Locating the 'Mahogany Ship': Using Geoarchaeological Methods to Test Historical Sources

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Abstract

The so-called Mahogany Ship remains one of Victoria's and the nation's most perplexing maritime mysteries. There have been numerous searches for the wreck, reportedly first seen in the coastal dunes of Armstrong Bay in south-western Victoria in 1836. The investigation decribed here utilises geoarchaeological methods to test an historical account of the wrecks first sighting, in which its location is described in terms of prominent geological features, lines of sight and measured distances. The approach taken in this study extracts geological and positional data from the account and translates them into graphical results using GIS. One key piece of information used in this study, which previous searchers either have ignored or failed to recognise, is a cross bearing. The study provides a possible explanation for the wreck's position in the dunes, and proposes an area measuring only 500 m × 100 m wherein the shipwreck is likely to be found.

INTRODUCTION

Over the decades, numerous individuals and groups have searched a 7 km × 2 km stretch of Armstrong Bay, between Warrnambool and Port Fairy in south-western Victoria, for the so-called 'Mahogany Ship' (Fig. 1) (Loney 1998:7; Quarrell 1996:3, 11, 21). Surveys of note took place in 1890, 1908, 1974, 1979 and 1981 (McKiggan 1985:31, 34, 35, 37, 38; SIT 1979). The search target is a land-bound wooden shipwreck, reportedly first sighted amongst the dunes in 1836 (Powling 2003). It could be one of Victoria's oldest recorded shipwrecks, and is certainly one of Victoria's and Australia's most enigmatic maritime mysteries (Heritage Council Victoria 2015). The wreck is believed by many to be that of an early European ship of discovery, despite the lack of any supporting historical evidence. Not seen since 1881, it is presumed buried beneath the moving sand dunes of the area (Johns 2011). Finding the wreck site is paramount to solving this mystery, as the vessel's remains are the only known evidence that can identify the ship and its likely provenance (Heritage Council Victoria 2015). Recently, Ruurd Snoekstra (2015) produced a detailed review of many of the historical sighting accounts and investigations, none of which so far have succeeded in their attempts to locate the wreck. The authors of the present article suggest that this is due largely to relevant data being ignored by the searchers, and aim to test the initial sighting description using modern techniques of geoarchaeology, including geographical information systems (GIS). This investigation uses geoscientific techniques—especially physical geography and geology—in a multi-disciplinary approach to demonstrate that the relevant search area, hereafter referred to as the search site zone (SSZ), can be reduced to an area measuring approximately 500 m ×100 m.

The initial 1836 sighting of the wreck allegedly was recorded in Hugh Donnelly's 'journal', excerpts of which are published in Powling (2003:92–94). Reportedly, these were taken from notes held by Basil Skeyhill, one of Hugh Donnelly's grandsons, which he claimed to have transcribed from his grandfather's journal, written after the events they describe, but, according to Powling (2003:7), probably no later than 1846. Skeyhill sent the notes to Ian McKiggan of Melbourne, the letter subsequently being forwarded to Powling (Powling 2003:92, and see 6–7 for

