Report Boulonnais Quarries

Sample

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Contact details :

Datafalk (Parallax 84)
9 Rue des colonnes,
75002, Paris
France

sample@datafalk.com

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General Map of the site

Captioned map

The map opposite shows the site of the Boulonnais quarries in Ferques, France.

The layout of the map divides the parts of the quarries into different coloured zones. An analysis of the different areas is available in the report

Total area of the site : 3.57 square kilometers

Coordinates : 50.831675122567646, 1.7378321213808654

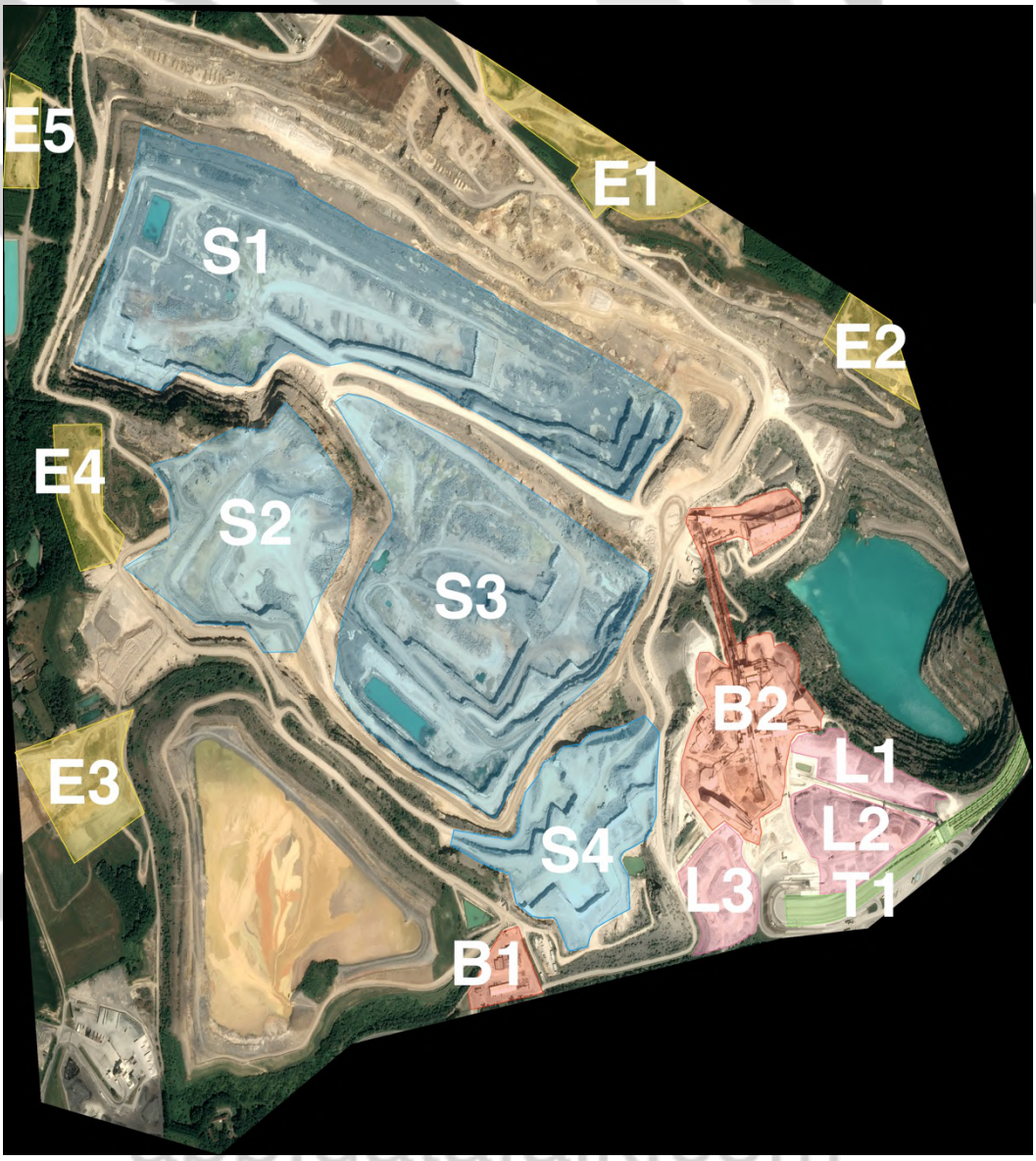

Figure 2 : Explained zoning of boulonnais quarries

B1 : administration building

B2 : Storage and crushing site

E1, E2, E3, E4, E5 : Extension zone (E3 : Extension of the storage reservoir).

L1, L2, L3 : Loading area for lorries

T1 : Rail loading zone (opening in 2020)

S1, S2, S3, S4 : Mining site

Most of the site is dedicated to quarrying. Much more than in the past. The entire site is mined at the same time.

Mining is evenly distributed.

Mine site in 3 dimensions

3D modelling of the Boulonnais mining site based on satellite data.

The modelling includes the height of the site and an overlay of images of the area.

