TECHNICAL NOTE

CLIENT	TRONOX KZN SANDS	
PROJECT	PORT DURNFORD MINE	
PROJECT SUB AREA	Backfill: Sand Stockpiles	
Note Subject	Options for storing sand during first phases of mining	
Document no:	EX942-TN01-B_PD Backfill Options	
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Client Representative	Lutendo Netshipale	
REVISION TRACKING		
Date	Revision Number	Comment
29 January 2024	A	
04 March 2025	B	Volumes Updated due to changed (flattened) slopes near wetlands and changed boundaries next to sensitive areas in terms of WSP requirements.

Client Approval Sheet

Name	Designation	Signature	Date
Lutendo Netshipale	Mine Engineer		
Sello Nzama	Project Manager		

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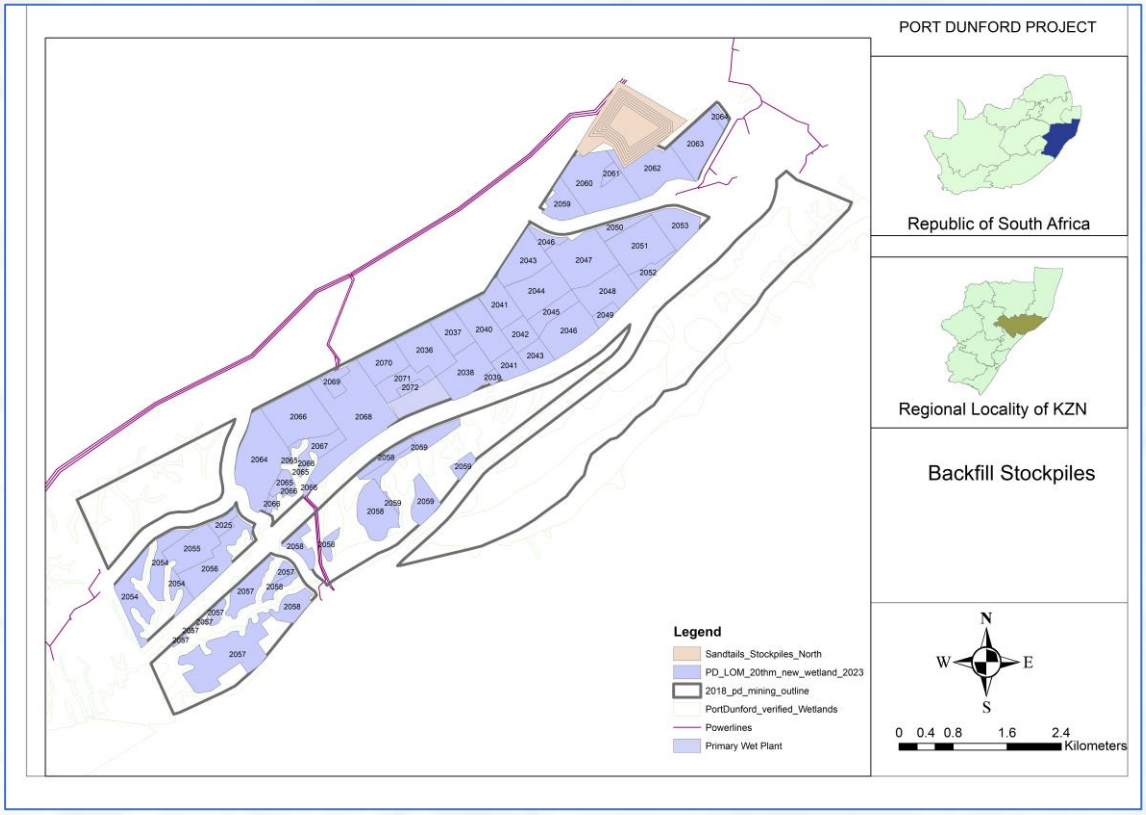
1 TERMS OF REFERENCE AND BACKGROUND

1.1 Appointment

Inqubeko Consulting Engineers has been commissioned by Tronox to review, comment and confirm the work done by Tronox on the conceptual design of the coarse tails (sand) stockpiles required as part of the mining process of the Port Durnford Ore Bodies.

The spatial orientation of the mine is shown below. The blocks indicate the mining areas as planned at present.



1.2 Problem Statement.

The major challenge with this ore body is the lack of space for a single Residue Storage Facility (RSF) large enough for the Life of Mine (LOM), and the area available (Site 9 on the Southwest end) is limited in capacity to not more that 3 years of mining.

External areas are not available, hence new RSF's must be developed in the mined-out pits (Site C). The RSF's planned at present requires relatively small volumes or tonnages sand. The result of these constraints is that the backfill of mined out pits with the coarse tailings is not available for more than 10 years. The limited capacity for sand in the walls of the TSF's means that shortly after mining commences, there will not be areas where the coarse sand tails can be stored, and without that mining cannot continue.

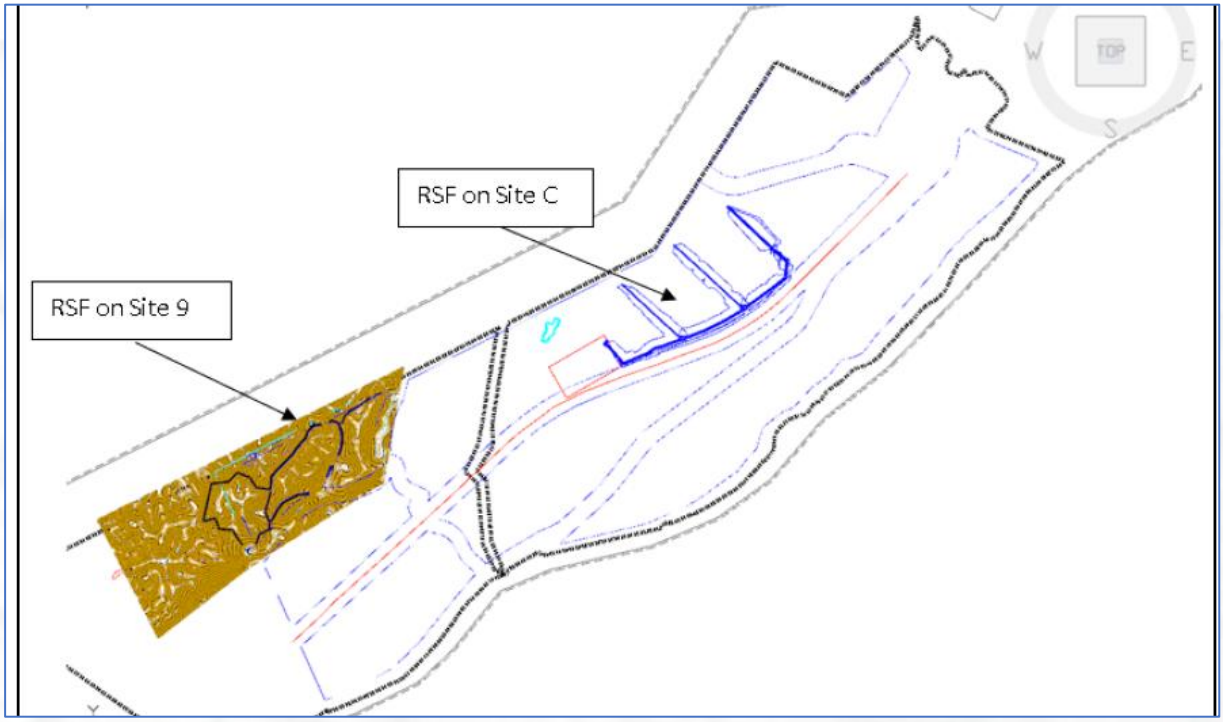
Tronox has investigated the matter and came up with possibilities to resolve this constraint or reduce the impact as far as possible by providing external stockpiles.

1.3 Scope of Study

The purpose of this study is to consider the proposed solutions and provide an opinion on the feasibility thereof with the view of progressing the development of the options into more detail. The study is done on a desk-top level of detail.

2 RESIDUE STORAGE FACILITIES (RSF)

The sites planned for the RSF's are shown on the following pages:



The walls of the RSF are built with the coarse sand tails. The RSF is prepared for accepting the first fine residue by building starter walls and infrastructure before mining commences. Once mining starts the first coarse tails is used to build the remainer of the containment walls. Once the sand walls for Site 9 are complete (in less than 18 months of mining) there is no location where the coarse tails can be placed since backfill in site C is not possible due the fact that the mine void will be used as an RSF and no backfilling can be done. That results in excess sand to be stored on other areas on the ore body.

3 SAND BALANCES AND SCHEDULE

The mine plan developed by Tronox results in a schedule of sand tonnages produced. The mine plan starts off with a period of 11 years of small-scale mining using a pilot type plant where the residue will be disposed of at Fairbreeze.

From year 12 onwards (2036 onwards on current timescale) the mine will produce at full capacity, producing between 15,6 and 18,5million tonnes of sand (coarse tails) per annum. At that time the external areas earmarked for sand stockpiles must be available since sand will be placed simultaneously on the RSF walls and the stockpiles in an intermittent fashion.

