terrain Hazard Study for the Proposed Development of New Public Riding School at the Restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III)

FIGURE B11

Location: Landfill Site II/III, Tseung Kwan O

Scale: NTS

Date: 29 May 2022



Photograph No.: A24428 **Date of Photograph: 3 Dec 1990** **Altitude: 10,000'**

Legend:

Approximate Boundary of the NTSA

Catchment Boundary

Approximate Boundary of the Site (Proposed public riding school development area)

- A linear feature, probably catchwater is aligned along the toe of the NTSA. Formation of eight man-made cut slopes were commenced along the toe of the NTSA, probably in association with the alignment of the catchwater. They were registered as Feature Nos. 12SW-A/C178, 12SW-A/C182, 12SW-A/C183, 12SW-A/C184, 12SW-A/C185, 12SW-A/C186, 12SW-A/C187 and 12SW-A/C188.
- A cross-shaped features are apparent in the middle portion of Catchment No. OH3. It was located at the intersection of two footpaths, possibly a resting place or sign indicator for hikers.

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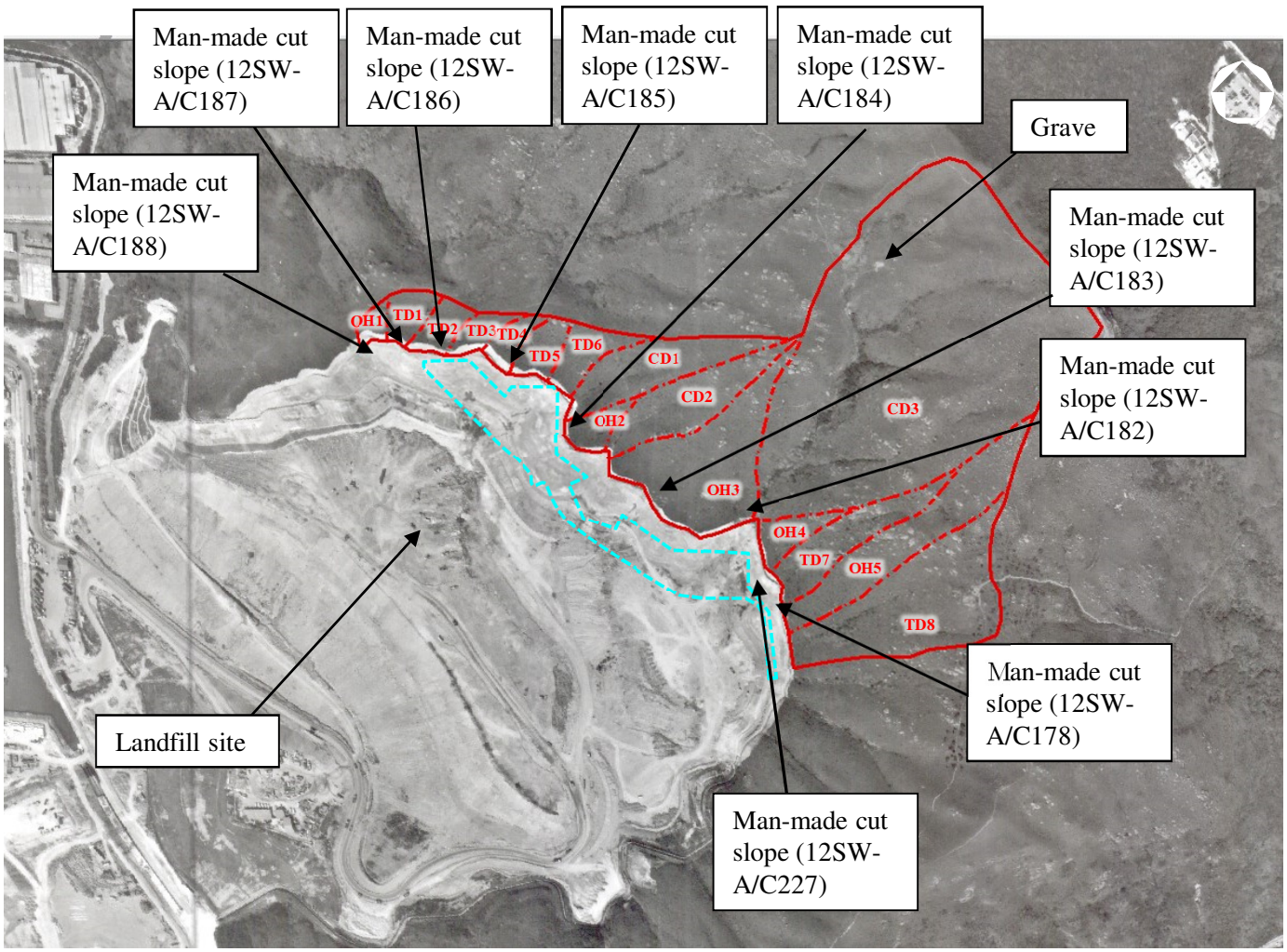
Project:
Natural Terrain Hazard Study for the Proposed Development of New Public Riding School at the Restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III)

FIGURE B12

Location
Landfill Site II/III, Tseung Kwan O

Scale NTS

Date 29 May 2022



Photograph No.: A32763 **Date of Photograph: 20 Oct 1992** **Altitude: 4,000'**

Legend:

Approximate Boundary of the NTSA

Catchment Boundary

Approximate Boundary of the Site (Proposed public riding school development area)

- A small patch of high reflectance bare soil is observed at the upper portion of Catchment No. CD3, possible a grave was constructed.
- Formation of feature Nos. 12SW-A/C178, 12SW-A/C182, 12SW-A/C183, 12SW-A/C184, 12SW-A/C185, 12SW-A/C186, 12SW-A/C187 and 12SW-A/C188 were completed.
- A cut slope was formed below Catchment Nos. TD7 and OH5, probably in association with the extension of the landfill site. This man-made slope was registered as Feature No. 12SW-A/C227.
- The area below the NTSA was continued to serve as landfill site.

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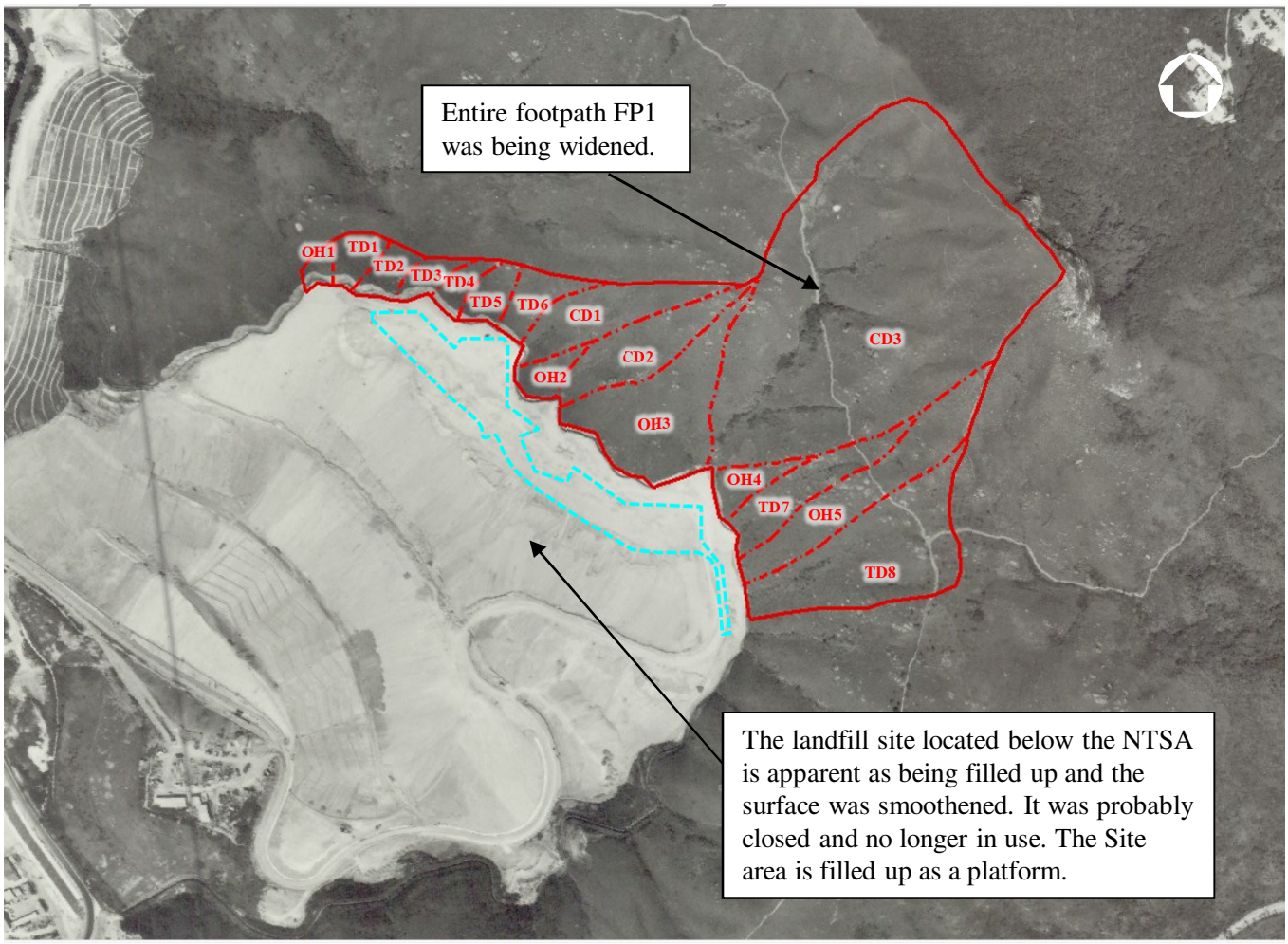
Project:
Natural Terrain Hazard Study for the Proposed Development of New Public Riding School at the Restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III)

FIGURE B13

Location
Landfill Site II/III, Tseung Kwan O

Scale NTS

Date 29 May 2022



Photograph No.: A39049 **Date of Photograph: 17 Oct 1994** **Altitude: 4,000'**

Legend:

Approximate Boundary of the NTSA

Catchment Boundary

Approximate Boundary of the Site (Proposed public riding school development area)

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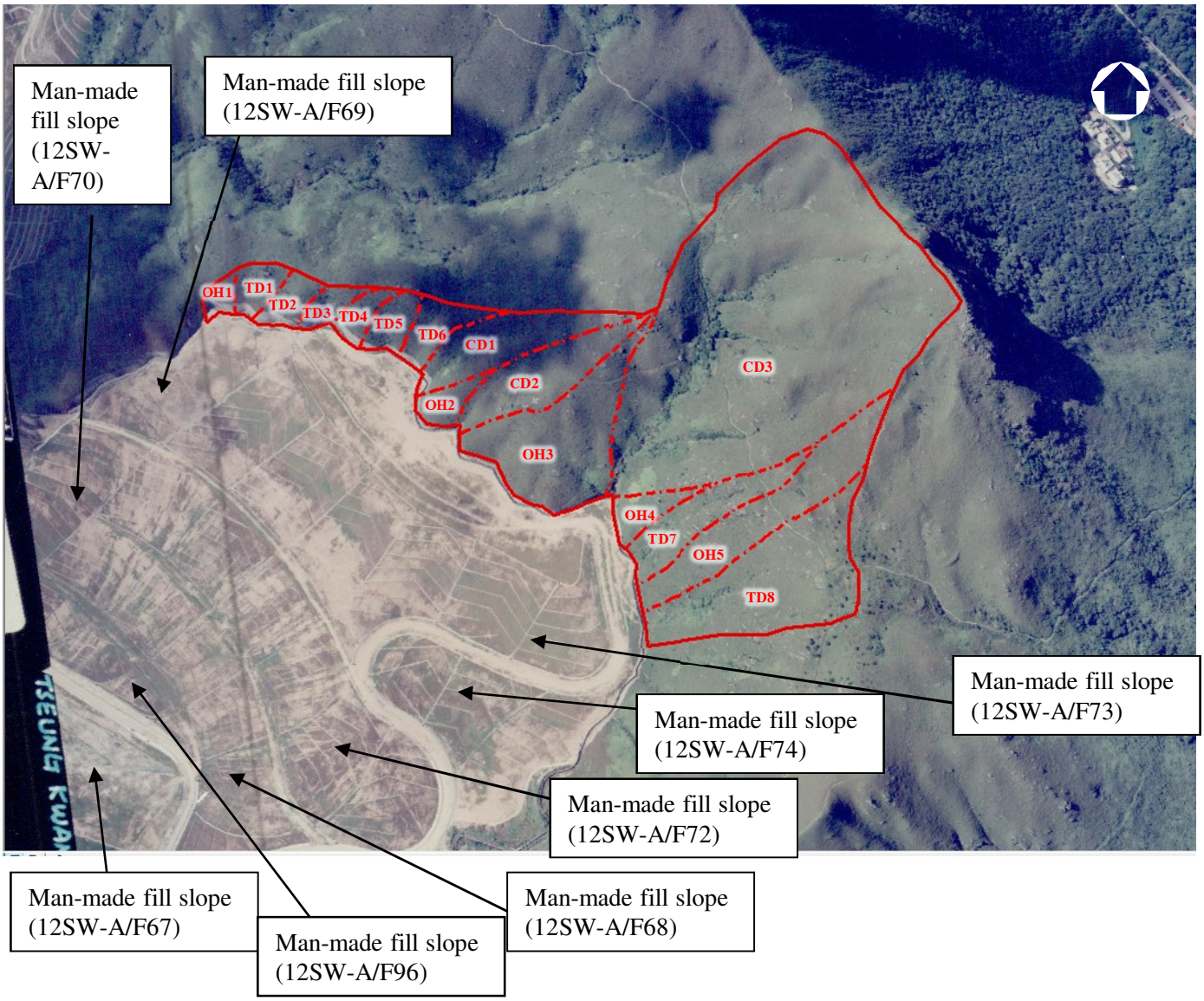
Project:
Natural Terrain Hazard Study for the Proposed Development of New Public Riding School at the Restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III)

FIGURE B14

Location
Landfill Site II/III, Tseung Kwan O

Scale NTS

Date 29 May 2022



Photograph No.: CN10018 **Date of Photograph: 18 Jul 1995** **Altitude: 3,500'**

Legend:

Approximate Boundary of the NTSA

Catchment Boundary

Approximate Boundary of the Site (Proposed public riding school development area)

- Eight man-made fill slopes were formed at the former landfill site which located below the NTSA. Man-made drainage channels are formed on the slope surfaces. They are registered as Feature Nos. 12SW-A/F67, 12SW-A/F68, 12SW-A/F69, 12SW-A/F70, 12SW-A/F72, 12SW-A/F73, 12SW-A/F74 and 12SW-A/F96.

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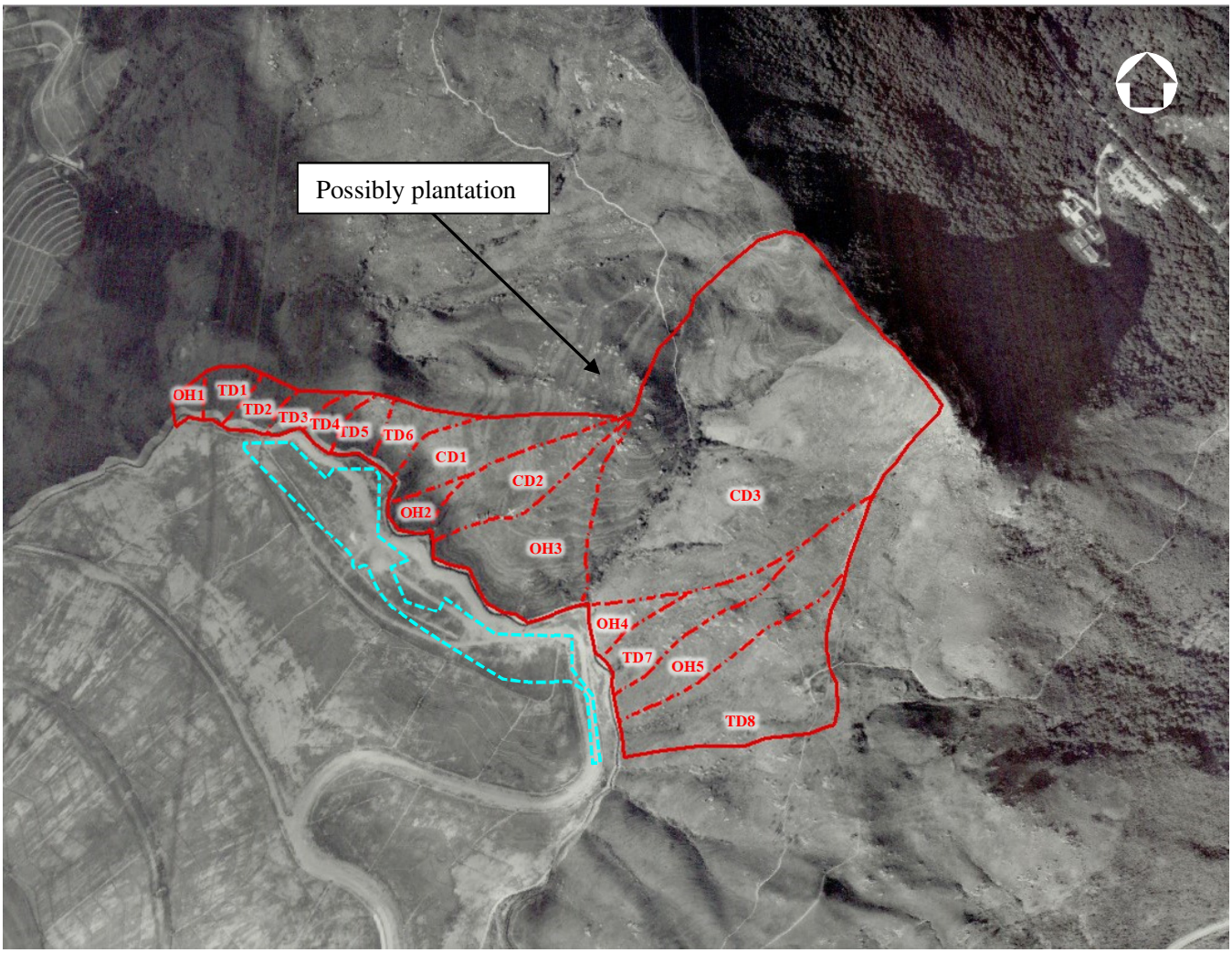
Project:
Natural Terrain Hazard Study for the Proposed Development of New Public Riding School at the Restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III)

FIGURE B15

Location
Landfill Site II/III, Tseung Kwan O

Scale NTS

Date 29 May 2022



Photograph No.: A42221 **Date of Photograph: 18 Jan 1996** **Altitude: 4,000'**

Legend:

Approximate Boundary of the NTSA

Catchment Boundary

Approximate Boundary of the Site (Proposed public riding school development area)

- Many linear features are apparent parallel to the contour lines in Catchment Nos. TD6, CD1, OH2, CD2, OH3 and CD3. A very thin layer of surface soil may be disturbed along these linear features by anthropogenic activities, possibly plantation.