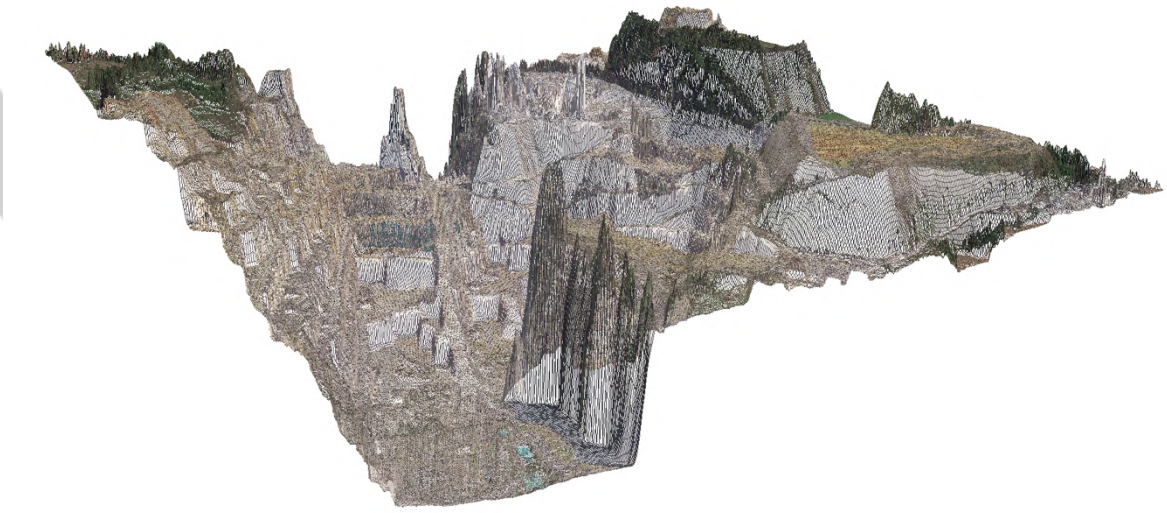

Figure 3 : 3d view of the site from the west

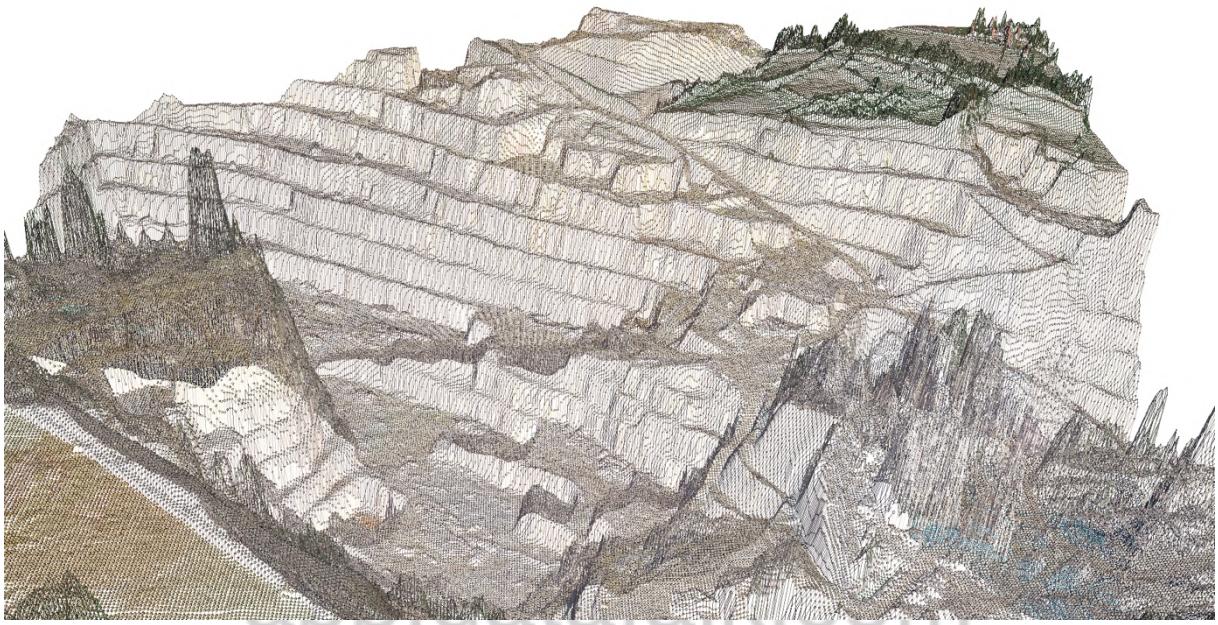

Figure 4 : 3d view of the site from the south

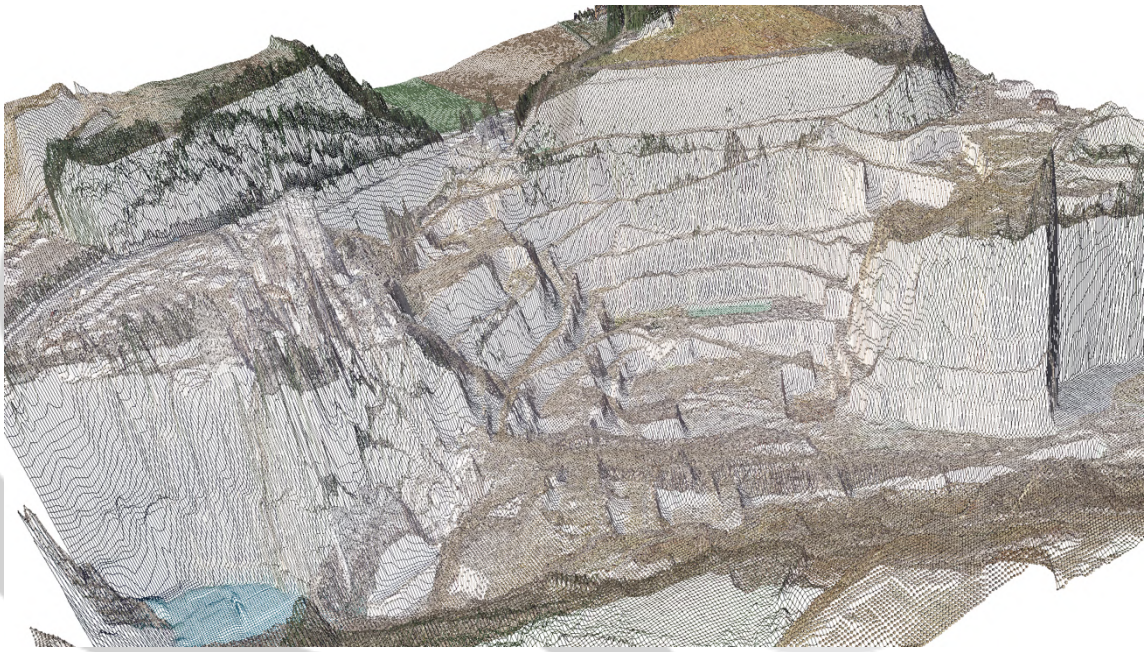

Figure 6 : 3d view of the site from the north

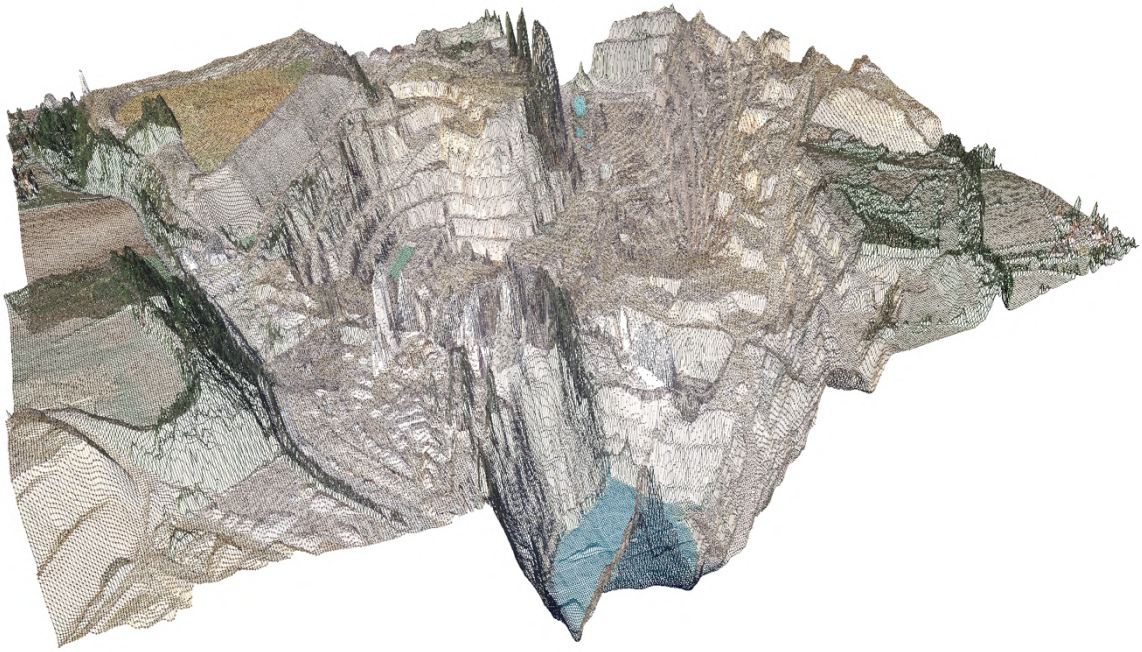

Figure 5 : 3d view of the site from the East

The site is much deeper than it appears on the satellite photos. The maximum depth is -45 metres below sea level.

Production

Estimated production based on 1 year difference

Site evolution

The evolution of the career is obvious. However, these changes are taking place in many different places, sometimes simultaneously.

We are going to analyse several of these areas with the aim of gaining an insight into the workplaces. But also to estimate the quarry's productivity over a one-year period.

Figure 7 : Photo of the quarry on 20 march 2022

Figure 8 : Photo of the quarry on 16 juin 2023

Estimated surface extracted

Figure 10 : Area that has undergone extraction for the purpose of mining rock

Figure 9 : surface area of rock extracted for mining

	Area of extraction surface (square metre)
	2588
	2115
	21750
	9207
	29645
	26522
	15948
	10722
	2413
	38766
	12798
	4828
	18322
	9414
Total	205038