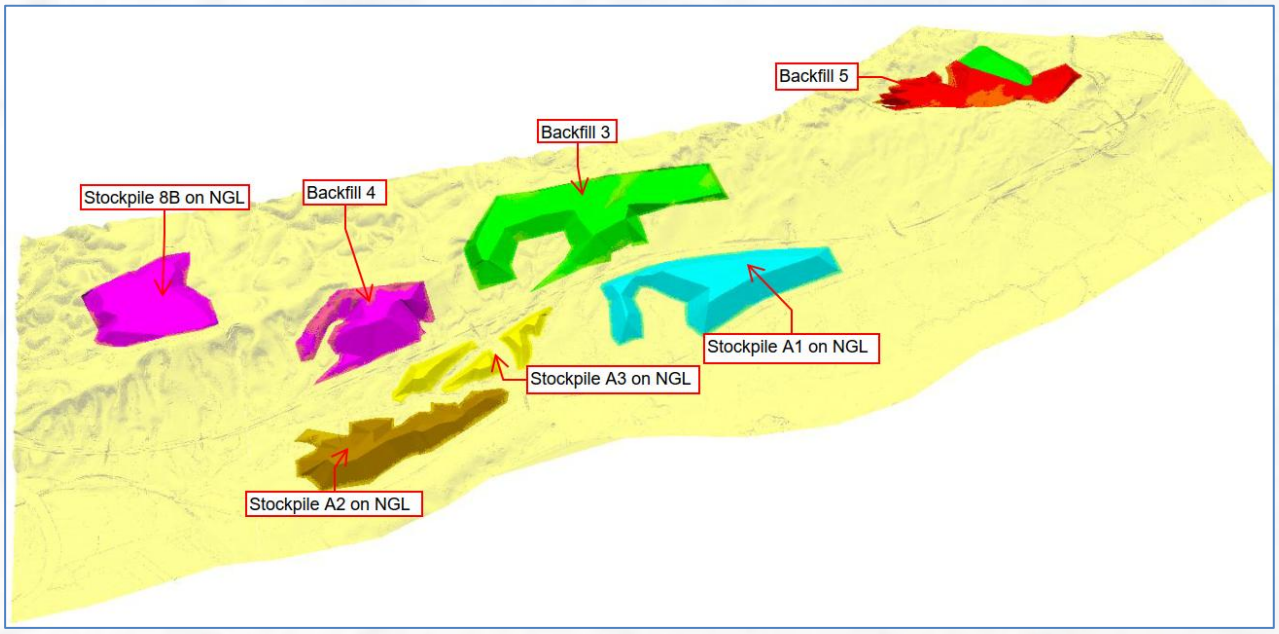
From the conceptual design of the RSF's it is estimated that about 70million tons of coarse tailings will be used in the construction of the sand walls for the different RSF's as summarized in the table below. This is only slightly more than 4 years production, but sand will be sent to the RSF and external stockpiles at the same time extending the period as shown later in the document.

RSF	Estimated Sand	Cumulative Sand to RSF
Site 9	16 Million tons	16
Site C Phase 1	16	32
Site C Phase 2	18	50
Site C Phase 3	18	68
Site C Phase 4	2	70

4 STOCKPILE OPTIONS

The ore bodies to the East of the N2 are considered marginal and can be sterilized for the placement of coarse tails. Once the mine blocks in site C have been mined out it will be used as a RSF. This will be done in 3 phases, and after each phase is mined out coarse tails will be used to build a portion of the RSF in the mined-out void. After mining of site C is completed, mining of remainder of sites will continue starting with the southern mine blocks. As each site is mined out it will be backfilled with coarse tails. The possible sites for coarse tails stockpiles are shown below.

Backfill A is on approved mine blocks which will not be mined, whilst backfill areas 3,4 and 5 is in mined-out pits, only becoming available a few years after the complete RSF on site C has been mined out, at present estimated in 2057.



The purpose of this study is to confirm what volumes are available outside the RSF walls and mine pits, hence going forward only sites A will be discussed.

This is a high-level analysis without going into the very detail of the topography and possible constraints on site not visible from the survey and the desktop investigation. It further assumes that the geotechnical conditions are suitable for accepting the estimated heights of the modelled stockpiles. These stockpiles are indicated on the figure above. Additional views of the different stockpiles are annexed to the note.

4.1 Stockpile A-1 to A-3 and North Stockpile.

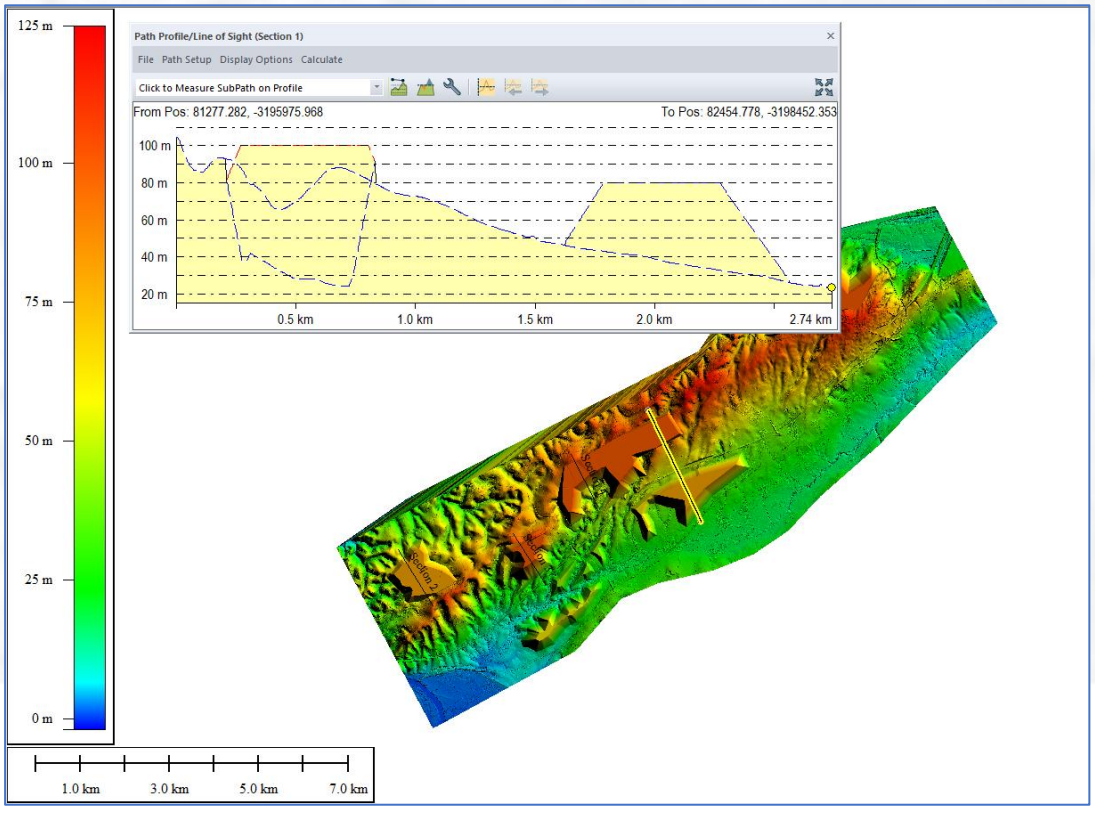
An analysis of the present topography using the 2008 LIDAR survey was done and a stockpile modelled on the surface, to determine the maximum volume of sand which can practically be placed within the approved area outside environmental buffers.

The stockpiles have been modelled with slopes of 1in3 (V:H) which is steep but stable. Where the stockpiles are bounded by a sensitive or wetland area the slopes have been flattened to 1in5 to ease management of drainage and minimize surface erosion. The slopes commence 32m from the environmental boundaries upwards to allow a buffer zone.

The volumes and capacity in tons of each stockpile based on an estimated density of 1.59tons per m3 is tabulated below.

Stockpile	Estimated Volume (m^3)	Estimated capacity (tons)
A-1	46 331 943	73 667 789
A-2	16 390 735	26 061 269
A-3	3 692 678	5 871 358
Stockpile 8B	26 862 536	42 711 432
North Pile	14 189 156	22 560 758
Totals	**107 467 048**	**170 872 606**

A Typical section through the stockpiles is shown below: Please note that the vertical scale is exaggerated, and the slopes will appear steeper than they are.



4.2 Stockpiles in mine pits and above ground at mine pits (Backfill areas)

Where a pit is mined open and is not be converted into a RSF, it will be backfilled to the original topography and then where possible the surface will be raised within agreed elevation limits. Again, the slope design criteria of 1in3 under normal circumstances and 1in5 adjacent to sensitive areas will apply.

The following areas are involved:

Backfill Area	Estimated Volume pit floor to ground (m^3)	Estimated Volume ground to new elevation (m^3)	Estimated Total volume (m^3)	Estimated capacity (tons)
#3	100 803 213	47 420 175	148 223 388	235 675 187
#4	33 976 031	10 881 724	44 857 755	71 323 830
#5	90 621 778	26 000 298	116 622 076	185 429 101
Totals			**309 703 219**	**492 428 118**

The total estimated volumes available in these stockpiles converted to tons and combined with the tonnages available in the RSF's are tabulated below.

	Estimated Volume (m^3)	Estimated capacity (tons)	Tons available in RSF's	Total Tons available
Totals	417 170 267	663 300 725	70 000 000	733 300 725

5 Discussion

Although sufficient volume seem to be available, some areas need to be mined out first before they can be backfilled. The first priority is to mine open the future RSF's. during that time all the sand must go the to above ground stockpiles for which only about 171 million tons are available. The mine sequence and related volumes must be adjusted to suit this constraint.

