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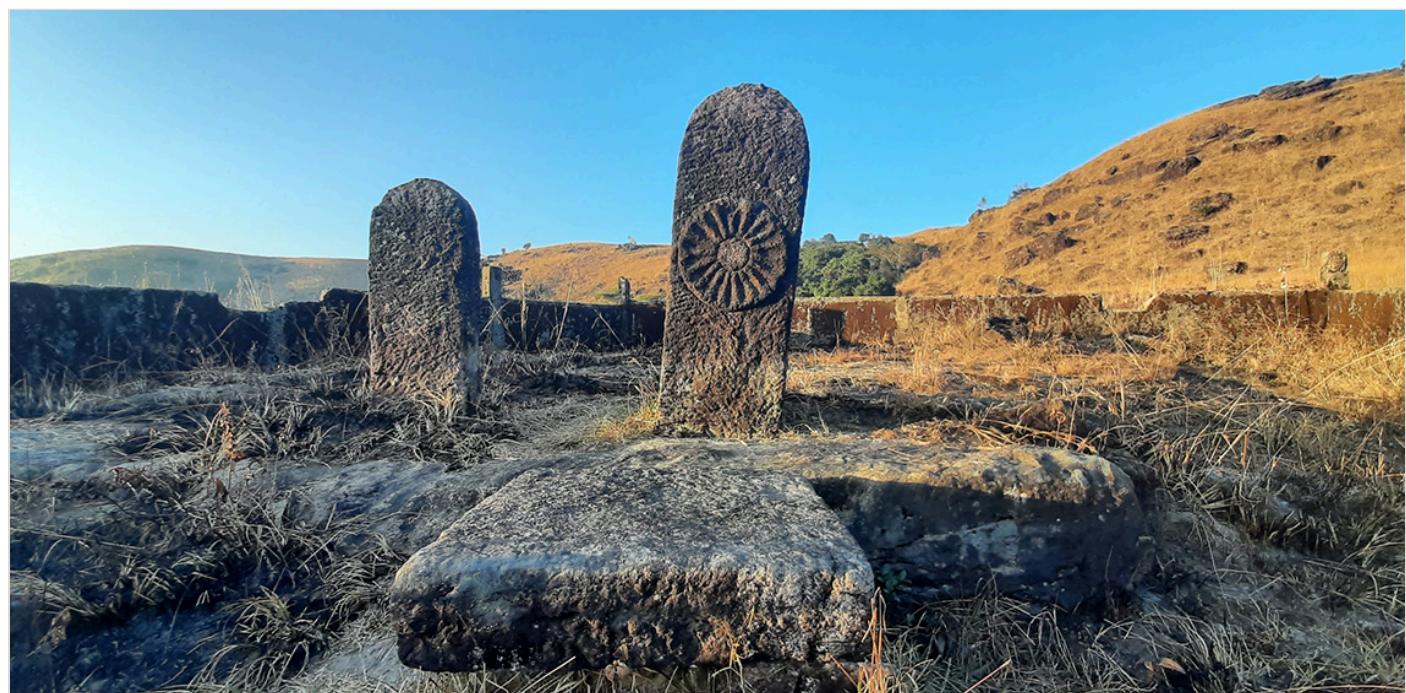
Breathing Life Sustainably - An Abandoned Settlement to an Open-Air Museum Twah Longwar

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Author(s): Naphibahun Lyngdoh ¹ 

¹ Meghalayan Age Limited, Malki Chinapatty, Shillong, East Khasi Hills, Meghalaya, India.



Twah Longwar is an abandoned settlement located in the State of Meghalaya in North-East India. It is located enroute to one of the world's雨iest places on earth – Mawsynram. *Twah Longwar* is an abandoned settlement with remnants of over twenty old houses, an ancient market, and a burial site. In a place where rainfall is a concern but also a major tourist attraction, and where lost architectural styles are only documented in photographs and oral traditions, an archaeological open-air museum built from traditional 'earth friendly' materials

will contribute immensely to showcasing the region's life-sized cultural history. This article will explain how a drone, LiDAR, GIS-based technologies and archaeological methodologies are used to create a digital reproduction of the settlement which is made available to everyone. This will allow those who are unable to travel to learn about Twah longwar's long-lost traditions. The procedure for physically reconstructing the settlement will also be demonstrated. The focus is also to take the museum outside the four walls of a building where generations to come will physically envision the legacy of indigenous architecture and social life, at the same time as safeguarding the environment in and around the site.

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The planned open-air museum at Twah Longwar will be reconstructed using sustainable and locally sourced materials from nearby villages. These materials would also have been utilised by the former occupants of this abandoned settlement, adding to the historical accuracy of the site.

