

TR11-89-102

15. SITE INVESTIGATION OF A PROPOSED OUTER HARBOUR FOR DEVONPORT

by W. R. Moore

INTRODUCTION

In a report on the future of the Port of Devonport Tydeman (1964) proposed that a new harbour be built E of the present breakwater at the mouth of the Mersey River (fig. 31). The berths in this outer harbour were visualized as being used for container and bulk cargo ships. It was proposed that two new breakwaters be built: the first N from the Signal Station to protect the existing dredged channel to the inner harbour, the second from East Devonport in a NW direction towards the mouth of the Mersey River to enclose the new outer harbour. This new berthing area would be dredged to a depth of 24 feet at low tide. The dredged material would be used to fill and reclaim a large area between proposed quays and the eastern breakwater.

It was recognized that the feasibility of this project would depend on the absence of rock in the proposed area, and a geophysical survey (sonar boomer) was undertaken by the Bureau of Mineral Resources to establish the thickness and extent of the covering sediments overlying the hard rock. The results are now available (Milsom, 1966).

Several geological and engineering studies have been made in this district, the most recent related directly to the proposed outer harbour project being that of Davies (1965); other relevant studies are listed in the bibliography.

In order to collect further information for interpreting the results of the sonar boomer survey, a technique for underwater geological mapping was worked out to cover the sea bottom over the area of the outer harbour. A description of this technique is given at the end of this report.

GEOLOGY

Proposed Outer Harbour Area

Underwater geological mapping of the outer harbour area proved that the geology of the sea floor is a continuation of that visible above low tide (fig. 50). A point on the eastern margin of East Beach continues out under the sea as a wide rock ledge of basalt rising 3 to 4 feet vertically from the sea floor. It was traced beyond the proposed eastern breakwater and beyond the 3 fathom line. The surface of this basalt is highly irregular and deeply dissected and is covered with heavy marine vegetation.

The remainder of the area is a flat wave-eroded rock platform of basalt covered for the most part with gravel and sand. Small patches of unweathered basalt outcrop flatly under a thin veneer of silt and mud. These basalt outcrops and associated gravel and sand are identical with basalt exposures along the shore of the Mersey River.

The gravel overlying the basalt rock platform is composed of pebbles of Precambrian quartzite and occasional basalt boulders or pebbles. No dolerite boulders or pebbles were found. The quartzite pebbles are well rounded, well sorted but not imbricated, thus having the properties of river gravel.

The areas mapped as fine gravel are similar except that no basalt outcrops were found there. The coarser gravel near the breakwater is a combination of quartzite pebbles and cobbles, boulders, angular blocks of basalt, and blocks of concrete. Most of the basalt appears to have been derived from the breakwater, although some outcrops of basalt are thought to be present on both sides of the breakwater. It is possible that the suspected outcrops of basalt (mapped as "near outcrop") are blocks buried within the gravel. The blocks of concrete are thought to have been ballast from a dredge which was wrecked on East Beach. The underwater mapping supports the two conclusions of Davies (1965) that the gravel is underlain by basalt rock and that only where such a rock surface exists do pebbles accumulate to form gravel banks below the low tide level.

A flat zone of sand with well developed ripple ridges occurs between the gravel banks paralleling the breakwater and the rock ledge at the point of East Beach. The sand is composed of quartz with minor amounts of basalt grains and shell fragments. Thin patches of quartzite gravel are frequently present and are particularly common in the sand near the margins of the gravel banks. The impression gained when swimming over the area mapped as sand was that the sand is thin; that it is a very recent deposit, possibly deposited since the breakwater was built; and that it overlies quartzite gravel. As no sluicing or probing equipment was available during this mapping the thickness of the sand is unknown.

Shoreline

Fine grained olivine basalt outcrops extensively along the shore at East Devonport (figs. 32, 50). On the W bank of the Mersey River near its mouth and along the shore N of the Signal Station a wave trimmed coastal platform of basalt is present in many places covered with a layer of superficial beach and river gravel. N of the Signal Station between high and low tide levels dolerite outcrops with basalt in very close proximity though the contact of the basalt and the dolerite is not exposed (figs. 32, 50).

From Mersey Bluff to the E end of Coles Beach almost continuous outcrops of basalt occur. At the E end of Coles Beach an outcrop of basalt occurs close to the dolerite. From the W end of Coles Beach to the Don River a continuous low platform of basalt is present.

