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Project acronym: **iVAMOS!**

Project title: iViable Alternative Mine Operating System!

Funding Scheme: Collaborative project



Mine Site Visit Report – Lee Moor Mine

Dissemination Level		
PU	Public	
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	<input checked="" type="checkbox"/>

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1 Executive Summary

The Lee Moor Mine site has four flooded pit which are non-operational. They are:-

- Whitehill Yeo Pit North Pool
- Whitehill Yeo Pit South Pool
- Cholwichtown Pit
- Parklands

These pits went non-operational in approximately 2008 and rehabilitation work on the surrounding area has been ongoing since then. The mineral mined here was Kaolin which is found amongst host rock made of granite. The hardness of the host rock varies depending on the degree of weathering. Information provided by the site owner suggests that a wide range of rock hardness can be found in these pits and that much of it is in the range that can be cut by the VAMOS mining vehicle. This is an excellent opportunity as it gives the chance to operate the Mining Vehicle over a range of hardness and production rates in one test site. The mine pits are covered by an existing mining permit and are accessed from the site office by dirt roads. The mine is approximately 15km from Plymouth by road.

Of the non-operation pits located at Lee Moor the Whitehall Yeo Pit North Pool was found to be suitable as a potential test site for the VAMOS field trials. The access road is quite good and not excessively steep and close the edge of the water there are suitable areas on which to locate the de-watering facility and the site office, control cabin etc. This area could also be used as the construction area for building the Launch and Recovery Vessel. The suitability of this area and of the approach road should be assessed by a suitably qualified person to confirm they are ok for the heavy plant required for the field trials. Furthermore a bathymetric survey needs to be done to see if the pit itself is suitable. The water level in these two pits is maintained by an overflow at the south end of the south pit. A gate on this overflow could be used to retain the water in the pit during the trails to avoid introducing sediment laden water into the local watercourse. As the north pool is the best for the trails and the south pool is where the overflow is located it may be deemed likely that the risk of sediment laden water entering this overflow is small.



Figure 1 –Map of Lee Moor Mine showing location of Whitehill Yeo, Cholwichtown and Parklands pits

2 Introduction and Objectives

The purpose of this visit to the Lee Moor mine was to evaluate its suitability for use as a test site for the VAMOS mining system. Additional information is available in the 'Mine Site Data Collection' document. Amongst other things, this covers geology, past exploration works and ore characteristics.

This document covers the following topics:-

- Topography of site to determine if vessel and vehicle can be deployed safely
- Potential locations for dewatering facility and control cabin etc.

2.1 Overview of Lee Moor Mine Site

The Lee Moor Mine site has four flooded pit which are non-operational. They are:-

- Whitehill Yeo Pit North Pool: - flooded virgin ground that's been hydraulically mined for china clay production. Likely 50m+ depth. Potential access from South or West.
- Whitehill Yeo Pit South Pool: - flooded virgin ground that's been hydraulically mined for china clay production. Likely 20m+ depth. Good in terms of access from South (large lay down area).
- Cholwichtown Pit: - flooded virgin ground that's been hydraulically mined for china clay production. Likely 50m+ depth. Potential access from South albeit possibly made up ground here.
- Parklands: - good depth still but has been backfilled with pumped mica so unsuitable.

These pits went non-operational in approximately 2008 and rehabilitation work on the surrounding area has been ongoing since then. The mineral mined here was Kaolin which is found amongst host rock made of granite. The hardness of the host rock varies depending on the degree of weathing. Information provided by the site owner suggests that a wide range of rock hardness can be found in these pits and that much of it is in the range that can be cut by the VAMOS mining vehicle. This is an excellent opportunity as it gives the chance to operate the Mining Vehicle over a range of hardness and production rates in one test site. The mine pits are covered by an existing mining permit and are accessed from the site office by dirt roads. The mine is approximately 15km from Plymouth by road.



Figure 2 – Lee Moor Mine- Overview showing access routes to flooded pits



Figure 3 – Lee Moor Mine- Site Entrance and Site Office locations

3 Topography, Access and Equipment Location

The mine site was evaluated to determine if access is acceptable for the field trials and possible locations for equipment were considered.

3.1 General

Location (site office):

Latitude 50° 26' 27.8"N

Longitude 4° 00' 36.9" W

3.1 Whitehill Yeo Pits

Situated North East of the site office are the Whitehill Yeo North & South Pits. They are linked by water with the North pit draining into the South pit. Water from the South pit drains to a water course via a gate and a pipe.