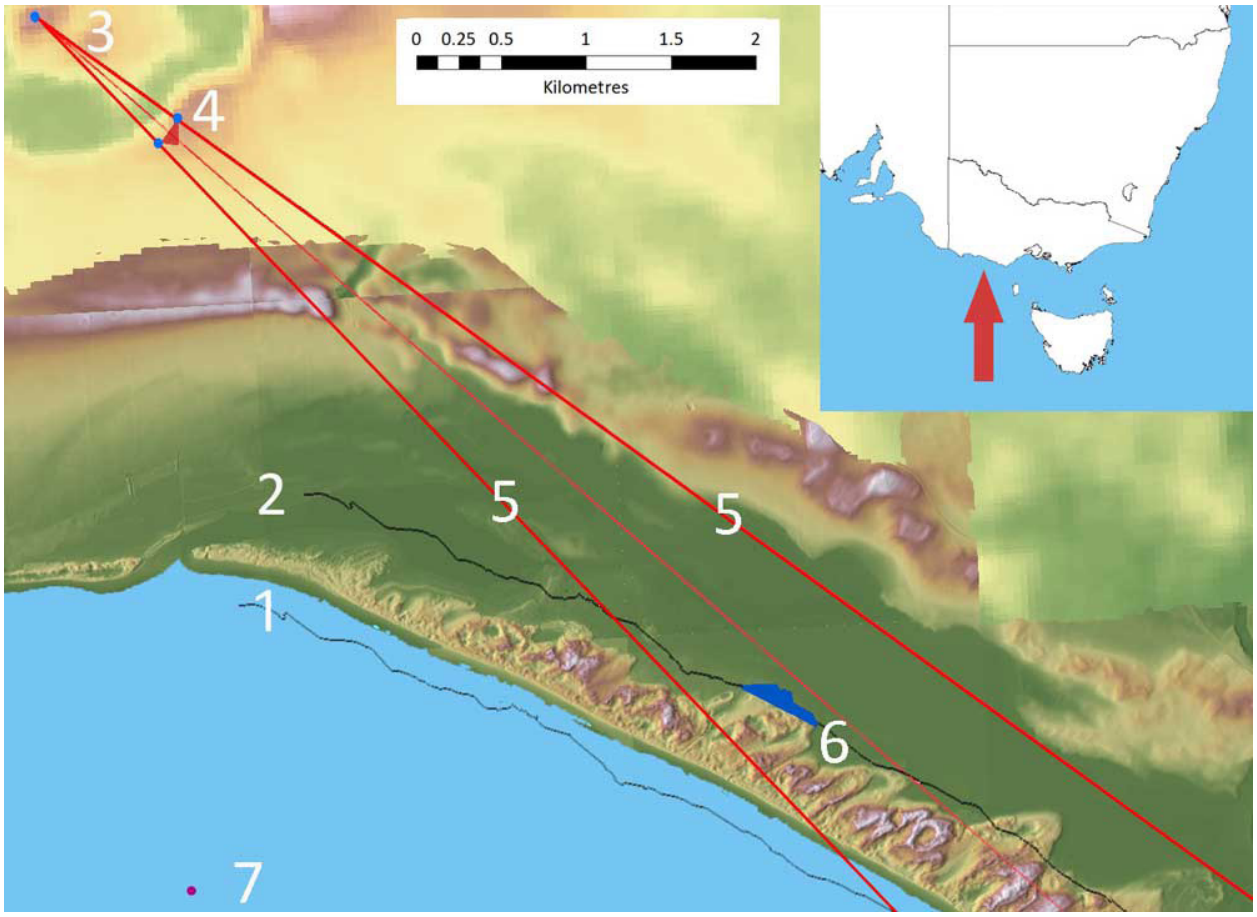

Fig. 1. Digital elevation model (DEM) of Armstrong Bay, in the vicinity of Kelly's Swamp and Tower Hill, on the western Victorian coast (oriented North at top). Numbered features apply to all DEM diagrams as follows: (1) -2 m low-water mark (LWM); (2) -2 m LWM projected 730 m inland; (3) peak of Tower Hill (single blue marker); (4) shoulder of Tower Hill (paired blue markers, with red triangle between denoting quarried church area); (5) lines of sight from Tower Hill peak through the shoulder (with median line between); (6) Site Search Zone (SSZ); (7) Helen Rock (red marker).

commentary on the journal and transcription). There are criticisms as to the account's veracity (see Johns 2011:63–65 for a good overview), and at the least it has been established that Donnelly's role in the account is fabricated (Fawcett 1999; Johns 2011:64–65; Snoekstra 2015: 117). Nevertheless, despite warning of its second-hand nature and possible embellishments by Skeyhill, Powling (2003:7) decided to accept the words as Donnelly's own, believing that the "general overall picture of the discovery can be taken as fact". Even Johns (2011:65) recognised that not all of Donnelly's evidence should be dismissed outright, despite the interjection of himself into the events.

The hypothesis of this article is that the historical account of the wreck's location is testable. Thus, for purposes of the present study, the veracity of particular details and the exact origin of the account is less important than its contents regarding the location of the wreck. These will be tested and will be found to be validated (true) if they are internally consistent; that is to say, if the account is fictional (false), obvious discrepancies within the data will be revealed when mapped using GIS. As will be shown, no such discrepancy has arisen.

Donnelly's journal account describes events in 1836 in and around Armstrong Bay. The events relate to the relocation of an "old wreck" amongst the dunes and the recording of its location by way of measurements and sightings. According to Donnelly, Captain Mills' purpose in these activities was to "sal-

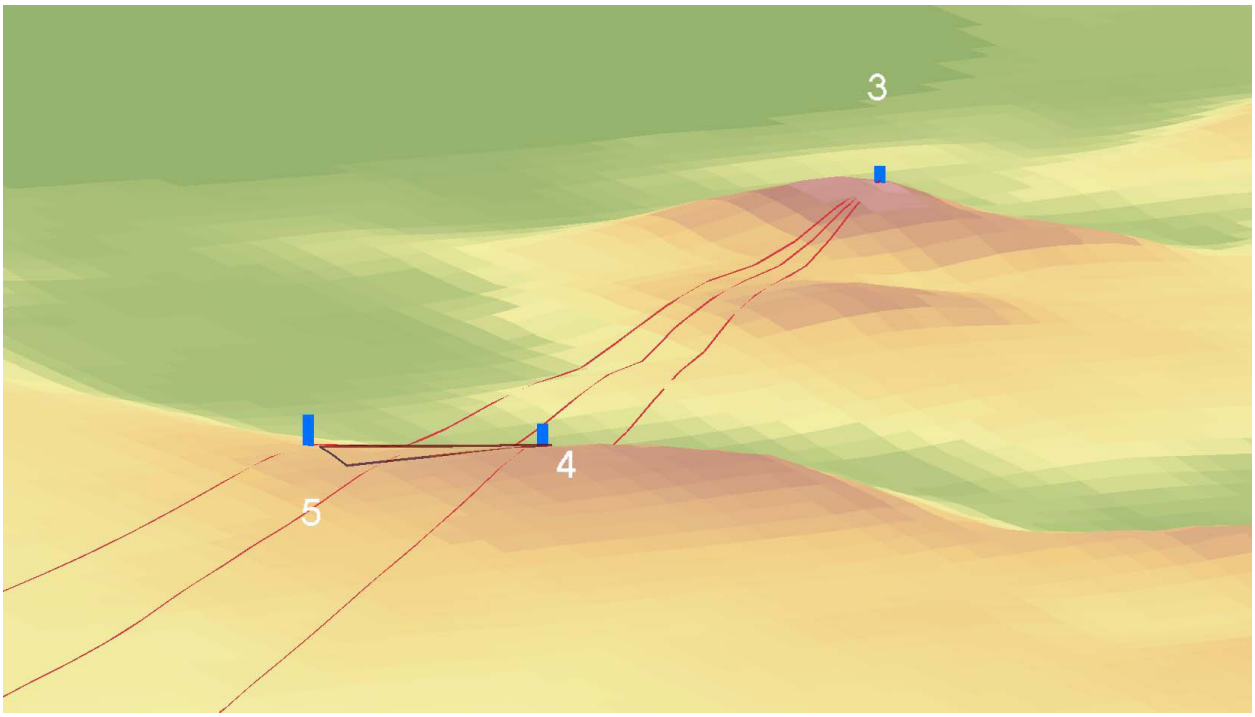

Fig. 2. Digital elevation model (looking north-west) of Tower Hill, showing the peak (3) and shoulder area (4).