The availability of the North Stockpile is risky since it is subject to possible constraints inherited from the Hillendale mining right as well as environmental concerns since it is bounded by the Mhlathuze River floodplain and is bisected by a drain line. Should that volume be removed from the available volumes, it will reduce the time during which sand can be accepted by about 2.5years to 2044.

6 RISKS.

The risks discussed below must be considered when evaluating the study and conclusions drawn therefrom. The overall eventual designs must conform to the best practice in the industry and all regulatory controls and guidelines such as the updated SANS10286 Code and other global standards such as GISTM which might become applicable at the time of detail design.

6.1.1 Geotechnical

The analysis is based on an initial investigation with limited information on the detail geotechnical conditions. The geotechnical assumptions must be tested by detailed geotechnical investigations and tests should the study commence to following phases.

6.1.2 Slope Stabilities

The assumed slope stabilities must be confirmed once the properties of the sand tails is known, tested against extreme weather conditions and seismic events.

6.1.3 Storm Water control

The storm water control systems from these stockpiles will require special attention and properly designed control structures, considering the erodible nature of the sands of which the stockpiles will be built. Sufficient budget must be allowed in all feasibilities for such infrastructure.

7 OTHER STORAGE OPPORTUNITIES

Based on the present information the following options need further investigation:

- The northern Jock Farm area on the northern boundary of the mining right has the potential to be enlarged if the full property up to the Mhlathuze River floodplain can be considered. This will be subject to environmental and ownership investigations.
- It could be possible to place sand on the filled RSF but that will depend a lot on the actual densities and strengths achieved in the stored fine residues. It is not expected to be substantial volumes, but it is a possibility.
- Again investigating the option of co-disposal of fines in the sand matrix. There are reports of positive results with in-pit mixing with the aid of re-flocculation in deposition piping. This could result in better consolidation and water recovery resulting in higher densities of the deposited residue and overall space saving.
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8 CONCLUSIONS

From this initial work the following is concluded.

- There are opportunities to develop off-site stockpiles for the excess sand during the first 10 to 12 years of mining. These stockpiles are located on areas previously considered for mining but has since been abandoned due to lower grades and lower tonnages.
- The mine plan and sequence will have to be adapted to suit the stockpile volume constraints.

9 RECOMMENDATIONS

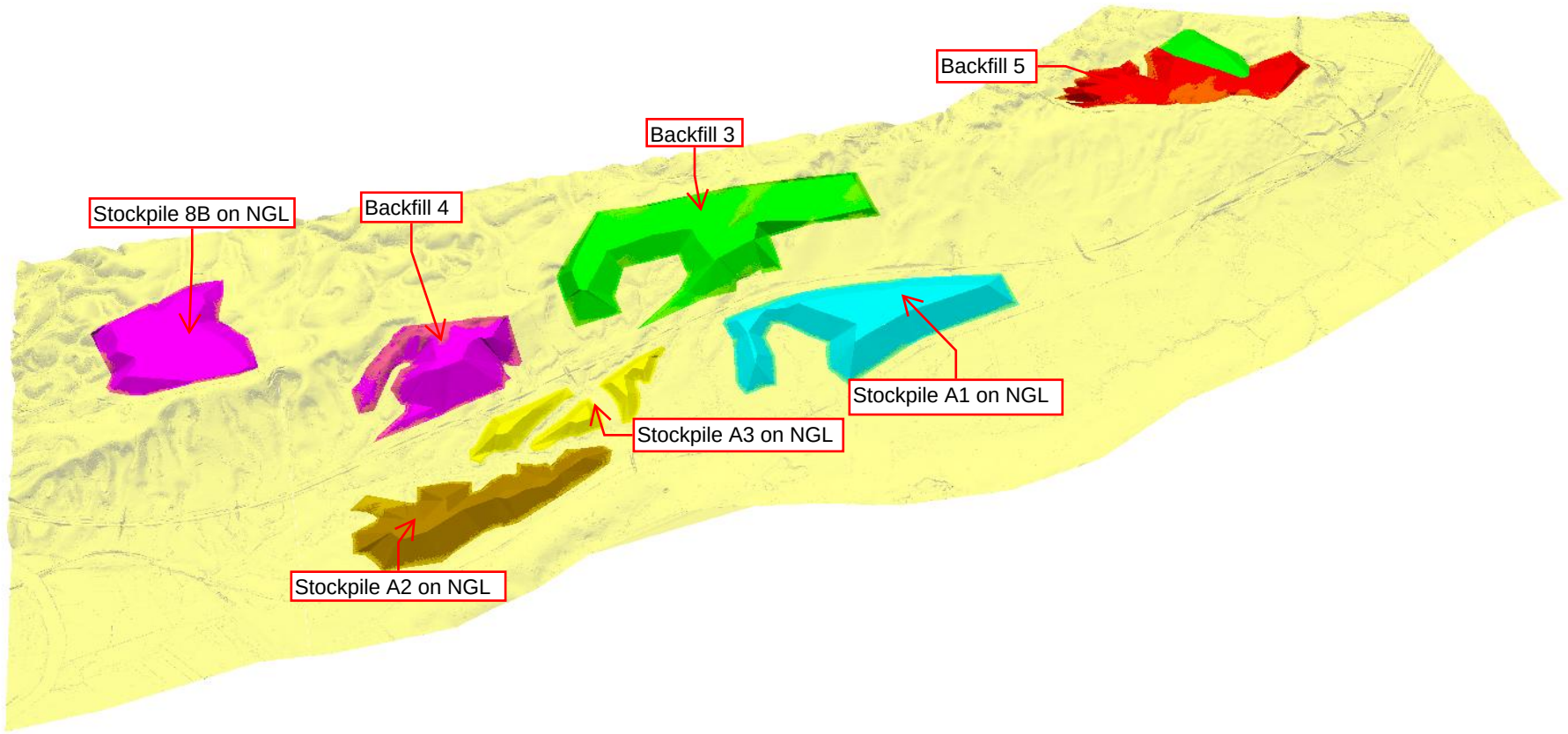
Considering the above it is then recommended as follows:

- Study the whole mining right area in more detail especially considering geotechnical conditions of the lower areas on the east of the N2 highway
- Investigate the possible opportunities and constraints of Jock's Farms area on the north boundary.
- Investigate the possible volumes available in capping the RSF's with sand
- Investigate the co-disposal possibilities, depositing coarse and fine tails in mined out areas in relatively close succession.