Figure 4 – Whitehill Yeo Pit North Pool – end of approach road from South



Figure 5 – Whitehill Yeo Pit South Pool – showing outlet gate on South bank

Of these two pits the North pit is most suitable a test site for the VAMOS field tests. From the site office a tarmac road leads to a dirt road which is then used to approach the pits. The final approach is down a relatively steep dirt road. This road is ok for 4WD vehicles but will need to be assessed by a transport company to assess if it is acceptable for HGV (Heavy Goods Vehicle) transport of the VAMOS equipment. If required some road improvement works may be necessary to allow for the movement of heavy equipment to and from site.



Figure 6 – Whitehill Yeo Pit South Pool – View to South showing approach road

The pit lake is approximately 350m North to South and 260m East to West. See figure below.

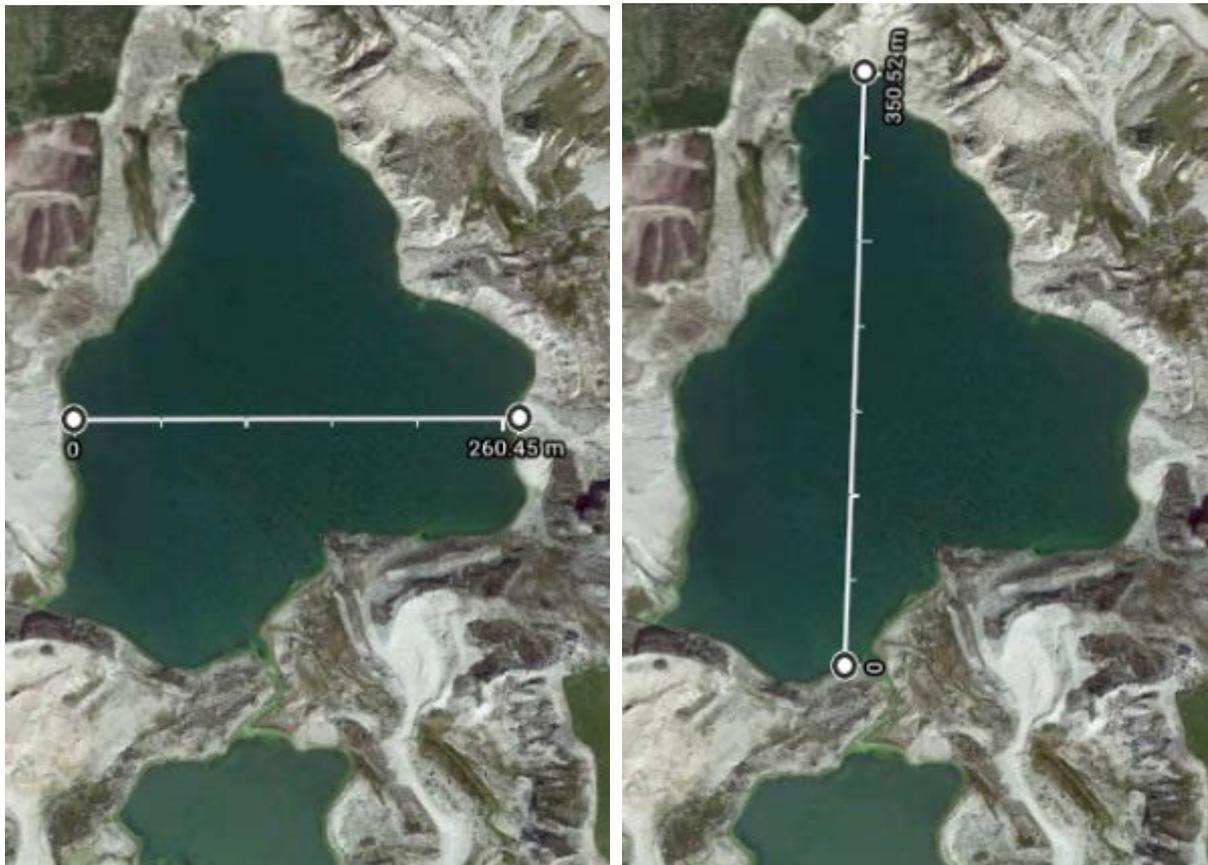


Figure 7 – Whitehill Yeo Pit North Pool – dimensions of lake

From the Southern approach there is a large flat area (100x40 mtr) which could be used for locating the crane, site office, control cabin etc. Also in the pit just South of the lake is a large area which appears suitable for use as the dewatering plant (80x20 mtr) and it is currently surrounded by earth ramps. Relatively little work should be required to enable this to be used for the dewatering facility. The figure below shows the location of these areas and the location of the water outflow and a large area which could be used for storage of equipment if required.