Twah longwar, a village perched above a ridge is an abandoned settlement located at Wahmawpat village, East Khasi Hills District, Meghalaya in North East India. It is located at 25°20'20" N 91°35'16" E (See Figure 1)

Twah longwar was one of the earliest settlements in this area, according to oral history, and one that was renowned for its trade. However, despite this renown Twah longwar experienced complete abandonment. Personal interviews indicate that residents of this region began leaving due to the East India Company's construction of better roads, which led residents to leave this area—which is still impassable to motor vehicles today. People also stated that plague was another factor in the population's departure with inhabitants leaving to relocate to other areas like Mawhlang, Weiloi, Saitshylliah, Mawsynram among others (See Figure 2).

The study of archaeology is not widely known or given much attention in the Khasi and Jaintia Hills of Meghalaya. Because of this, the majority of archaeological sites are still undiscovered and even the exposed sites have been demolished for modernization therefore, salvage archaeology is frequently required. Turning the abandoned Twah longwar settlement into an Open-Air Museum will not only prevent it from further deterioration, but will also aid in understanding the history of the people who once lived there and serve in conserving and preserving the broader archaeological area.

This paper describes a site-related continuing initiative that involves both physical and digital site rehabilitation. This project is unique as this will be the first archaeological open-air museum in the state. This will serve as a tourist attraction that will be open to the public so that they can observe, participate in, and experience the historical features and cultural elements of Twah longwar's past people's. This will allow visitors to experience history first-hand through the Open-Air Museum and gain insight into the way of life of those who once lived in Twah longwar.

The methodology to achieve the aim of turning the Twah longwar abandoned settlement into an open-air museum, is based on the following series of sequential stage:

- Surface exploration of the site
- Data collection including documentation of the site, collecting samples and material remains from the site, and collecting oral history from people
- Survey which includes GIS and drone mapping of the site
- Understanding the archaeological remnants of the site
- Archaeological site excavation
- Scientific methodology which includes dating of the material finds in order to understand the chronology of the site
- Reconstructing the houses physically
- Reconstructing the houses digitally
- Turn the site into an open- air museum which will be opened to the public.

Understanding the site

The Khasi are an indigenous ethnic group in Meghalaya, India's north-eastern most state.

The Khasis did not have a written script until the 19th century. Therefore, oral narratives from the people of the village and archaeological finds from the site are the only way to comprehend the history of this abandoned settlement.

The history and archaeological finds in India's north-eastern region are abundant.

Although many new studies have emerged recently, Northeast India has not made as much progress in the field of archaeological research as the rest of the nation and the rest of the world.

Moreover, the majority of these sites are not recognised or protected. Creating an open-air museum will not only protect the site from further deterioration, but it will also enhance the history of the area and show visitors the broader historical context of the region. This will serve as an archaeological tourist attraction while also providing employment for people in rural areas.

Surface exploration of the site of Twah Longwar has been carried out. Modern technology has greatly aided in comprehending the area before archaeological excavations are carried out. Architects are assisting with the digital reconstruction of the structures, and a drone crew has contributed to the GIS and LiDAR scan to better the understanding of the site.

Archaeological finds at Twah Longwar

The findings based on archaeological surface studies of the site include megaliths: menhirs, and dolmens, remnants of the old market, a burial site, and structures of the dwellings with small amounts of iron slag (See Figures 3-7).

UAV remote sensing survey for the archaeological site at Twah Lognwar

Unmanned Aerial Vehicles or UAVs were used for documenting and understanding the archaeological site.

The creation of 3D digital models using high-resolution aerial data captured by UAVs is a great way to better comprehend the site in its broader context.

When compared to using ground or surface documentation, using UAVs has created accurate topographical maps while also saving a significant amount of time.

Aerial photography could also be used to understand structures clearly. This makes it possible to interpret and understand the area better, particularly the structures that are masked by dense vegetation (See Figure 7).

The team from Meghalaya Basin Development Authority, Government of Meghalaya led by Shri Y Kishore Kumar, Technical Specialist UAVs/RPAS have assisted with the UAV survey (See Figure 8).

In order to obtain high resolution (cm level) materials including a contour map, digital surface model map, digital terrain map, land use and land cover map, UAV orthomosaic map, aerial images, and videos for the Twah longwar abandoned settlement, the following equipment and software were used:

Drones:	Matrice 300 RTK & Mavic 2 Pro UAVs
Sensor:	RGB 45 Megapixel & LiDAR (Zenmuse L1)
Software:	Pix4Dmapper which transform ground or aerial images in digital maps and 3D models, (DSM, DTM & Ortho image)
ArcGIS:	It was used for analysing and composing the final maps

The maps processed by using the aforementioned equipment are:

Contour Map

By looking at the Contour map (See Figure 9) we can understand the terrain of the Twah Longwar site. With the help of these contour lines we can see a three-dimension image from a two-dimension image. The contour map helps to understand the lengths, slopes, and width of the hills and valleys of Twah longwar.

Digital Surface Model Map

By looking at the Digital Surface Model (DSM) map we can see all the structures that are present on the surface of the site (See Figure 10). The red line indicates the boundary of the site. The structures are also visible on the map. The digital Surface Model captures both natural and man-made structures.