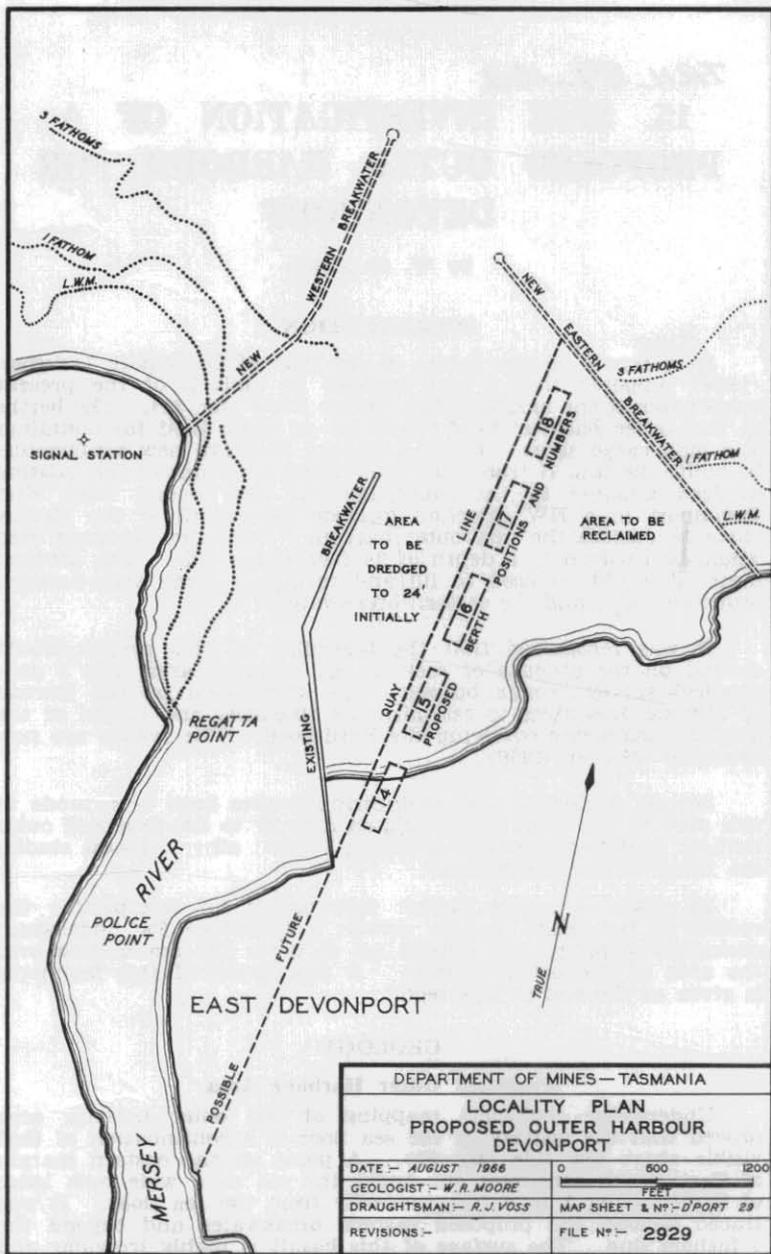
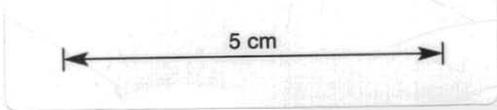


FIGURE 31



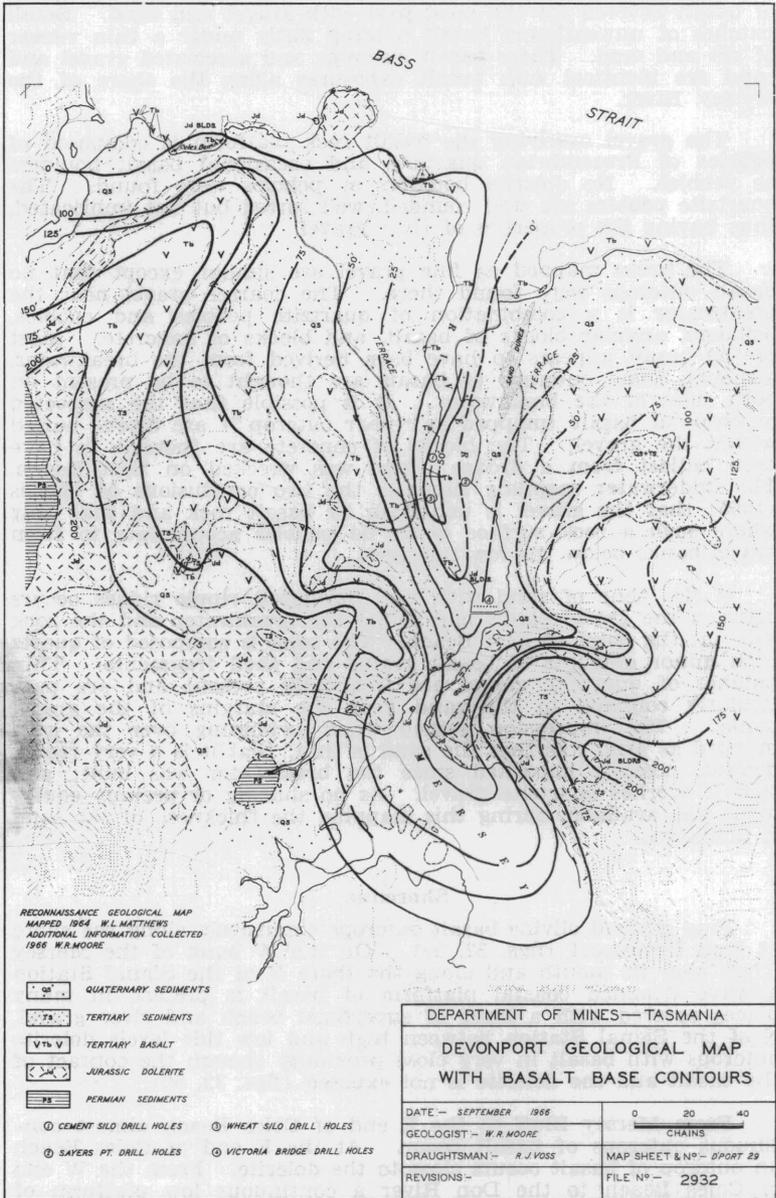
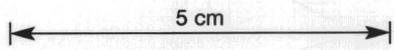