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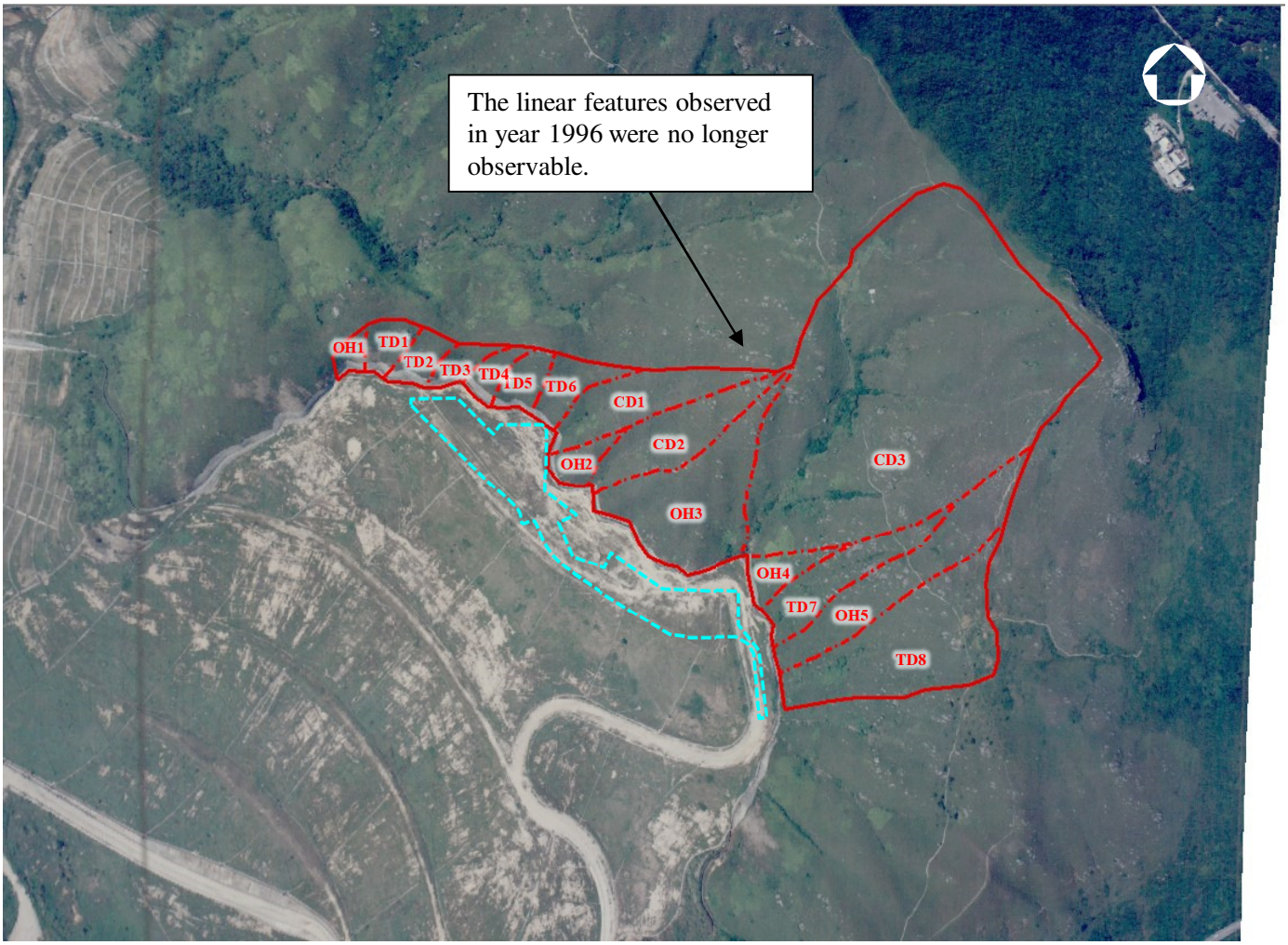
Project:
Natural Terrain Hazard Study for the Proposed Development of New Public Riding School at the Restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III)

FIGURE B16

Location
Landfill Site II/III, Tseung Kwan O

Scale NTS

Date 29 May 2022



Photograph No.: CN17111 **Date of Photograph: 26 May 1997** **Altitude: 4,000'**

Legend:

Approximate Boundary of the NTSA

Catchment Boundary

Approximate Boundary of the Site (Proposed public riding school development area)

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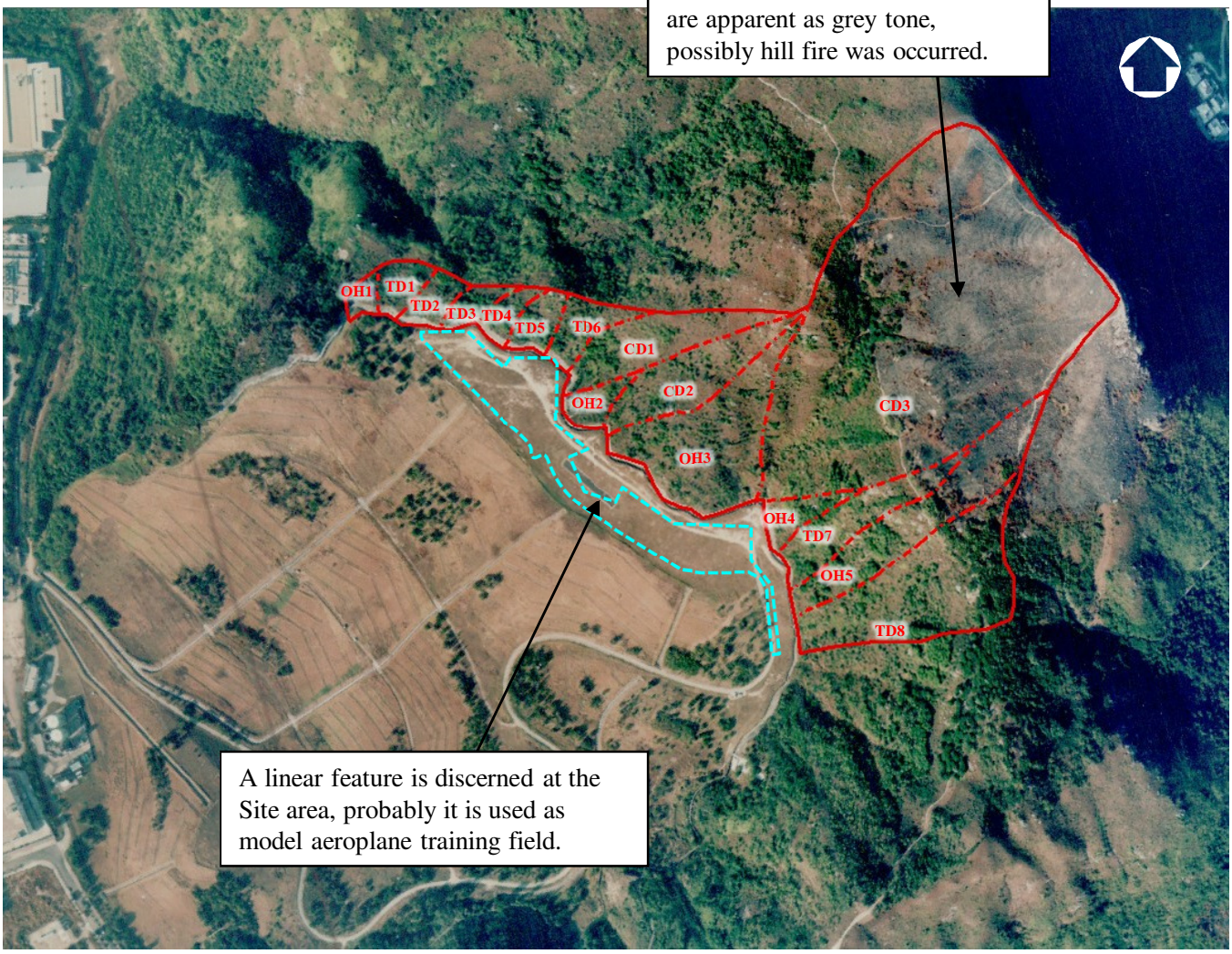
Project:
Natural Terrain Hazard Study for the Proposed Development of New Public Riding School at the Restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III)

FIGURE B17

Location
Landfill Site II/III, Tseung Kwan O

Scale NTS

Date 29 May 2022



Photograph No.: CW62911 **Date of Photograph: 16 Dec 2004** **Altitude: 4,000'**

Legend:

Approximate Boundary of the NTSA

Catchment Boundary

Approximate Boundary of the Site (Proposed public riding school development area)

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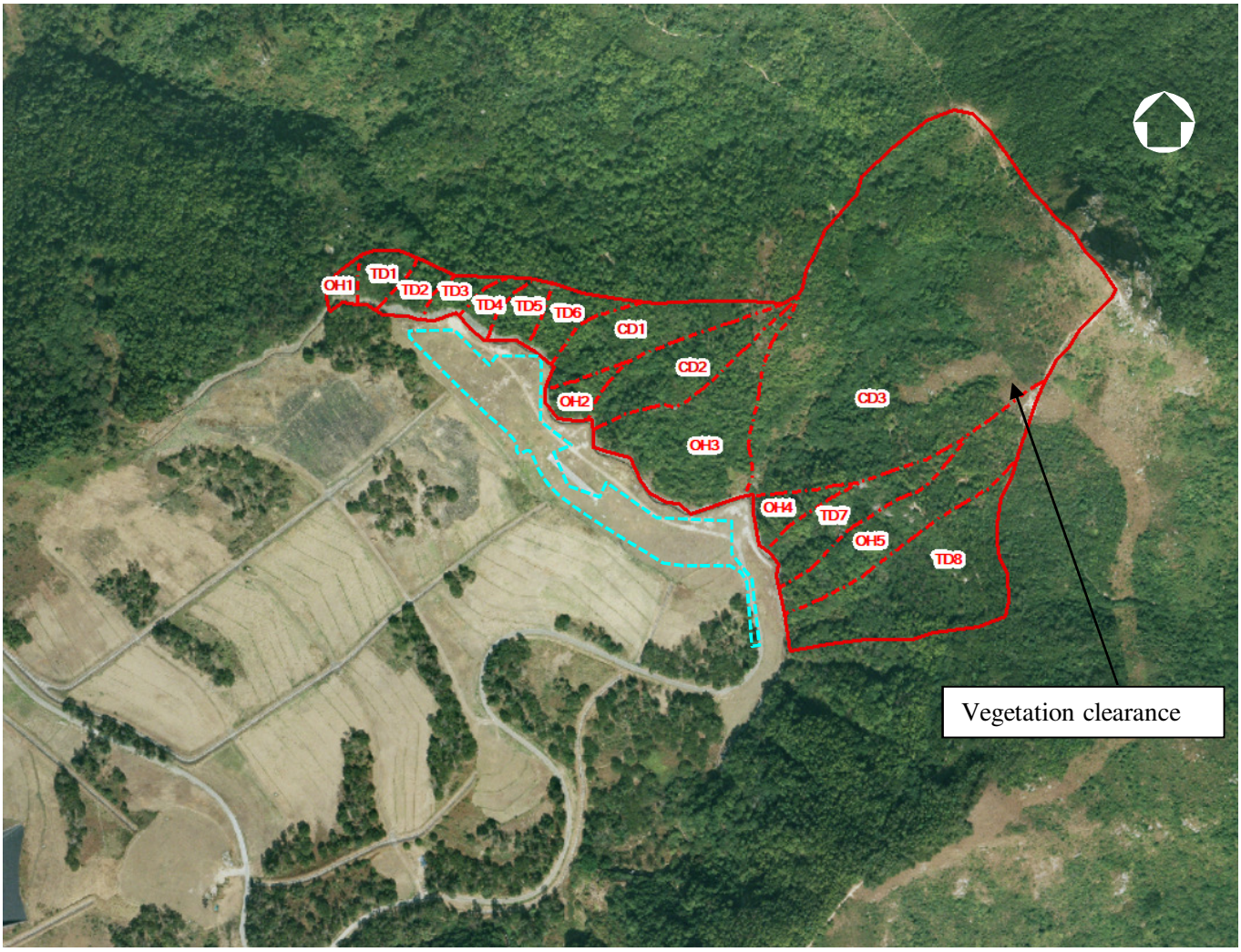
Project:
Natural Terrain Hazard Study for the Proposed Development of New Public Riding School at the Restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III)

FIGURE B18

Location
Landfill Site II/III, Tseung Kwan O

Scale NTS

Date 29 May 2022



Photograph No.: E046899C **Date of Photograph: 5 Oct 2018** **Altitude: 6,900'**

Legend:

Approximate Boundary of the NTSA

Catchment Boundary

Approximate Boundary of the Site (Proposed public riding school development area)

- No observable significant change to the NTSA since 2010s till present except the vegetation growth or clearance.

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Project:
Natural Terrain Hazard Study for the Proposed Development of New Public Riding School at the Restored Tseung Kwan O Stage II/III Landfill (TKOL-II/III)

FIGURE B19

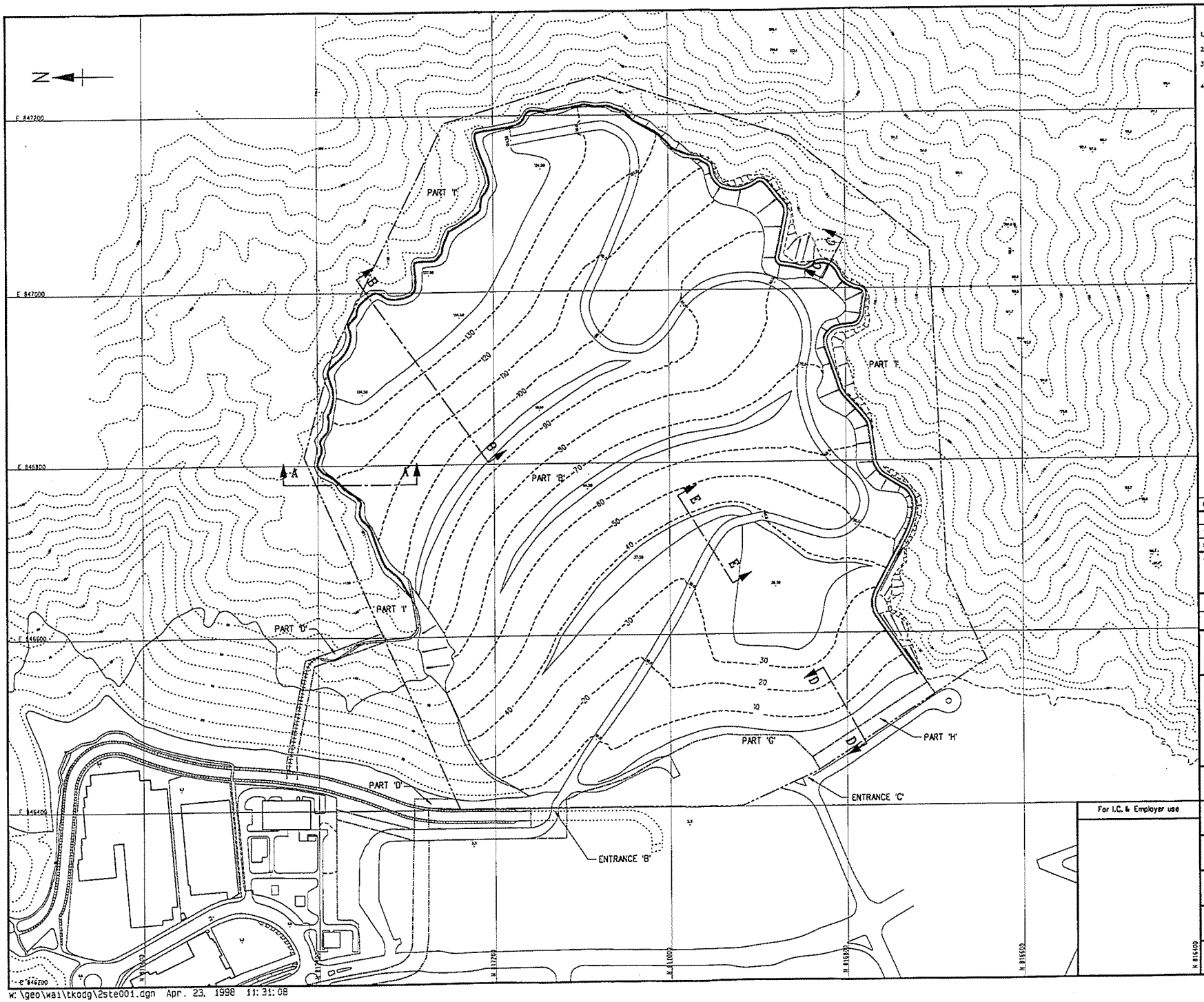
Location
Landfill Site II/III, Tseung Kwan O

Scale NTS

Date 29 May 2022

Appendix E

Relevant As-built Drawings of Stage II/III Landfill



NOTES:

1. ALL GRIDS ARE HONG KONG GRID 1980.
2. ALL LEVELS ARE IN METRES ABOVE PRINCIPAL DATUM.
3. FOR SECTIONS REFER TO DRAWING NOS. STG2/STE/DRW/011 AND STG2/STE/DRW/012.
4. FORMATION LEVELS TO BE CONFIRMED ONCE DEPTH OF EXISTING COVER KNOWN.