vage the timber” to use at the whaling camp. Donnelly’s account gives the bearings of the wrecksite in terms of line of sight descriptions and distance measurements, which can be confirmed and therefore validated or, alternatively, disproved. It is clear that the lines of sight described by Donnelly are transit lines, such being a line that passes through two observable points as well as a third point whereupon the observer is located. A transit line is a recognised navigational tool, and is confirmed here by observing and plotting the designated angles and distances comprising the given bearings of the wreck site. When the transit line is combined with a cross-bearing, the possible location of the site is narrowed substantially.

The eastern coastline of Armstrong Bay runs approximately in a NW–SE direction, and consists of sandy beach backed by dunes. The seabed features hidden rocky reefs, including Helen Rock (Fig. 1:7). Beyond the dunes is a low-lying lagoon and marsh, known as Kelly’s Swamp, which empties intermittently via an opening to the sea. North-west of the swamp is an extinct volcano known as Tower Hill (Fig. 1:3–4). The crater rim of the volcano forms a ‘shoulder’, and within the crater lies a central cone—a prominent peak called Tower Hill Island (Fig. 2). Following are the excerpts from Donnelly’s journal account that describe the wreck’s location. The text is provided as written by Basil Skeyhill, except for some bracketed minor edits and punctuation marks added for the sake of clarity (for a copy of the hand-written letter, see Powling 2003:92–94).

> The Old Wreck lay broadside on her stern alongside a hummock on a grassy flat adjacent to the swamp edge. Helping the captain[,] we ran the two lines which we had spliced from [the] Summertime low water edge over the hummocks to the Port Side of her stern, the full line fell short so using the line again from a sealer’s club pushed into the sand I counted off one hundred knots. The Captain told me to enter into a[n] old logbook [that he] had brought along, [‘]800 yards from low water to Port Stern[’].
>
> The Captain and Charles [then] ran the line from Stern to Bow[:] 17 knots I counted. [‘]100 feet length[,’] said Captain, [‘]enter it Curly[’].
>
> Then they ran the line over her beam[:] between six and seven knots. [‘]40 foot beam[,’] said the Captain[, ‘]enter it Curly[’].
>
> The old ship was laying at a angle[,] but as her decking was covered in sand, so it was easy to stand, the Captain cleared a space of decking and[,] taking out his clasp knife[,] began to hack at a join in the ship’s decking. We heard the Cap-

> tain [yell,] 'Damm it to Hell['.] [T]his was unusual of Captain Mills[,] as he was not a man given to oaths or cursing, but we saw the reason[—]he had snapped off the point of his knife. The Captain said[, ']I do not know this type of timber but[,] but it is as hard as iron['.] [H]e sent Joe Wilson to fetch two axes from the boat. Joe and Charles reigned blows on a join in the decking and a piece came away with a rending sound. When it was handed to me I was surprised at the weight of it. Charles said ['']this is strange John. They who built this ship used spikes of the same timber to fasten the decking to the other timber. [The] Captain then took out his compass and[,] from where the jagged ends of the main mast could be seen[,] took a bearing and said ['']enter in the logbook, bow in line with the South Edge of Tower and highest pinnacle Nor Nor West". [...] I said to the Captain, ['']why all the measurements, Captain, to which he replied ['']Salvage reasons[,] Curly[,] the timber from this Old Wreck I could do with at our Camp and Try Works [...']. ['W]e could salvage the timber [and] use bullocks to drag it over the Hummocks to water edge and tow it to our works by Whaleboats['] (Powling 2003:92–93).

Donnelly claimes to have visited the wrecksite a second time, in 1844, and found that "the ship appeared to have settled deeper in the sand, the bow was completely covered but the stern was clearly visible" (Powling 2003:10). Two years later, in 1846, Donnelly writes that he visited the site again, this time accompanied by a surveyor, Will Pickering. They took a compass bearing and noted that it varied by two degrees from Captain Mills' earlier reading (Powling 2003:10).

A second recorded description of the bearings of the wreck attributed to Captain Mills came to light in 1877 (see p. 31, below). The main significance of this testimony is that it is consistent with his first description. Others have used this second Mills observation primarily to trace the line of sight between the peak of Tower Hill and the wreck (Powling 2003:22), as well as to establish various cross-bearings. The current study deals with the two observations separately, in order to minimise confusion (the second description is discussed on pp. 31–32, below). For purposes here, the first observation is the most important, as it references both the peak and shoulder of Tower Hill, as well as the projected low water mark. Significantly, none of the previous searches to date have utilised this latter data point.