Digital Terrain Map

A Digital Terrain Map (DTM) was processed using full-waveform laser scanning (See Figure 11). This provides a three-dimension elevation of the Twah Longwar site but without natural and man-made structures.

Land Use Land Cover Map

The Land Use and Land Cover Map (LULC) aids in understanding the human activities and natural components in the area. As can be seen in Figure 12, the black lines drawn over the LULC map depict the structures at Twah Longwar.

UAV Orthomosaic Map

The UAV orthomosaic map depicts the entire representation of the hamlet of the Twah Longwar site. In this image, a detailed representation of the site is shown (See Figure 13).

LiDAR

The LiDAR image (See Figure 14) helps to identify hidden objects and structures obscured by vegetation, constructions etc

In order to gain a complete understanding of the site, one might use the detailed representation provided by the aerial survey. An archaeologist can also establish a more complete understanding of the landscape, the structures, and the information from this point on that are required to carry out the work in its next phase.

These photographs and videos can be utilised to create three-dimensional models of the site and other relevant structures.

Archaeological methodology to be used for understanding the site

Surface investigation which was carried out earlier, was done to establish evidence of past human activity, remnants of the settlements, and understand the context of discovered artifacts.

Additionally, surface investigation is done to determine the potential area for excavation

Excavation is only possible during the dry season and winter because this region receives the highest rainfall in the world.

The material findings will be examined after the site has been cleared, surveyed, and excavated. To further understand the site's chronology, some of the materials will be sent for scientific dating.

We will use site-specific conservation techniques and as such, the materials found during the excavation will be treated, restored as necessary, and stored using standard storage procedures before being displayed to tourists.

Digital Reconstruction

After the site investigation, collection of data, geographical survey, excavation, scientific dating, and conservation methods have been carried out, the data processed will be used for reconstructing the abandoned settlement. The abandoned settlement of Twah Longwar will be reconstructed digitally and physically (See Figure 16).

The site will be reconstructed digitally using several software packages like AutoCAD, photoshop, and Adobe Illustrator Draw. After this digital reconstruction, the data can be made available online for anyone who wants to visit the site but are unable to do so physically. A three-dimension virtual tour can also be made for those who wish to explore the site. The three-dimensional virtual tour will feature the voice of a person who will narrate the history of the site, and this will be combined with texts, sound effects, moving photographs, and other digital components.

A three-dimensional film of the site showcasing its location, elevation, and a 360-degree picture of the abandoned settlement of Twah Longwar, was created using the data processed following the UAV remote sensing survey and after understanding the architectural structures of the site.

Conceptual Digital reconstruction of the houses has also been done using the generated aerial pictures. Similarly, the entire site can be reconstructed in the same manner.

Physical reconstruction of the settlement

A number of the houses at Twah Longwar will be restored, and the site will be physically reconstructed.

The planned open-air museum at Twah Longwar will be reconstructed using sustainable and locally sourced materials from nearby villages (See Figures 17abcd). These materials would also have been utilised by the former occupants of this abandoned settlement, adding to the historical accuracy of the site.

Once all of this work is completed, the Open-Air Museum will be made accessible to visitors who want to see what life was like for the inhabitants of the Twah longwar village before they abandoned the area. In contrast to the museum's four walls, this will provide them with a real-world experience.

Additionally, this will play a significant role in safeguarding and maintaining this site's heritage for the benefit of coming generations. Fewer people now get to see older buildings and experience village life, which dates back to earlier times, while modern constructions continue to be built.

 **Keywords** **settlement**

archaeological open-air museum

documentation

digitalisation

 **Country** India

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| Corresponding Author

Naphibahun Lyngdoh

Meghalayan Age Limited

Malki Chinapatty

Shillong, East Khasi Hills, Meghalaya

India

[E-mail Contact](#)