FIGURE 32



Along the W bank of the Mersey River from its mouth to the present wharves basalt outcrops sporadically. Basalt is known to extend beyond 200 feet out into the river. In a drill hole put down 300 feet from the shore no basalt was present but dolerite was encountered beneath 34 feet of clay, gravel and sand (fig. 33).

Four small outcrops of basalt are present along the railway embankment between the cement silo sites and the wheat silos. Here the basalt is 22 feet thick but it is only 10 feet thick at a spot 60 feet closer to the river leading Hughes (1958, p. 118) to conclude that the silos were placed close to the edge of a basalt flow. On the E bank of the Mersey at Sayers Point basalt is known to extend to approximately 300 feet out into the Mersey River at a depth of 23 feet below the water line (Evans and Sprigg, 1962).

The southernmost exposure of basalt along the shores of the Mersey is a poor outcrop near the shipyard at Woods Point. Further upstream, large boulders of dolerite are present along the W bank of the Mersey to Victoria Bridge. Immediately upstream from this bridge dolerite outcrops on both banks of the river and extends across it.

STRATIGRAPHY

PERMIAN MUDSTONE

The oldest rocks in the vicinity of Devonport are Permian mudstone with a little sandstone which outcrops to the W of Devonport overlooking the Don River and in a small poorly exposed area in Horsehead Creek. Similar soft mudstone is thought to underlie all the flat areas between Quoiba and Latrobe. Local base level control by hard dolerite permitted the Mersey River during the Pleistocene to erode the soft Permian sediments upstream from the dolerite gorge and to form the present depositional basin.

JURASSIC DOLERITE

Dolerite outcrops widely at Devonport extending S from the Mersey Bluff to Hillcrest and the Stoney Rise Road, S to Kelcey Tier and SE across the Mersey River to Dooleys Hill. In the vicinity of Devonport the thickness of dolerite is approximately 200 feet, but it appears to be greater to the S at Kelcey Tier.

If the dolerite around Devonport is a single sill, as appears likely from its outcrop pattern, this sill must plunge to the N and NE, and would reach sea level at Devonport on the beach N of the Signal Station and also at Mersey Bluff and Pardoes Point.

TERTIARY PERIOD

PRE-BASALT SEDIMENTS

The only Tertiary sediments definitely known to occur below the basalt are the sediments encountered in the drill holes at the cement silo site and beneath the Mersey River near this site.

Here in all the holes drilled through the basalt a sequence of massive quartzo-feldspathic sand grading into coarser carbonaceous grit and sand was encountered. The sand changed abruptly into green clay derived from dolerite. The thickness of the pre-basaltic Tertiary sand varies from 4 inches to 11 feet but it is usually 6 to 7 feet.

BASALT

Basalt underlies much of the built-up area of Devonport and East Devonport overlying the dolerite. It forms a low, soft, rounded landscape which contrasts with the irregular, steep, high landscape of the dolerite at Kelcey Tier and Dooleys Hill to the S and SE.

The thickness and number of flows of basalt which covered the irregular Tertiary topography are unknown except for isolated measurements in those drill holes which have penetrated into the underlying Tertiary sediments or Jurassic dolerite. The greatest thickness of basalt penetrated so far is 57 feet at the cement silo site where two flows are thought to be present, but the total thickness is probably no more than 100 feet.

POST-BASALT SEDIMENTS

The sand below the basalt at the cement silo site does not resemble lithologically the sand around Devonport found at the surface. The areas of gritty and pebbly sand at Hillcrest, near the Devonport medical centre, are the largest and best exposed outcrops of Tertiary post-basaltic sand. Small areas of grit, sand and clay overlie dolerite to the S and SE of the medical centre and similar gritty sand and clay occur on top of Dooleys Hill.

Burns (1964) included the sediments at the medical centre and those on top of Dooleys Hill in his Wesley Vale Formation and showed on his map an area in a broad marshy valley in East Devonport as "Wesley Vale sands". Matthews (1964) mapped this area as "Quaternary Sediments". On examination of this valley, which is rapidly becoming a built-up area, the writer found the outcrops so poor and few that it was difficult to determine if the sediments were Tertiary or Recent or both, so no attempt has been made to sub-divide these sediments on the regional geological map (fig. 32).