METHODOLOGY

The methodology of this current study encompassed three steps: (1) data collection; (2) digitisation and processing; and (3) assessment, interpretation and determination of the SSZ. Information was gathered from primary and secondary historical sources, including visual information from historic and modern maps. Geophysical, spatial and other remote sensing outputs provided the necessary technical information. The main datasets include aerial photographs from the South Warrnambool Flood Study (Hayse 2007), Light Detection and Ranging (Lidar) imaging data (DELWP 2014) and a 1:50,000 scale geological map of Warrnambool (Orth 1988). Additional spatial data came from historical maps, including the Department of Crown Lands and Survey's 1837 plan of Yangery Parish (VDCLS 1837).

The geographical measurements used in this analysis follow the description and chronological sequence as given in Donnelly's journal. Other relevant measurements were obtained from maps, after they had been digitised and entered into GIS software. Lidar and radar data also were processed to obtain high resolution contours for digital elevation models (DEM). Precise measurements taken from two- and three-dimensional imagery were used to generate transit lines and a cross-bearing line. These then were overlayed onto the digitised maps for spatial modelling, the results from which the SSZ was determined. In short, the historical sightings were tested by virtually charting the observations, landmarks and reported bearings provided in Donnelly's account. The graphical results are illustrated in Figures 1–4.

RECONSTRUCTING SITE LOCATION

Following is an analysis of the different evidential elements contained in Donnelly's account of Mills' positional sighting of the wreck, along with other relevant information used to reconstruct the location of the wrecksite.

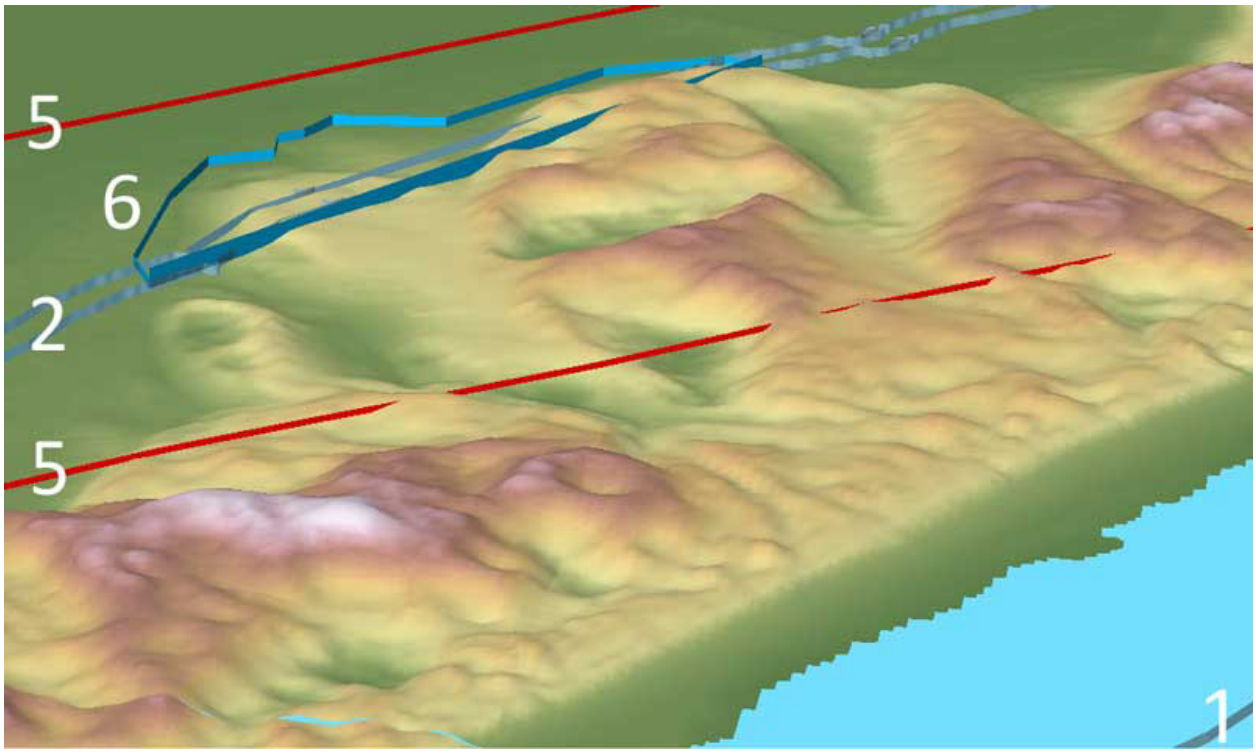

Fig. 3. Digital elevation model of the Site Search Zone looking north-east: (1) -2 m low-water mark; (2) line projected 730 m inland from low-water mark; (5) lines of sight from Tower Hill peak through the shoulder; (6) Site Search Zone.