Gallery Image



FIG 1. THE ABANDONED SETTLEMENT OF TWAH LONGWAR. PHOTO BY NAPHIBAHUN LYNGDOH



FIG 2. THE PERSONAL INTERVIEW WITH THE LOCALS OF WAHMAWPAT VILLAGE. PHOTO BY NAPHIBAHUN LYNGDOH



FIG 3. THE BURIAL SITE. PHOTO BY NAPHIBAHUN LYNGDOH



FIG 4. BURIAL SITE, A DOLMEN, A MENHIR SURROUNDED BY A STONE CIRCLE. PHOTO BY NAPHIBAHUN LYNGDOH



FIG 5. MENHIRS AT THE SITE. PHOTO BY NAPHIBAHUN LYNGDOH



FIG 6. DOLMENS AND MENHIRS WITH CARVING. PHOTO BY NAPHIBAHUN LYNGDOH



FIG 7A. AERIAL VIEW OF THE ABANDONED SETTLEMENT. PHOTO BY NAPHIBAHUN LYNGDOH



FIG 7B. AERIAL VIEW OF THE ABANDONED SETTLEMENT. PHOTO BY NAPHIBAHUN LYNGDOH



FIG 8. THE TEAM ALONG WITH THE PEOPLE OF WAHMAWPAT VILLAGE, UAV SURVEY. PHOTO BY NAPHI LYNGDOH

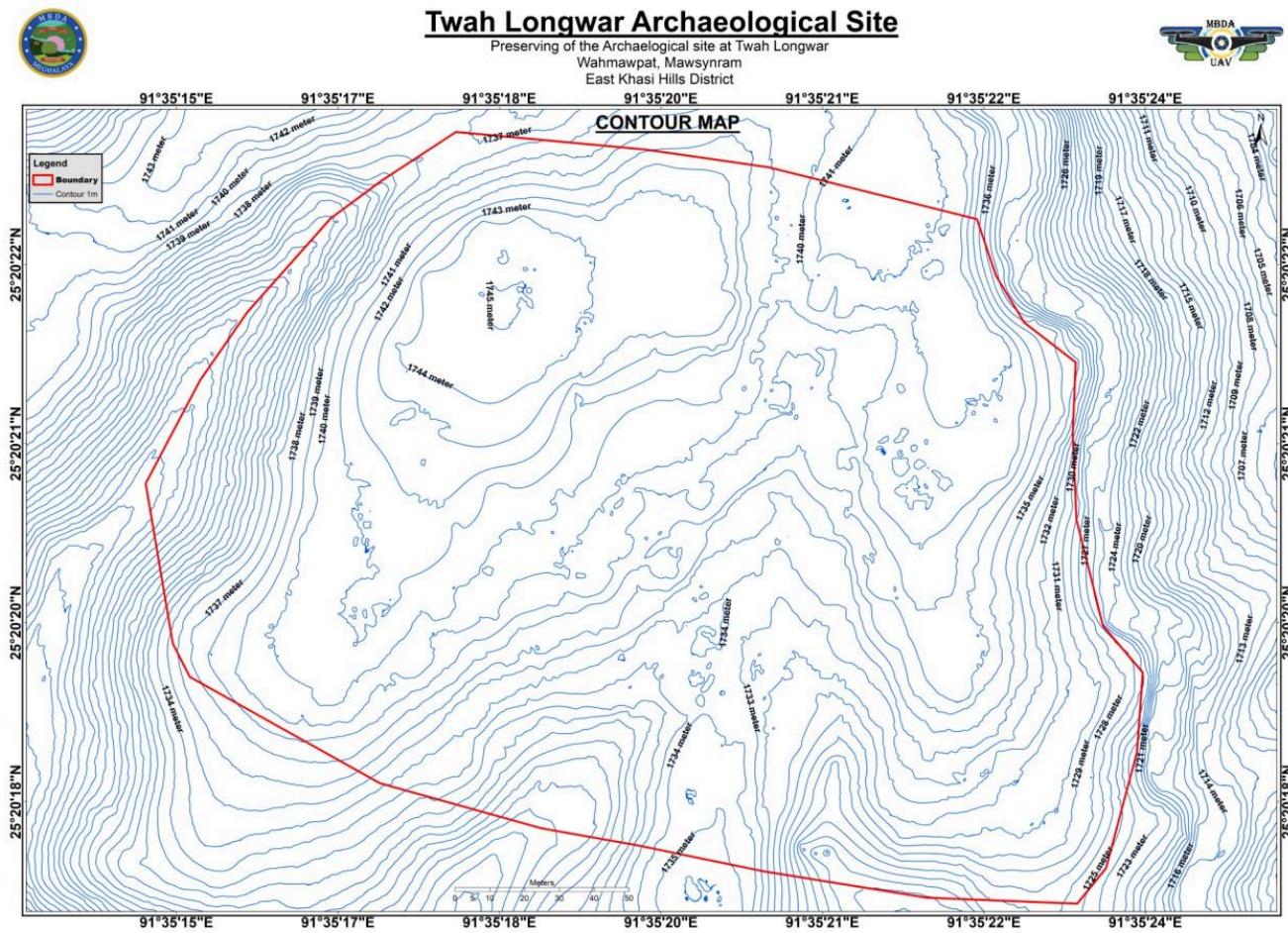


FIG 9. CONTOUR MAP. PHOTO BY NAPHIBAHUN LYNGDOH

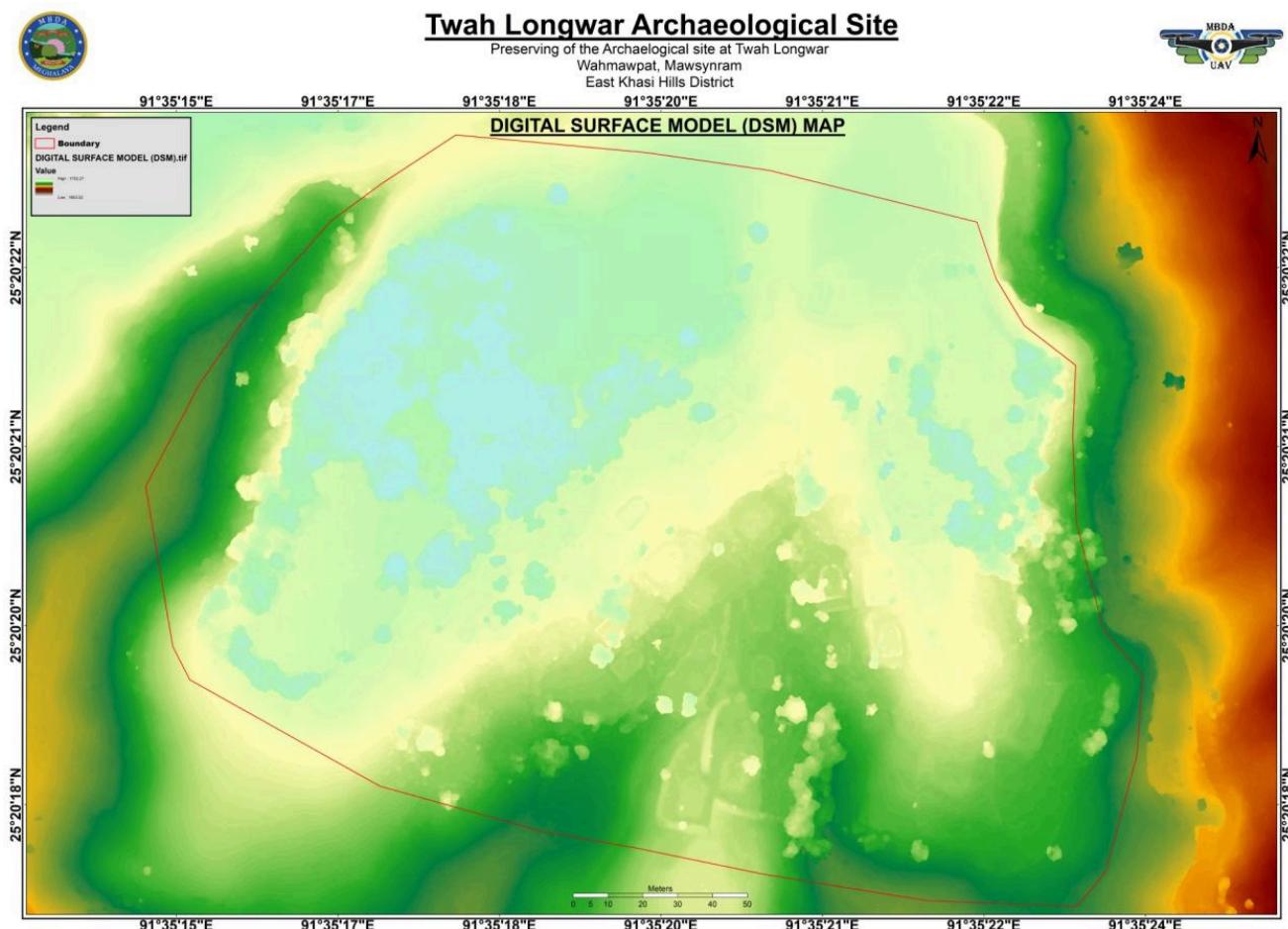


FIG 10. DIGITAL SURFACE MODEL MAP. PHOTO BY NAPHIBAHUN LYNGDOH



Twah Longwar Archaeological Site

Preserving of the Archaeological site at Twah Longwar
Wahmawpat, Mawsynram
East Khasi Hills District