Table of extraction areas

Figure 11 : table of extraction areas

Estimated height extracted

Figure 8 : Elevation of an extraction point

Figure 9 : Elevation of an extraction point

$$Height\ difference = Elevation\ figure\ 8 - Elevation\ figure\ 9$$

$$15\ \text{meters} = 41\ \text{m} - 26\ \text{m}$$

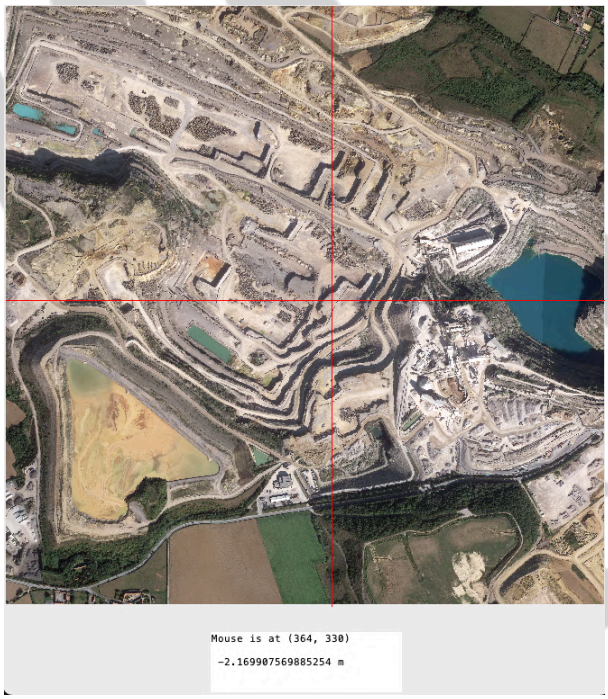

Figure 10 : Elevation of an extraction point

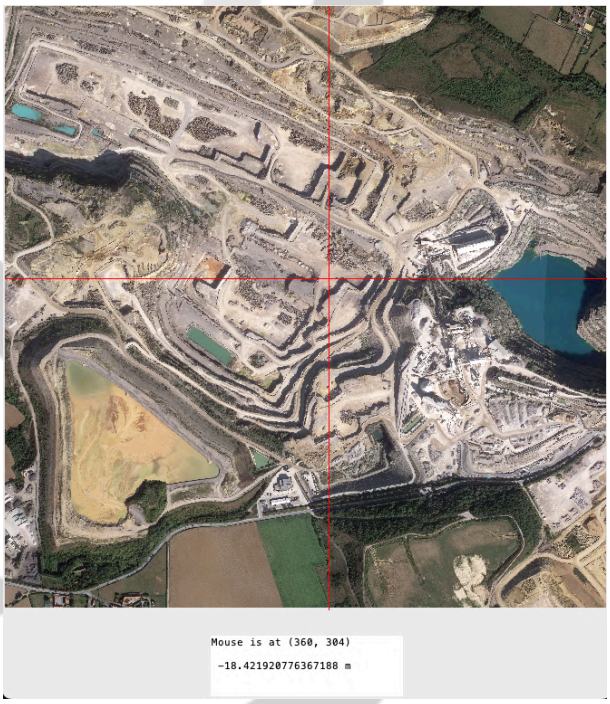

Figure 11 : Elevation of an extraction point

$$Height\ difference = Elevation\ figure\ 10 - Elevation\ figure\ 11$$

$$16\ \text{meters} = (-2)\text{m} - (-18)\text{m}$$

*Elevation is negative because we are bellow the sea level

Figure 12 : Elevation of an extraction point

Figure 13 : Elevation of an extraction point

$$Height\ difference = Elevation\ figure\ 12 - Elevation\ figure\ 13$$

$$16\ \text{meters} = 5\text{m} - (-11)\text{m}$$

*Elevation is negative because we are bellow the sea level

The average elevation between two extraction strata is 15 metres.

Estimation of mass extracted

$$Volume\ of\ limestone\ extracted\ =\ Area\ of\ extraction\ surface\ \times\ Height$$

$$3\ 075\ 570\ \mathrm{m}^3\ =\ 205\ 038\ \mathrm{m}^2\ \times\ 15\ \mathrm{m}$$

Calcul with current data

$$Mass\ extracted\ =\ Volume\ of\ limestone\ extracted\ \times\ Density\ of\ limestone$$

$$8\ 304\ 039\ \mathrm{tons}\ =\ 3\ 075\ 570\ \mathrm{m}^3\ \times\ 2{,}7\ \mathrm{tonnes/m}^3$$

In conclusion, total extraction on the site between 20 March 2022 and 16 June 2023 is 8,304,039 tonnes.

This figure is approximate and represents only the quantity of limestone extracted.

It does not include all of the work involved in organzing, levelling or developing the site.

Over the given period, this corresponds to just under 20,000 tonnes of marketable material extracted per day. This is in line with the expected figures for this facility.

Trench on site for comparative study

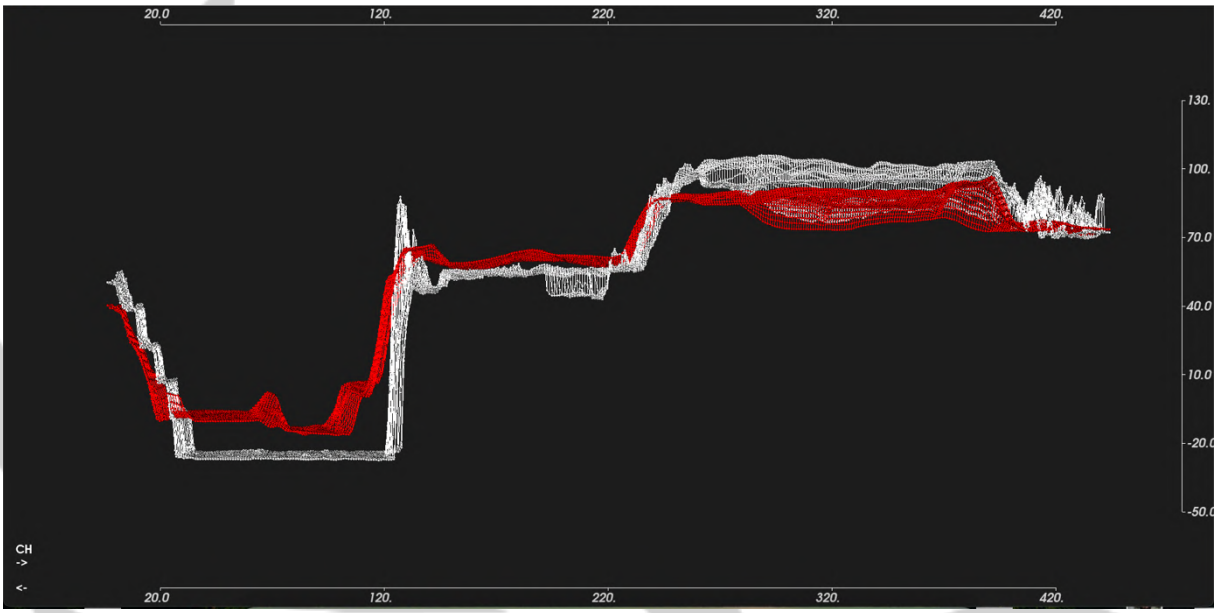

Figure 12 : Cross-section of the 3D model between two time periods on the western section

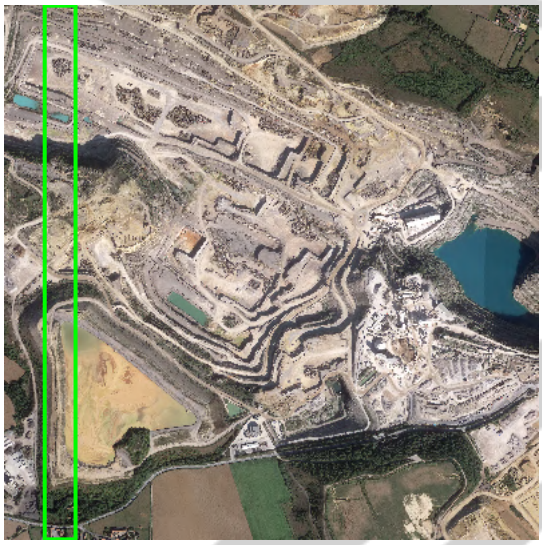

Figure 13 : Cross-section of the 3D model on the western section

The oldest section is shown in red and the youngest section in white.

The slice shown above shows a clear progression of extraction on the north-western part.

As well as an increase in the level of sludge in the reservoir to the south-west of the site.