LEGEND:

- SITE BOUNDARY
- BOUNDARY BETWEEN OFF SITE PARTS
- EXISTING CONTOURS
- CONTOURS AFTER REPROFILING

Rev.	Date	Description	Initial
	Designed	Drawn	Checked
Initial			
Date			

Approved

CAD ref. Made ZETTERDEEN REF: TKOMSE, TKO-ALDON

Contract no. EP/SP/29/95

Contract
TSEUNG KWAN O
LANDFILLS RESTORATION

Drawing title
STAGE II/III
FINAL INTERMEDIATE COVER
LAYER FORMATION PLAN

Drawing no. STG2/STE/DRW/001

Scale 1:2000

For I.C. & Employer use

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 賓尼
ENGINEERS & SCIENTISTS

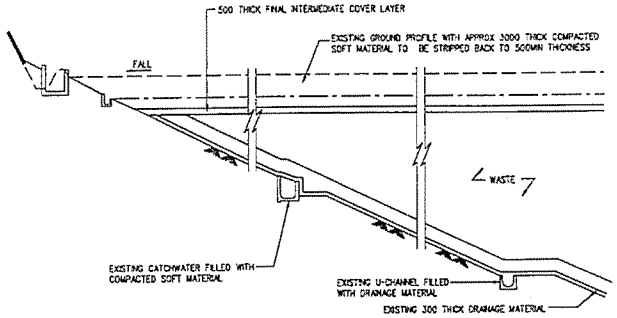
Construction Contractor
CHUN WO CONSTRUCTION & ENGINEERING CO., LTD.

Environmental Consultants
ERM (HK) LTD.

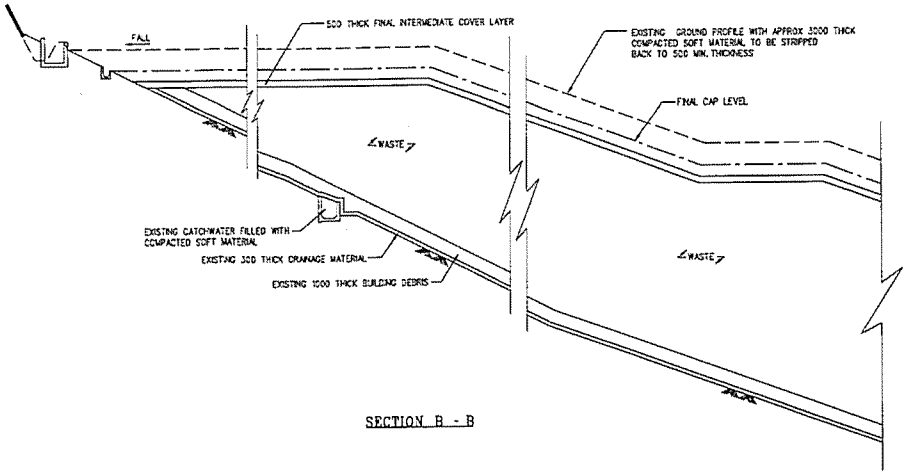
Independent Checking Engineer
MOUCHEL ASIA LIMITED
CONSULTING ENGINEERS

SWIRE BFI WASTE SERVICES LTD.

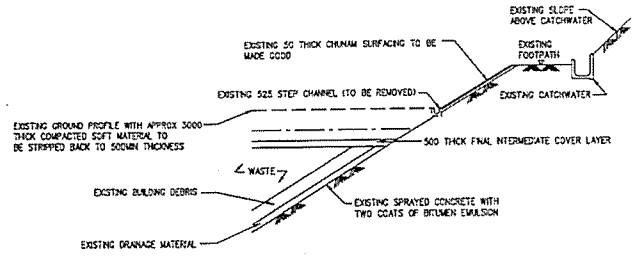
w:\geo\wai\tkodg\2ste001.dgn Apr. 23, 1998 11:31:08



SECTION A - A



SECTION B - B



SECTION C - C

NOTES :

1. ALL DIMENSIONS IN MILLIMETRES.
2. ALL LEVELS ARE IN METRES ABOVE PRINCIPAL DATUM.
3. FOR LOCATIONS OF SECTIONS REFER TO DRAWING NO. STG2/STE/DRW/001
4. THICKNESS OF EXISTING COVER LAYER TO BE CONFIRMED ON SITE.

LEGEND:

EXISTING GROUND PROFILE

FINAL CAP PROFILE

Rev.	Date	Description	Initial
	Designed	Drawn	Checked
Initial			
Date			

Approved

CAD ref. MAPP 25TEGYLDON REF: TYD-ALDON

Contract no. EP/SP/29/95

Contract

TSEUNG KWAN O LANDFILLS RESTORATION

Drawing title

STAGE II/III FINAL INTERMEDIATE COVER LAYER CROSS SECTIONS SHEET 1 OF 2

Drawing no. STG2/STE/DRW/011

Scale 1 : 200

For I.C. & Employer use

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 ENGINEERS & SCIENTISTS

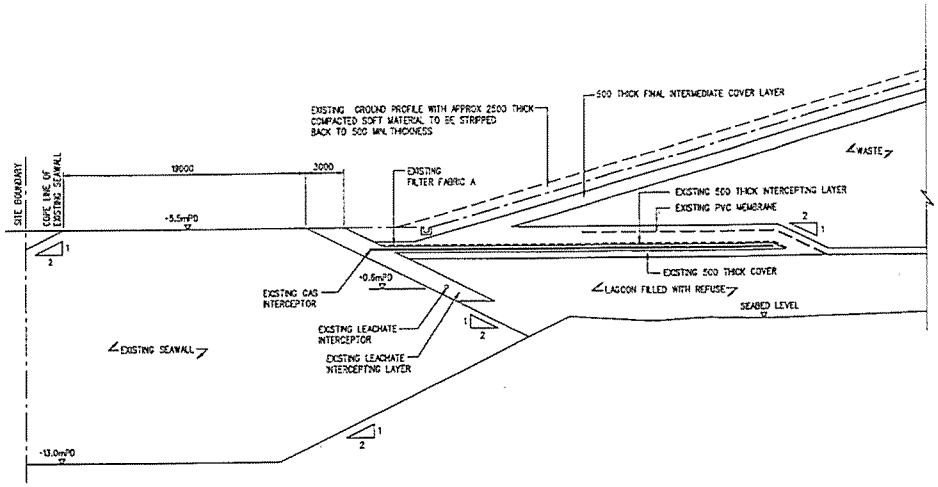
Construction Contractor: CHUN WO CONSTRUCTION & ENGINEERING CO., LTD.

Environmental Consultants: ERM (HK) LTD.

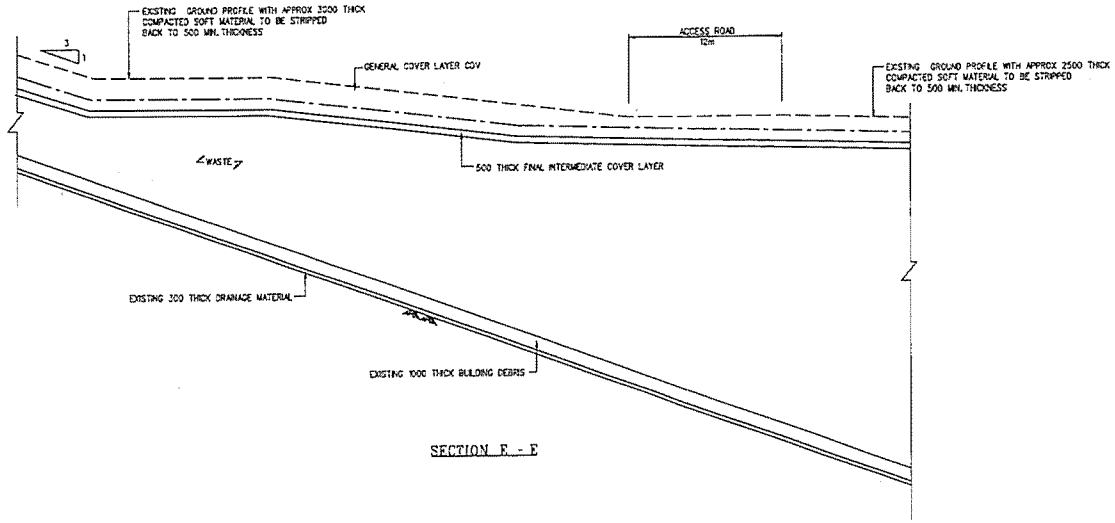
Independent Checking Engineer: MOUCHEL ASIA LIMITED CONSULTING ENGINEERS

SWIRE BFI WASTE SERVICES LTD.

w:\geo\wai\tkogq\2ste011.dgn Apr. 23,. 1998 11:45:09



SECTION D - D



SECTION E - E

NOTES :

1. ALL DIMENSIONS IN MILLIMETRES.
2. ALL LEVELS ARE IN METRES ABOVE PRINCIPAL DATUM.
3. FOR LOCATIONS OF SECTIONS REFER TO DRAWING NO. STG2/STE/DRW/001.
4. THICKNESS OF EXISTING COVER LAYER TO BE CONFIRMED ON SITE.

LEGEND:

EXISTING GROUND PROFILE

FINAL CAP PROFILE

Rev.	Date	Description	Initial

	Designed	Drawn	Checked
Initial			
Date			

Approved

CAD ref. MAIN ZSTE012.DGN REF: TXCH-ALIGN

Contract no. EP/SP/29/95

Contract
TSEUNG KWAN O LANDFILLS RESTORATION

Drawing title
STAGE II/III FINAL INTERMEDIATE COVER LAYER CROSS SECTIONS SHEET 2 OF 2

Drawing no. STG2/STE/DRW/012

Scale 1 : 200

For I.C. & Employer use

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 ENGINEERS & SCIENTISTS 賓尼

Construction Contractor
CHUN WO CONSTRUCTION & ENGINEERING CO., LTD.

Environmental Consultants
ERM (HK) LTD.

Independent Checking Engineer
MOUCHEL ASIA LIMITED CONSULTING ENGINEERS

SWIRE BFI WASTE SERVICES LTD.

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SITE LIMIT OF PORTION B
SEWAGE TREATMENT PLANT

ENTRANCE GATE TO BE RELOCATED HERE

AREA B2

AREA B1

FOOTWAY

EXISTING FOOTPATH

PROPOSED SAND TRAP

EXISTING OPEN CHANNEL

SITE LIMIT OF PORTION A

BOUNDARY OF CLEAR WATER BAY COUNTRY PARK

PROPOSED CATCHWATER

PROPOSED CUT-OFF DRAIN

PROPOSED RESTRICTED BYE-PASS CHANNEL

EXISTING CATCHWATER

LOCATION OF WEIGHBRIDGES

WHEEL WASHING BAY

TYPE 'E' OPEN CHANNEL

STREAM DIVERSION CHANNEL

ACCESS ROAD

EXISTING TRIPLE CELL BOX CULVERT

TEMPORARY HAUL ROAD

AREA A1

WEIGHBRIDGE

SITE BOUNDARY OF RECEPTION AREA OF KOWLOON BAY REFUSE TRANSFER STATION

SITE LIMIT OF PORTION A

EXISTING SEAWALL

EXISTING SINGLE CELL BOX CULVERT

CLEAR WATER BAY COUNTRY PARK

817 200 N

817 600 N

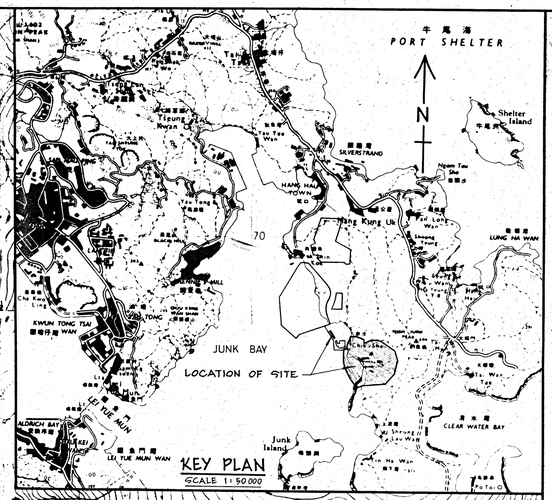
814 800 N

846 400 E

846 800 E

847 200 E

847 600 E



NOTES:

1. ALL LEVELS ARE SHOWN IN METRES ABOVE P.D.
2. ALL DIMENSIONS ARE SHOWN IN METRES.
3. HYDROSEEDING SHALL BE APPLIED IN SECTOR A ONLY.
4. THE SITE IS COMPOSED OF PORTION A, PORTION B AND PORTION C.
5. PORTION C IS SHOWN ON DRAWING No. NDD 6236

LEGEND :-

- EXISTING SLOPE
- PROPOSED LANDFILL CONTOUR
- PROPOSED CUT SLOPE CONTOUR
- EXISTING LEVEL
- EXISTING PLATFORM LEVEL
- PROPOSED PLATFORM
- EXISTING LANDFILL CONTOUR
- EXISTING CUT SLOPE CONTOUR
- SECTOR A

AS CONSTRUCTED

no.	date	description	initial
B		CHECKED: (S.I.O.W)	20-11-92 S.T. TSE
		CERTIFIED: (ENGINEER)	11/2/93 M.Y. TANG
A	21.3.91	LIMITS OF AREA A1 AND AREA B1 TO BE RELEASED BY THE CONTRACTOR SHOWN	

REVISION

	name	date
surveyed		
designed	K.S. CHAN	3.2.89
drawn	T.C. ANGEL CHAN	10.2.89
traced	T.C. ANGEL CHAN	11.2.89
checked	K.S. CHAN	18.4.89
approved	G.C. YIP	20.4.89

Chief Engineer 19.5.89

contract no. CV / 89 / 05

file no. SP 9/1/44 1III

project no. 17 DR

contract

JUNK BAY LANDFILL
STAGE II PHASE II — SITE WORKS AND SANITARY LANDFILL

drawing title

GENERAL LAYOUT OF LANDFILL

drawing no. NDD 6235 B

scale 1 : 2 000

office

DRAINAGE (DESIGN) DIVISION
CIVIL ENGINEERING OFFICE

CIVIL ENGINEERING SERVICES DEPARTMENT HONG KONG

AS CONSTRUCTED

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SETTING OUT POINTS	CO-ORDINATES	
	NORTHING (m)	EASTING (m)
A	817 991.20	846 086.70
B	817 984.10	846 074.60
C	817 425.30	846 179.70
D	817 429.80	846 186.30

817 600 N

817 500 N

817 400 N

817 300 N

817 200 N

846 000 E

846 100 E

846 200 E

846 300 E

846 400 E

846 500 E

SITE LIMIT OF PORTION C

SITE LIMIT OF PORTION B

SITE LIMIT OF PORTION A

AREA B2

AREA B1

AREA A1

ENTRANCE GATE TO BE RELOCATED HERE

LOCATION OF WEIGHBRIDGES

WHEEL WASHING BAY

EXISTING OPEN CHANNEL

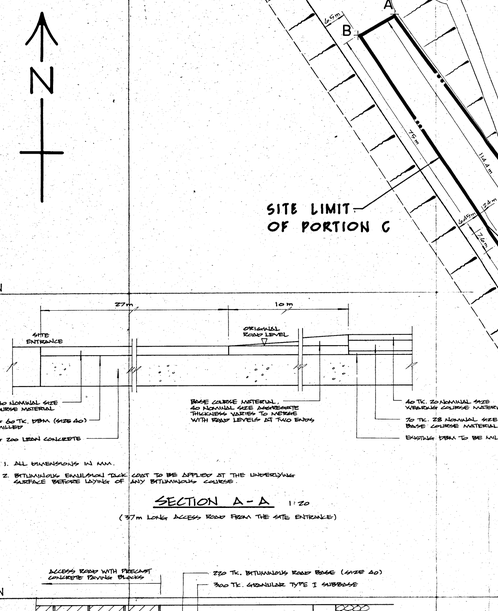
STREAM DIVERSION CHANNEL

Sewage Treatment Works

ROAD

Nullah

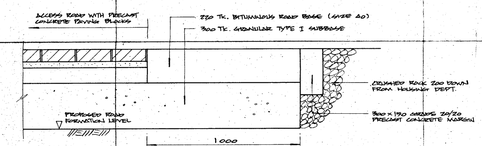
Ramp



NOTES : 1. ALL DIMENSIONS IN mm.
2. BITUMINOUS ENGULFING TACK COAT TO BE APPLIED AT THE UNDERLYING SURFACE BEFORE LAYING OF ANY BITUMINOUS COURSE.