QUATERNARY SEDIMENTS

A wide range of Quaternary sediments occur at Devonport. These include beach and river deposits. Old landslides have deposited talus on the NW flank of Dooleys Hill.

THE PRE-BASALT SURFACE

Nowhere in the vicinity of Devonport have undoubtedly pre-basalt Tertiary sediments been found on the surface. In drill holes below the basalt their thickness is usually 6-7 feet, exceptionally 11 feet. It can be assumed that the pre-basalt Tertiary sediments are not present on the surface or if present their thickness does not exceed 25 feet, the contour interval of the regional geological map of Devonport. Therefore it is possible to draw the contours on the base of the basalt, which are the contours of the pre-basalt surface, from the mapped boundaries of the basalt and dolerite (fig. 32).

On the foreshore of the beach N of the Signal Station dolerite and basalt outcrop within 2 feet of each other. At the southern end of Hillcrest overlooking Coles Beach dolerite and basalt outcrop within 6-8 feet of each other. Matthews (pers. comm.) reports a similar condition above the old quarry N of the mouth of Horsehead Creek. On Dooleys Hill the contact zone is less clear because of slumping, but dolerite boulders and basalt, probably outcrops, appear within a short distance of each other on the western face of the hill.

The contours show a steep valley on the W bank of the present Mersey River but on the E bank, particularly N of Victoria Bridge, no dolerite-basalt contact can be found. If the sediments, shown as both Tertiary and Quaternary in the E-W valley and East Devonport, belong to the Wesley Vale Formation as mapped by Burns (1964), and if they underlie the basalt as is possible, basal contours can be extended close to the coast at East Devonport. Neither Burns (1964) nor Rundle (1958a,b) mentioned these Tertiary sediments in the texts of their reports but both showed them in their figures (Burns, figs. 76 and 77; Rundle, fig. 2). These figures show Tertiary leads crossing the sediments and entering the sea at East Beach. Burns showed the lead as only a minor stream, but separate from his major lead through Wesley Vale, whereas Rundle interpreted it as the pre-Tertiary lead of the Mersey River.

Within the limitations of the assumptions, the pre-basalt surface contours around Devonport indicate that the pre-basalt valley was at least 250 feet deep; therefore, it was not a minor valley. Its position was approximately that of the present Mersey River, N of Horsehead Creek.

PRESENT CHANNEL OF THE LOWER MERSEY RIVER

In 1937 Askew carried out a detailed investigation of the Mersey River from the port to beyond the Heads using a hand drill and probe with a sluice attached. Results from such methods are today considered unreliable, but the results of Askew's investigation have been largely confirmed by the dredging of his proposed channel to a depth of 23 feet.

Sections across the channel were drawn from Askew's probes and drill holes and a series of these are reproduced in fig. 33. The cross sections show that the rock ledge, presumably basalt, slopes gradually out from the western bank to end abruptly in the river. This ledge is covered with gravel and sand averaging 3-4 feet