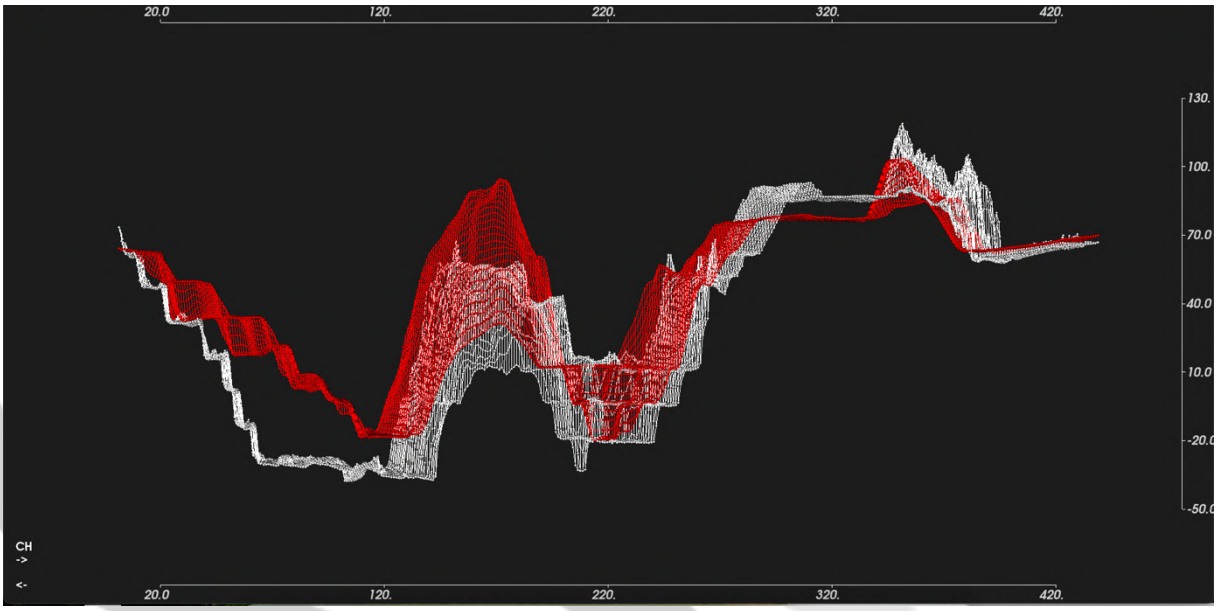

Figure 15 : Cross-section of the 3D model between two time periods on the western section

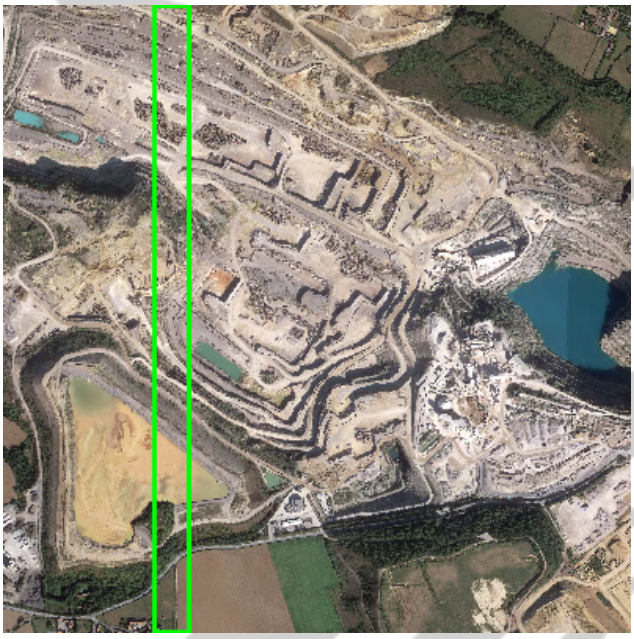

Figure 14 : Cross-section of the 3D model on the western section

The oldest section is shown in red and the youngest section in white.

The slice shown above shows a clear progression of extraction on the north-western part and the center part of the quarries.

Clear hollowing of the northern flank.

As well as an increase in the level of sludge in the reservoir to the south-west of the site.

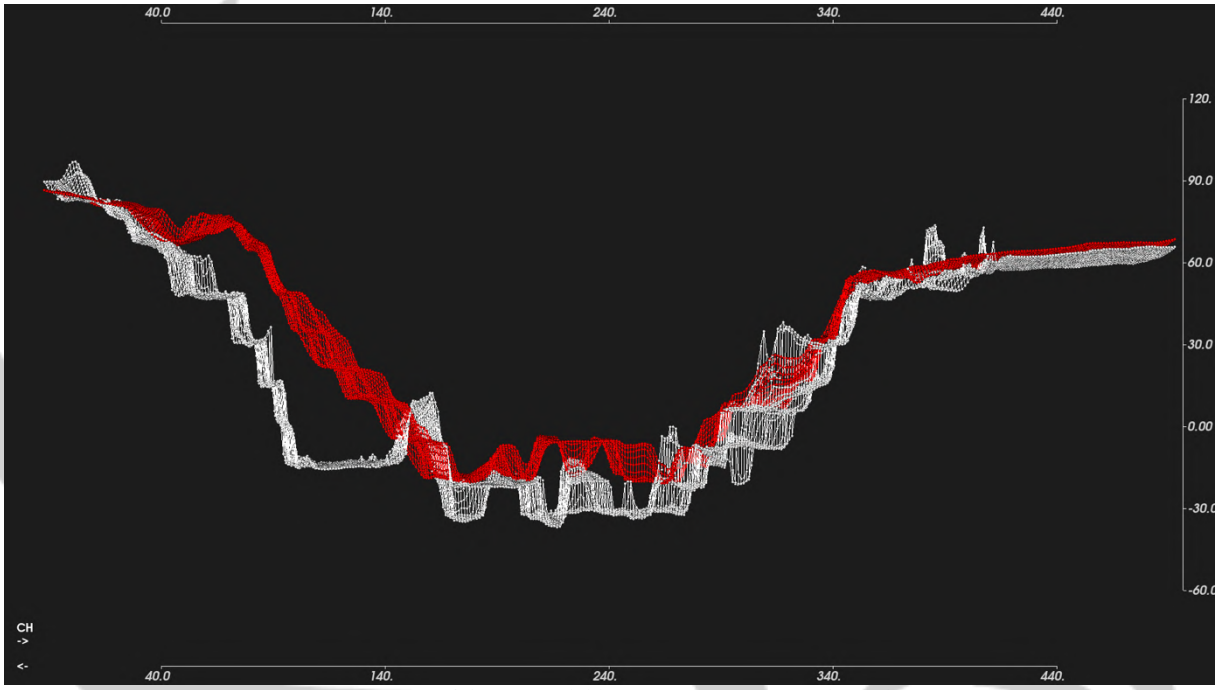

Figure 16 : Cross-section of the 3D model between two time periods on the center section

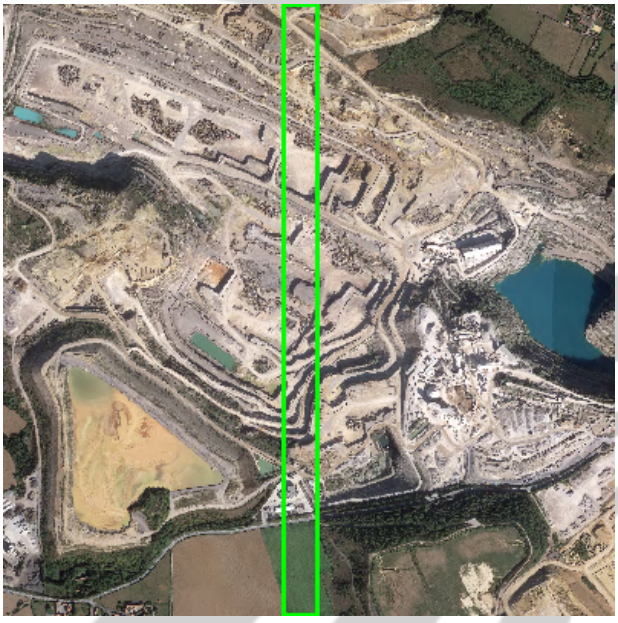

Figure 17 : Cross-section of the 3D model on the center section

The oldest section is shown in red and the youngest section in white.

The slice shown above shows a clear progression of extraction on the north-western part and the center part of the quarries.

Clear hollowing of the northern flank.