Report compiled by

F.J. Pretorius Pr Eng

TRONOX KZN SANDS
PORT DURNFORD MINE
SAND TAILS STORAGE AREAS

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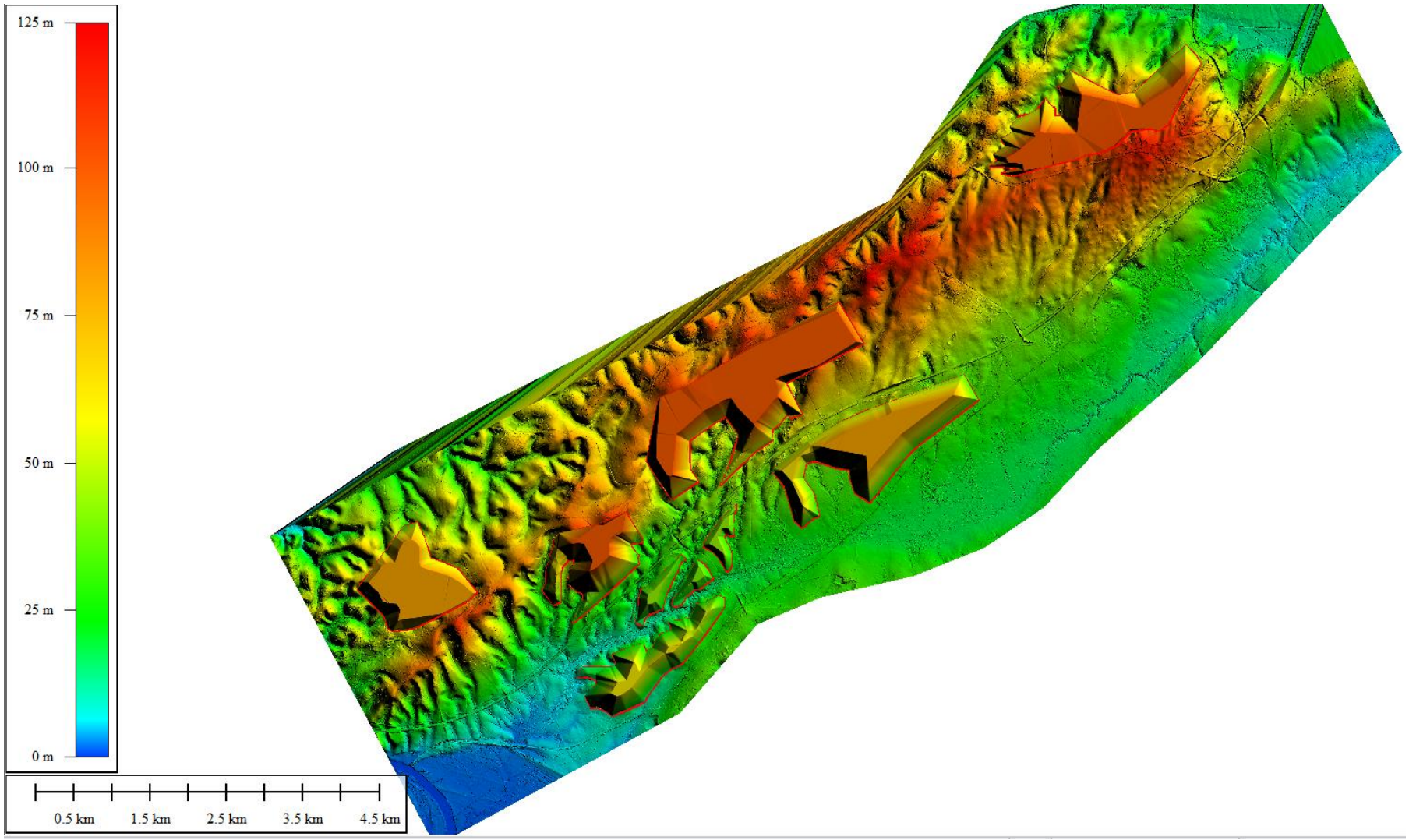
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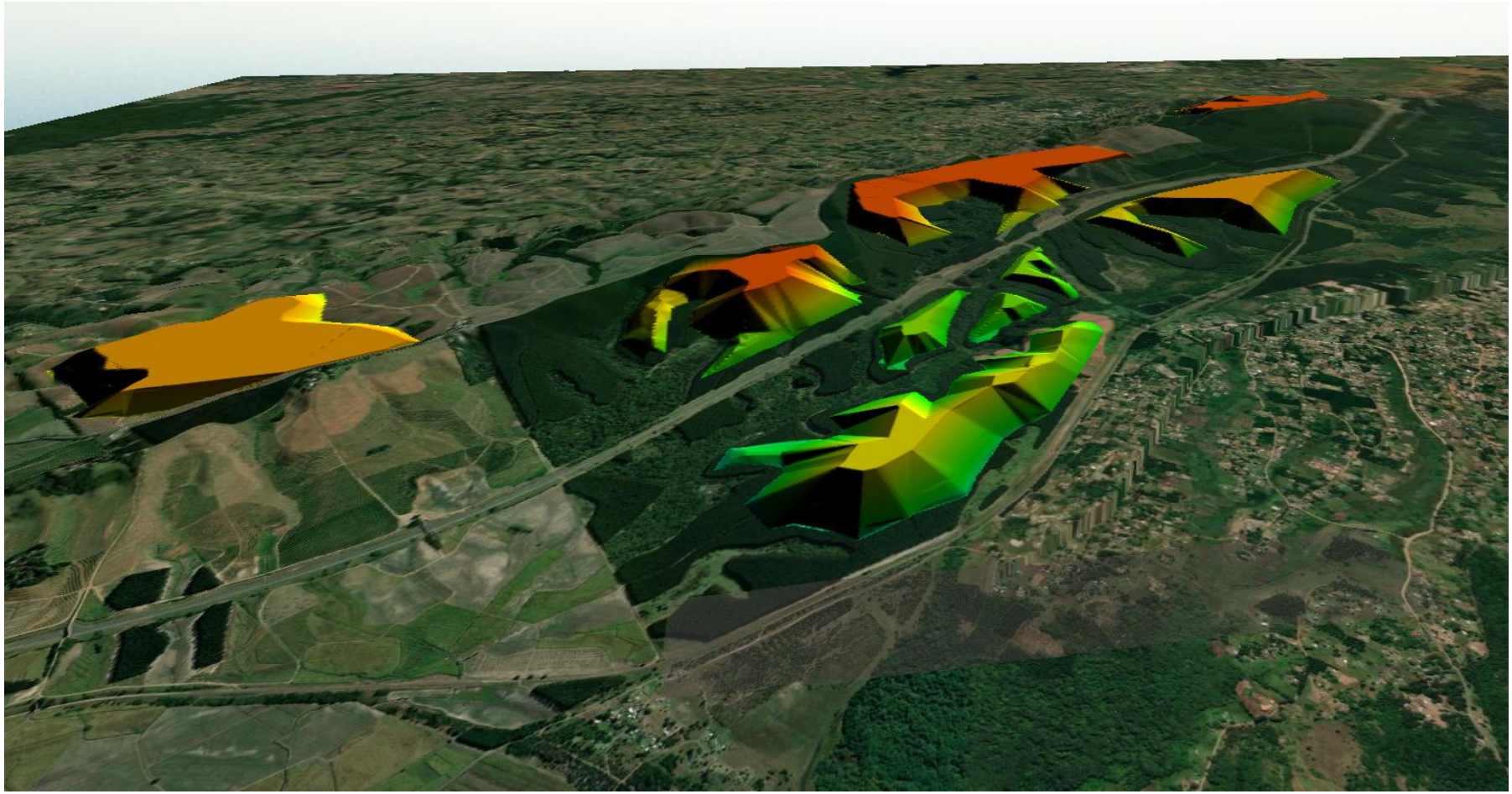