Figure 8 – Whitehill Yeo Pit – Equipment Location

The area highlighted for LARV construction and site office is quite soft and waterlogged. This area will need to be assessed by a crane hire company to determine if it is suitable for the bearing loads imposed by a portable crane. Some civil engineering work may be required on this ground to make it suitable for the loads imposed by heavy plant. The natural flow from the dewatering plant to the pit will need to be redirected.



Figure 9 – Launch site seen from the south side



Figure 10 – Quayside Launch site



Figure 11 – Whitehill Yeo Pit – Potential area for de-watering plant



Figure 12 – Outgoing pipe from dewatering plant to launch site

The figure below shows a 200m working radius of the LARV from the proposed area for the control cabin and site office. This allows access to the majority of the lake with only the Northern tip being out of reach.



Figure 13 – Whitehill Yeo Pit – 200m working radius

Around the perimeter of the pit there are some areas of exposed rock which may be used to locate anchor points for manoeuvring the LARV. Other anchor points may be needed that would require excavation to locate rock or some kind of spreader plate to allow anchoring in soft material. The figure below shows a notional arrangement for the location of the anchor points and the area of the lake that could be covered.

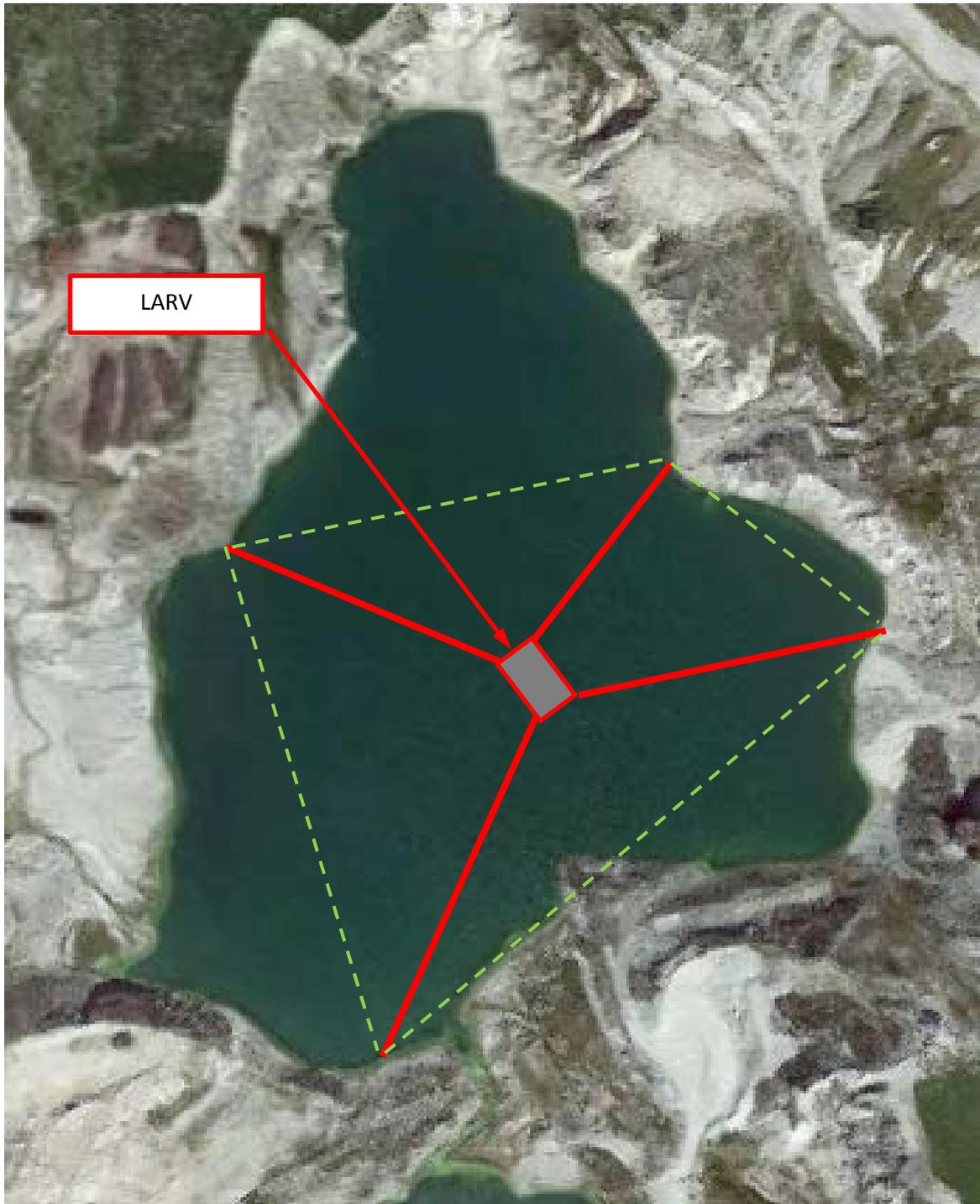


Figure 14 - Plan view showing possible location of anchors for vessel manoeuvring

3.2 Cholwichtown Pit

Situated due East of the site office are the Cholwichtown and Parklands Pits. They are separated by a narrow strip of ground. These pits were visited briefly to assess their suitability as a back-up plan to Whitehill Yeo. The access road to the pit is quite steep and the area adjacent to the water is limited in size. This area could probably be made to work as a trial site but compared to Whitehill Yeo it would require considerably more work with the area available for locating equipment causing concern.



Figure 15 – Cholwichtown Pit – Plan View



Figure 16 – Cholwichtown Pit – end of approach road

3.3 Environmental Factors

Environmental conditions such as temperature and precipitation must be considered for the test site. The graph below shows the temperature and precipitation for Plymouth which is 11km South of the Lee Moor Mine area. There will inevitably be differences in temperature due to local weather patterns, but the information below should be enough to highlight any concerns due to seasonal changes.