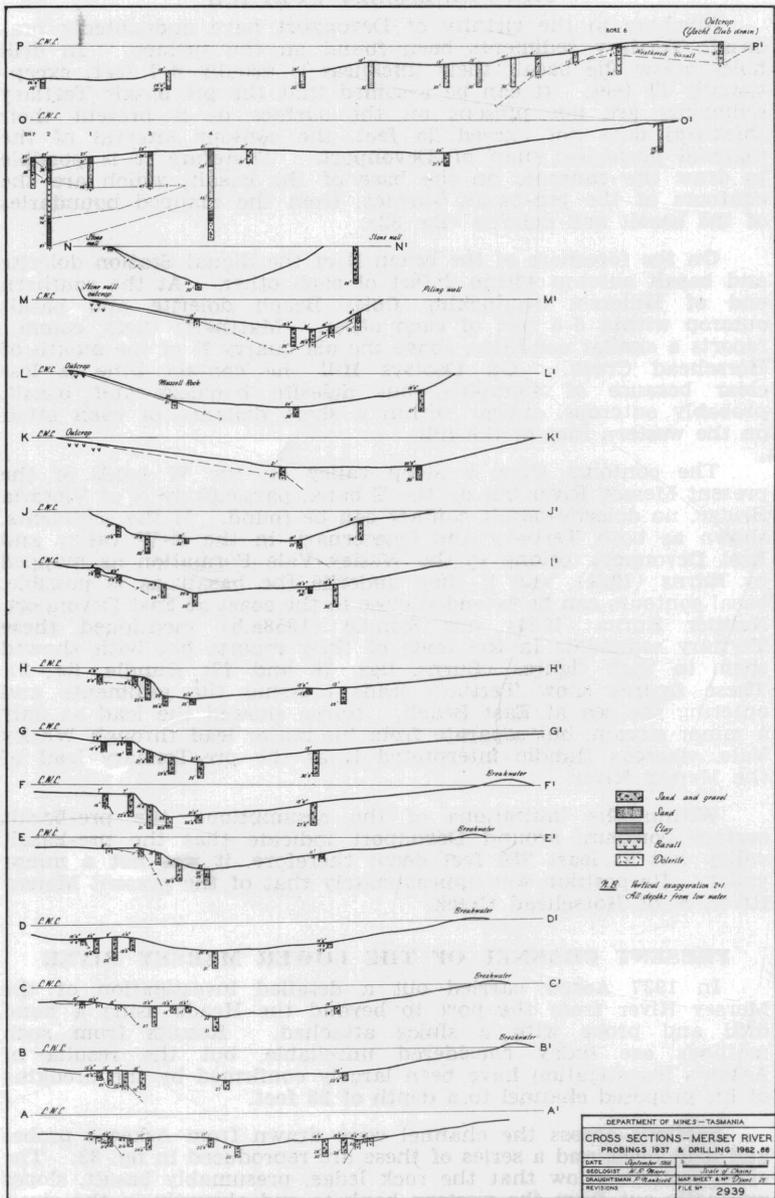


FIGURE 33

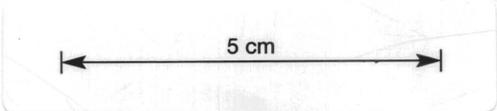
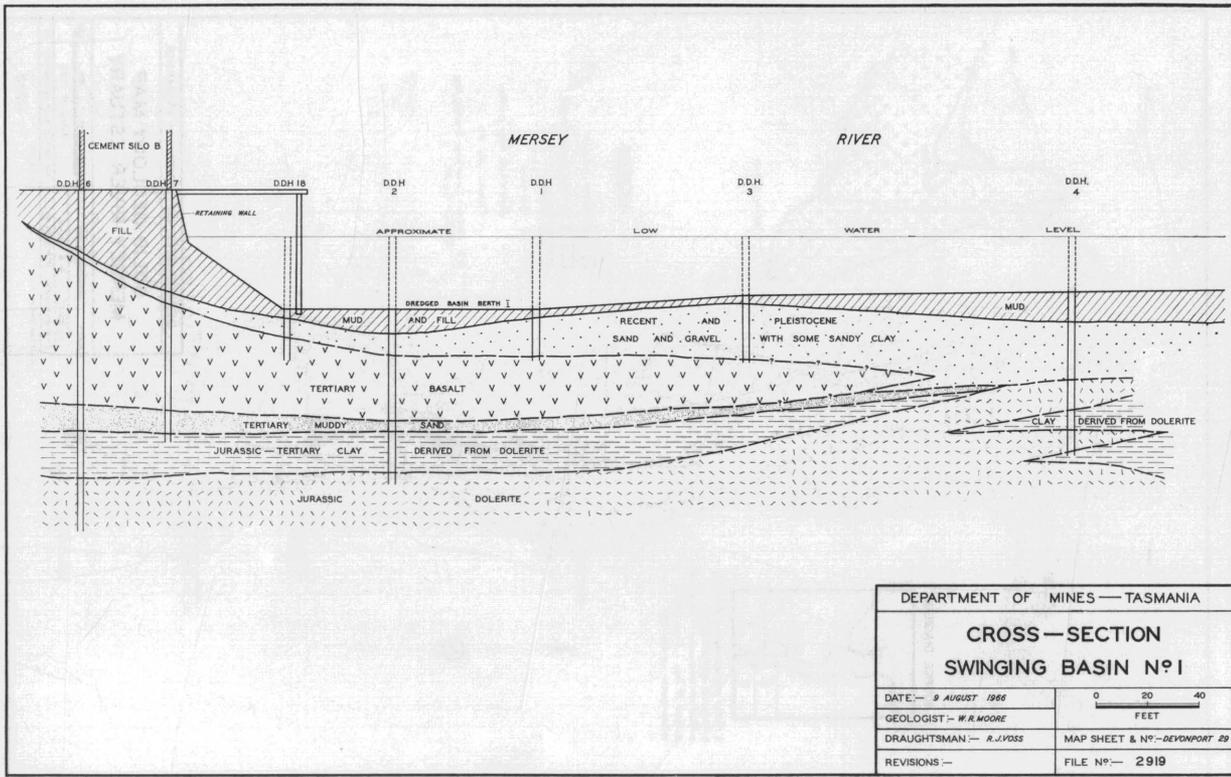
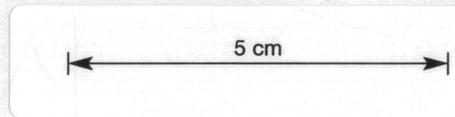


Figure 34



DEPARTMENT OF MINES — TASMANIA	
CROSS — SECTION SWINGING BASIN N° 1	
DATE:— 9 AUGUST 1966	0 20 40 FEET
GEOLOGIST — W. R. MOORE	MAP SHEET & N° — DEVONPORT 29
DRAUGHTSMAN — A. J. VOSS	FILE N° — 2919
REVISIONS —	