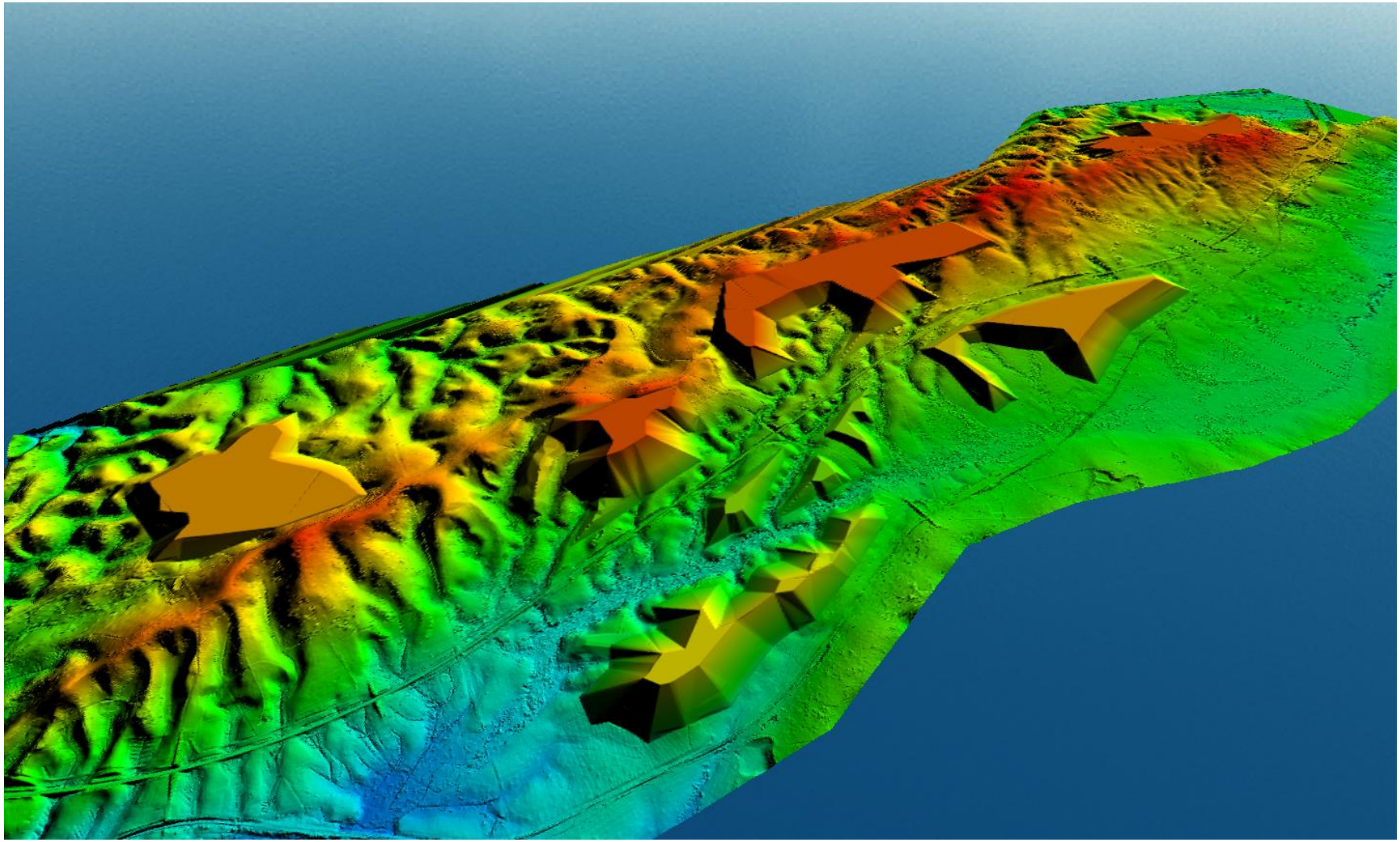

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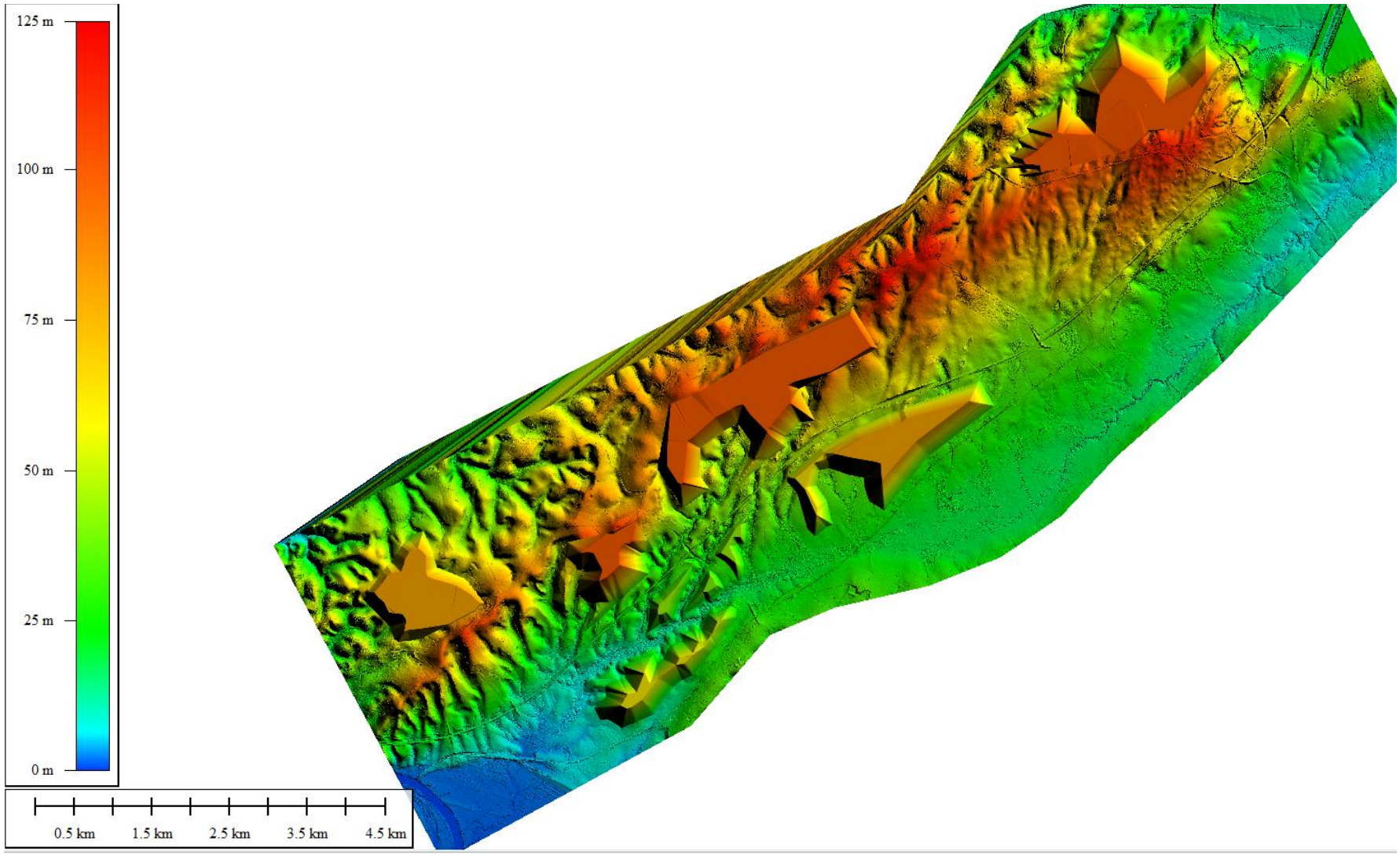
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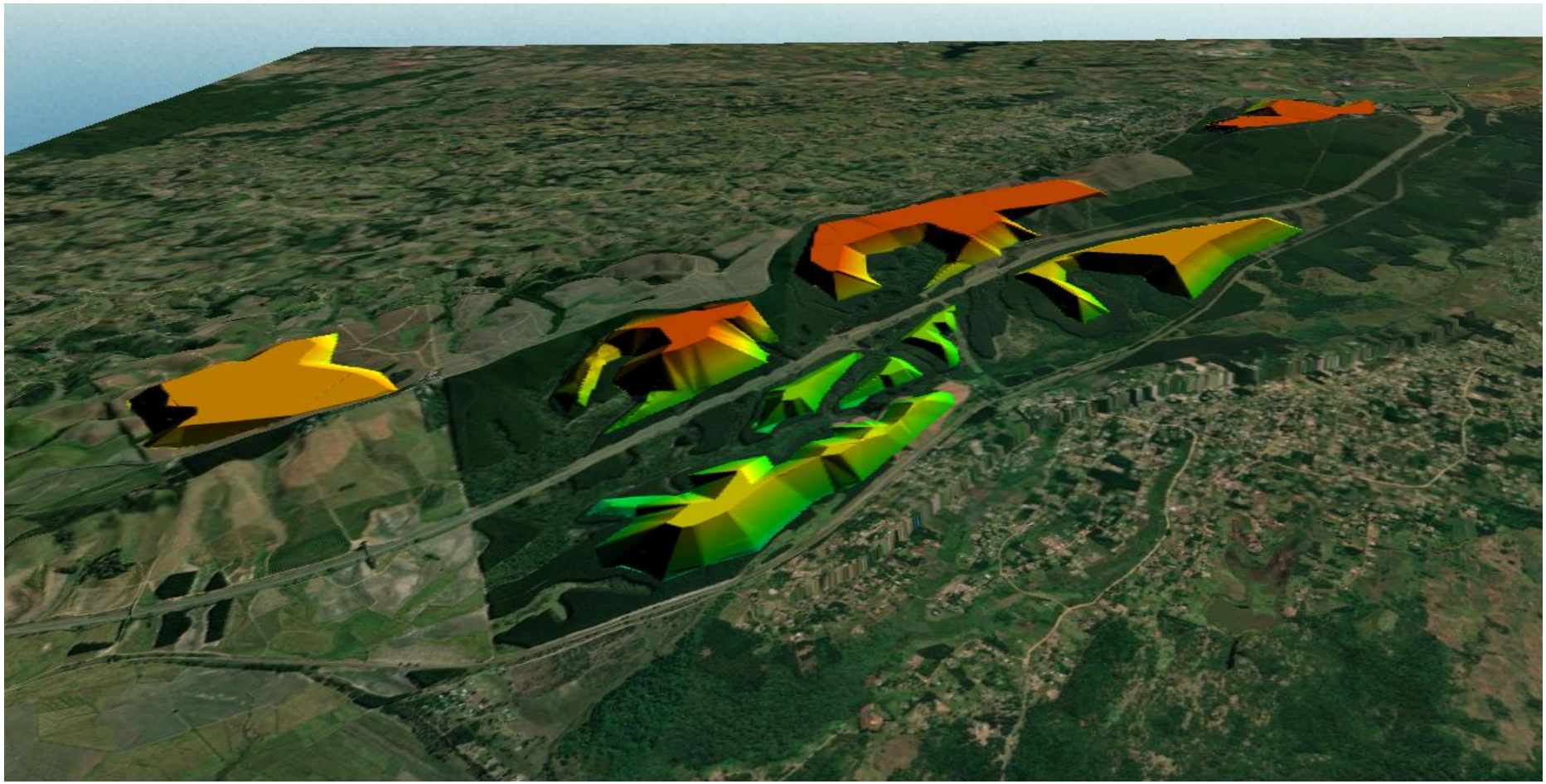