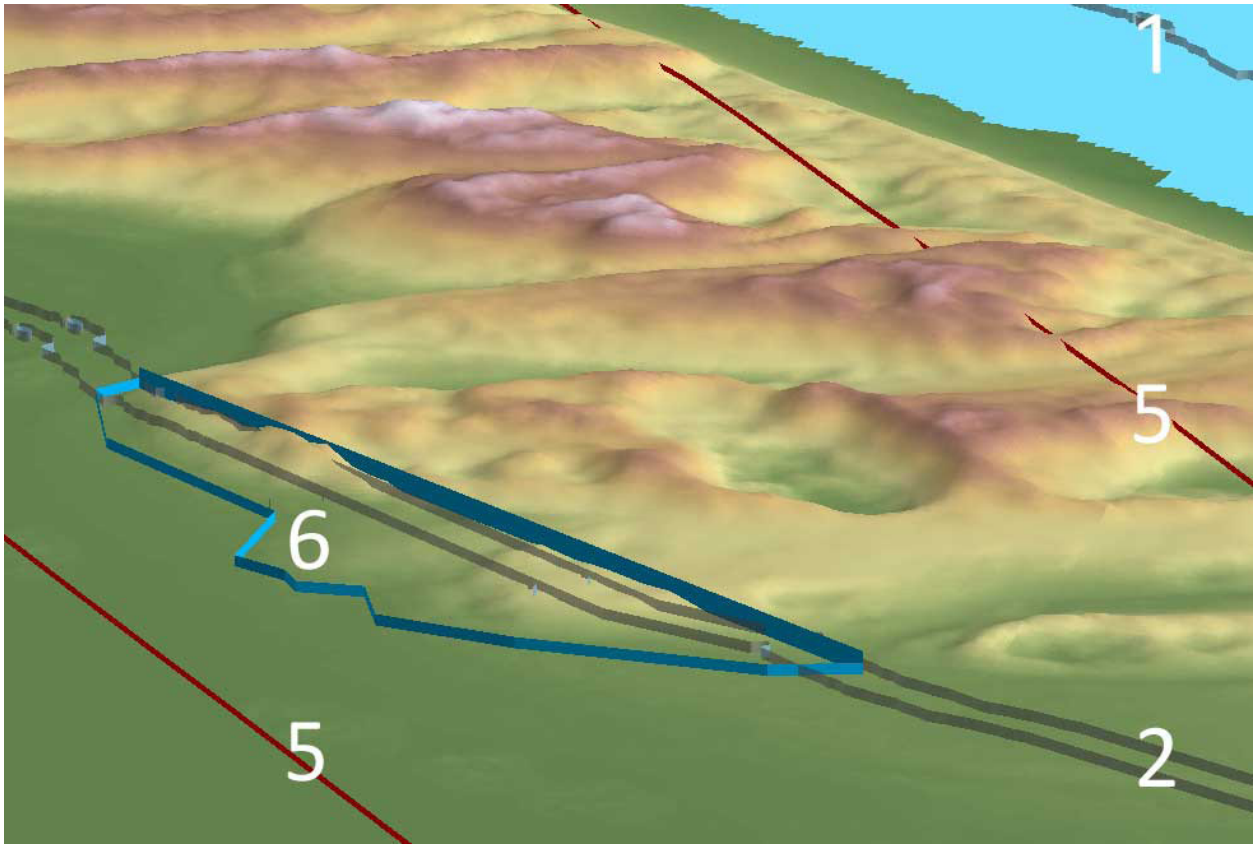

Fig. 4. Digital elevation model of the Site Search Zone looking south-east: (1) -2 m low-water mark; (2) -2 m low-water mark projected 730 m inland; (5) lines of sight from Tower Hill peak through the shoulder; (6) Site Search Zone.

Low-water mark (LWM)

Mills' survey team began by measuring inland from the summertime LWM: "Helping the captain[,] we ran the two lines which we had spliced from [the] Summertime low water edge over the hummocks to the Port Side of her stern" (Powling 2003:92). This line was ascertained in GIS using a combination of bathymetric and terrestrial Lidar contour lines. The tidal range in the survey area is one metre, and when this is expressed in terms of horizontal spread (distance to either side of the zero contour), it equates to a band width of 10 m. The zero contour was set by Lidar readings at the time of Lidar scanning. This band thus includes depth contour variations of ±1 m. The seabed has a gentle positive slope as it reaches the beach, but as not all sections of these contours are continuous, a line of best fit was used to generate a single continuous line. The -2 m contour line, labeled line 1, was selected as the LWM, since it represents the lowest (summertime) tide level. This line then was projected inland in keeping with the trek of Mills' team, "800 yards from low water to Port Stern" (Powling 2003:92), and labeled as line 2 (Figs 3 and 4). Thus, the sighting of the SSZ was 800 yds, or approximately 730 m, along the line trekked from the LWM to the wreck. The 10-m wide band created by depth contour variations represents the error range and forms the seaward boundary of the polygon-shaped SSZ. The landward boundary of the SSZ is the 2-m dune contour derived from the terrestrial Lidar scans (Figs 3–4).

Mill's team ran lines over the hummocks, which gave a reported distance that then, as now, constitutes the making of a cross-bearing. It is assumed that they walked perpendicularly to the shoreline, rather than following a northerly compass bearing. Errors arise from the horizontal and vertical deviations of their direction and distances traversed. The degree of error for the vertical plane, due to the hummock/dune height, was estimated to be 5–10 m, whilst the error due to deviations from a given direction (in the horizontal plane) was estimated to be 10 m. This is shown graphically, and allowed for in our results, by the seaward boundary of the site zone (SSZ) (Figs 3–4).

Stranding height and surroundings

"The Old Wreck lay broadside on her stern alongside a hummock on a grassy flat adjacent to the swamp edge" (Powling 2003:92). Measuring 730 m from the LWM would put the wreck on the far side of the dunes, adjacent to the swamp edge, which is in agreement with this description by Donnelly. This also is in accord with Donnelly's discussion with Captain Mills about salvaging the wreck, in which he notes that the salvaged timber would have to be dragged "over the hummocks to [the] water['s] edge" (Powling 2003:93). The current plot of the measurements places it possibly within an adjacent sand dune, as one might expect. Additionally, this reflects the later observations that the wreck was being covered slowly by sand. The most reasonable explanation for such a wreck location is that the ship entered through the mouth of the lagoon and became stranded. (This, of course, assumes that a tsunami or similar natural phenomenon being the cause unlikely). Thus, whilst the ship would appear to be far inland when viewed under the assumption that it wrecked on the foreshore, it would be close to the water's edge, as expected, if it had, in fact, become stranded on the lagoon side.