Trench on site for comparative study on northen flank

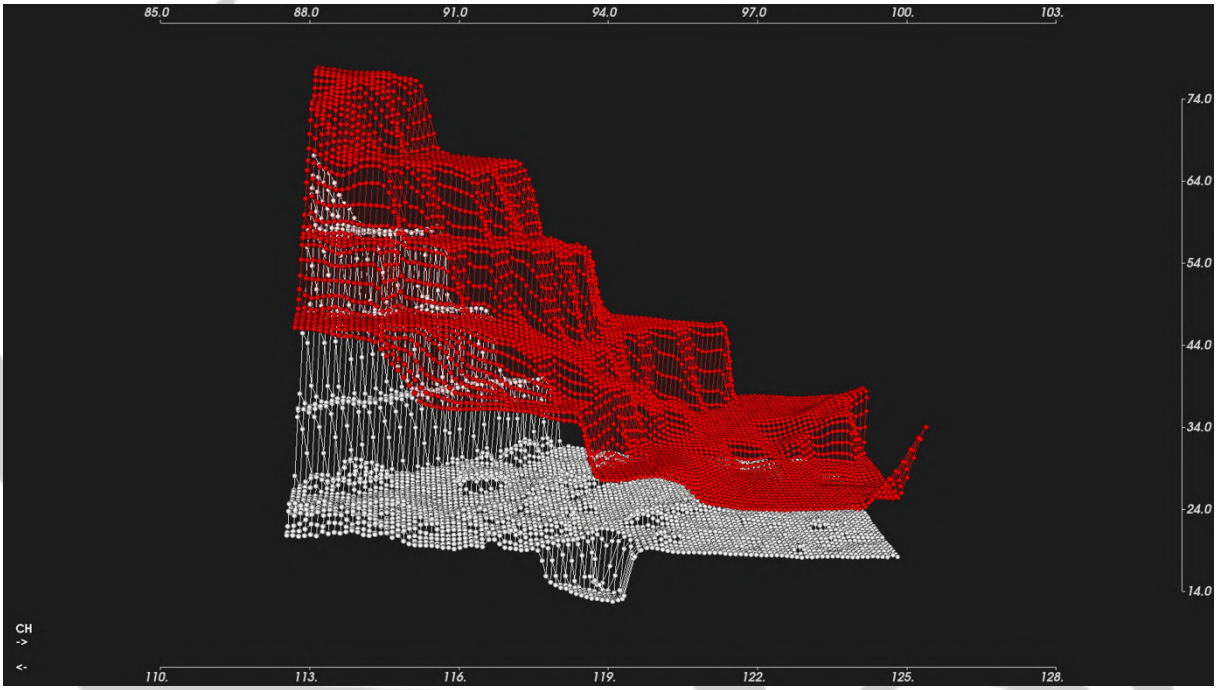

Figure 18 : Cross-section of the 3D model between two time periods on the north-western section

Figure 19 : Cross-section of the 3D model on the north-western section

The oldest section is shown in red and the youngest section in white.

Here you can see the side of the quarry, with a clear increase in extraction. Supported by a change in process to reduce the number of stages.
As well as a flattening of the ground, certainly with a view to optimising future extraction.

Stock Pile estimation

Height estimation

The 3d models below are the result of shaping the elevations obtained using satellite data for the L2 zone.
Area usually used for the supply of materials to road hauliers

