INVESTIGATION OF
PROPOSALS FOR IMPROVEMENT OF
FISHING PORTS ON FAR NORTH COAST

JANUARY, 1957
HARBOURS & RIVERS BRANCH
PUBLIC WORKS DEPARTMENT OF N.S.W.

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JANUARY, 1957.

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HARBOURS AND RIVERS BRANCH
DEPARTMENT OF PUBLIC WORKS, N.S.W.

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INTRODUCTION:

Since 1946 there have been frequent representations for the improvement of Evans Head to provide safer access for fishing boats. Following the partial destruction of Byron Bay Jetty and the loss of the greater part of the fleet of fishing boats at Byron Bay in the storm of 1954, there have been frequent requests for an adequate and safe harbour in Byron Bay. The fishermen at Byron Bay have stated in deputations to the Minister that they are prepared to pay a levy of one half-penny per pound of fish towards the cost of any scheme.

EXISTING PORTS:

From information supplied by the Fisheries Branch, Chief Secretary's Department, fishing boats now operate from the following places: - Tweed Heads, Byron Bay, Ballina, Evans Head, Iluka, Hannie Waters, Sandon River, Wooli, Woolgoolga, Coff's Harbour, Sawtell and Nambucca Heads. Fishermen's Co-operatives are located at Tweed Heads, Byron Bay, Ballina, Evans Head, Maclean (Clarence River), Wooli, and Macksville (see figure 1).

The draught of a fishing boat may be from 18 inches to 6 ft, the majority being from 3 to 4 feet.

At the present there are a total of 306 boats operating between Coff's Harbour and Tweed Heads and the distribution is as shown in the following table. Information available is not sufficiently detailed to dissect the number of boats engaged in deep sea and estuary fishing. The majority of deep sea fishermen operate only from their home port and fish within a range of 10 to 20 miles of that port. Boats are not equipped to remain at sea for more than 24 hours.
Co-operatives & Associated

Ports | No. of Boats | Length | Draught
--- | --- | --- | ---
Tweed Heads (c) | 13 | 35-40 feet | 3-5 feet
Byron Bay (c) | 12 | 20-45 " | 2-4 "
Ballina (c) | 12 | 30-70 " | 3-6 "
Evans Head (c) | 38 | 25-60 " | 2½-4 "

Maclean (Co-op)

Iluka
Hannie Waters
Sandon River
Wooli (c)

Hacksville (Co-op)

Woolgoolga
Coff's Harbour
Sawtell
Nambucca Heads

φ prior to destruction in February, 1954, 25-30 boats operated and the number was restricted by facilities available at the jetty.

φφ Increased from 7 in 1946.

(c) Indicates Co-operative Society and port.

PRODUCT:

The Fisheries Department gives the following figures for fish, prawns and crayfish handled for the year 1954-55:-

<table>
<thead>
<tr>
<th>Co-op.Soc.</th>
<th>Fish</th>
<th>Prawns</th>
<th>Crabs &amp; Crayfish</th>
<th>Market Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tweed Heads</td>
<td>43,429 lbs.</td>
<td>30,797 lbs.</td>
<td>-</td>
<td>£8,000</td>
</tr>
<tr>
<td>Byron Bay</td>
<td>328,634 &quot;</td>
<td>34,504 &quot;</td>
<td>-</td>
<td>34,000</td>
</tr>
<tr>
<td>Ballina</td>
<td>461,024 &quot;</td>
<td>449,161 &quot;</td>
<td>1,022 lbs. Crabs</td>
<td>100,900</td>
</tr>
<tr>
<td>Evans Head</td>
<td>229,073 &quot;</td>
<td>1,376,426 &quot;</td>
<td>12,914 lbs. Crays</td>
<td>206,800</td>
</tr>
<tr>
<td>Maclean</td>
<td>2,197,807 &quot;</td>
<td>365,436 &quot;</td>
<td>12,341 lbs. Crays</td>
<td>247,400</td>
</tr>
<tr>
<td>Wooli</td>
<td>41,721 &quot;</td>
<td>20,263 &quot;</td>
<td>-</td>
<td>6,400</td>
</tr>
<tr>
<td>Hacksville</td>
<td>284,940 &quot;</td>
<td>47,180 &quot;</td>
<td>27,251 lbs. Crays</td>
<td>37,900</td>
</tr>
</tbody>
</table>