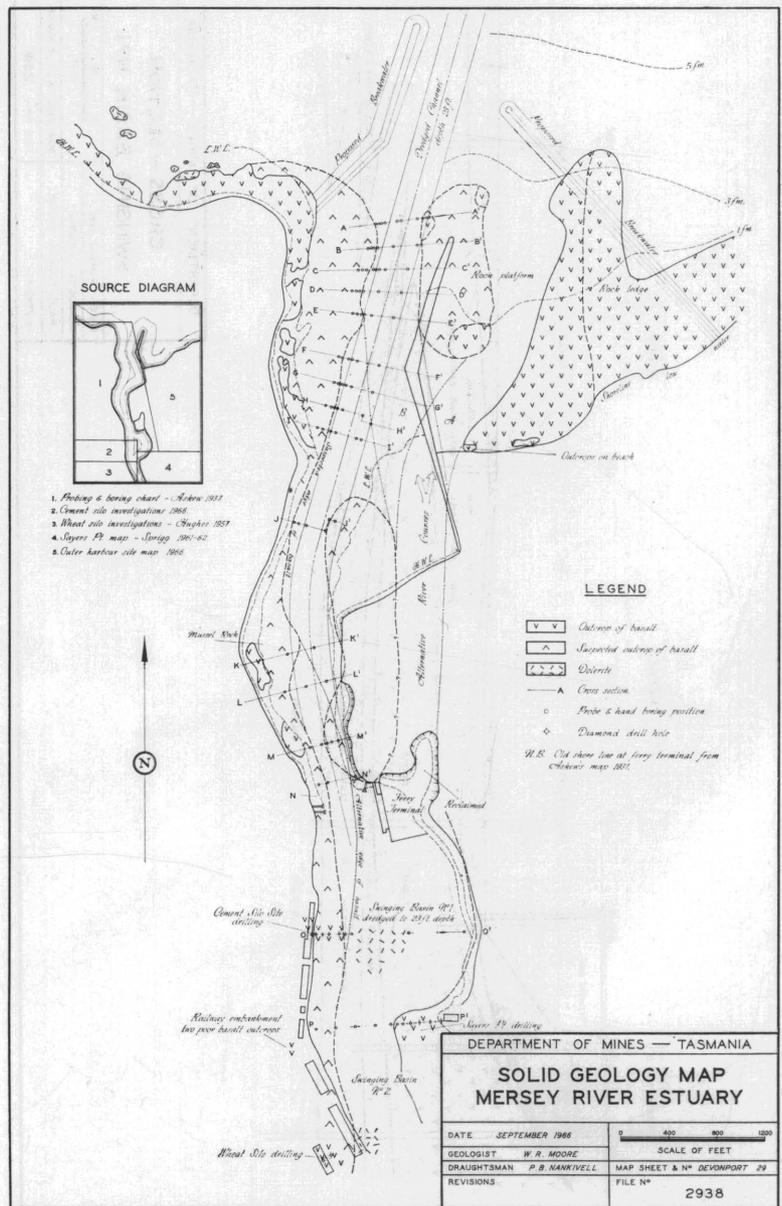
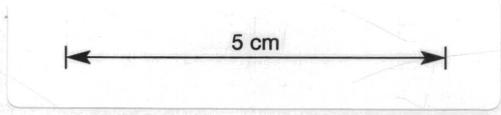


FIGURE 35



thick. Beyond this rock ledge thicker gravel was penetrated by the probe and drill but no "solid rock" was encountered. A ledge of basalt is known to be present along the western margin of Swinging Basin No. 1 near the cement silos site (fig. 34). The rest of the floor of the swinging basin is composed of Quaternary and Tertiary sand, gravel and clay underlain by Jurassic dolerite. By using the data collected by Askew it is possible to trace this ledge along the W bank of the channel from the mouth of the river to the wheat silos site.

On the E side of the river isolated occurrences of basalt have been located in the channel and basalt has been found in the drill holes at Sayers Point. A basalt platform has been mapped beneath the N section of the present breakwater (fig. 35). In this area Askew reported rocks close to the surface (fig. 33, cross section A).

At Sayers Point Evans and Sprigg (1962) reported that basalt was encountered in 6 holes at depths of 17 to 24 feet below low water. It is not known how far beneath the river this basalt extends, but the rock contours drawn on the top of the basalt by Evans and Sprigg are steep, particularly N of Sayers Point. Therefore, it is unlikely that the basalt extended far out into the river from Sayers Point and it is thought that the floor of Swinging Basin No. 2 is composed of Quaternary and Tertiary sand, gravel and clay underlain by Jurassic dolerite (see Hughes, 1957).

North of Swinging Basin No. 1, near the entrance to the navigation channel, Askew struck rock, presumably basalt, sloping down from both the E and W banks of the river (cross-section M, fig. 33). These basalt occurrences may be part of one continuous sheet joined below the depth of Askew's probe and continuing out to sea.

PLEISTOCENE CHANNELS OF THE LOWER MERSEY RIVER

The position and configuration of the present lower Mersey River course dates from Pleistocene times when the river's eroding power was much greater than it is today, allowing the river to cut through the basalt into the dolerite at the gorge upstream from Victoria Bridge. At this locality the position of the Mersey River coincides with that of the Tertiary deep lead of pre-basalt times. The similarity of the pre-basalt and post-basalt positions of the river must be related to the post-basalt topography. After the basalt flowed into the valley, covering the pre-basalt river sediments, the post-basalt topography must have been such that the ancestor of the present Mersey River was deflected away from the softer sediments of the deep lead in the Wesley Vale region and became superimposed on the harder basalt and dolerite. Once the river eroded down into the harder basalt and dolerite it was fixed in its present course.