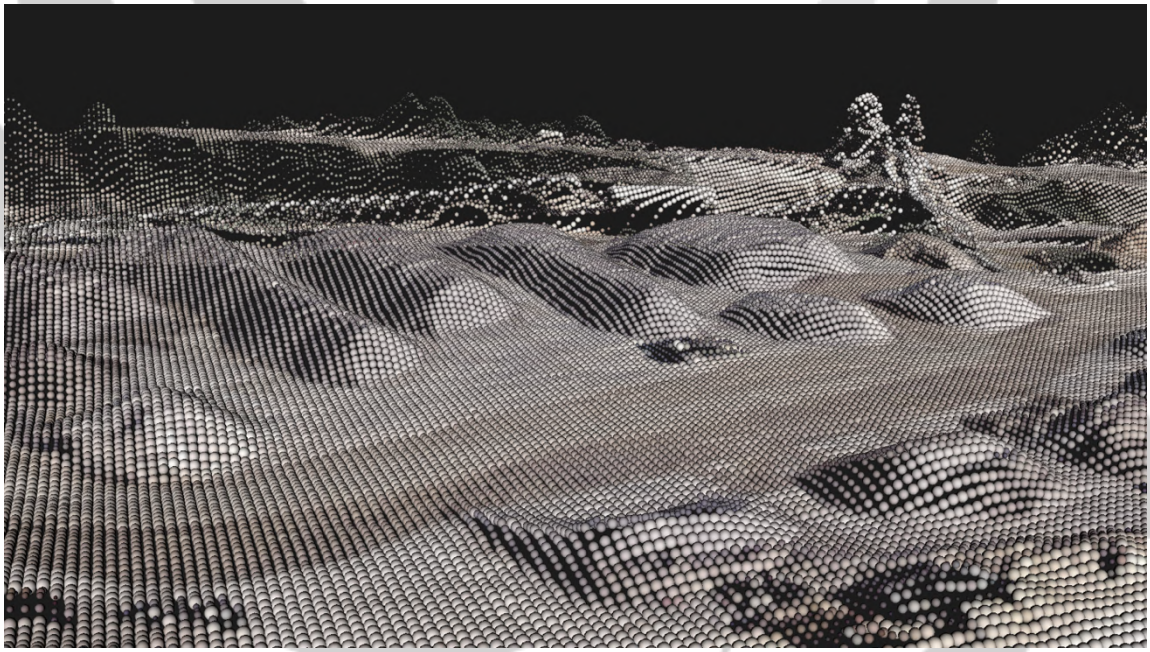

Figure 20 : 3d modelling of stock piles

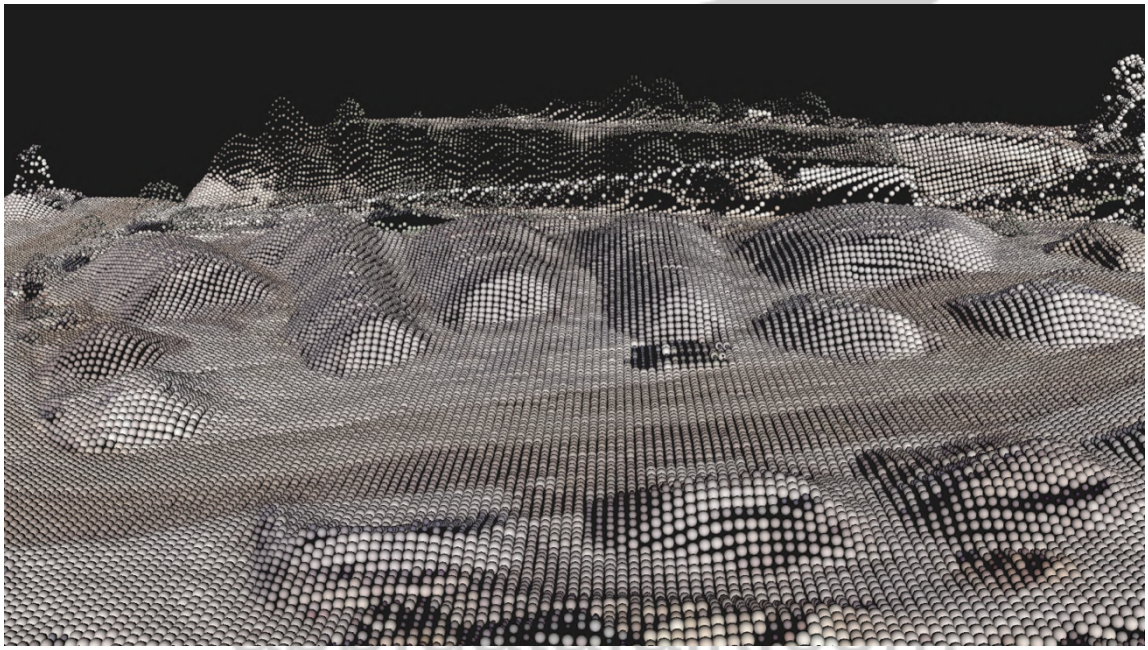

Figure 21 : 3d modelling of stock piles

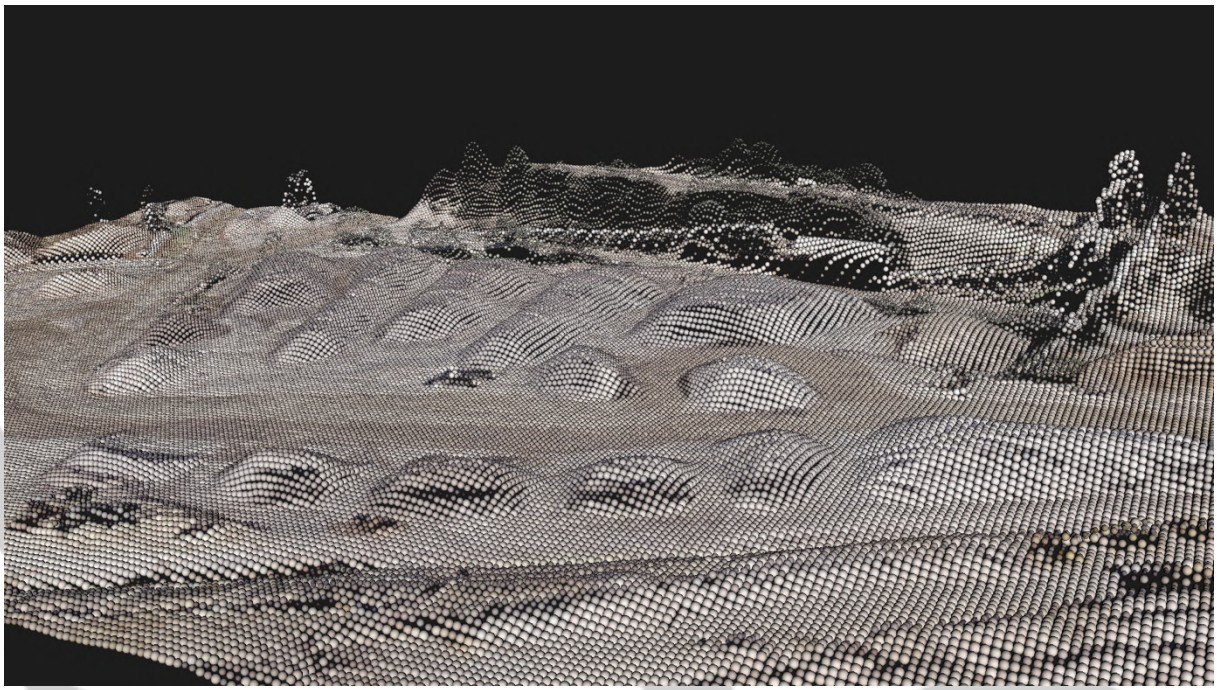

Figure 23 : 3d modelling of stock piles

Figure 22 : Enlarged area on the stock pile site

Figure 25 : Elevation on stock pile 2

Figure 24 : Elevation on stock pile 5

Figure 27 : Elevation on stock pile 3

Figure 26 : Elevation on stock pile 4

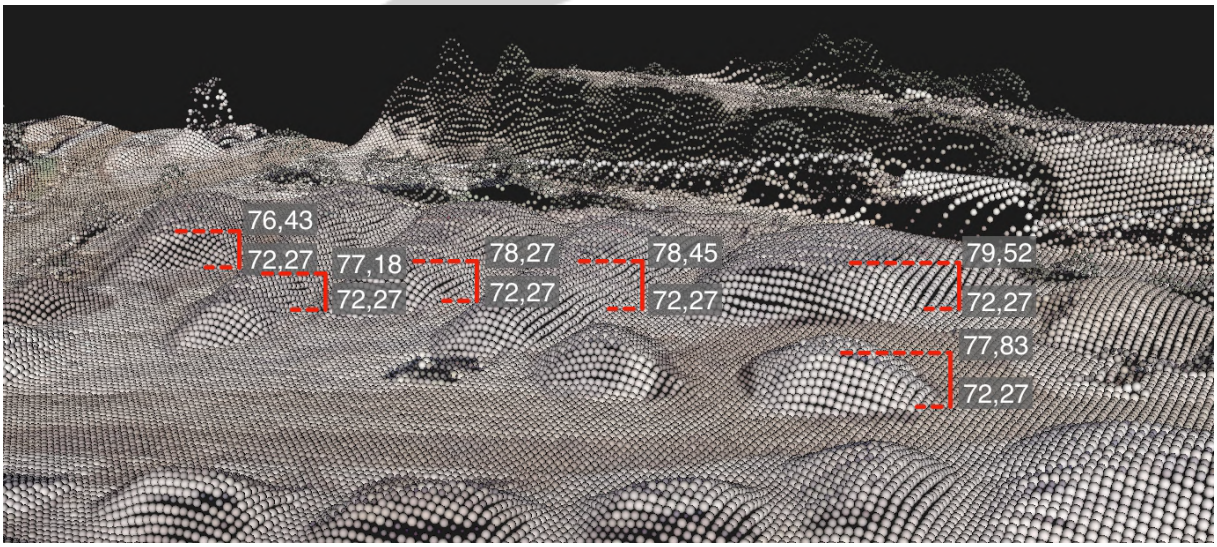

Figure 28 : Difference elevation applied to 3d modelling

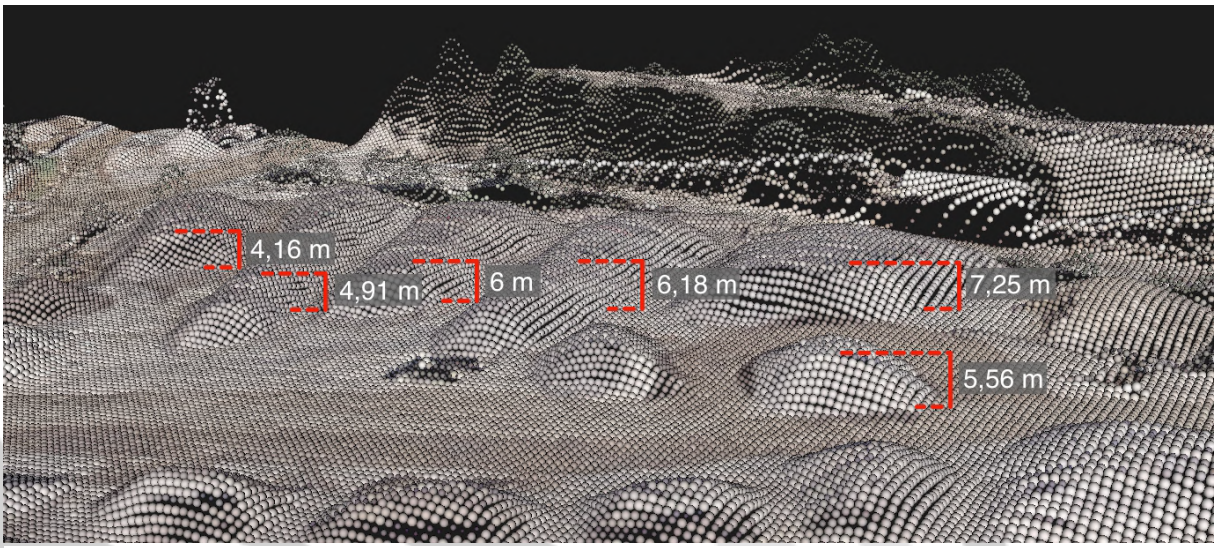

Figure 29 : Elevation in metres applied to 3d modelling

This enabled us to obtain an accurate estimate of the height of each of the stockpiles.