By defining the dune contours formed initially by flood events, as well as aeolian factors, we should be able to identify the dune in which the wreck is likely to be found. Although no coring data was utilised in this investigation, a previous study of the adjacent lagoon by Sherwood and Magilton (1987) provides a profile of the underlying geology and water table. The results of that study put the water table at slightly less than 2 m below the dune and swamp level (Magilton 1987:51). That depth, along with the existing height of the dune overburden, would be sufficient to cover a wreck.

Furthermore, considering the water level during past flood events, the +2 m dune contour from the Lidar data would appear to be relevant to events at the time of wrecking (as well as subsequent events that concealed the wreck), and thus to determining the location of the wreck. Flood studies confirm a potential water depth of between 2 and 10 m, which

could confer the necessary navigable depth (see below, pp. 33–34). In fact, the +2 m contour line intersects both line 2 (LWM projection) and the SSZ.

Transit line through peak and shoulder

"[The] Captain then took out his compass and[,] from where the jagged ends of the main mast could be seen[,] took a bearing and said [']enter in the logbook, bow in line with the South Edge of Tower and highest pinnacle Nor Nor West" (Powling 2003:93). This statement confirms that the ship was oriented with its bow pointing towards Tower Hill. In turn, it also support's Powling's (2003:9) conclusion that Mills' measurement was taken from the LWM to the port side of the ship's stern, which therefore is the closest part of the wreck to the shore. A plot of the transit lines from Tower Hill Island through the shoulder provide bearings that intersect the cross-bearing provided by the LWM projection, line 2. A line of sight with three points in transit gives a much more precise location than a single point bearing. The third point in this case is where the cross-bearing intersects; that is, where Mills stood when recording his line of sight, which theoretically marks where the wreck still lies. His bearing can be considered reliable, since Mills was a coastal navigator and would have been well versed in using transit lines. However, likely errors have been estimated and accounted for as previously discussed. Furthermore, changes in magnetic declination caused by shifts in magnetic north over time (see Natural Resources Canada 2017) could, in this case, insert a (secondary) inter-cardinal point to the west, and so the use of magnetic compass bearings has been avoided.

The peak of Tower Hill Island is a volcanic cone prominently visible for many kilometres in most directions. From south-south-east, the peak has the aspect of a conical hill with a somewhat flattened top (possiby due to erosion), complicating current measurements taken from it. The DEM shows that one point is higher than the rest, and so this point was used as the origin for the transit lines (Fig. 2).

What Mills calls the "South Edge of the Tower" is what herein is referred to as the shoulder. From the vantage point of the dunes, at the edge of the swap, the shoulder appears as a gentle slope declining westward. Unfortunately, part of the shoulder was quarried in the past, altering its contour. In order to account for this, the north and south limits of lines of sight were delineated, respectively, by the most prominent point and the lowest visible point of the shoulder. Two lines of sight (lines 5) then were drawn from the peak (point 3) through the north and south delineators (points 4) on the shoulder (Figs 1–4). A third line (i.e. a median line) then was drawn bisecting the angle formed by the two lines 5 (Figs 1–2). Whilst this line may be the closest we can get to the Mills transit line position, subsequent geological and other changes render this as an approximation. Nevertheless, it still produces a SSZ in which Mills' line of sight should lie, passing through the wreck site and landmarks, even with the estimated errors.

Site of the Iron Church

In 1858, James Lynar arrived in Port Fairy to head up the first Electric Telegraph Office, becoming Postmaster in 1865 when the two offices were combined (Powling 2003:27). He had heard Captain Mills (then the Harbour Master) discussing the old wreck and made notes about it (Powling 2003:27). In 1890, Lynar sent a letter to Joseph Archibald when he learned of the latter's investigations of the wreck. In it he relates Mills' description of the bearings of the wreck:

> Captain Mills gave me her bearings, as well as his memory would permit, viz:— Well to the eastward of Gorman's Lane, proceed eastward along the beach till you bring the point of land on which the old iron church stood in a line with the highest point of Tower Hill Island. The wreck would be almost in a straight line with those objects, well in the hummocks (Powling 2003:28).

As previsouly mentioned, while this information is considered of secondary importance for the sake of this study, it must be addressed, since it reportedly comes from the same eye-witness (Mills) and therefore should be consistent with the details of the primary account. The observer's point on the line of sight that Mills

Fig. 5. Historic photograph of the parsonage (in foreground) and 'old iron church' at Tower Hill, c. 1859. (T. Hannay, National Library of Australia, 54833794. Retrieved 09 March 2017 from <http://trove.nla.gov.au/version/211857655>).

describes is at the beach, and therefore the line is simply an extension of the first transit line he described. Unfortunately, he gives no cross-bearing other than the general comment of "well in the hummocks". Nevertheless, the line described is consistent with his initial transit line, and confirms that it does indeed intersect the wreck. It also validates the accuracy of the words set down by Donnelly and, using GIS and correcting for errors, can be shown to pass through the SSZ.