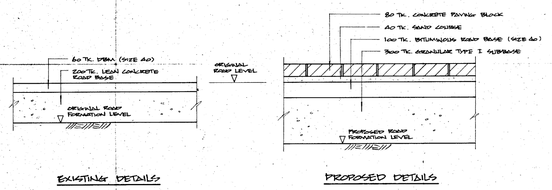
SECTION A-A 1:20

(97m LONG ACCESS ROAD FROM THE SITE ENTRANCE)



SECTION B-B 1:20

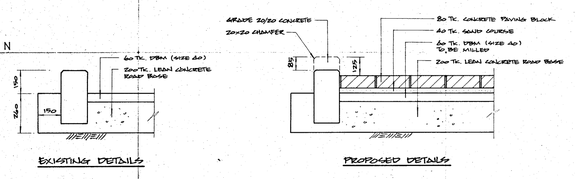
(DETAILS OF THE TREATMENT ROAD EQUIPMENT AT THE END OF THE PRECAST CONCRETE PAVING BLOCKS)



EXISTING DETAILS PROPOSED DETAILS

DETAILS OF CONCRETE PAVING BLOCKS WITHOUT LEAN CONCRETE ROADBASE

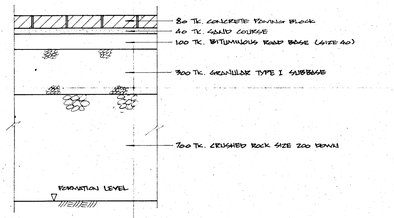
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EXISTING DETAILS PROPOSED DETAILS

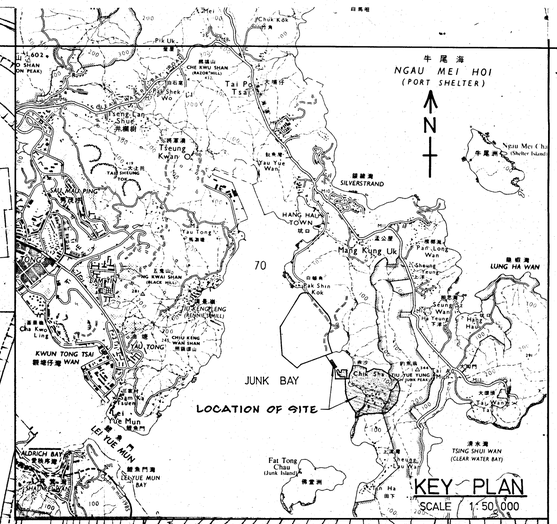
DETAILS OF CONCRETE PAVING BLOCKS BETWEEN WEIGHBRIDGE AND WHEEL WASHING BAY

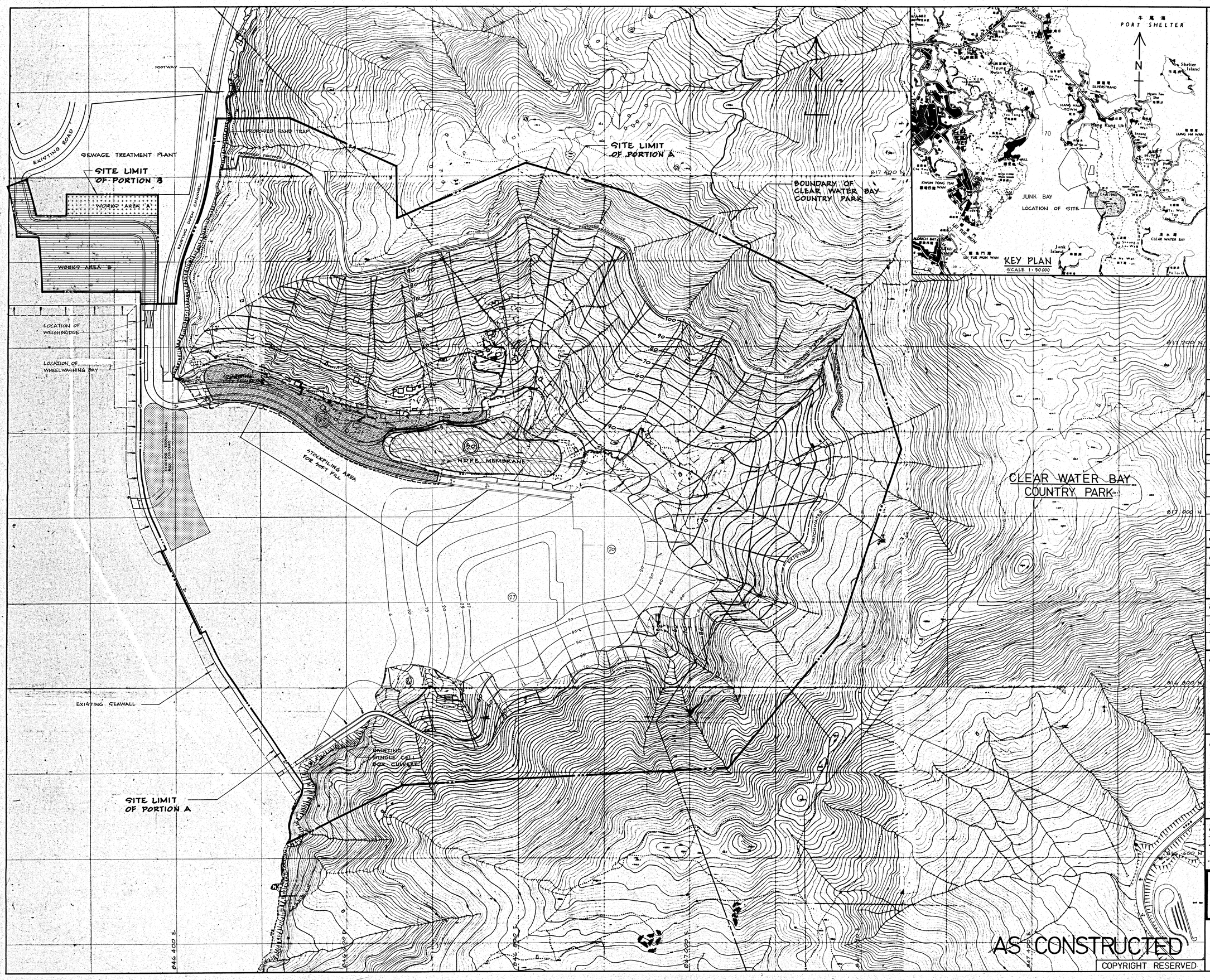
1:20



DETAILS OF CONCRETE PAVING BLOCKS AT SORT SPOTS

1:20


牛尾海
NGAU MEI HOI
(PORT SHELTER)
N
Ngau Mei Chau (Shelter Island)
Tai Po Tsai
Tseung Kwan O
SILVERSTRAND
HANG HAU TOWN
Hang Hau Wai
Hang Hau Tsuen
Mang Kung Uk
Fat Tong Wan
LUNG YAU WAN
Tai Tong
Tai Tong Wan
Kwun Tong Tsai
KWUN TONG TSAI WAN
Ngau Chi Wan
Ngau Chi Shan
Ngau Chi Wan Chuen
Ngau Chi Wan Tsuen
Ngau Chi Wan Village
Ngau Chi Wan Hill
Ngau Chi Wan Shan
Ngau Chi Wan Shan Hill
Ngau Chi Wan Shan Ridge
Ngau Chi Wan Shan Ridge Hill
Ngau Chi Wan Shan Ridge Hill
Ngau Chi Wan Shan Ridge Hill



NOTES:

1. ALL DIMENSIONS ARE SHOWN IN METRES.
2. ALL LEVELS ARE SHOWN IN METRES ABOVE P.D.
3. THE CONTRACTOR SHALL BUILD UP THE PROPOSED STOCKPILE AREA OF APPROX. CAPACITY 50,000 CU M WITHIN THE TIME FOR COMPLETION FOR SECTION 1 OF WORKS.
4. ALL SURFACE CHANNELS WITHIN THE STOCKPILE AREA SHALL BE PROPERLY COVERED WITH TIMBER BOARDS OR OTHERS APPROVED MATERIAL BEFORE BUILDING UP THE STOCKPILE AREA.
5. FOR DETAILS OF STOCKPILE AREA, PLEASE REFER TO DRAWING No. NDD 6243 AND NDD 6245.
6. FOR DETAILS OF HDPE MEMBRANE, PLEASE REFER TO DRAWING No. NDD 6245

LEGEND :-

- PROPOSED CUT SLOPE CONTOUR
- EXISTING SLOPE
- 5.5 EXISTING LEVEL
- (20) EXISTING PLATFORM LEVEL
- PROPOSED PLATFORM TO BE COVERED WITH PVC MEMBRANE.
- EXISTING LANDFILL CONTOUR
- EXISTING CUT SLOPE CONTOUR
- (5.0) PROPOSED PLATFORM LEVEL
- KOWLOON BAY REFUSE TRANSFER STATION
- 8.7 PROPOSED LEVEL

AS CONSTRUCTED

A — CHECKED: (S.I.O.W.) 20-11-92 S.T. TSE
CERTIFIED: (ENGINEER) M.Y. TANG

no.	date	description	initial
REVISION			

	name	date
surveyed		
designed	K. S. CHAN	10·1·89
drawn	T. C. ANGEL CHAN	11·1·89
traced	T. C. ANGEL CHAN	13·1·89
checked	K. S. CHAN	18·5·89
approved	S. C. YIP	22·5·89

Chief Engineer 31.5.89

contract no. CV / 89 / 05

file no. SP 9/1/44 1III

project no. 17 DR

contract

JUNK BAY LANDFILL
STAGE II PHASE II — SITE WORKS AND SANITARY LANDFILL

drawing title

SITE PREPARATION WORKS — CUT SLOPES AND STOCKPILE AREA

drawing no. NDD 6237A

scale 1 : 2 000

office

DRAINAGE (DESIGN) DIVISION
CIVIL ENGINEERING OFFICE

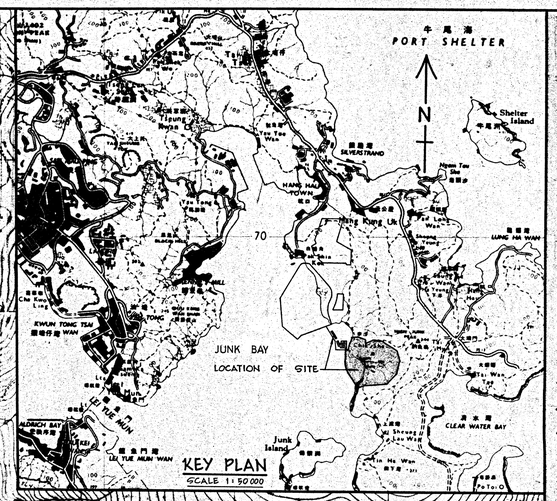
CIVIL ENGINEERING SERVICES DEPARTMENT HONG KONG

NOTES :

1. ALL LEVELS ARE SHOWN IN METRES ABOVE P.D.
2. ALL DIMENSIONS ARE SHOWN IN METRES EXCEPT PIPE SIZE IN MILLIMETRES.
3. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DRAWING No. NDD 6237.
4. FOR DRAINAGE DETAILS PLEASE REFER TO DRAWING No. NDD 6244 AND NDD 6245
5. FOR EXISTING DRAINAGE RECORD PLEASE REFER TO DRAWING No. NDD 6275

LEGEND :

- PROPOSED CUTTING SLOPE
- EXISTING SLOPE
- 100 EXISTING LEVEL
- (20) EXISTING PLATFORM LEVEL
- EXISTING LANDFILL CONTOUR
- EXISTING CUT SLOPE CONTOUR
- EXISTING MANHOLE AND SEWER
- PROPOSED SURFACE CHANNEL
- PROPOSED STEPPED CHANNEL AND CATCHPIT
- 300 ϕ PROPOSED SUB-SOIL DRAIN
- PROPOSED CATCHPIT WITH CONCRETE COVER
- EXISTING SURFACE CHANNEL
- EXISTING STEPPED CHANNEL AND CATCHPIT
- KOWLOON BAY REFUSE TRANSFER STATION
- PROPOSED STANDARD MANHOLE TYPE 'J'
- 1 800 ϕ PROPOSED CONCRETE PIPE
- 225ϕ PROPOSED CONCRETE PIPE WITH 150 mm THICK CONCRETE SURROUND



LEGEND :

- PROPOSED SUB-SOIL DRAIN CATCHPIT
- CHUNAM SURFACING
- ROCK (WITHOUT CHUNAM SURFACING)

AS CONSTRUCTED

no.	date	description	initial
B		CHECKED: (S.I.O.W)	20-11-93 A.T. TSE
		CERTIFIED: (ENGINEER)	11/12/93 M.Y. TANG
A	1.11.91	GENERAL REVISION	

REVISION

	name	date
surveyed		
designed	K. S. CHAN	9. 2. 89
drawn	Chan Sui Chun S. C. CHAN	10 - 2 - 89
traced	Chan Sui Chun S. C. CHAN	13 - 2 - 89
checked	K. S. CHAN	18. 5. 89
approved	S. C. YIP	31.5.89

Chief Engineer

contract no. CV / 89 / 05

file no. SP 9 / 1 / 44 1 III

project no. 17 DR

contract:

JUNK BAY LANDFILL
STAGE II PHASE II — SITE WORKS AND SANITARY LANDFILL

drawing title

SITE PREPARATION WORKS — SURFACE DRAIN AND SUB-SOIL DRAIN

drawing no. NDD 6238B

scale 1 : 2 000

office

DRAINAGE (DESIGN) DIVISION
CIVIL ENGINEERING OFFICE

CIVIL ENGINEERING SERVICES DEPARTMENT HONG KONG

AS CONSTRUCTED

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FOOTWAY

EXISTING ROAD

SEWAGE TREATMENT PLANT

SITE LIMIT OF PORTION B

WORKS AREA 'A'

AZZEAR ROAD

WORKS AREA 'B'

PROPOSED BAND TRAP

PROPOSED FOOTPATH

EXISTING OPEN CHANNEL

SITE LIMIT OF PORTION A

PROPOSED CATCHWATER

BOUNDARY OF CLEAR WATER BAY COUNTRY PARK

LOCATION OF WEIGHBRIDGE

LOCATION OF WHEELWASHING BAY

EXISTING STREAM DIVERSION

ACCESS ROAD

PROPOSED CATCHWATER

PROPOSED PERIMETER CHANNEL

PROPOSED PERIMETER BUND

EXISTING CATCHWATER

EXISTING SEAWALL

EXISTING SINGLE CELL BOX CULVERT

SITE LIMIT OF PORTION A

B17 400 N

B16 800 N

B16 200 N

B15 600 N

B46 400 E

B47 000 E

B47 600 E

CLEAR WATER BAY COUNTRY PARK

PORT SHELTER

JUNK BAY

LOCATION OF SITE

KEY PLAN

SCALE 1:50 000

NOTES:

1. ALL DIMENSIONS ARE SHOWN IN METRES.
2. ALL LEVELS ARE SHOWN IN METRES ABOVE P.D.
3. THE SEQUENCE OF LANDFILLING IS TENTATIVE ONLY. THE CONTRACTOR MAY PROPOSE ALTERNATIVE LANDFILLING SEQUENCE FOR ENGINEER'S AGREEMENT.