Mass estimation for stock pile n°5

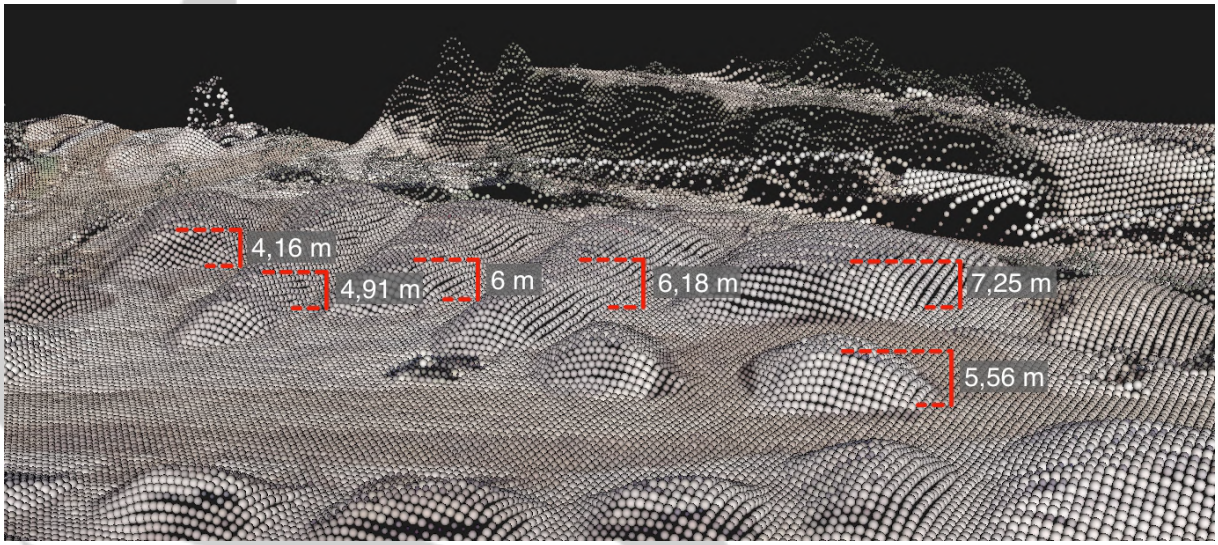

Figure 31 : Elevation in meters applied to 3d modelling

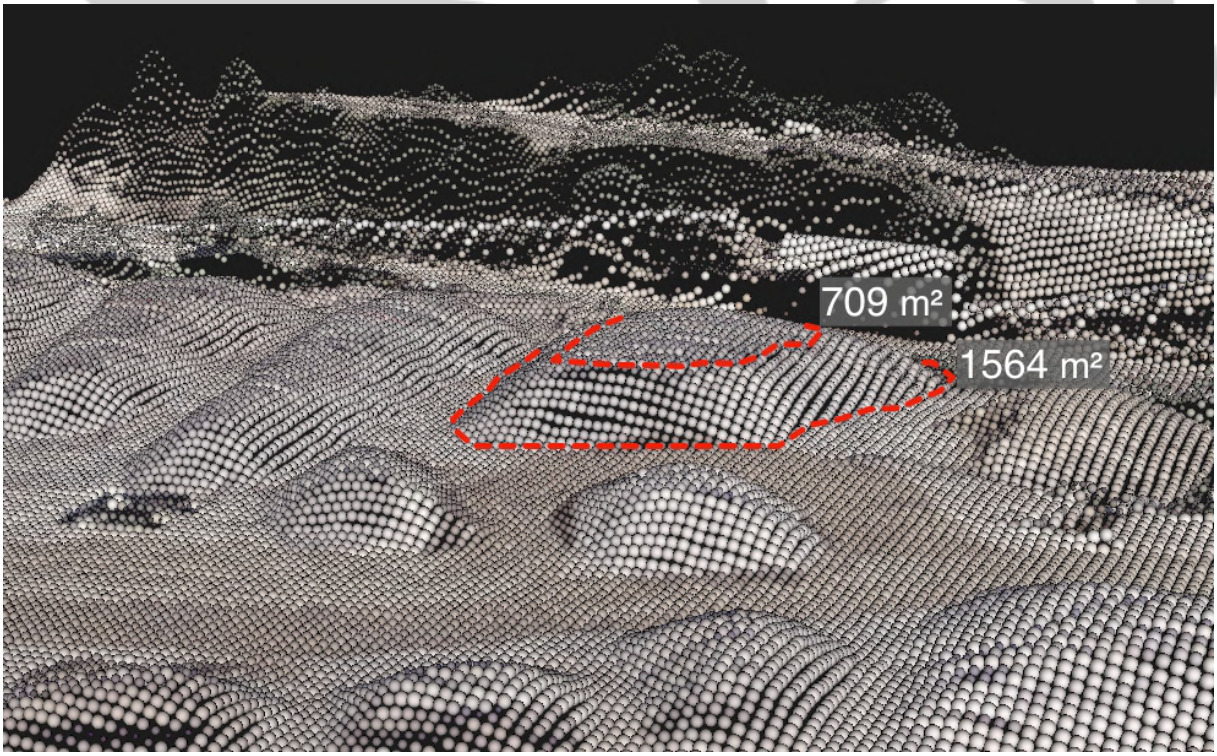

Figure 30 : Surface in square meters applied to 3d modelling

Calculating the volume of a truncated cone :

$$V = \frac{1}{3} \times h \times (A1 \dot{+} \sqrt{A1 \times A2} \dot{+} A2)$$

- *V is the volume of the truncated cone*
- *h is the height between the two surfaces*
- *A1 is the base surface (wider)*
- *A2 is the upper (smaller) surface*

$$V = \frac{1}{3} \times 7,25 \times (1564 \dot{+} \sqrt{1564 \times 709} \dot{+} 709)$$

$$\sqrt{1564 \times 709} \approx \sqrt{1108876} \approx 1053,03$$

$$V = \frac{1}{3} \times 7,25 \times (1564 \dot{+} 1053,03 \dot{+} 709)$$

$$V = \frac{1}{3} \times 7,25 \times (3326,03)$$

$$V = \frac{1}{3} \times 7,25 \times (3326,03) \approx 8037,90$$

$$V \approx 8037,90$$

In conclusion, the assumed volume of stockpile no. 5 is 8,037 cubic metres.