NOTE: Some of this production would have been from estuarial fishing particularly for Maclean and Hacksville.
The following records submitted by the Byron Bay Co-operative show the catch for the six years prior to the destruction of the Byron Bay Jetty:

<table>
<thead>
<tr>
<th>Period</th>
<th>Deep Sea Fish</th>
<th>Netted Fish</th>
<th>Prawns</th>
<th>Market Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/7/48 to 30/6/49</td>
<td>324,063</td>
<td>123,989</td>
<td>-</td>
<td>$22,525</td>
</tr>
<tr>
<td>1/7/49 to 30/6/50</td>
<td>357,656</td>
<td>216,663</td>
<td>16,264</td>
<td>$32,504</td>
</tr>
<tr>
<td>1/7/50 to 30/6/51</td>
<td>275,618</td>
<td>56,375</td>
<td>17,271</td>
<td>$36,992</td>
</tr>
<tr>
<td>1/7/51 to 20/6/52</td>
<td>560,432</td>
<td>100,667</td>
<td>7,212</td>
<td>$44,622</td>
</tr>
<tr>
<td>1/7/52 to 30/6/53</td>
<td>531,481</td>
<td>109,529</td>
<td>56,284</td>
<td>$56,909</td>
</tr>
<tr>
<td>1/7/53 to 31/12/53</td>
<td>486,960</td>
<td>55,596</td>
<td>3,770</td>
<td>$40,860</td>
</tr>
</tbody>
</table>

The Fisheries Branch advises that there is a slight downward trend in the production of fish for all ports and a steady increase in prawns. This is expected to continue.

PROPOSED PORTS:

There are twelve existing ports but representations for improvements have been received only in regard to Evans Head and Byron Bay. No investigations have been made other than for these two from which only deep sea fishermen operate.

At Evans Head the entrance is sometimes bar bound and is frequently dangerous and representations have been made for works to improve the entrance.

Prior to 1954 Byron Bay Jetty was used to unload fish and boats were removed from the water by the jetty cranes for maintenance and when storms were expected. The Bay gives only limited protection from storms.

Three proposals have been put forward for Byron Bay, a breakwater harbour based on the inner cape of Cape Byron (see figure 2), a basin in Belongil Creek with entrance works, and improvements of Brunswick River to make a safe port.

These will be discussed in detail later.

WINDS, WAVES, SAND MOVEMENT, ETC.

The conditions which are found to exist at any unimproved port/
port are the combined result of several factors. On the ocean side
the main ones are waves (which result from winds), ocean currents,
tidal currents and the supply of marine sands. The latter is,
however, dependent on all the others and all may be modified by
local geographical features. All are subject to periodical and
erratic variations with the seasons and the weather.

On the landward side the main factors are topography, rainfall
and tidal compartment which affect the capacity to maintain an
opening to the ocean and to prevent shoaling.

Any scheme for improving or establishing a port must consider
the above factors and how they will affect or be affected by the
proposed scheme.

Records of wave producing winds for a period of twelve months
have been obtained from the Weather Bureau and these are shown in
figure 10.

Wave-refraction diagrams (figure 11a and figure 11b) show the
final directions of ocean waves at the shore and indicate the
resultant direction of sand movement along the beaches. For the
depth of entrance required for fishing boat ports the sand move-
ment by wave action in the breaker zone would have more effect than
littoral currents.

Aerial photographs were taken at monthly intervals for a period
of fifteen months, from July, 1955, to September, 1956, to record
any seasonal changes in the vicinity of the proposed ports and to
show the movement of sand and shoals. Typical photographs for each
port are attached to this report.

Hydrographic surveys for the various proposals were carried out
from September, 1955, to January, 1956.

REQUIREMENTS FOR A FISHING PORT:

The following are the main requirements for a fishing port on
this part of the coast:

1. Access with at least 6 feet depth at low water - width about
   150 feet.
2. Entry and exit to be reasonably safe in weather suitable for fishing. (With the tidal compartments existing or necessary for the proposals considered, it would not be possible to be sure of safe entry during an ebb tide for all weather conditions under which boats could be at sea, except at extremely high cost).

3. Secure anchorage for about 40 boats (with the possibility of expansion if required) to a depth of six feet at low water minimum.