LEGEND:-

- EXISTING SLOPE
- 5.5 EXISTING LEVEL
- (27) EXISTING PLATFORM LEVEL
- (40) PROPOSED PLATFORM LEVEL
- EXISTING LANDFILL CONTOUR
- EXISTING CUT SLOPE CONTOUR
- PROPOSED LANDFILL CONTOUR
- PROPOSED CUT SLOPE CONTOUR
- KOWLOON BAY REFUSE TRANSFER STATION

AS CONSTRUCTED

A — CHECKED: (S.I.O.W.) 30-11-92 S.T. TSE
CERTIFIED: (ENGINEER) 25-8-93 M.Y. TANG

no.	date	description	initial
REVISION			

	name	date
surveyed		
designed	K. S. CHAN	28·1·89
drawn	T.C. ANGEL CHAN	30·1·89
traced	T.C. ANGEL CHAN	31·1·89
checked	K. S. CHAN	18·5·89
approved	S. C. YIP	

Chief Engineer 31.5.89

contract no. CV/89/05

file no. SP 9/1/44 1III

project no. 17 DR

contract:

JUNK BAY LANDFILL
STAGE II PHASE II — SITE WORKS AND SANITARY LANDFILL

drawing title

SITE WORKS AND TENTATIVE LANDFILL SEQUENCE
(SHEET 1 OF 3)

drawing no. NDD 6239 A

scale 1:2 000

office

DRAINAGE (DESIGN) DIVISION
CIVIL ENGINEERING OFFICE

CIVIL ENGINEERING SERVICES DEPARTMENT HONG KONG

AS CONSTRUCTED

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FOOTWAY

EXISTING ROAD

SEWAGE TREATMENT PLANT

SITE LIMIT OF PORTION B

WORKS AREA 'A'

ACCESS ROAD

WORKS AREA 'B'

LOCATION OF WEIGHBRIDGE

LOCATION OF WHEELWASHING BAY

EXISTING STEAWALL

SITE LIMIT OF PORTION A

PROPOSED SAND TRAP

EXISTING DRAINAGE CHANNEL

PROPOSED CATCHWATER

EXISTING SINGLE CELL BOX CULVERT

SITE LIMIT OF PORTION A

BOUNDARY OF CLEAR WATER BAY COUNTRY PARK

EXISTING CATCHWATER

PROPOSED CATCHWATER

EXISTING DRAINAGE CHANNEL

PROPOSED DRAINAGE CHANNEL

CLEAR WATER BAY COUNTRY PARK

817 200 N

817 000 N

816 800 N

816 600 N

814 600 N

814 400 E

814 600 E

814 800 E

815 000 E

815 200 E

815 400 E

815 600 E

815 800 E

816 000 E

816 200 E

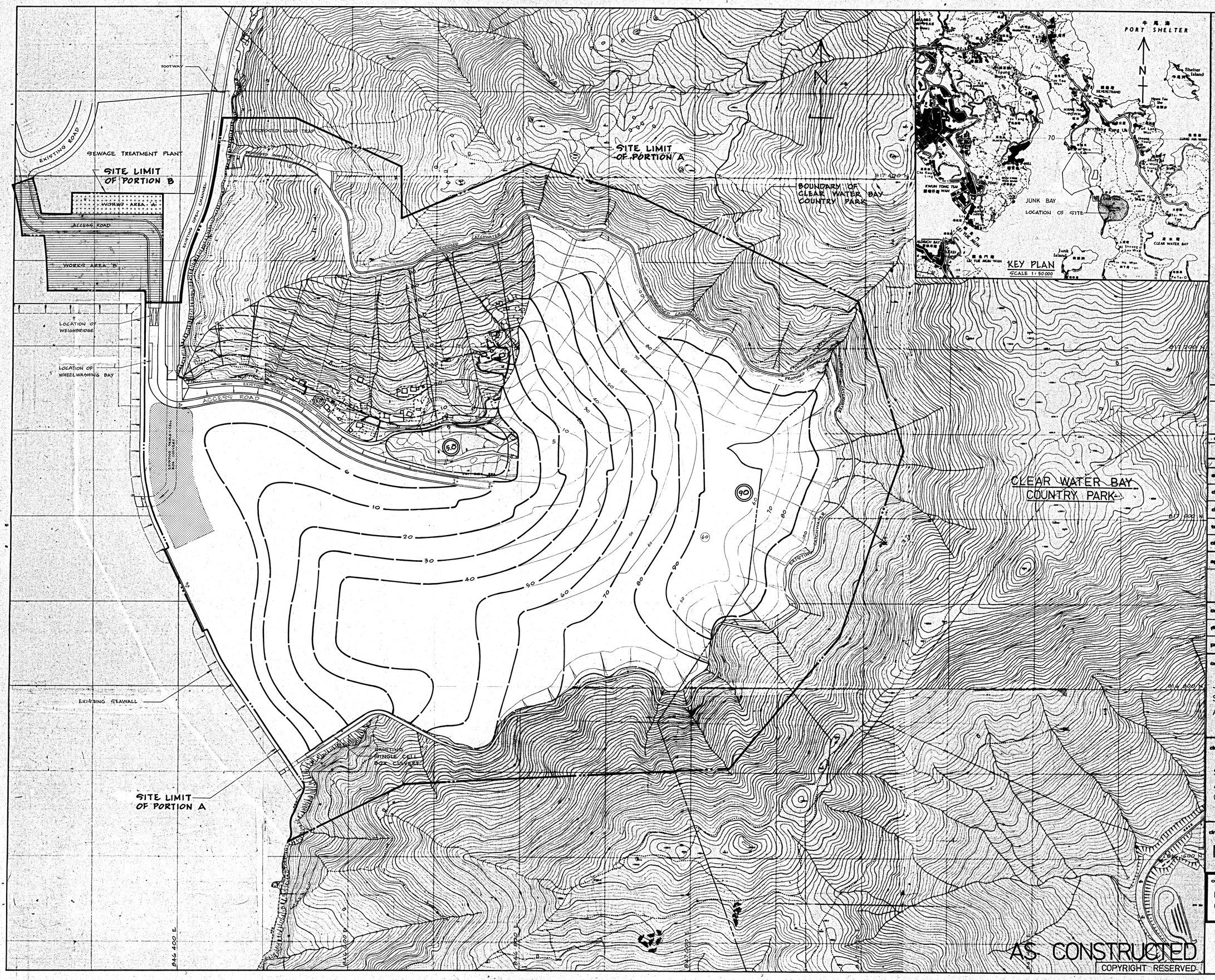
816 400 E

816 600 E

816 800 E

817 000 E

817 200 E



NOTES:

1. ALL DIMENSIONS ARE SHOWN IN METRES.
2. ALL LEVELS ARE SHOWN IN METRES ABOVE P.D.
3. THE SEQUENCE OF LANDFILLING IS TENTATIVE ONLY. THE CONTRACTOR MAY PROPOSE ALTERNATIVE LANDFILLING SEQUENCE FOR ENGINEER'S AGREEMENT.

LEGEND :-

- EXISTING SLOPE
- 5.5 EXISTING LEVEL
- (60) EXISTING PLATFORM LEVEL
- (90) PROPOSED PLATFORM LEVEL
- EXISTING LANDFILL CONTOUR
- EXISTING CUT SLOPE CONTOUR
- PROPOSED LANDFILL CONTOUR
- PROPOSED CUT SLOPE CONTOUR
- KOWLOON BAY REFUSE TRANSFER STATION

AS CONSTRUCTED

A — CHECKED (S.I.O.W.) 20-11-92 L.T. TSE
CERTIFIED: (ENGINEER) 25-8-93 M.Y. TANG

no.	date	description	initial
REVISION			

	name	date
surveyed		
designed	K.S. CHAN	2.2.89
drawn	T.C. ANGEL CHAN	3.2.89
traced	T.C. ANGEL CHAN	4.2.89
checked	K.S. CHAN	18.5.89
approved	S.C. YIP	22.5.89

Chief Engineer 31.7.89

contract no. CV / 89 / 05

file no. SP 9/1/44 1III

project no. 17 DR

contract

JUNK BAY LANDFILL
STAGE II PHASE II — SITE WORKS AND SANITARY LANDFILL

drawing title

SITE WORKS
AND TENTATIVE LANDFILL SEQUENCE
(SHEET 3 OF 3)

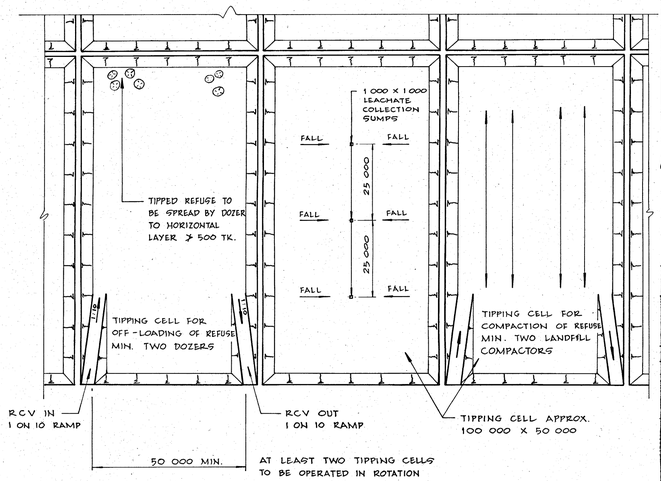
drawing no. NDD 6241A

scale 1 : 2 000

office

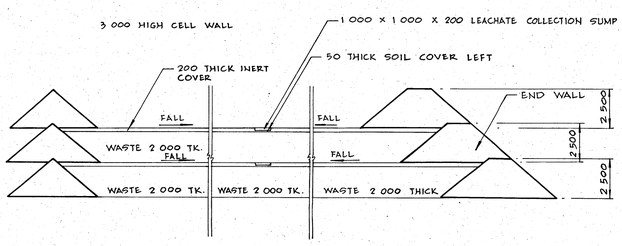
DRAINAGE (DESIGN) DIVISION
CIVIL ENGINEERING OFFICE

CIVIL ENGINEERING SERVICES DEPARTMENT HONG KONG



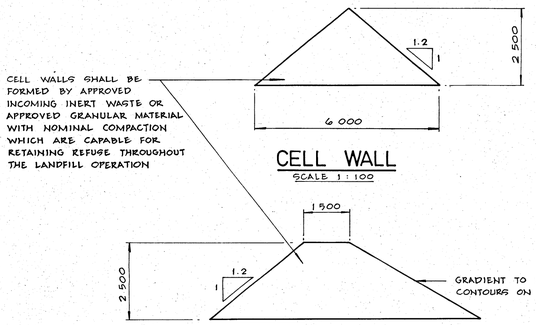
TYPICAL OPERATION OF CELL COMPACTION METHOD

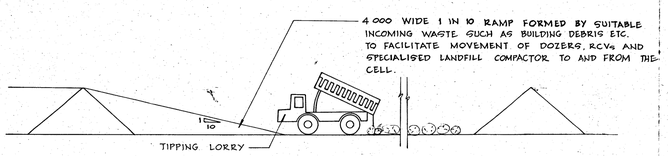
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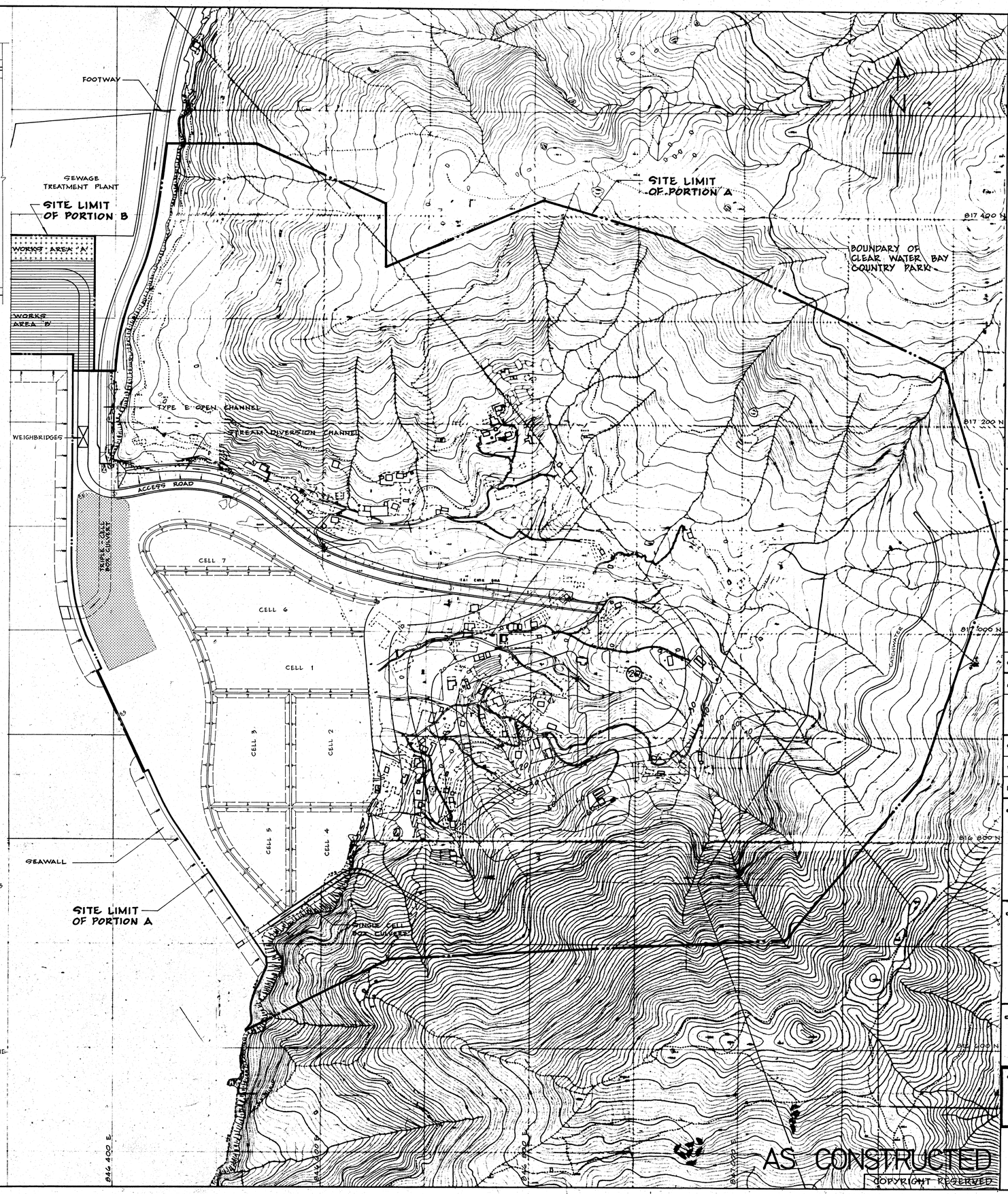


TYPICAL SECTION OF TIPPING CELL

SCALE 1:200







NOTES:

1. ALL LEVELS ARE SHOWN IN METRES ABOVE P.D.
2. ALL DIMENSIONS ARE IN MILLIMETRES EXCEPT GRIDS IN METRES.
3. THE LAYOUT OF TIPPING CELLS TO BE PROPOSED BY THE CONTRACTOR IN ACCORDANCE WITH P.S. CL. 33.03
4. MINIMUM 3 Nos. OF LEACHATE COLLECTION SUMPS SHALL BE PROVIDED IN EACH CELL.

LEGEND :-

- EXISTING SLOPE
- PROPOSED SLOPE
- (20) EXISTING PLATFORM LEVEL
- —6— PROPOSED CONTOUR LEVEL
- 104 EXISTING LEVEL
- 55 PROPOSED LEVEL
- KOWLOON BAY REFUSE TRANSFER STATION

AS CONSTRUCTED

A — CHECKED (S.I.O.W.) 20-11-92 S.T. TSE
CERTIFIED: (ENGINEER) 25-8-93 M.Y. TANG

no.	date	description	initial
REVISION			

	name	date
surveyed		
designed	K. S. CHAN	19·4·89
drawn	T. C. ANGEL CHAN	20·4·89
traced	T. C. ANGEL CHAN	26·4·89
checked	K. S. CHAN	18·5·89
approved	S. C. YIP	

Chief Engineer

contract no. CV/89/05

file no. SP 9/1/44 1III

project no. 17 DR

contract

JUNK BAY LANDFILL
STAGE II PHASE II — SITE WORK AND SANITARY LANDFILL

drawing title

GENERAL ARRANGEMENT OF LANDFILL OPERATIONS

drawing no. NDD 6242 A

scale 1:2 000

office

DRAINAGE (DESIGN) DIVISION
CIVIL ENGINEERING OFFICE

CIVIL ENGINEERING SERVICES DEPARTMENT HONG KONG

N

E 847200

E 847000

E 846800

E 846600

E 846400

E 846200

N 817600

N 817400

N 817200

N 817000

N 816800

N 816600

N 816400

PART 'I'

PART 'I'

PART 'B'

PART 'I'

PART 'D'

PART 'D'

PART 'C'

PART 'H'

ENTRANCE 'B'

ENTRANCE 'C'

DISCHARGE INTO 1500 STEPPED CHANNEL

C16 C17 C18 C19 C15 C10 C9 C8 C20 C7 C6

HW1 HW2 HW3 HW4

NOTES:

1. ALL GRIDS ARE HONG KONG GRID (1980).
2. ALL LEVELS ARE IN METRES ABOVE PRINCIPAL DATUM.
3. FOR LOCATION OF DAYLIGHT SUB-SURFACE DRAINAGE REFER TO DRAWING NO. STG2/SUR/DRW/001/R.