With its increased eroding power during the glaciation periods of the Pleistocene the river was able to cut through the dolerite into the Permian sediments upstream from Horsehead Creek and through the basalt into the dolerite as far down stream as Swinging Basin No. 1, and possibly as far as the sea, with a basalt ledge

existing on both banks of the present Mersey River. If the basalt ledge postulated on the E bank is continuous to the sea, the present channel of the Lower Mersey River is its only channel.

North of Swinging Basin No. 1, near the entrance to the navigation channel, Askew reported rock, presumably basalt, sloping down from both banks of the river (cross-section M, fig. 33). These basalt occurrences may be parts of a once continuous sheet joined below the depth of Askew's probe in the middle of the navigation channel, and continuing out to sea and linking the basalt of the outer harbour with that on the W bank of the Mersey River and the beach at Devonport.

A third hypothesis is that the basalt on the E bank reported by Askew may be connected with the basalt ledge at the cement and wheat silos and to the basalt at Mussel Rock on the W bank, with a buried Pleistocene river channel beneath the now re-claimed inlet behind the ferry terminal, reaching the sea by routes A or B (fig. 35). From known and suspected outcrops of basalt both channels would appear to have been too narrow to be developed as a site for a possible port.

CONCLUSIONS

(1) Within the limitations of the known rock distribution in the vicinity of Devonport a pre-basalt Tertiary lead existed in the Lower Mersey River. The position and size of the lead cannot be accurately assessed but evidence suggests that it was located near the present Mersey River channel or to the E near East Beach.

(2) It appears that the Mersey River eroded its present course in the Pleistocene, cutting down through the basalt to the underlying Tertiary sediments and the Jurassic dolerite upstream and downstream from Victoria Bridge, as far as Swinging Basin No. 1 and possibly even as far as its present mouth.

(3) In the outer harbour area the basalt point at East Beach extends out to sea for an unknown distance as a rock ledge 3-4 feet high. This ledge has been proved to extend beyond the proposed position of the eastern breakwater and the 3 fathom line.

(4) In the area to be dredged for the outer harbour a flat wave-trimmed platform of basalt occurs and it is thought that this is part of a more extensive wave-trimmed rock platform which extends from the existing breakwater to the rock ledge off the point of East Beach. The platform is covered by gravel and sand and is identical with the rock platform present around the shores of Devonport. The thickness of the gravel and sand is unknown but is considered to be thin. From historical records and the examination of basalt occurrences present beyond the northern extremity of the existing breakwater, the seaward slope of the rock platform must be gentle if the basalt is continuous in this area. If the slope of this rock platform is gentle, the gravel overlying it must be thin.

(5) If the rock platform is not continuous, any Pleistocene river course cut through the basalt in the East Beach area must be narrow.

GEOLOGICAL INTERPRETATION OF THE GEOPHYSICAL INVESTIGATIONS

The results of the sonar boomer traverses (fig. 50) carried out by the Bureau of Mineral Resources (Milsom, 1966) show that over most of the area traversed a strong and constant reflection horizon occurs at a shallow depth of 5 to 10 feet below the sea floor, except on the traverse off the point at East Beach. Here the sonar reflection horizon and the trace of the sea bottom, established independently by means of an echo sounder, coincide. From the underwater mapping it has been established that from this point at East Beach a rock ledge of basalt with no overlying sediments extends out under the sea. The ledge is 4-5 feet high protruding above a wave-trimmed basalt platform covered with a thin layer of water-saturated gravel, sand and silt in the area where the sonar boomer traverses were undertaken. Inshore, the basalt of the wave-trimmed platform is exposed on the sea floor where it is completely unweathered, all products of weathering being removed as soon as formed by the scouring of heavy seas. Such a rock surface is thought to underlie the entire outer harbour area and would provide the strong and constant reflection horizon found along the sonar boomer traverses below a thin layer of water-saturated sediments of gravel, sand and silt.

The two deeper and less consistent reflections found along the sonar traverses are probably from the contact horizon of the basalt with underlying Tertiary sediments, probably clay derived from the weathering of dolerite, and the unweathered dolerite.

UNDERWATER MAPPING TECHNIQUE

Both scuba and hookah diving equipment were used in the outer harbour mapping. Of these two methods the hookah equipment with its unlimited supply of air was found to be more useful, allowing the divers to spend a long time under the water. Scuba was found to be useful close to the shore where rocks prevented the approach of the boat carrying the compressor and air tank (traverse A-A, fig. 50).

After an experimental period, systematic mapping of the outer harbour commenced late in May, 1966, and was completed by the end of July when the weather became too bad for efficient mapping.