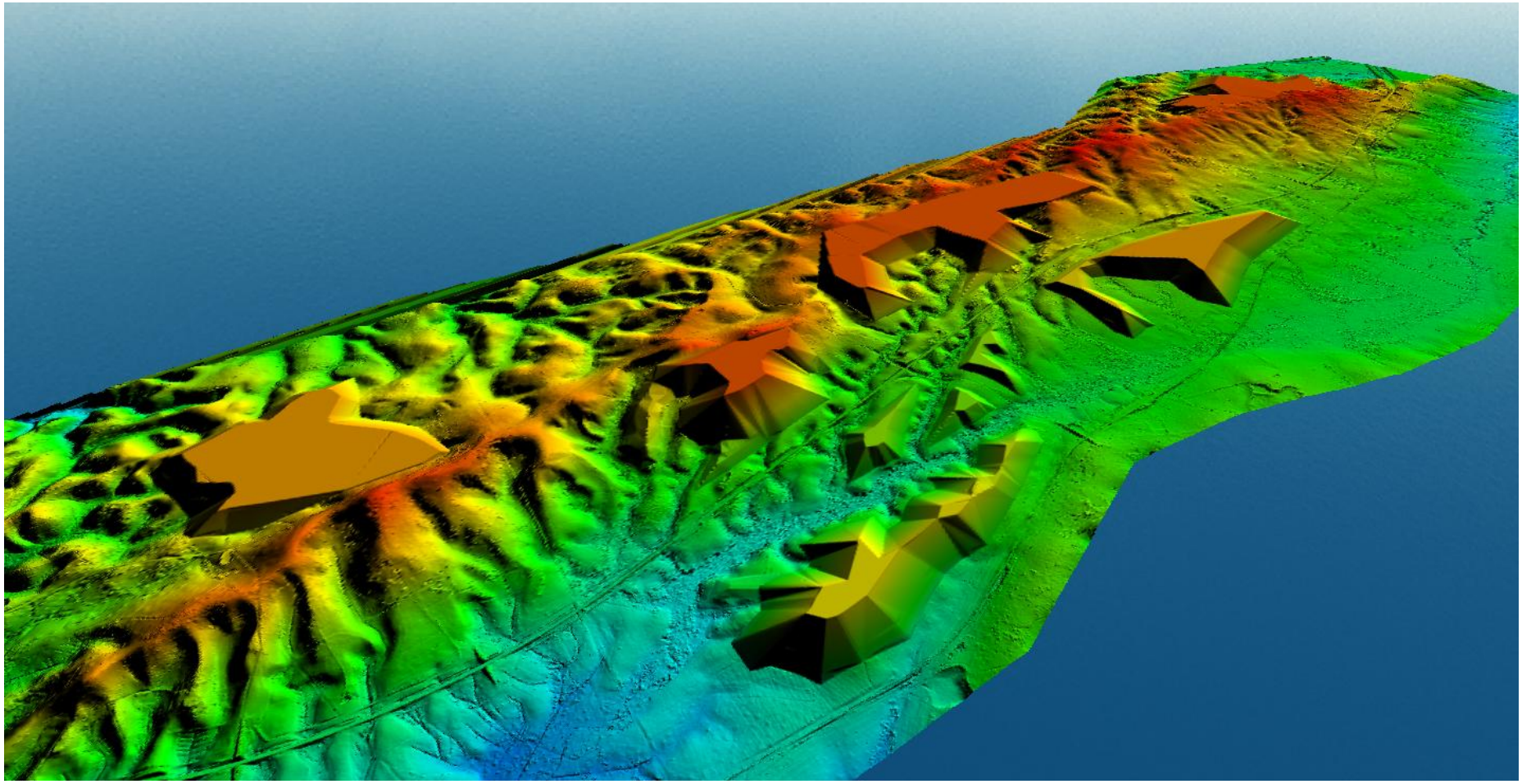

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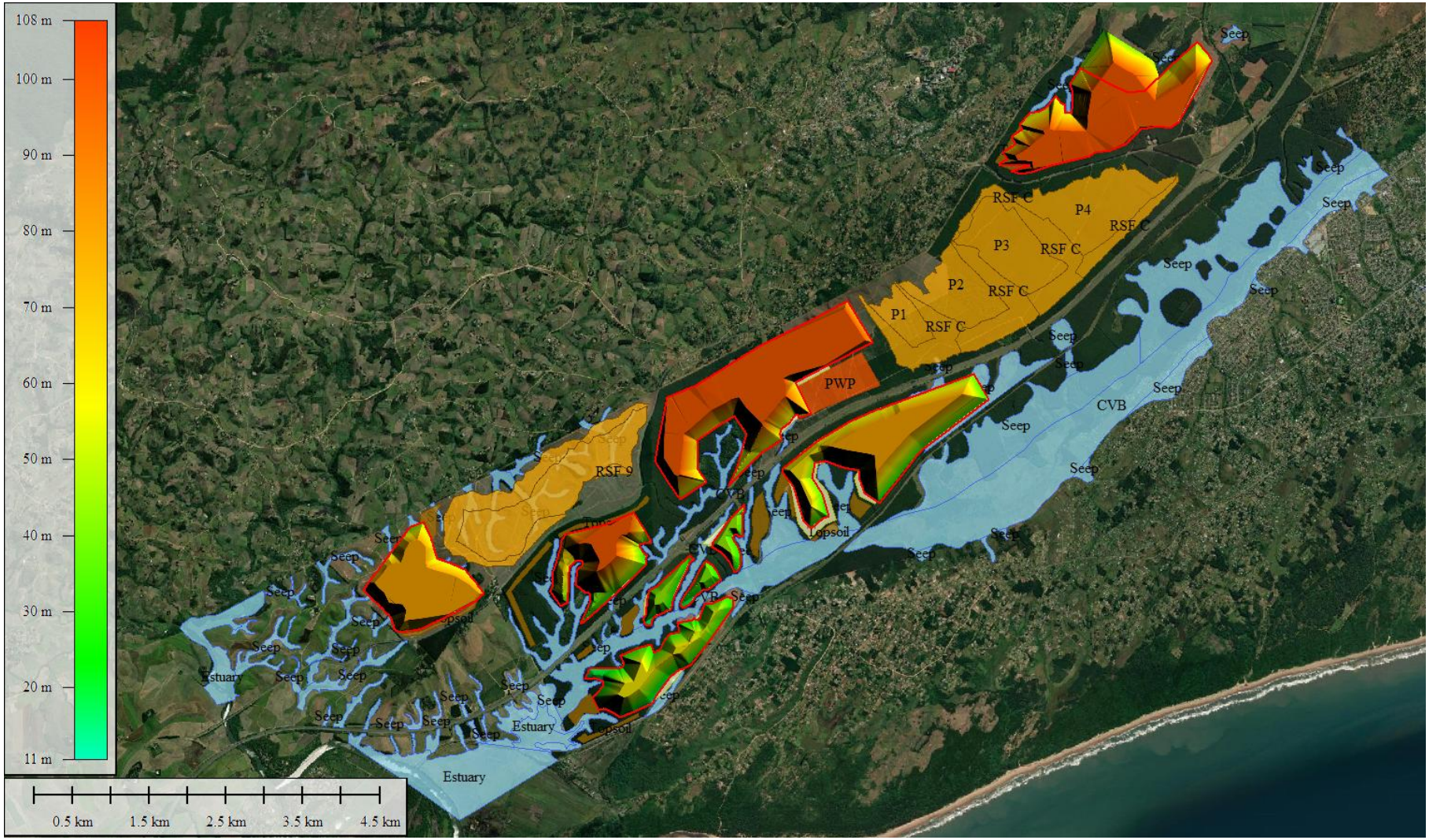