4. Area for jetty with freezing and processing works adjacent.

5. Road access to jetty and rail within a reasonable distance.

**INDIVIDUAL PROPOSALS:**

(a) **Byron Bay - Breakwater Harbour:**

The approximate location for a breakwater harbour in Byron Bay as proposed by the local fishermen is as shown in figure 2.

Aerial photographs show that there is a large sand movement around Cape Byron. Both wave action and the prevailing littoral current within the Bay, which is from east to west at this location, would carry sand westward past the end of the proposed breakwater. With the refraction of waves that would occur around the end of the breakwater portion of this sand would be carried into and deposited in the proposed harbour.

Although wave refraction diagrams show that there is little if any tendency for sand to move easterly along the beach towards the proposed harbour area, photographs and other records show that at times there is a large build up of sand west of the inner cape on which the proposed breakwater would be based. This action would continue after the construction of the breakwater but accentuated by waves refracted around its outer end. The natural forces which now periodically remove this accumulation of sand would not act after construction of the breakwater and progressive shoaling of the harbour area could be expected.

Provision of a gap in the breakwater as advocated in earlier proposals/
proposals would not relieve shoaling but could be expected to make it more rapid as both wave action and littoral current would move sand through the gap to augment that moving around the end of the breakwater.

It is also possible that construction of a breakwater might cause a back eddy along the beach from west to east and further add to the tendency of shoal.

The proposed harbour or any modification to same seems so certain to shoal that further consideration is not warranted. In addition, the proposed works could not be constructed for less than £500,000.

(b) Belongil Creek:

Belongil Creek is a creek with a catchment of 8.8 square miles and outlet to the sea through the coastal dunes north of Byron Bay jetty. The catchment is mostly flat and sandy with low run-off. The creek is not able to maintain a permanent opening and the outlet location varies over a distance of about a quarter of a mile. The beach reforms between the ocean and the creek and it has sometimes been necessary to cut an artificial outlet to release stored rainwater and the opening made has closed rapidly by natural processes. Only six of the twelve photographs taken show the entrance open and then only in the form of a narrow gutter.

Although the creek has an area of about 20 acres between the railway line and the beach which is normally covered with water, this area has a bottom which is at about mean high tide level (see figure 4). Any works to establish a port would, therefore, involve dredging a basin as well as stabilising an entrance.

To maintain an entrance with six feet depth at low water and width of 150 feet, a tidal compartment of about 30 acres at mean sea level, would be required. The entrance to such a basin if constructed would not remain open unless confined. An entrance although confined would not remain open without an adequate tidal compartment.

A combination of breakwaters and training walls, as shown in figure 4, seems to be required to give a reasonably satisfactory entrance. It might be possible to omit the northern breakwater as sand movement appears to be almost entirely to the north. (Several
photographs show shoals of sand moving north along the beach). All waves, other than those from the north east, will cause a northerly drift and only those north of north east would cause any southerly movement. However, winds from this direction are frequent at certain periods (see figure 10) and it seems that two breakwaters would be advisable.

The minimum works required to provide a reasonably satisfactory port would be:-

- **Southern Breakwater**: 900 lin.ft.
- **Northern Breakwater**: 700 " "
- **Training Walls**: 1500 " "
- Dredge basin of 20 acres to 6' depth at low water.
- Dredge or excavate tidal compartment of 300 acres, to R.L. 0.0 (Low Water Datum).
- Dredge entrance channel.
- Stabilise sand between breakwaters and training walls.

For the height of waves that could reach the breakwaters it would be necessary to use stone or blocks of about 4 tons weight and to construct the southern breakwater to a height of about 15 feet above low water and the northern to about 10 feet.

As there is but little runoff from the catchment of Belongil Creek, the basin could be expected to need frequent dredging to remove sand carried in by tidal action. Although provision of a 300 acre tidal compartment would result in the entrance channel remaining clear, sand would still be carried into the basin by tidal action but would not be removed.

Estimated cost of necessary works would be:-

- **Breakwaters**: 52,500 tons stone @ £2. 2. 0 £110,250
- **Training walls**: 9,800 " " @ £1. 2. 0 10,780
- **Plant & establishment L.S.**: 60,000
- **Dredging and excavation 5,220,000 cu.yds. @ 2/6d.**: 625,500
- **Total - say**: £806,530

Probable annual dredging charges £10,000 per annum

Previous reports on proposals for Byron Bay indicate that suitable stone for breakwaters and training walls is available.
within about four miles.