Mapping the sea bottom offered no unusual problems. The major problems were those of surveying, mainly locating observation points. Two divers working together swam on compass traverses from located starting points marked by buoys. The attendant boat kept ahead of the divers, sailing on the same compass course. Two surveyors also accompanied the divers in a second boat. When an observation was required, the divers signalled and the boats were stopped. The divers then inflated a small plastic bottle with a nylon line attached to it. The bottle was sent to the surface; the surveyors took up the position marked by the bottle and established its position by compass from known points on the shore. The oil bath prismatic compasses used by the surveyors were not as accurate as hoped because the distances involved were too great for precision. In all except a very calm sea, the surveyors experienced great difficulty in obtaining accurate bearings from a small moving boat. Shore mounted theodolites

were used for traverses close in shore but with most of the traverses the staff could not be read. Range finders mounted on the shore would have been more suitable if they had been available.

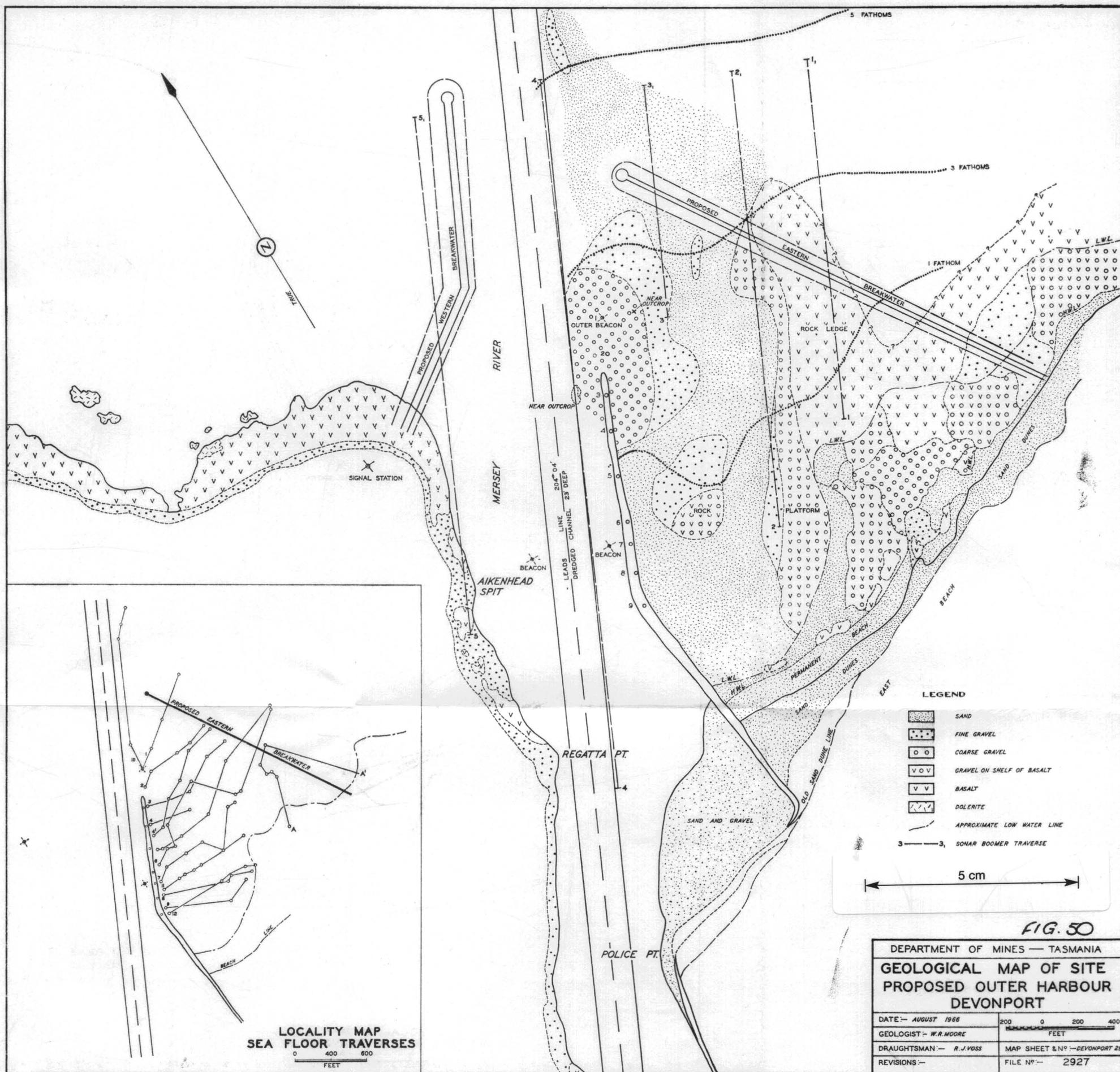
The base map used was an aerial photograph enlarged to a scale of 200 feet : 1 inch with only 4 ground control stations located accurately, i.e., the navigation lead lights, the outer beacon, the southern half of the existing breakwater and the landward end of the proposed eastern breakwater. An accurately surveyed base map showing high and low water level would have been a great advantage.

ACKNOWLEDGEMENTS

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