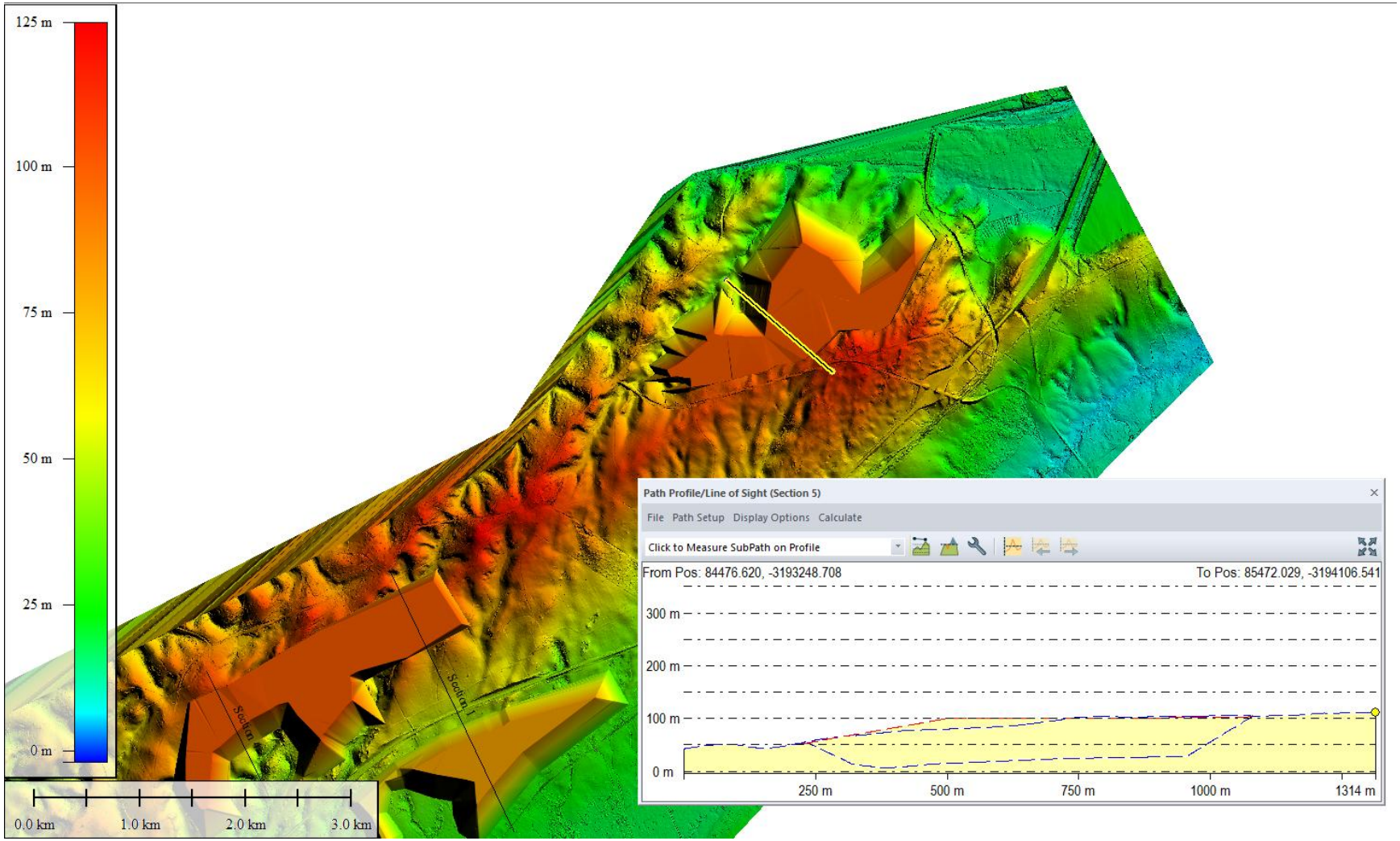
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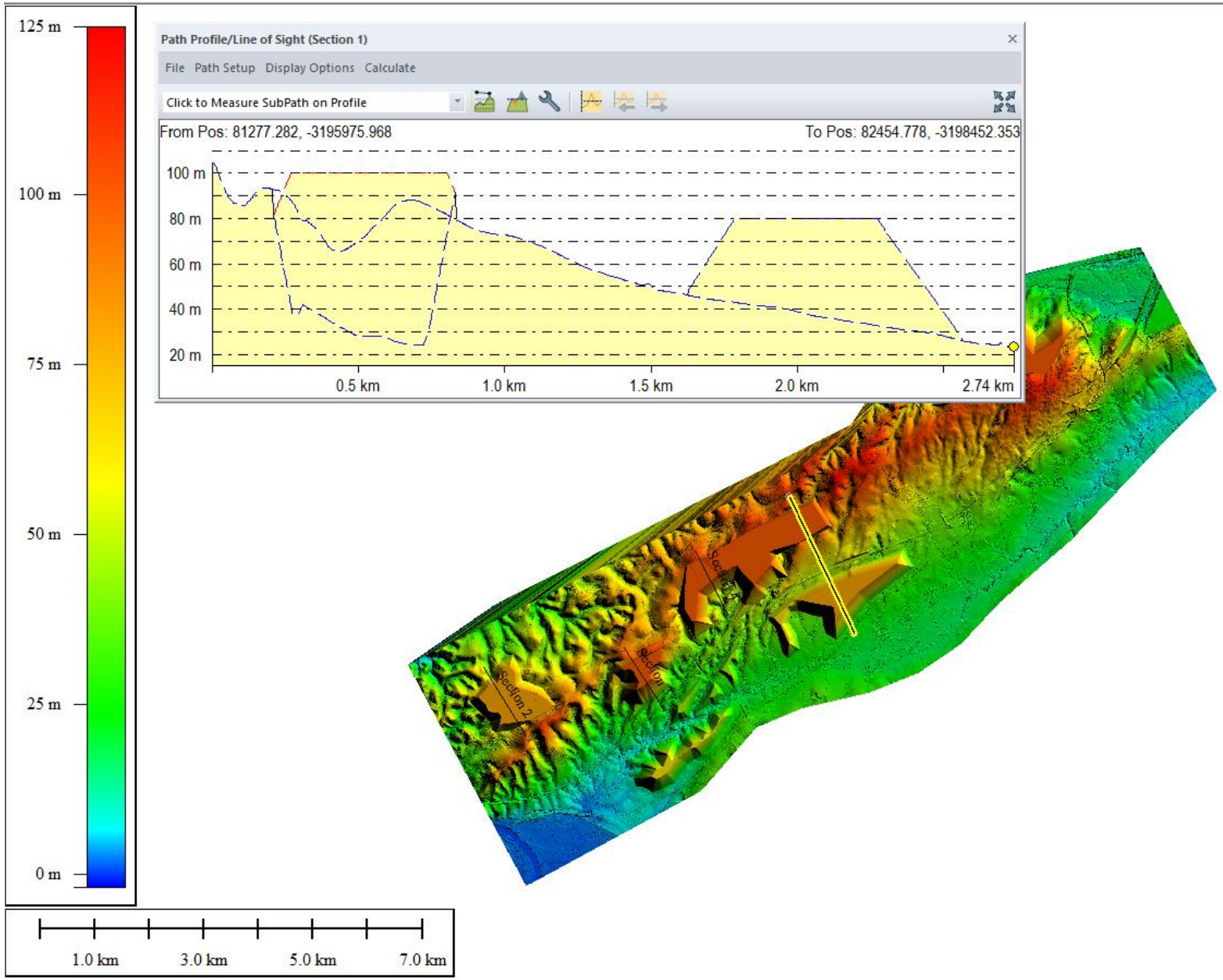
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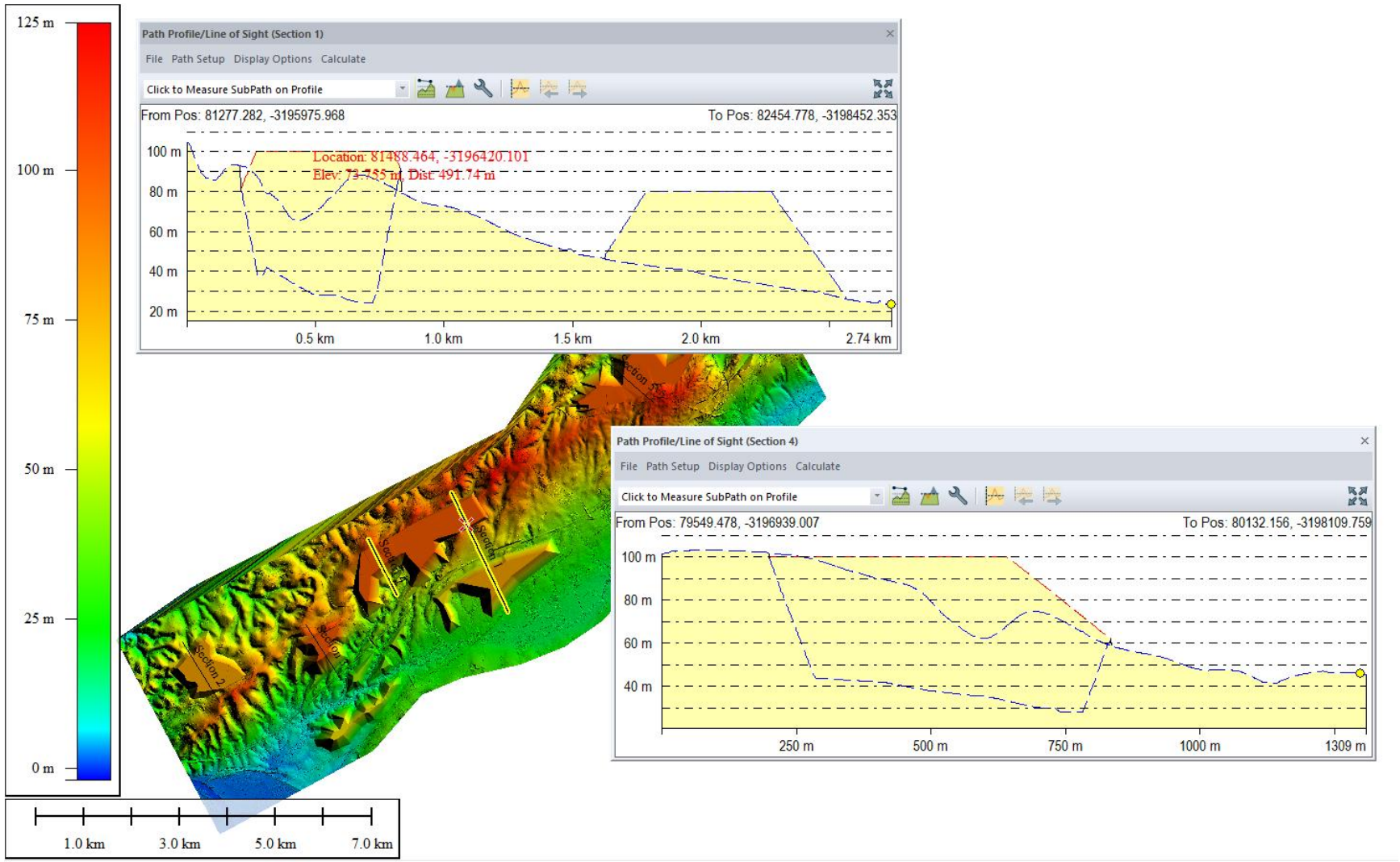
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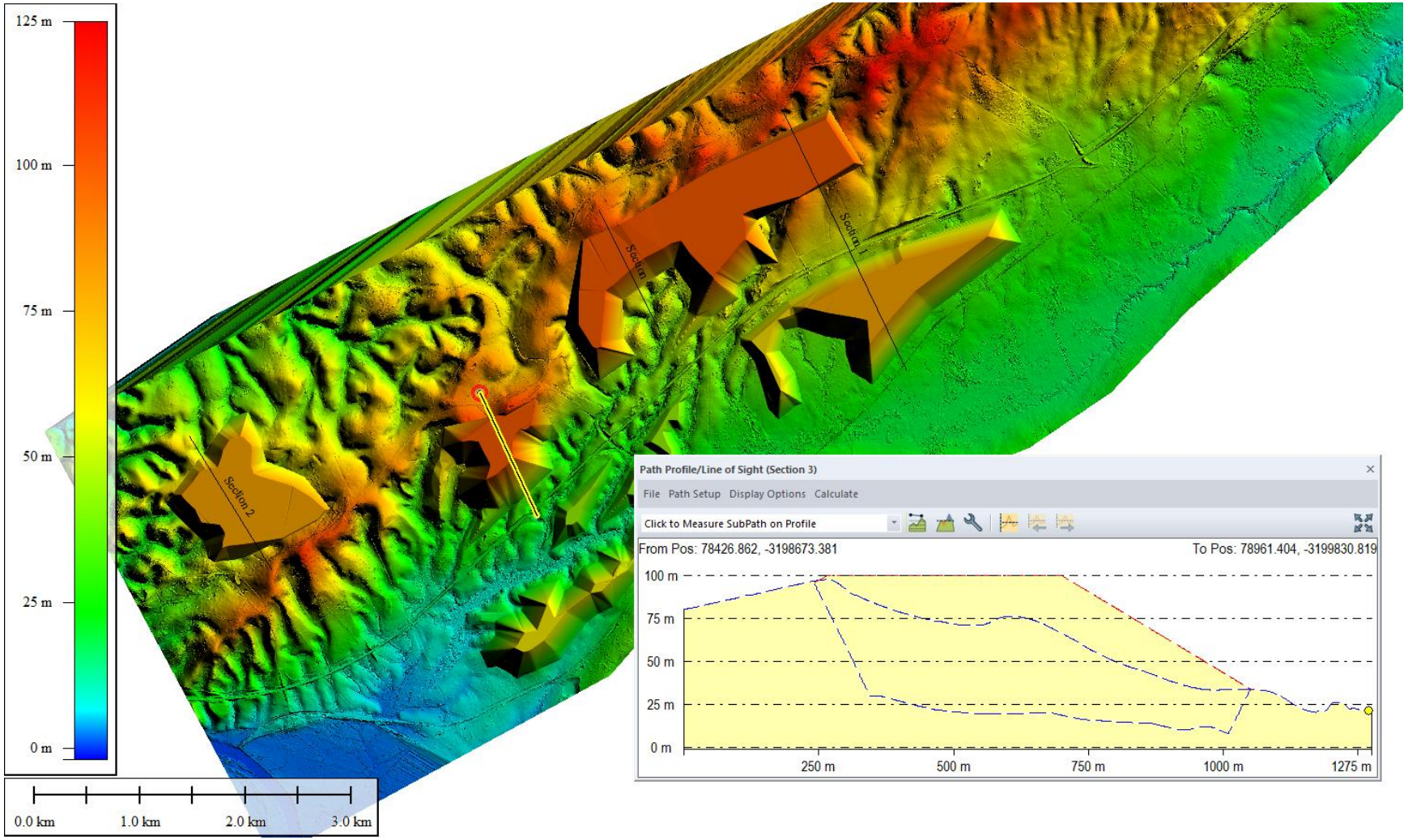