LEGEND :

- SITE BOUNDARY
- SITE BOUNDARY (FENCE)
- 80 UPVC PIPE (RIB DRAIN)
- 100 UPVC PIPE (SPINE DRAIN)
- 100 UPVC (COLLECTOR PIPE)
- HW1 100 UPVC PIPE HEADWALL
- LIMIT OF LLDPE

Details of Revision	Date

	Designed	Drawn	Checked
Initial			
Date			

Amendment to the Registered Design approved

CAD ref. MAIN: A2STE006.DGN
REF: TKOSF-AB, S2-PTRD, S2SUBDRN & RTKO-ALDGN

ENVIRONMENTAL PROTECTION DEPARTMENT
THE GOVERNMENT OF THE HONG KONG SPECIAL ADMINISTRATIVE REGION

Contract no. EP/SP/29/95

Contract title
TSEUNG KWAN O LANDFILLS RESTORATION

Drawing title

STAGE II/III SUB SOIL DRAIN LAYOUT PLAN

AS CONSTRUCTED RECORD DRAWING

Drawing no. STG2/STE/DRW/006/R

Scale 1 : 2000

CONTRACTOR

SWIRE SITA WASTE SERVICES LIMITED.
DATE :

INDEPENDENT CONSULTANTS

MOUCHEL ASIA LIMITED.
DATE :

Binnie Black & Veatch Hong Kong Limited

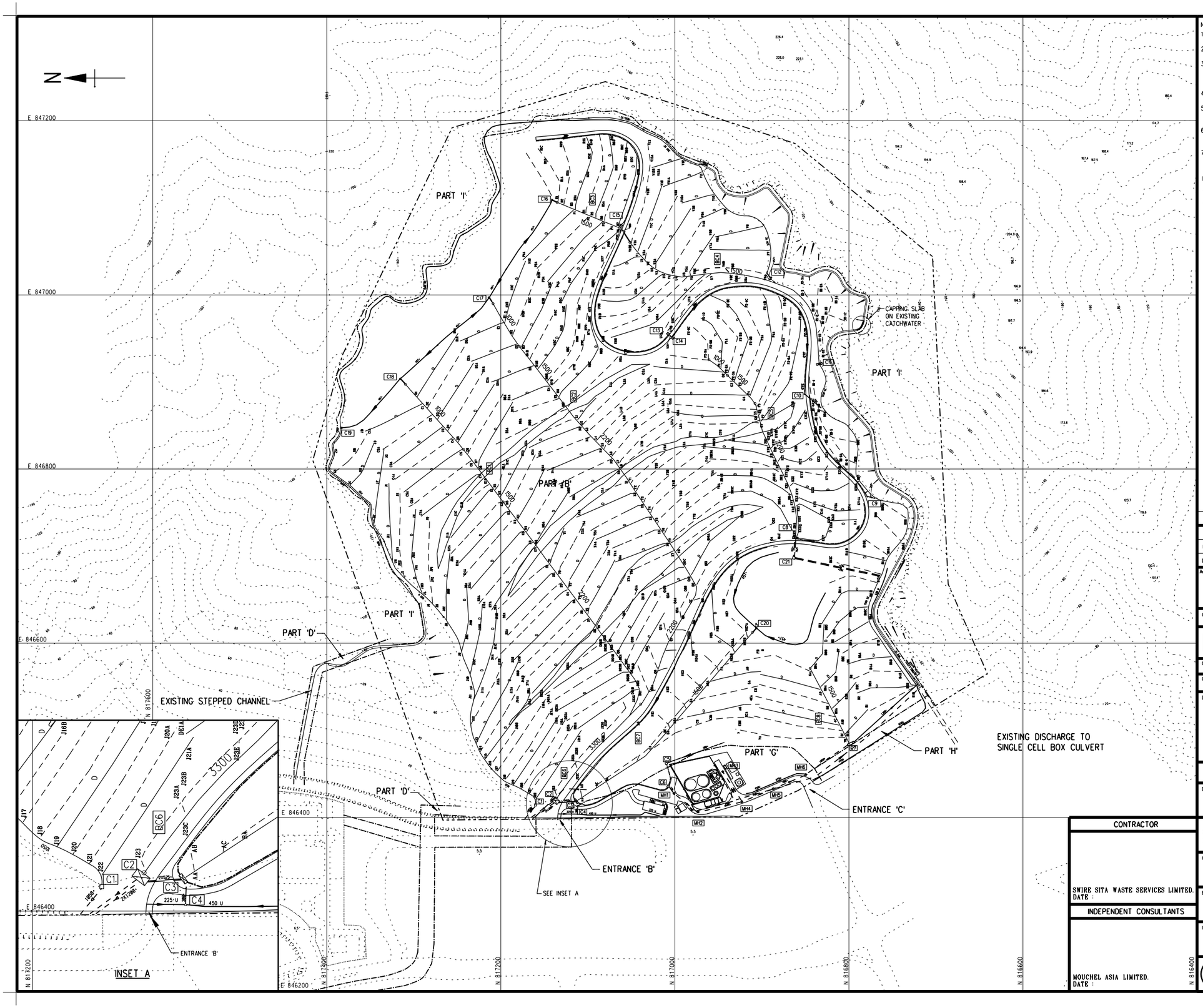
Construction Contractor
CHUN WO CONSTRUCTION & ENGINEERING CO., LTD.

Environmental Consultants
ERM (HK) LTD.

Independent Consultants
MOUCHEL ASIA LIMITED
CONSULTING ENGINEERS

SWIRE SITA WASTE SERVICES LTD.

D:\a2ste006.dgn 2008/12/17 上午 08:45:57



NOTES:

1. ALL GRIDS ARE HONG KONG GRID 1980.
2. ALL LEVEL ARE METRES ABOVE PRINCIPAL DATUM.
3. FOR SURFACE WATER DETAILS REFER TO DRAWING NOS. GENL/SUR/DRW/001/R TO 008/R AND STG2/SUR/DRW/011/R TO 020/R.
4. PLATFORM PERIMETER DRAINS LAID AT 1 : 125.
5. FOR PRECAST CONCRETE PIPE, ALL PIPES BEDDINGS CLASS B AS PER DSD DRAWING NO. 1048.
6. ALL PRECAST CONCRETE PIPES CLASS H TO BS 5911: PART 100 : 1988 UNLESS OTHERWISE STATED.
7. FOR AS-CONSTRUCTED DETAILS OF CATCHPITS AND MANHOLES, REFER TO STG2/SUR/DRW/002/R.

LEGEND :

- SITE BOUNDARY
- EXISTING STEPPED CHANNEL
- 1000 BC1 — BAFFLED CHANNEL OF BC1 WITH BASE WIDTH 1000mm
- 250mm DIAMETER NETLON PIPE
- NETLON WITH DAYLIGHT
- 457 — PERIMETER DRAIN PERFORATED HDPE PIPE OF DIA. 457mm
- 1050 SC — STEPPED CHANNEL OF SIZE 1050mm
- 300 — ROADWAY DRAIN 300mm DIA. PERFORATED PIPE
- 600 U — U-CHANNEL WITH SIZE 600mm
- 300 — HDPE PIPE OF DIAMETER 300mm
- 300 — PRECAST CONCRETE PIPE OF DIAMETER 300mm
- RECTANGULAR CHANNEL WITH WIDTH 1200mm
- PIPEWORK CONNECTION TO DOWNSLOPE SURFACE CHANNEL
- CATCHPIT
- CP1 — CATCHPIT NUMBER
- CONNECTION BETWEEN DIFFERENT SIZES OF BAFFLED CHANNELS / U-CHANNELS
- TAPER SECTION / APRON STRUCTURE

Details of Revision	Date

	Designed	Drawn	Checked
Initial			
Date			

Amendment to the Registered Design approved

CAD ref. MAIN: A2SUR001.DGN
REF: TKOSF-AB, S2-PTRD, S2TOPDRN & RTKO-A1.DGN

ENVIRONMENTAL PROTECTION DEPARTMENT
THE GOVERNMENT OF THE HONG KONG SPECIAL ADMINISTRATIVE REGION

Contract no. EP/SP/29/95

Contract title
TSEUNG KWAN O LANDFILLS RESTORATION

Drawing title

STAGE II/III SURFACE WATER DRAINAGE LAYOUT PLAN

AS CONSTRUCTED RECORD DRAWING

Drawing no. STG2/SUR/DRW/001/R

Scale 1:2000

CONTRACTOR

SWIRE SITA WASTE SERVICES LIMITED.
DATE :

INDEPENDENT CONSULTANTS

MOUCHEL ASIA LIMITED.
DATE :

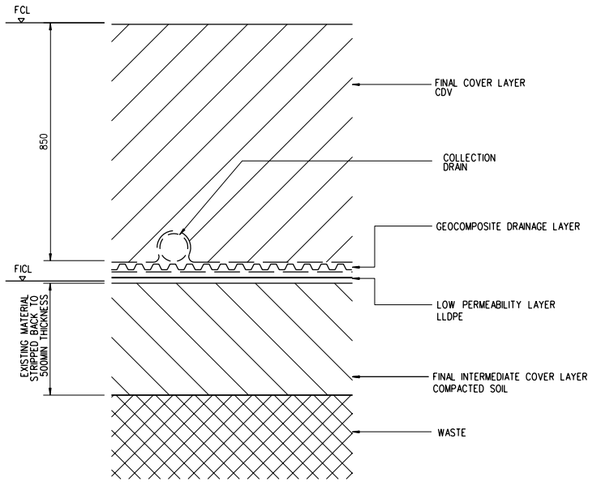
Binnie Black & Veatch Hong Kong Limited

Construction Contractor
CHUN WO CONSTRUCTION & ENGINEERING CO., LTD.

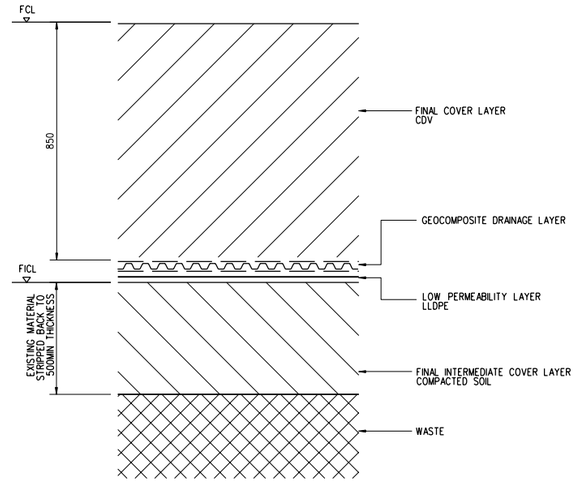
Environmental Consultants
ERM (HK) LTD.

Independent Consultants
MOUCHEL ASIA LIMITED
CONSULTING ENGINEERS

SWIRE SITA WASTE SERVICES LTD.



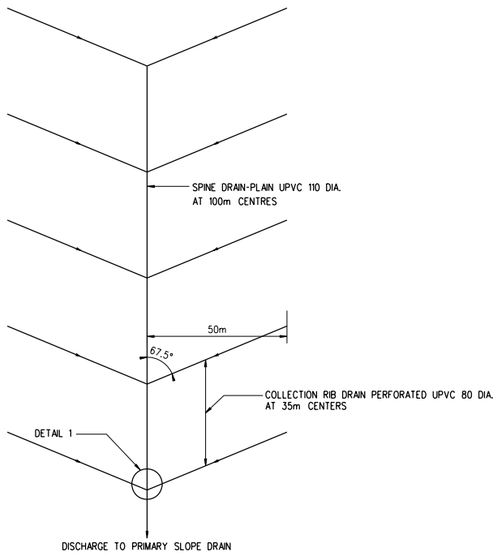
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PLATFORMS
1 : 10



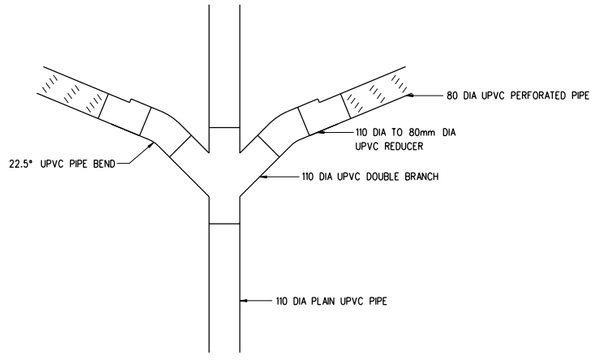
CAP TYPE 2
SLOPES
1 : 10

NOTES:

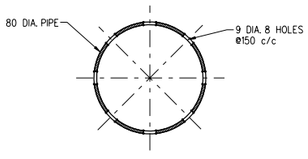
1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE STATED.



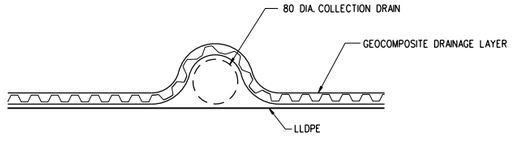
PLATFORM SUB-SOIL DRAIN
(PROVIDED ON ALL PLATFORMS)
1 : 1000



TYPICAL CONNECTION DETAIL
DETAIL 1
1 : 10



DETAIL OF PERFORATIONS
1 : 2



COLLECTION RIB DRAIN DETAILS
1 : 5

COLLECTION RIB DRAIN DETAILS REVISED			12/99
Details of Revision			Date
	Designed	Drawn	Checked
Initial			
Date			

Amendment to the Registered Design approved

CAD ref. MAIN: AGSTE001A.DGN
REF: RTK0-A1.DGN

ENVIRONMENTAL PROTECTION DEPARTMENT
THE GOVERNMENT OF THE HONG KONG SPECIAL ADMINISTRATIVE REGION

Contract no. EP/SP/29/95

Contract title
TSEUNG KWAN O LANDFILLS RESTORATION

Drawing title

CAP GENERAL DETAILS SHEET 1 OF 3

AS CONSTRUCTED RECORD DRAWING

Drawing no.	Scale
GENL/STE/DRW/001/R	AS SHOWN

CONTRACTOR

SWIRE SITA WASTE SERVICES LIMITED.
DATE :

INDEPENDENT CONSULTANTS

MOUCHEL ASIA LIMITED.
DATE :

Binnie Black & Veatch Hong Kong Limited

Construction Contractor
CHUN WO CONSTRUCTION & ENGINEERING CO., LTD.

Environmental Consultants
ERM (HK) LTD.

Independent Consultants
MOUCHEL ASIA LIMITED
CONSULTING ENGINEERS

SWIRE SITA WASTE SERVICES LTD.

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Appendix F

GEO Memo for Previous NTHS Report 2023

MEMO

From	CGE/ME, GEO, CEDD	To	Environmental Assessment Division, EPD
Ref. ( ) In	ME-30-2010-5-6	(Attn.:	Mr. H L HO)
Tel. No.	2762 5199	Your Ref. ( ) in	EP 183/06/B/10-01
Fax. No.	2714 0245	dated 3.4.2023	Fax. No. 2591 6662
Date	18 May 2023	Total page	1

Contract No. EP/SP/29/95
Tseung Kwan O Landfills Restoration
Proposed Public Riding School at Tseung Kwan O Stage II/III Landfill
Submission of Natural Terrain Hazard Study Report (NTHS) (Rev.1)

I refer to your above-referenced memo enclosing the NTHS report (Rev.1) and responses to comments submitted by the Consultants, Modern Consulting Engineers Limited for the proposed public riding school at the captioned site.

2. This Office has no further geotechnical comment on the NTHS report (Rev.1).

3. The submitted NTHS report is retained in our Office for reference.

(Alan K L CHU)
for Chief Geotechnical Engineer/Mainland East
Geotechnical Engineer Office
Civil Engineering and Development Department

ATFY/AKLC
ME3064058

Appendix G

Technical Information Kit for TKOL II/III by EPD

Tseung Kwan O Stage II/III Landfill

Background & Technical Information



Environmental Protection Department

(ver 202003)

Tseung Kwan O Stage II/III Landfill (TKOL-II/III)

1 Background

1.1 Tseung Kwan O Stage II/III Landfill (TKOL-II/III) is one of the remaining restored landfills and is available for development into community or recreational facilities.

1.2 TKOL-II/III is located at TKO Area 105, Tseung Kwan O, New Territories and was formed by infilling of the Tai Chik Sha Valley. The site is now surrounded by Green Belt zone of High Junk Peak, while the western part is facing to commercial and residential developments, such as LOHAS Park and HSBC Data Centre. Its location, along with some general information, is shown in **Annex I**.

1.3 TKOL-II/III was operated by the Civil Engineering Department (CED) [1] between 1988 and 1995; during which time, it received approximately 12.6 million tonnes of domestic, commercial, construction, industrial and special wastes.

1.4 Upon its completion as a waste disposal site, TKOL-II/III was allocated to Environmental Protection Department (EPD) by Lands Department (LandsD) under the arrangement of Temporary Government Land Allocation up to 2029. EPD has implemented comprehensive restoration works on the site, which were completed in 1999. The site is now in the Aftercare period[2] undertaken by EPD's Restoration Contractor – SUEZ NWS R&R (Hong Kong) Limited.

1.5 Both the environmental performance and the long term settlement characteristics of TKOL-II/III are being closely monitored in the Aftercare period. The Restoration Contractor has been carrying out regular inspections on leachate, landfill gas, groundwater, surface water, noise, air and settlement. All measurements indicated compliance of pre-set standards, confirming that, with necessary mitigation measures, TKOL-II/III is safe for Afteruse development. The annual average monitoring results in 2018 are tabulated in **Annex II** for reference.

[1] CED was the predecessor of the current Civil Engineering and Development Department

[2] Aftercare includes the operation and maintenance of the landfill gas and leachate management systems, maintenance of the capping system and the carrying out of regular environmental monitoring and audit for the restored landfills.

2 Site Information of Platforms

2.1 TKOL-II/III covers a total area of approximately 42 hectares (ha), of which about 2.8 ha is flat area. Three pieces of flat areas, namely Lot A (upper platform of about 1.7 ha at +140 mPD), Lot B (middle platform of about 0.7 ha at +40 mPD), and Lot C (lower platform of about 0.4 ha at +6 mPD) are available for the development of afteruse facilities for compatible uses. Proposed afteruse facilities could be developed at Lot A, Lot B, and Lot C. Survey maps with the approximate footprint of Lot A and Lot B are shown in **Annex III**.

2.2 Lot A and Lot B are currently open to government departments and non-profit-making organizations as a training field of Unmanned Aerial Vehicle for land surveying. The temporary use of the Lots will be terminated when the Lots are granted to the successful applicant for the proposed Afteruse Facility. Lot C located adjacent to the existing treatment facilities and site office has an area of about 0.4 ha for development. Site photos of the Lots and the surrounding are shown in **Annex IV**.

2.3 The approximate datum level of TKOL-II/III is shown in **Annex IV**. Technical information of the Lots is summarised below:

Area	**Approximate Datum Level (mPD)**	**Maximum Allowable Loading (kPa)**(Note)	**Approximate Flat Area (ha)**
Lot A	+140	50	1.7
Lot B	+40	~~50~~ 40	0.7
Lot C	+6	50	0.4

Note: To protect the underground restoration facilities, development of any Afteruse Facility at Lot A, Lot B and Lot C shall not exceed the maximum allowable loading.

3 Site Access

3.1 The main entrance of the Site is located at the junction of Chun Yat Street and Chun Sing Street, Tseung Kwan O.

3.2 Lot A, Lot B and Lot C can be accessed via a vehicle access road within the TKOL-II/III. This access road is basically a paved one-lane road with narrow shoulders. Vehicles heavier than 5.5 tonnes are not allowed to use this access road. The traffic speed on the access road is limited to 10 km/hr. The road is currently possessed and managed by the Restoration Contractor and is not open

to the public. As this access is intended to be used for operation and maintenance of the restoration facilities and carrying out aftercare works, it is not up to public road standard, e.g. no street lighting. A plan of the access road is shown in **Annex V**.