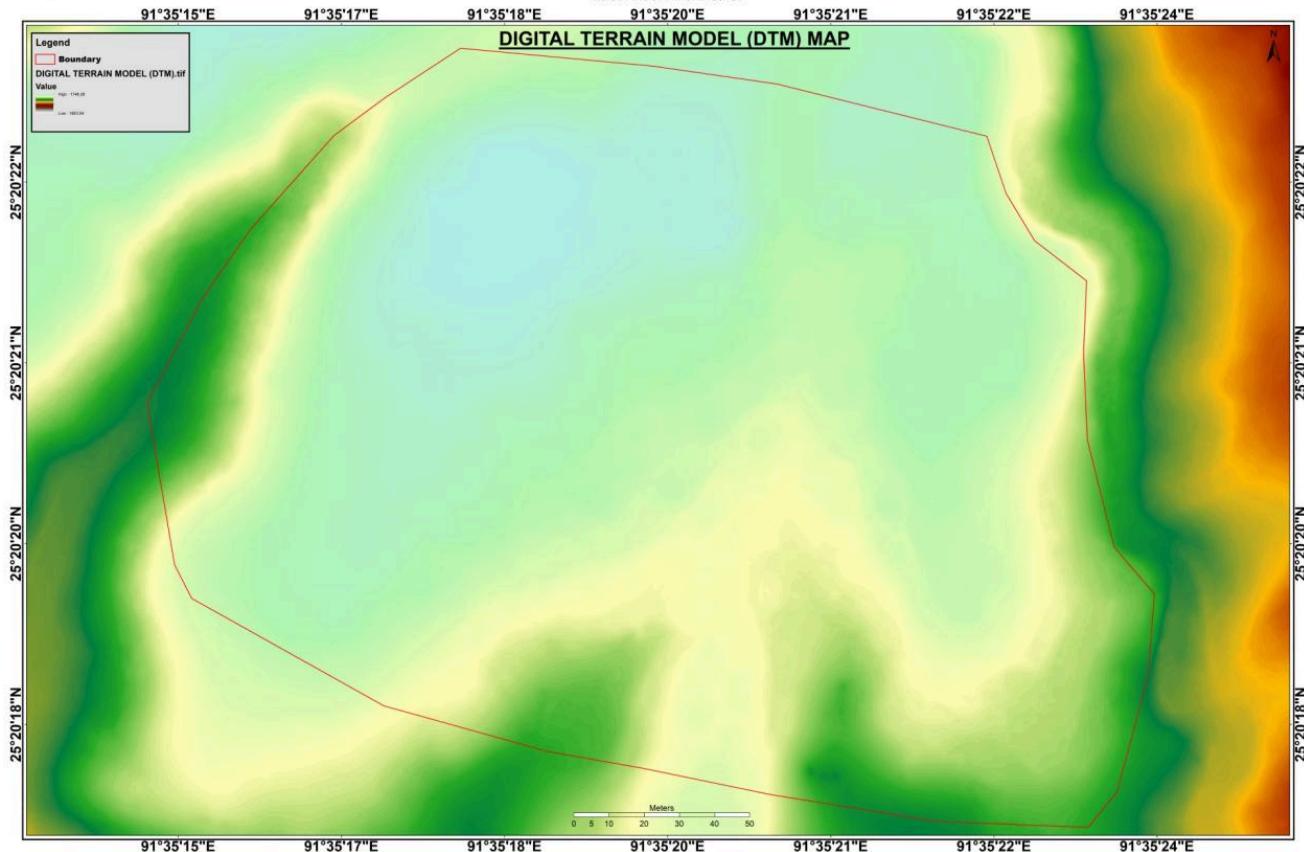


FIG 11. DIGITAL TERRAIN MAP. PHOTO BY NAPHIBAHUN LYNGDOH



Twah Longwar Archaeological Site

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East Khasi Hills District

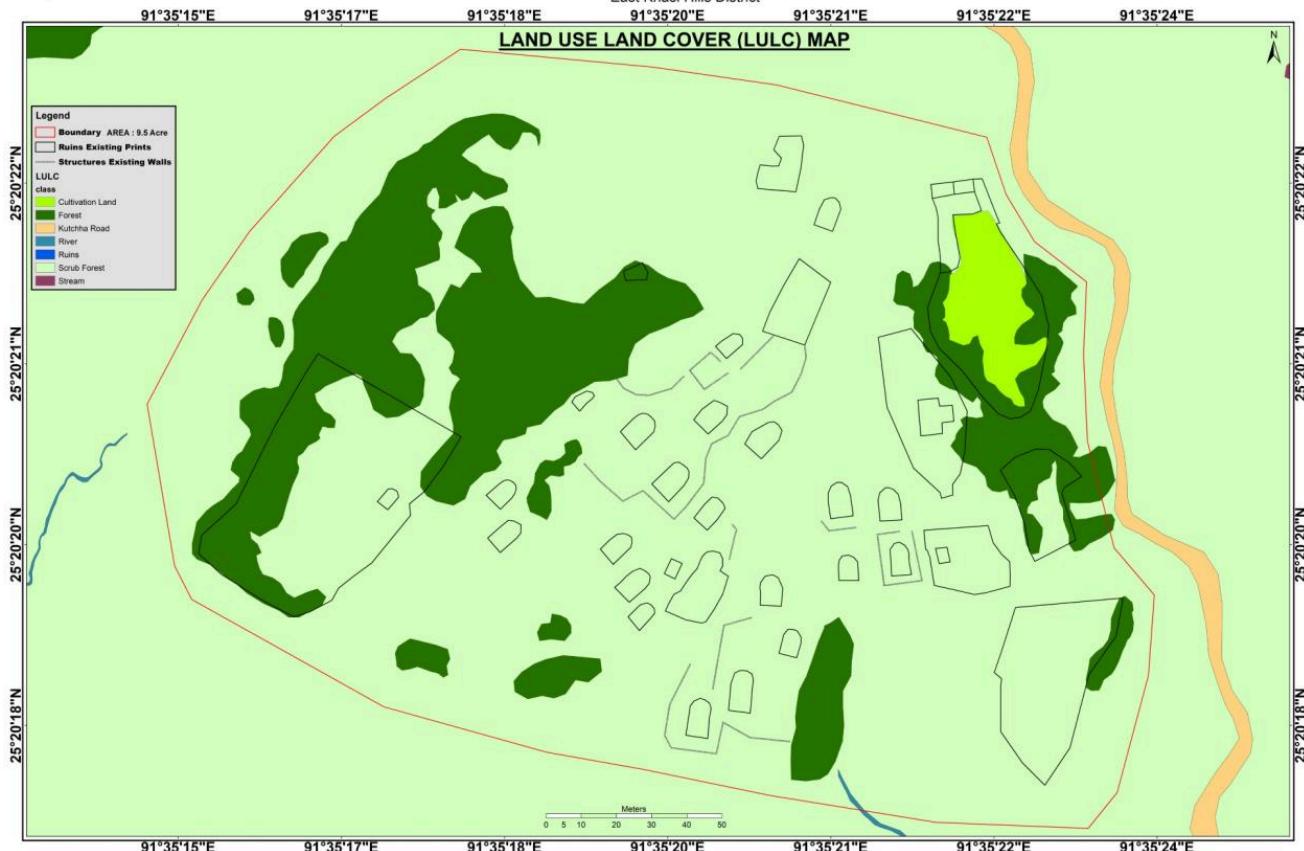


FIG 12. LAND USE AND LAND COVER MAP (LULC). PHOTO BY NAPHIBAHUN LYNGDOH



Twah Longwar Archaeological Site

Preserving of the Archaeological site at Twah Longwar
Wahmawpat, Mawsynram
East Khasi Hills District