Future Evolution

Expension of the current site

Captioned map

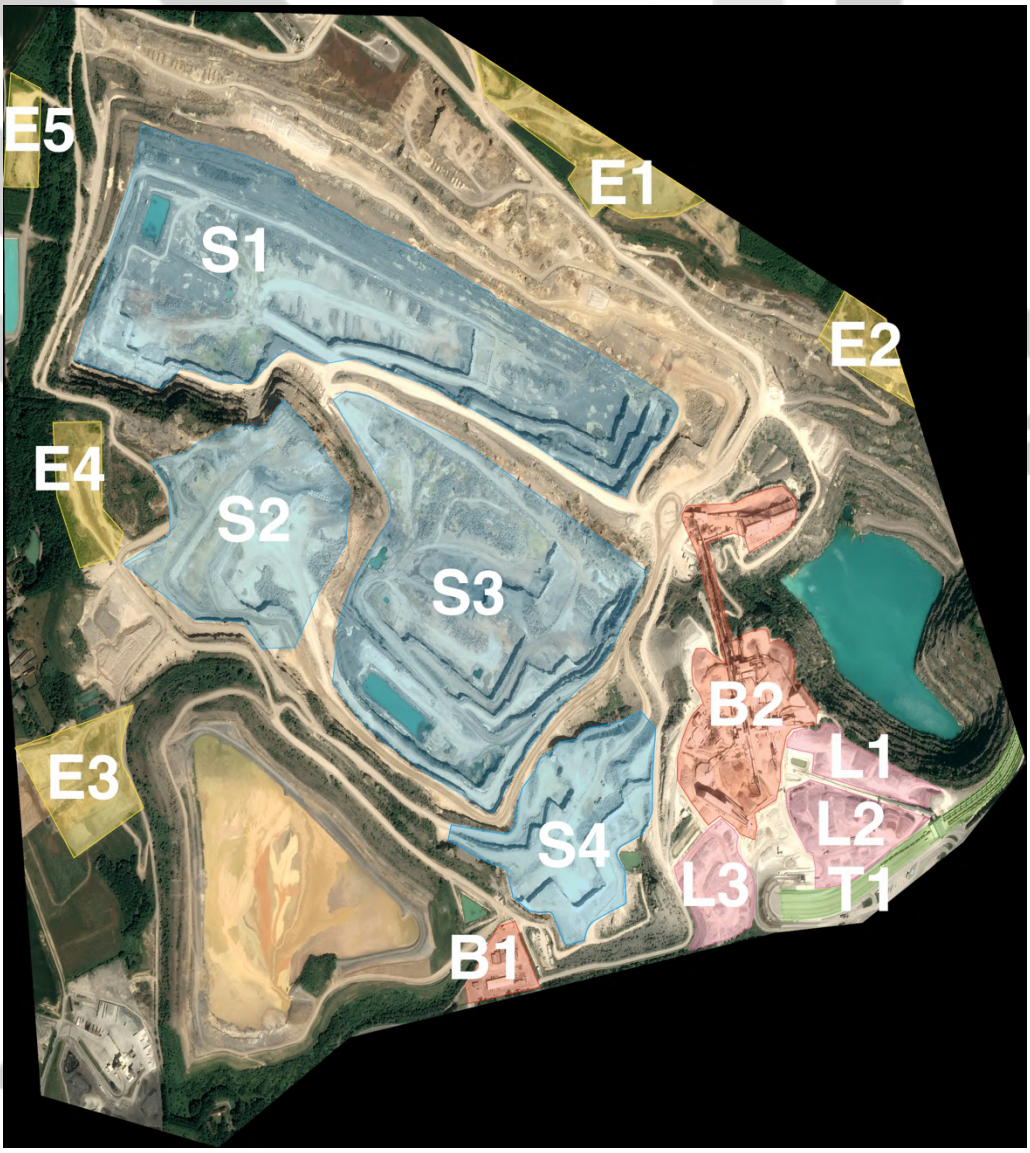

Figure 36 : General plan of the boulonnais quarries site with the different zones

Expansion in zone E3

Figure 39 : Zone e3 on 20 March 2022

Figure 38 : Zone e3 on 16 June 2023

Figure 40 : Zone e3 on 23 September 2023

The site is clearly being developed**.**

The development is tending to come together on the west and south sides.

Development looks set to accelerate in 2023.

	20/03/2022	16/06/2023	23/09/2023
Area under development	4587	46133	65460
New development	4587	41546	23914
Change over time	0	905,7%	41,9%
Total	9174	87679	89374

Table development area in m²

Figure 41 : Table development area in square meters over time

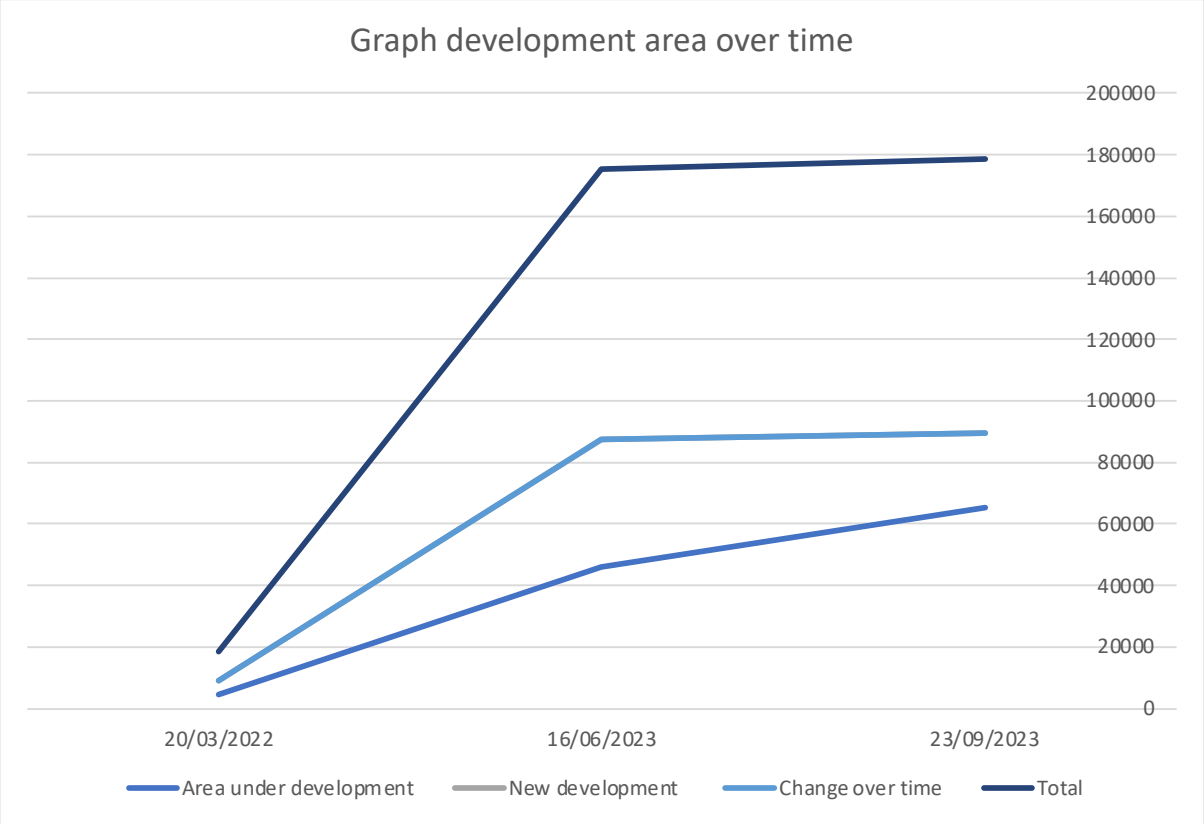

Figure 42 : Graph development area in square meters over time

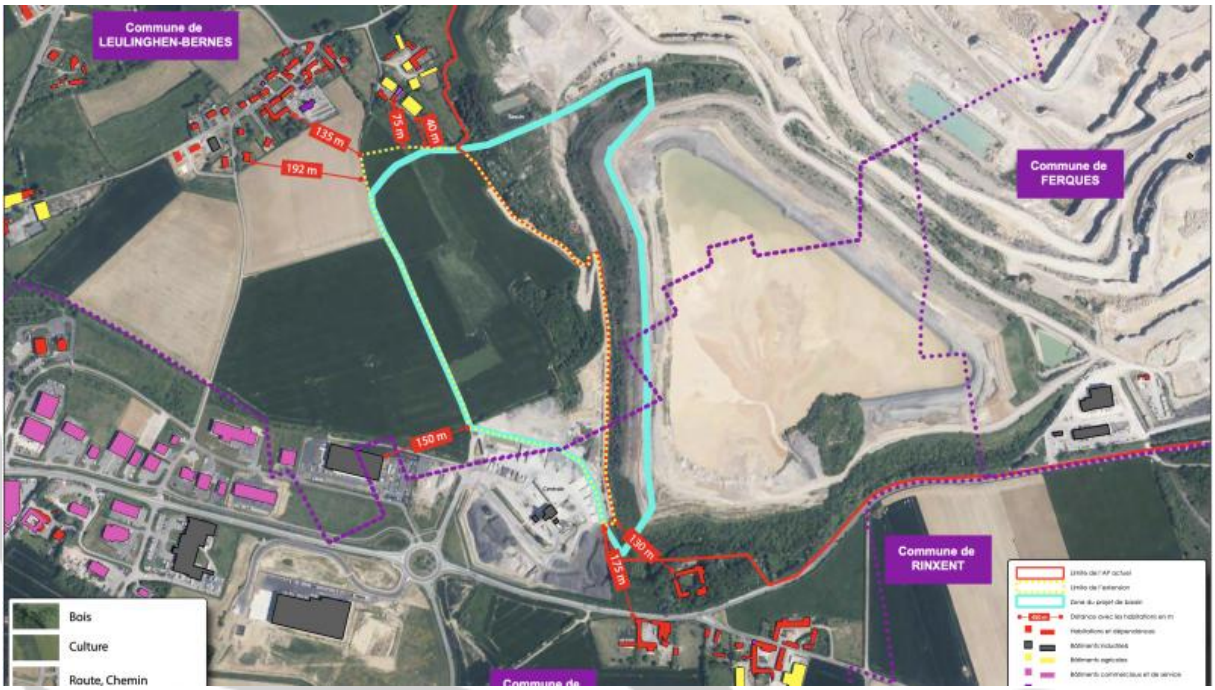

Figure 43: Aerial view of the quarries. The extension of the basin is indicated by the green line. Copyrights Carrières du Boulonnais

In conclusion, development work on zone E3 is well underway.

It should be noted that the works began before the necessary permits were obtained (at the beginning of 2024).

An acceleration has been noted since 2023 and could continue in 2024/2025.