3.3 It is necessary to obtain consent from the Restoration Contractor for using the vehicular access during construction and operation stage of the proposed works.

3.4 It is required either to upgrade the existing access road or construct a new road leading directly to Lot A, Lot B and Lot C in order to facilitate its development.

4 Site Conditions and Constraints

4.1 Restoration Facilities and On-going Aftercare Works

4.1.1 The restoration works at TKOL-II/III include a multi-layer capping system (consisting of compacted soil, geomembrane, geonet and geotextile), a landfill gas and leachate extraction, collection and treatment system, and other ancillary facilities. If there are any proposed works which may affect, modify, interfere with or interrupt the restoration facilities and the Aftercare works, modification / re-provision proposal is required to be submitted for the concerned parties' agreement.

4.2 Settlement and Geotechnical Condition

4.2.1 TKOL-II/III used to be a dumping site for domestic, commercial, construction, industrial and special wastes; therefore it may not exhibit homogeneous geotechnical properties. Due to the diverse nature and depth of wastes buried in landfill, settlement of the landfill surface may be resulted. It affects the serviceability of the infrastructure (including road pavement, drains, utilities, etc.). When structures are constructed on site, loading of the structure and its foundation may cause additional settlement that could be greater than those in surrounding unloaded areas.

4.2.2 Since the site is overlooked by steep natural terrain, natural terrain hazard study would probably be required for any proposed infrastructure works to the satisfaction of the Geotechnical Engineering Office.

4.3 Landfill Gas Hazard

4.3.1 Landfill gas is a generic term used to describe the mixture of gaseous product generated as a result of the waste decomposition in landfills. It is both flammable and asphyxiating, and has the potential to cause fire and explosion. It may pose potential hazard to construction and maintenance of the proposed works and hence the design of the works should take into consideration of this potential hazard and incorporate mitigation measures as necessary.

4.4 Public Utilities

4.4.1 There is no provision of water supply, electricity, public drainage / sewerage system and other public utilities at both Lot A, Lot B and Lot C. It is required to make arrangement with the utility undertakers for the provision of such utilities and services in order to enable the development of the platforms, including how to connect to the existing network / system of these utilities and services in the vicinity.

4.5 Fire Services

4.5.1 The existing vehicular access within TKOL-II/III may not be up to an emergency vehicular access (EVA), and improvement works may be required subject to the development requirements of potential interim uses / permanent uses.

4.6 Outline Zoning Plan (OZP)

4.6.1 The Site falls into the "Open Space" zone in the Outline Zoning Plan (OZP) No. S/TKO/20. The full set of OZP including the Plan, Notes and Explanatory Statement is available at the website of the Town Planning Board (TPB) (http://www.info.gov.hk/tpb/index.html). An extract of OZP highlighting the vicinity of TKOL-II/III is shown in **Annex VI**. The always permitted uses for Open Space and the permitted uses with or without conditions on application to the TPB are also shown in **Annex VI**.

4.6.2 In accordance with the OZP for the Site, no new development, or addition, alteration, and / or modification to or redevelopment of an existing building shall result in a total development and / or redevelopment in excess of a maximum plot ratio of 0.1 and a maximum building height of 1 storey, or the plot ratio and height of the existing building, whichever is the greater.

5 Reference Documents

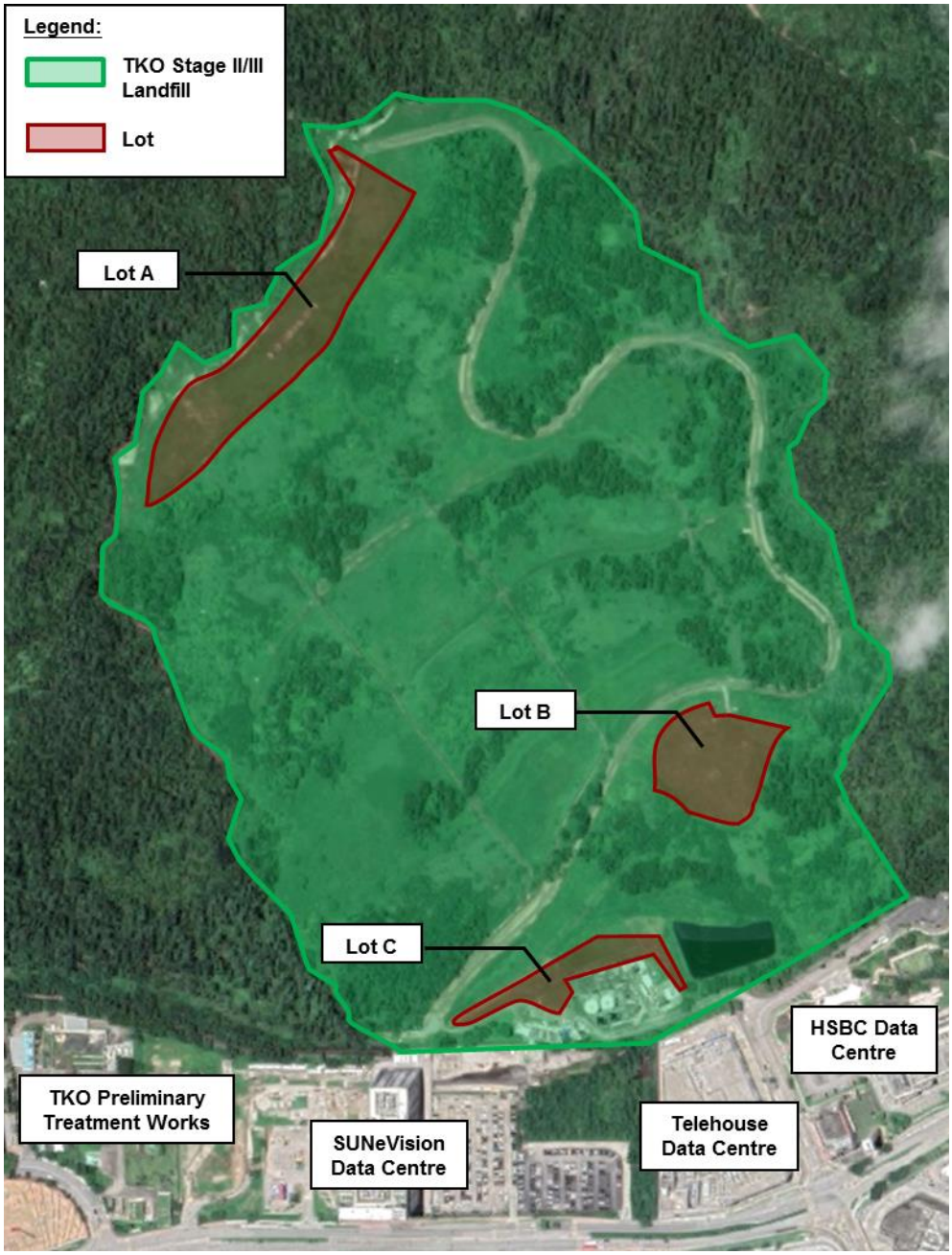
For more detailed information of TKOL-II/III site, reference can be made to the following documents.

Document No.	Title
1	Contract No. EP/SP/29/95 Tseung Kwan O Landfills Restoration Contract - Specification - Contract Drawings - Slope Design Review Reports (2017) - Environmental Monitoring Data (2018)
2	Contract No. FD 01-052 Provision of Services for Geotechnical Review and Site Investigation Works for Tseung Kwan O Landfills Afteruse Development (2004)
3	Contract No. EP/SP/29/95 Tseung Kwan O II/III Landfill Topographic Survey (2020)
4	Contract No. EP/SP/29/95 Restoration of Tseung Kwan O Landfills - Detail Environmental Impact Assessment Report (1998)

Contract No. EP/SP/29/95 **Tseung Kwan O Landfills Restoration Contract As-built Drawing List**		
	Drawing Number	**Drawing Title**
1	STG2/STE/DRW/003/R	Stage II/III Cap Layout Plan
2	STG2/STE/DRW/021/R	Stage II/III Final Cap Cross Sections Sheet 1 of 3
3	GENL/STE/DRW/001/R	Cap General Details Sheet 1 of 3
4	GENL/STE/DRW/002/R	Cap General Details Sheet 2 of 3
5	GENL/STE/DRW/003/R	Cap General Details Sheet 3 of 3

Contract No. EP/SP/29/95 **Tseung Kwan O Landfills Restoration Contract As-built Drawing List**		
	Drawing Number	**Drawing Title**
6	STG2/SUR/DRW/001/R	Stage II/III Surface Water Drainage Layout Plan
7	STG2/G&L/DRW/002/R	Stage II/III Gas and Leachate Management Schematic Layout Plan
8	STG2/G&L/DRW/003/R	Stage II/III Gas and Leachate Extraction System P&ID

Annex I – General Information of Tseung Kwan O Stage II/III Landfill



District	Sai Kung
Completion of Restoration Works	1999
Land Use Zoning	Open Space
Flat Area (approx.)	2.8 ha
Current Status	• Lot A and Lot B are currently used as an Unmanned Aerial Vehicles (UAVs) Training Area and are opened for booking by government departments or non-profit making organization.

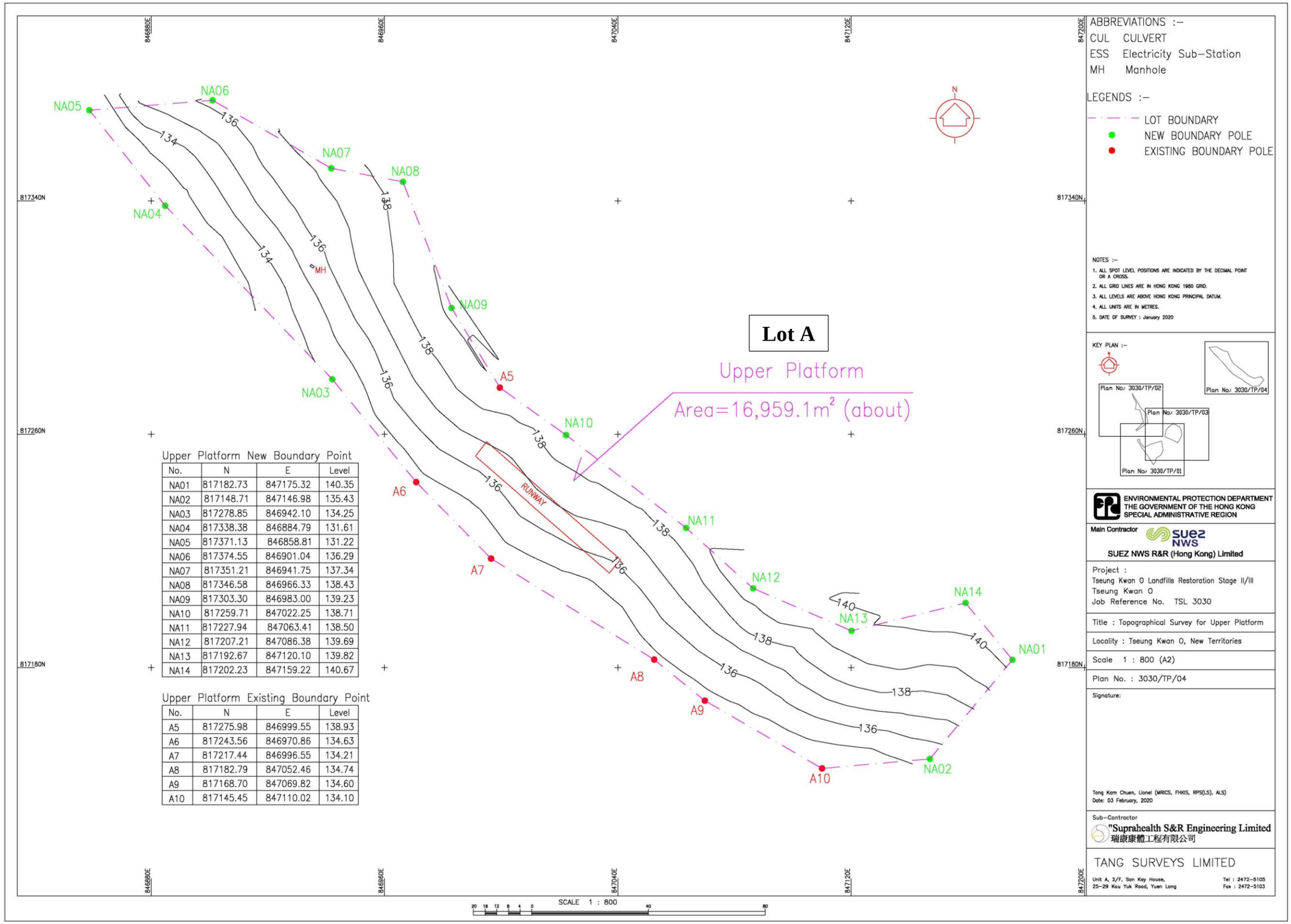
Other Information

- TKOL-II/III mainly comprises slopes.
- Existing site access road is not opened to the public and is not up to public road standard.
- TKOL-II/III is surrounded by Green Belt zone of High Junk Peak and its western part is facing to commercial and residential areas.
- There are landfill restoration facilities including landfill gas and leachate management systems installed at TKOL-II/III and the Restoration Contractor is carrying out landfill aftercare works on a regular basis; any proposed uses shall be compatible with these facilities and the aftercare works.

Annex II – Annual Average Landfill Gas Monitoring and Ground Settlement Data in 2018

Description	Average value in 2018	Safety Limit
Methane content in passive vent pipes located at the landfill boundary	Non-detectable	N/A
Methane content in landfill gas monitoring wells located at the landfill boundary	Non-detectable	N/A
Total landfill gas collected	About 4,730,000 m^3	N/A
Surface emission (Methane)	2.8 ppm	10,000 ppm
Ground settlement (Compared with 2017)	About 8 mm	N/A

Annex III - Site Survey Map of Tseung Kwan O Stage II/III Landfill



Upper Platform New Boundary Point

No.	N	E	Level
NA01	817182.73	847175.32	140.35
NA02	817148.71	847146.98	135.43
NA03	817278.85	846942.10	134.25
NA04	817338.38	846884.79	131.61
NA05	817371.13	846858.81	131.22
NA06	817374.55	846901.04	136.29
NA07	817351.21	846941.75	137.34
NA08	817346.58	846966.33	138.43
NA09	817303.30	846983.00	139.23
NA10	817259.71	847022.25	138.71
NA11	817227.94	847063.41	138.50
NA12	817207.21	847086.38	139.69
NA13	817192.67	847120.10	139.82
NA14	817202.23	847159.22	140.67

Upper Platform Existing Boundary Point

No.	N	E	Level
A5	817275.98	846999.55	138.93
A6	817243.56	846970.86	134.63
A7	817217.44	846996.55	134.21
A8	817182.79	847052.46	134.74
A9	817168.70	847069.82	134.60
A10	817145.45	847110.02	134.10

ABBREVIATIONS :–
CUL CULVERT
ESS Electricity Sub–Station
MH Manhole

LEGENDS :–
LOT BOUNDARY
NEW BOUNDARY POLE
EXISTING BOUNDARY POLE

NOTES :–
1. ALL SPOT LEVEL POSITIONS ARE INDICATED BY THE DECIMAL POINT OR A CROSS.
2. ALL GRID LINES ARE IN HONG KONG 1980 GRID.
3. ALL LEVELS ARE ABOVE HONG KONG PRINCIPAL DATUM.
4. ALL UNITS ARE IN METRES.
5. DATE OF SURVEY : January 2020

KEY PLAN :–
Plan No.: 3030/TP/01
Plan No.: 3030/TP/02
Plan No.: 3030/TP/03
Plan No.: 3030/TP/04

ENVIRONMENTAL PROTECTION DEPARTMENT
THE GOVERNMENT OF THE HONG KONG SPECIAL ADMINISTRATIVE REGION

Main Contractor
SUEZ NWS R&R (Hong Kong) Limited

Project :
Tseung Kwan O Landfills Restoration Stage II/III
Tseung Kwan O
Job Reference No. TSL 3030

Title : Topographical Survey for Upper Platform

Locality : Tseung Kwan O, New Territories

Scale 1 : 800 (A2)