FIG 13. ORTHOMOSAIC MAP. PHOTO BY NAPHIBAHUN LYNGDOH

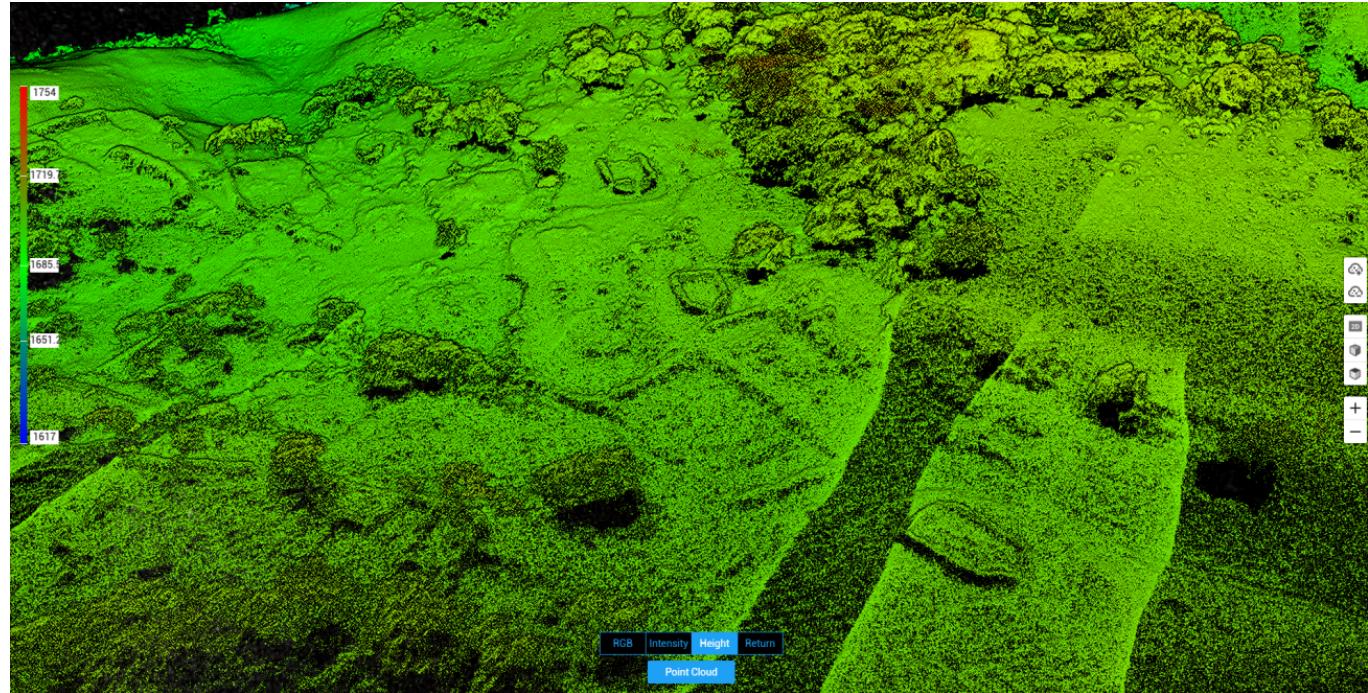


FIG 14. LIDAR IMAGE OF THE SITE. PHOTO BY NAPHIBAHUN LYNGDOH



Twah Longwar Archaeological Site

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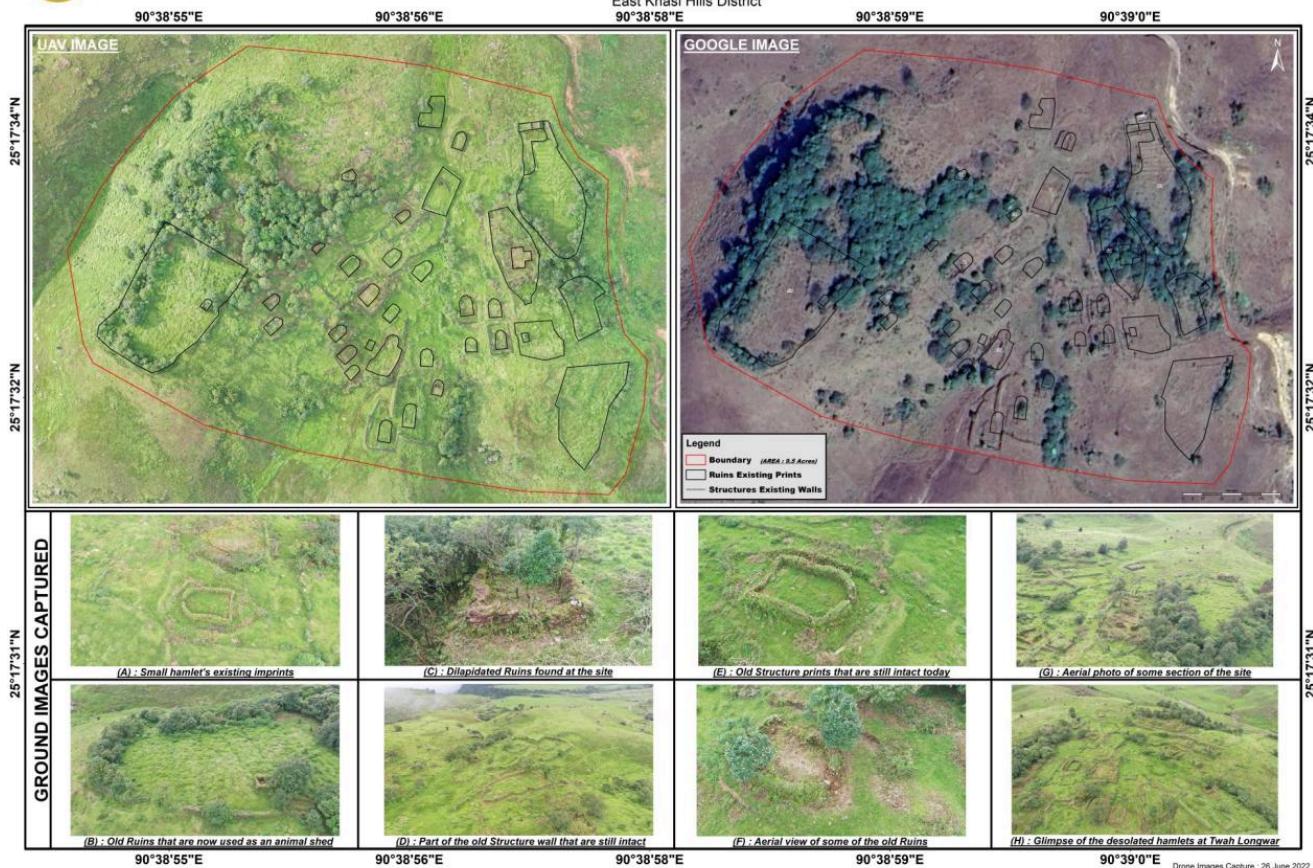


FIG 15. A DETAILED REPRESENTATION OF THE SITE. PHOTO BY NAPHIBAHUN LYNGDOH



EXISTING STRUCTURE



CONCEPTUAL PROPOSAL

FIG 16. A DIGITAL IMAGE SHOWING THE RECONSTRUCTION OF THE REMNANTS OF ONE OF THE HOUSES. PHOTO BY NAPHIBAHUN LYNGDOH



FIG 17A. LOCALLY AVAILABLE MATERIAL WHICH WILL BE USED FOR THE PHYSICAL RECONSTRUCTION OF THE SITE.
PHOTO BY NAPHIBAHUN LYNGDOH



FIG 17B. LOCALLY AVAILABLE MATERIAL WHICH WILL BE USED FOR THE PHYSICAL RECONSTRUCTION OF THE SITE.
PHOTO BY NAPHIBAHUN LYNGDOH



FIG 17C. LOCALLY AVAILABLE MATERIAL WHICH WILL BE USED FOR THE PHYSICAL RECONSTRUCTION OF THE SITE.
PHOTO BY NAPHIBAHUN LYNGDOH



FIG 17D. LOCALLY AVAILABLE MATERIAL WHICH WILL BE USED FOR THE PHYSICAL RECONSTRUCTION OF THE SITE.
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