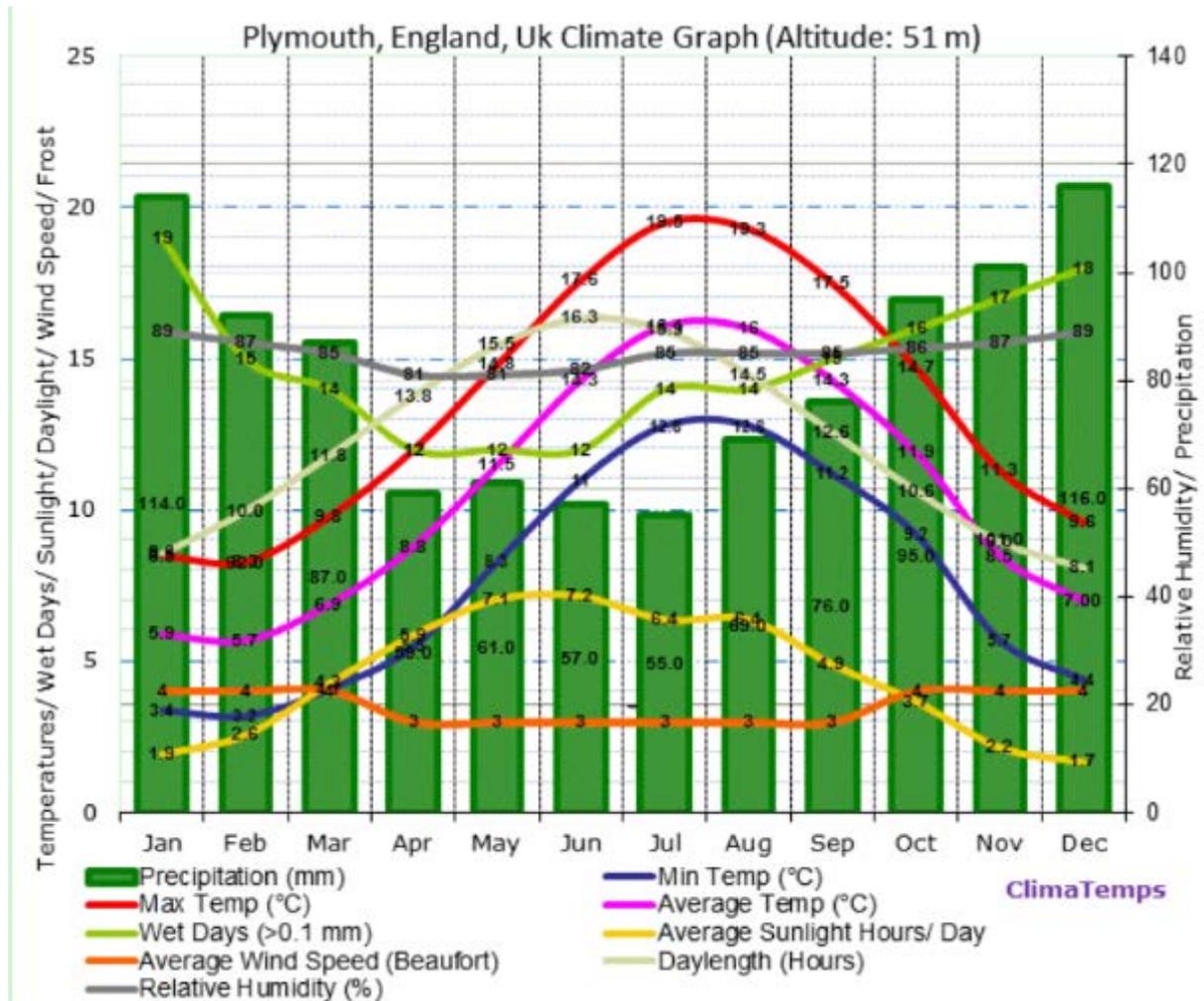


Figure 17 - Temperature graph for Plymouth - Source 1

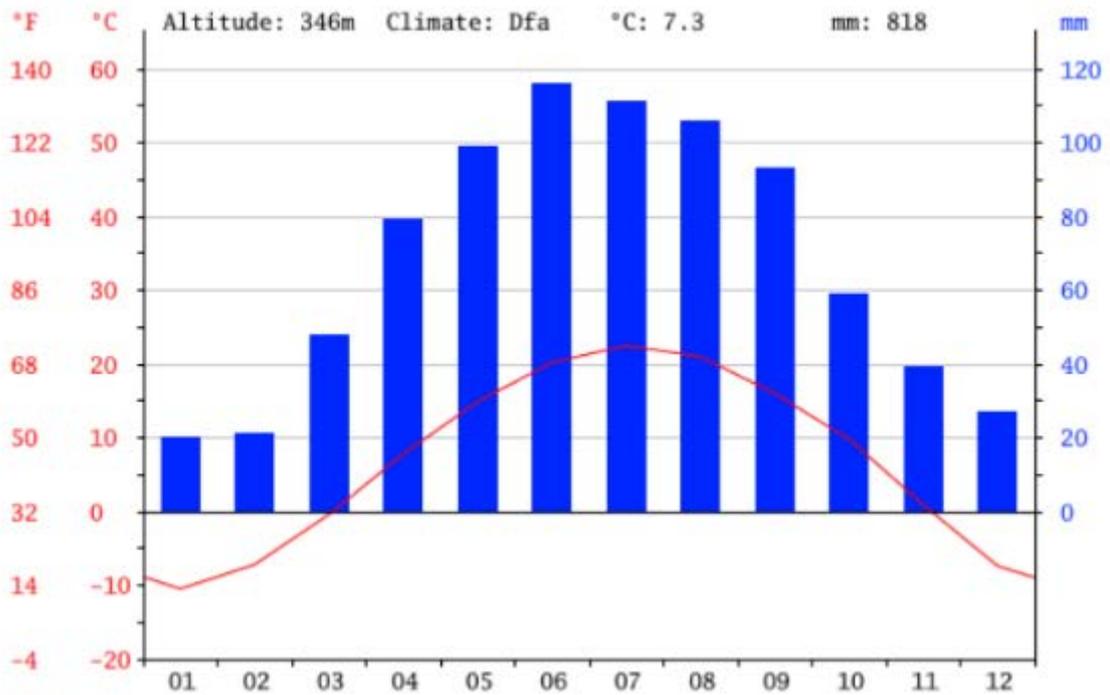


Figure 18 - Temperature graph for Plymouth - Source 2

Sources:

- 1) <http://www.plymouth.climatemps.com/>
- 2) <https://en.climate-data.org/location/127047/>

It is worth noting that since these mines went non-operational the area has been used as a repository for treated sewerage waste that did not meet the required grade for agricultural use. Bearing this in mind, if this site is to be used for the VAMOS trials appropriate personal hygiene should be observed to avoid any unfortunate consequences.

A water sample for the purpose of measuring acidity was not taken from this site as there was no evidence of the water being acidic.