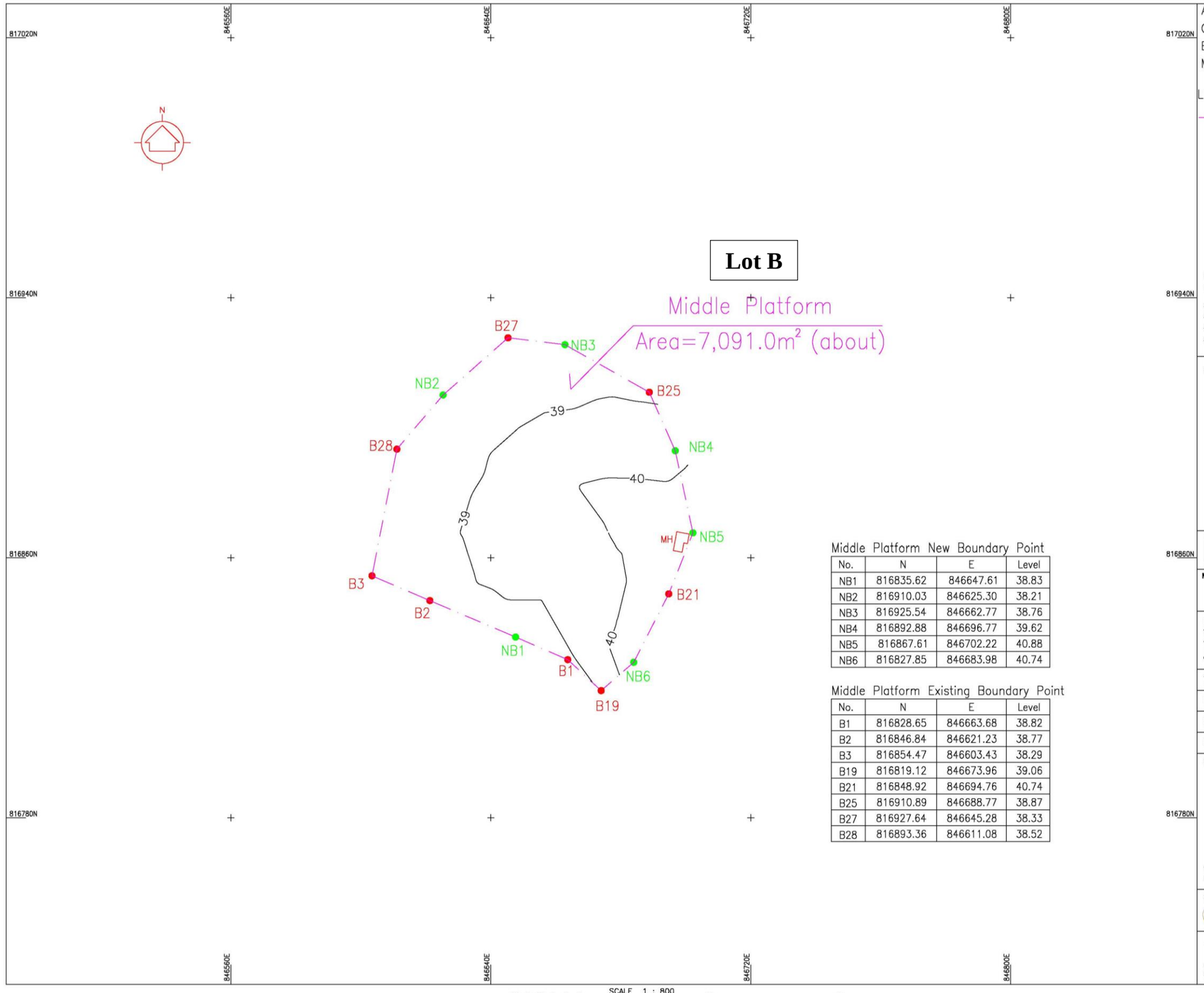
Plan No. : 3030/TP/04

Signature:

Tang Kam Chuen, Lionel (MRICS, FHKIS, RPS(LS), ALS)
Date: 03 February, 2020

Sub–Contractor
"Suprahealth S&R Engineering Limited
瑞康康體工程有限公司

TANG SURVEYS LIMITED
Unit A, 2/F, San Kay House, 25–29 Kau Yuk Road, Yuen Long
Tel : 2472–5105
Fax : 2472–5103



Middle Platform New Boundary Point

No.	N	E	Level
NB1	816835.62	846647.61	38.83
NB2	816910.03	846625.30	38.21
NB3	816925.54	846662.77	38.76
NB4	816892.88	846696.77	39.62
NB5	816867.61	846702.22	40.88
NB6	816827.85	846683.98	40.74

Middle Platform Existing Boundary Point

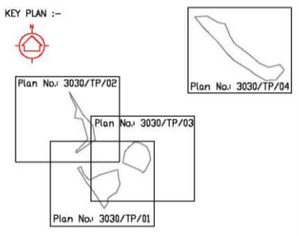
No.	N	E	Level
B1	816828.65	846663.68	38.82
B2	816846.84	846621.23	38.77
B3	816854.47	846603.43	38.29
B19	816819.12	846673.96	39.06
B21	816848.92	846694.76	40.74
B25	816910.89	846688.77	38.87
B27	816927.64	846645.28	38.33
B28	816893.36	846611.08	38.52

ABBREVIATIONS :–
CUL CULVERT
ESS Electricity Sub–Station
MH Manhole

LEGENDS :–
LOT BOUNDARY
NEW BOUNDARY POLE
EXISTING BOUNDARY POLE

NOTES :–
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3. ALL LEVELS ARE ABOVE HONG KONG PRINCIPAL DATUM.
4. ALL UNITS ARE IN METRES.
5. DATE OF SURVEY : January 2020

KEY PLAN :–



ENVIRONMENTAL PROTECTION DEPARTMENT
THE GOVERNMENT OF THE HONG KONG SPECIAL ADMINISTRATIVE REGION

Main Contractor
SUEZ NWS R&R (Hong Kong) Limited

Project :
Tseung Kwan O Landfills Restoration Stage II/III
Tseung Kwan O
Job Reference No. TSL 3030

Title : Topographical Survey for Middle Platform

Locality : Tseung Kwan O, New Territories

Scale 1 : 800 (A2)

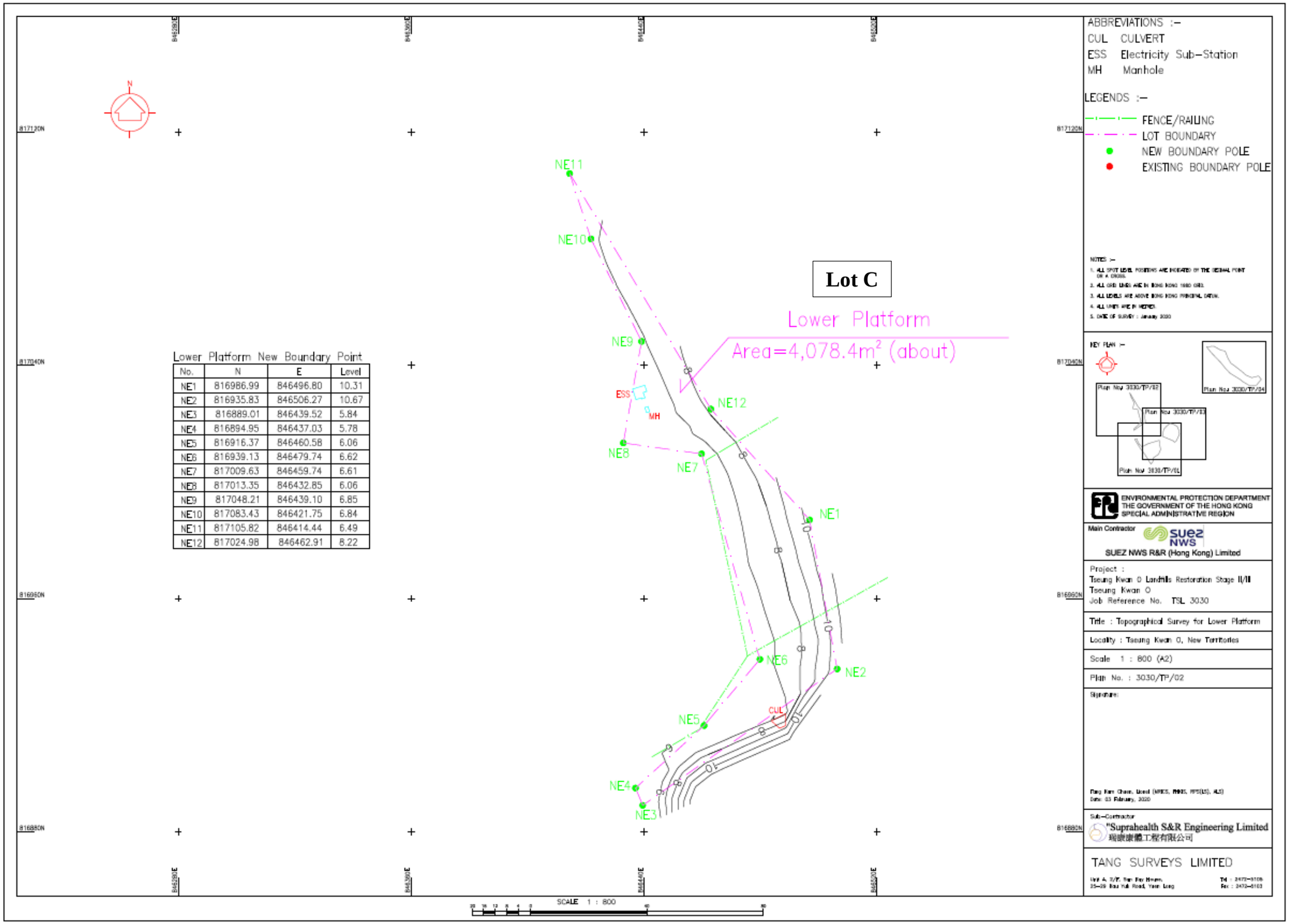
Plan No. : 3030/TP/03

Signature:

Tang Kam Chuen, Lionel (MRICS, FHKIS, RPS(LS), ALS)
Date: 03 February, 2020

Sub–Contractor
"Suprahealth S&R Engineering Limited
瑞康康體工程有限公司

TANG SURVEYS LIMITED
Unit A, 2/F, San Kay House, 25–29 Kau Yuk Road, Yuen Long
Tel : 2472–5105
Fax : 2472–5103



Lower Platform New Boundary Point

No.	N	E	Level
NE1	816986.99	846496.80	10.31
NE2	816935.83	846506.27	10.67
NE3	816889.01	846439.52	5.84
NE4	816894.95	846437.03	5.78
NE5	816916.37	846460.58	6.06
NE6	816939.13	846479.74	6.62
NE7	817009.63	846459.74	6.61
NE8	817013.35	846432.85	6.06
NE9	817048.21	846439.10	6.85
NE10	817083.43	846421.75	6.84
NE11	817105.82	846414.44	6.49
NE12	817024.98	846462.91	8.22

ABBREVIATIONS :–
CUL CULVERT
ESS Electricity Sub–Station
MH Manhole

LEGENDS :–
FENCE/RAILING
LOT BOUNDARY
NEW BOUNDARY POLE
EXISTING BOUNDARY POLE

NOTES :–
1. ALL SPOT LEVEL POSITIONS ARE INDICATED BY THE DECIMAL POINT OF A CROSS.
2. ALL GRID LINES ARE IN HONG KONG 1980 GRID.
3. ALL LEVELS ARE ABOVE HONG KONG PRINCIPAL DATUM.
4. ALL UNITS ARE IN METRES.
5. DATE OF SURVEY : January 2020

KEY PLAN :–
Plan No. 3030/TP/02
Plan No. 3030/TP/03
Plan No. 3030/TP/04
Plan No. 3030/TP/01

ENVIRONMENTAL PROTECTION DEPARTMENT
THE GOVERNMENT OF THE HONG KONG SPECIAL ADMINISTRATIVE REGION

Main Contractor
SUEZ NWS R&R (Hong Kong) Limited

Project :
Tseung Kwan O Landfills Restoration Stage II/III
Tseung Kwan O
Job Reference No. TSL 3030

Title : Topographical Survey for Lower Platform

Locality : Tseung Kwan O, New Territories

Scale 1 : 800 (A2)

Plan No. : 3030/TP/02

Signature:

Tang Kam Chuen, Lloyd (MRICS, RPS(LS), ALS)
Date: 03 February, 2020

Sub–Contractor
"Suprahealth S&R Engineering Limited
瑞康康體工程有限公司

TANG SURVEYS LIMITED
Unit A, 2/F, Yan Kay House, 25–29 Sau Yuk Road, Yuen Long
Tel : 2472–8108
Fax : 2472–8103

Annex IV – Site Photos of Tseung Kwan O Stage II/III Landfill



Main Entrance of TKO-II/III



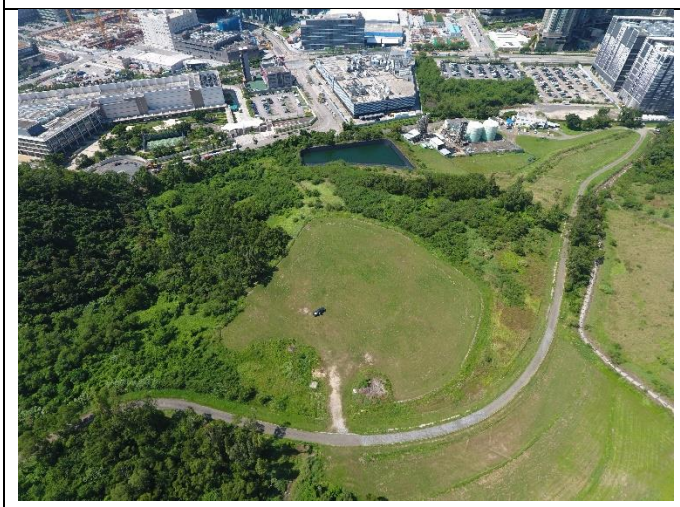
Entrance of TKO-II/III at Chun Sing Street



Aerial View of the Lot A



General View of the Lot A



Aerial View of the Lot B

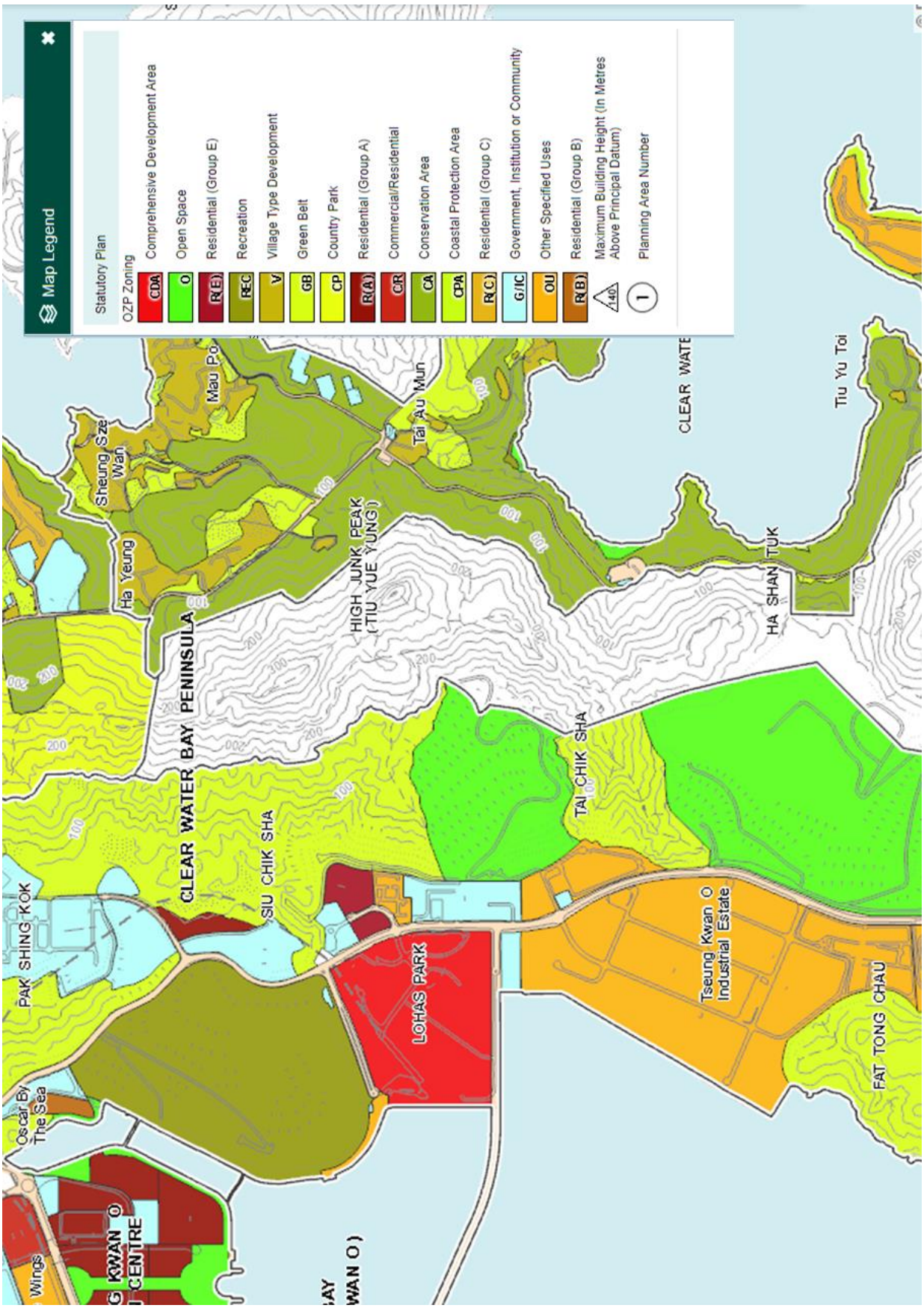


Aerial View of the Lot C,
Site Office and Treatment Facilities

Annex V – Datum Levels and Site Access of Tseung Kwan O Stage II/III Landfill



Annex VI – Extract of the Tseung Kwan O Outline Zoning Plan



OPEN SPACE

Column 1 Uses always permitted	Column 2 Uses that may be permitted with or without conditions on application to the Town Planning Board
Aviary Barbecue Spot* Bathing Beach* Field Study/Education/Visitor Centre Park and Garden Pavilion Pedestrian Area Picnic Area Playground/Playing Field Promenade* Public Convenience Sitting Out Area Zoo*	Cable Car Route and Terminal Building* Eating Place Government Refuse Collection Point Government Use (not elsewhere specified) Holiday Camp Mass Transit Railway Vent Shaft and/or Other Structure above Ground Level other than Entrances* Pier* Place of Entertainment Place of Recreation, Sports or Culture Private Club Public Transport Terminus or Station Public Utility Installation Public Vehicle Park (excluding container vehicle) Religious Institution Service Reservoir Shop and Services Tent Camping Ground Utility Installation for Private Project

** Add where appropriate*

Planning Intention

This zone is intended primarily for the provision of outdoor open-air public space for active and/or passive recreational uses serving the needs of local residents as well as the general public.