The old iron church did not exist at the time of Mills' initial account, nor of his second (see Powling 2003:29 for a likely explanation of its appearance in Mills' bearing descripton). It was built in 1855 on a triangular plot that sat on the shoulder of Tower Hill. The church was demolished some time later and the grounds on which it stood were quarried. While the church site cannot be located on old property boundary maps (such as the Yangery map, VDCLS 1837), the triangular plot in which it was situated can, and thus it can be superimposed onto maps using GIS (Figs 1–2). The adjacent parsonage sat close by, on the property's eastern boundary (Powling 2003:29). Two historic photographs of the church and parsonage (Figs 5–6) show how the buildings were oriented to each other and to the boundary, and also give an indication of their sizes. From this, the limits of where the church once stood—not far west of the boundary—can be determined. The importance is clear when drawing a transit line from the peak through the church site, as many previous search attempts have done. Once again, lines of sight within sector limits aid in the limiting of errors that arise.

The search site zone

The sight lines (5, including the median line) from the peak passing through the shoulder and down to the projected LWM (line 2) fall within the sector that includes the resulting SSZ (6), which measures approximately 500 m × 100 m (Figs 1, 3–4). The SSZ contains some dune contours along the edge of the swamp, the highest of which is 10 m. Subsequent to the initial sighting of the wreck, the dunes are known to

Fig. 6. Historic photograph of the 'old iron church' at Tower Hill, 1866 (J.H. Soden, National Library of Australia, 49376204. Retrieved 9 March 2017 from <http://trove.nla.gov.au/version/182665133>).

have shifted with the prevailing south-westerlies, which led to the wreck's increased burial between subsequent sightings (Doyle 2006:4; Powling 2003:10, 51). However, the main dunes of this coastal area have been shown to be stable, especially the older easterly ones (Gill 2003). Confirmation of main dunes and blowouts is seen on maps dating back to 1847 (Powling 2003:55; Gill 1987:35–44). Dune movement gradually reduced over time, and was slowed particularly after the introduction of marram grass in 1862 (Powling 2003:37–38; Gill 2003:30 July 1980 letter). Therefore, it is likely that a wreck buried there would be found in dune contours between 2 and 10 m in height (for reasons outlined above, pp. 30–31). The dune to the immediate east of the SSZ cannot be excluded definitively, but it is considered less likely as it is either too flat or too steep to provide sufficient room for a wreck (Fig. 1).

The lagoon mouth as the means of entrance to the swamp

Floods have raised the water level in the lagoon and across the sandbar at its mouth, and have deepened all channels up to an estimated 3–5 m as a result of scouring (Hayse 2007:57–63). This rise in water levels is accentuated further by storm water, storm surges and tidal waters. It is not improbable that a ship with an estimated draught of 2–3 m would try to seek shelter in the lagoon. The projected sea level rise in the Future Coasts study (DELWP 2014) shows that Kelly's Swamp may become inundated permanently up to the 2-m contour. This is equivalent to storm surge and river flooding filling the lagoon, with additional scouring of the lagoon bed. As discussed above (pp. 30–31), the 2-m contour intersects line 2 (LWM projection) and runs through the SSZ. Sources have shown that the swamp and lagoon are subject to regular seasonal flooding. Additionally, scouring caused by flood waters has deepened the entrance and removed the sand bar, leading to a significant widening of the mouth. Aerial photographs of the lagoon entrance in 1977 (Swinburne Institute of Technology 1979:5), along with modelling of the lagoon during the 1946 flood (Hayse 2007:55–66), shows the mouth to have been as