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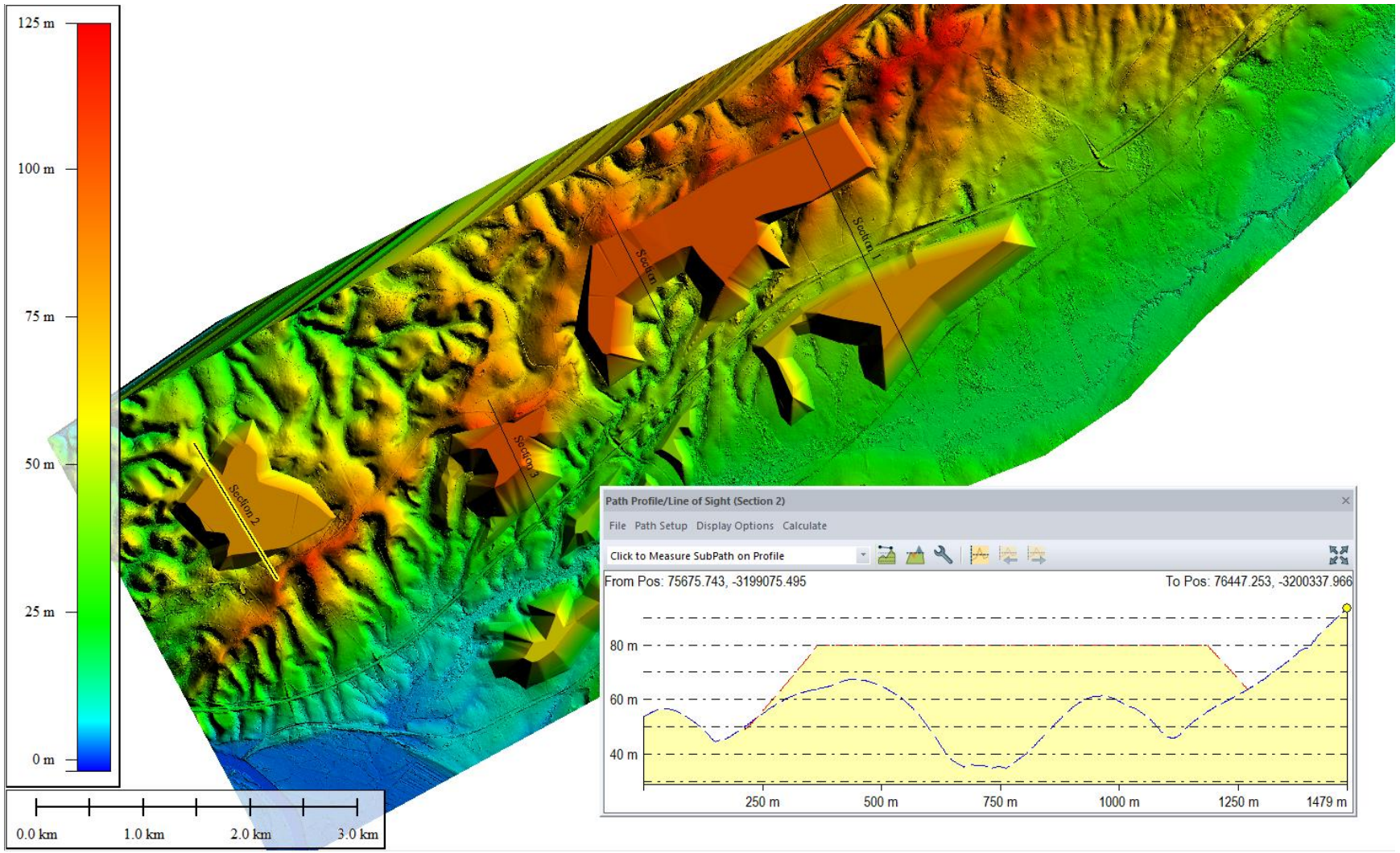
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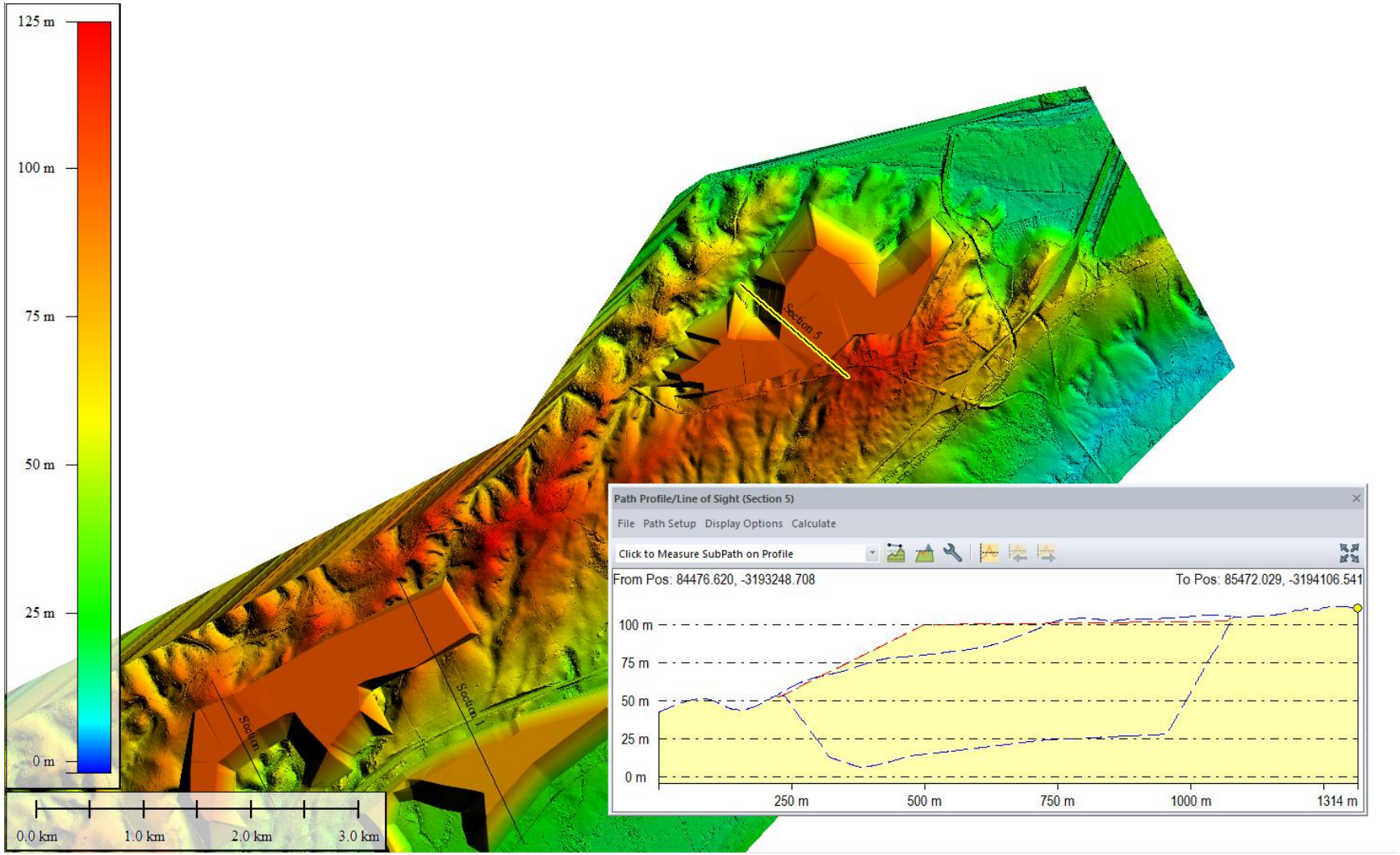
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