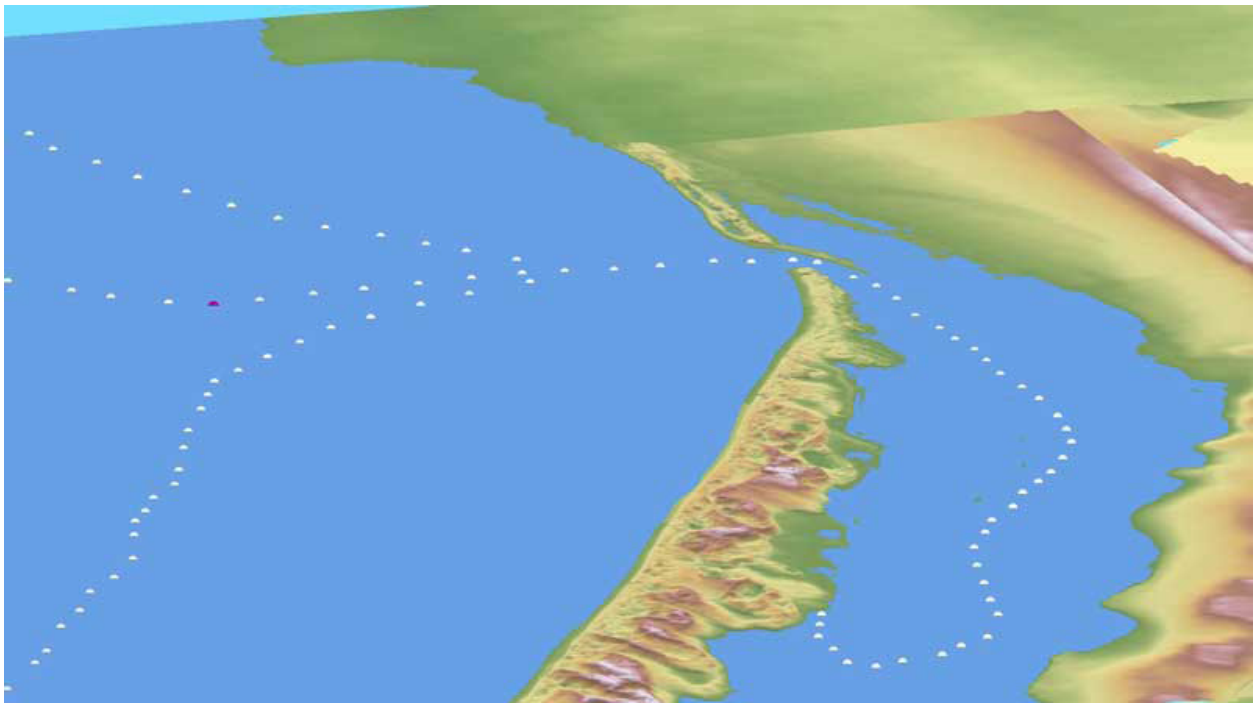

Fig. 7. Digital elevation model (looking west) of Armstrong Bay showing possible routes of approach to Kelly's Swamp. The water level as shown is 2 m over the model's low-water mark. Purple marker denotes the location of Helen Rock.

wide a one kilometre. This means that in the past the lagoon and swamp were subject to greater encroachment from the sea than perhaps they are today (Gill 1987:42). This also gives an indication of the effect of overwash related to cyclonic storms, which not only would erode the sandbar, but would provide a vessel sufficient clearance to pass over the bar and into the lagoon by raising the apparent sea level.

DISCUSSION

This study of the historical account of Captain Mills' first sighting of the old wreck—the Mahogany ship—focused on the positional information it contains, with the hypothesis that the data extracted from that information can be tested using geoarchaeological means to determine their veracity and plausability for identifying the location of the wreck. The following information provided in the account formed the basis for this investigation:

- Tower Hill Island (the peak) was used as a bearing point (3);
- The shoulder of Tower Hill was used as a bearing point (4); and
- The projected low water contour (line 2) was used as a cross-bearing.

Furthermore, the study assumes that the size and location of the major dunes have not changed enough since the first half of the 19th century to materially impact the search (Powling 2003: 44, 95), fully recognising that aeolian influences led to the gradual burial of the ship by shifting sands).

Some researchers previously have ignored Mills' initial sighting description (as given by Donnelly), or at least some parts of it. The reasons for this are many and varied, including that it puts the wreck too far inland. One plausible explanation for the wrecks general placement in the dunes has been offered here in order to demonstrate that pinpointing the exact location is not merely an exercise in hypotheticals. The ship may well have entered into the lagoon when it was flooded and finished up hard against the lee side of a dune, where it became stranded.

Those researchers who have accepted the initial account as true and who have attempted to determine the wreck's location by plotting lines of sight typically have relied on Mills' second recorded description and the position of the old

iron church. The problem with this approach is that the exact position of the church currently is not demonstrable. A second problem is that the lines of sight are restricted by the present height of the dunes, which now are taller than at the time of the initial sighting.

Perhaps the biggest mistake made in previous searches was not recognising the cross-bearing, but instead looking elsewhere for it (Powling 2003:29) or skewing the data to support a particular outcome or argument (e.g., McCrae's map; Powling 2003:35).

Finally, some researchers have chosen to reject the initial account out of hand. For example, all of Donnelly's account was repudiated by one historian whilst omitting his written records (Snoekstra 2015:117). This study has attempted to show that the locational information contained in Donnelly's account can be accepted as true and accurate in a navigational sense, even if other details, such as his involvement in the actual surveying, were fabricated. It has been shown here that the initial account is factually consistent, both internally and with secondary descriptions, and is verified by charting the information with GIS. The account may one day be verified by archaeological findings, rather than speculation. Mills was a sea captain and versed in navigation and surveying. Donnelly simply recorded in writing the navigational technique of transit lines based on geographical landmarks commonly used for coastal inshore navigation. When mapped in GIS, these lines build a picture that is consistent with the recorded description. Not having the skills of a navigator, Donnelly would not have been able to imagine (or perhaps even understand) such concepts and devise such descriptions, but could have recalled easily enough what he was told by, or overheard from, Captain Mills.

The chances of a wreck in the Armstrong Bay area are high, as attested by the region's designation as 'Shipwreck Coast'. Another factor of possible wreck causation in this area is the presence of Helen Rock, a hidden offshore reef in line with the mouth of the lagoon (Figs 1 and 7). The combination of the reef and its location along the approach to the bay, an apparent safe refuge, may have produced a veritable 'ship trap'. Underwater survey of the reef and surrounding seabed may one day reveal artefactual evidence of a wrecking event. The large number of shipwreck sightings and accounts over the years in this area suggest that there likely is more than one wreck at Armstrong Bay (Powling 2003:46). The specific qualities of the Mahogany Ship (or of any other wreck, for that matter) are not germane to the search process, as these would be revealed upon the wreck's discovery. The focus here is only on where the wreck lies—and finding it.

CONCLUSIONS

This study begins with the hypothesis that the location description given by Mills (through Donnelly) can be tested using geological and geograhical means. It has been shown that, from the line of sight bearings, cross bearing and measurements in the description, the possible location of the wreck can be narrowed to an area that is eminently manageable and searchable using whatever survey methods necessary with reasonable time and resources. This study has demonstrated how a geo-archaeological approach, using modern software tools and remote sensing data, can be applied to testing historical sources. The next step is a detailed archaeological investigation of the search site zone identified herein, as well as an underwater search of the seabed along the approach to Kelly's Swamp, and around Helen Rock in particularly.

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