(c) Brunswick Heads:

The Brunswick River has a catchment of 23 square miles and a tidal compartment of about 300 acres. The entrance channel has apparently been stable since the earliest records in 1883 with a depth of about six feet at low water and a width of 150 to 200 ft. However, a bar forms which has a depth of from 2 to 3 feet and the direction of the outer channel varies considerably.

The entrance lies between a rocky bluff and reef on the north and a sand spit on the south. Photographs show that the outer portion of the entrance channel may vary from a position hard against the northern reef requiring a north-easterly approach, to south-easterly along the southern beach. The channel seems to favour a position slightly north of east and passing between a rock pinnacle and the northern reef. The rock pinnacle lies on the centre line of the inner channel and about 150 ft. south of the reef. This pinnacle, although not found during the hydrographic survey, shows clearly in the photographs. Fishermen say that its top is at about the level of low water.

Although there is a large tidal compartment, areas with sufficient depths for anchorage are limited and channels are shallow, restricting the movement of boats except at high tide. Only 12 boats at present use the river. The location of anchorages may be seen in photographs of figure 7.

In addition to the shallow bar at the entrance the rocks to the north of the entrance channel are dangerous except in calm weather. The pinnacle previously referred to and two other rocks whose location is shown approximately in fig. 6, have frequently damaged boats. (It has not been possible to accurately locate the rocks to date as they are usually hidden by surf). These rocks are particularly dangerous when waves are from the north east as boats then have to approach the entrance from that direction, just skirting the reef, and then turning sharply into the channel. The fishermen are very anxious to have these rocks removed.

To/
To provide a reasonably satisfactory port it would be necessary to construct breakwaters to stabilise the entrance and prevent the shallow bar forming. It would also be necessary to improve the inner section to give more anchorage space and better channels.

Movement of sand into the river seems to be large. When shoals are removed by floods or freshes they reform very quickly. Photographs show that shoal conditions return in under six weeks. In all photographs taken the shape of the southern sand spit indicates a large inward movement of sand, both water borne and wind blown. This movement would have to be reduced if the internal channels are to be improved without excessive dredging.

Wave refraction diagrams show that sand movement towards the entrance can come from either the north or the south. North east winds cause a southerly drift and south east winds a northerly drift. Winds from both directions are frequent (fig.10). It would, therefore, be necessary to construct breakwaters both north and south of the entrance to satisfactorily reduce sand movement into the river. There is also a movement of wind driven sand from the southern beach towards the junction of the main and South Arms of the river.

Construction of breakwaters as shown in fig.6, would be necessary to provide a depth of 6 ft. at low water and also reduce inward sand movement. Two alternatives are shown, which would be of about the same cost. That shown by continuous lines seems to be the best location for ease of entry and is also on the line of the most constant channel as shown by aerial photographs. Before choosing the final location it would be necessary to determine accurately the location and depth to rock.

Under present conditions a large internal shoal forces the main arm of the river to deviate to the north. Construction of a training wall, as shown in fig. 6, would maintain a straight, deeper channel and probably improve depths in the north arm also.

A possible suitable location for a jetty and processing and packing plant would be near the end of Tweed Street.

The minimum works necessary to make a reasonably satisfactory
Port would be:

Northern Breakwater  800 lin.ft.
Southern     "     1200 " "
Training Wall    800 " " (plus 800 ft. access)
Sand Stabilisation - Southern Beach

The breakwaters would need to be constructed to about 15 ft. above low water and have stone or blocks of 4 ton weight.

An estimate of cost is:

<table>
<thead>
<tr>
<th></th>
<th>Breakwaters</th>
<th>Training Wall</th>
<th>Access to Training Wall</th>
<th>Sand Stabilisation</th>
<th>Plant &amp; Establishment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>72,000 tons stone @ £2.3.0</td>
<td>15,500 &quot; &quot; @ £1.3.0</td>
<td>2,000 cu.yds. sand @ 2.0</td>
<td>1,000 &quot; &quot; quarry waste @ £1.0.0</td>
<td>L.S. 1,000</td>
</tr>
<tr>
<td></td>
<td>£154,800</td>
<td>15,295</td>
<td>200</td>
<td>1,000</td>
<td>L.S. 60,000</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Total - £232,895</td>
</tr>
<tr>
<td>Say</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Say - £232,000</td>
</tr>
</tbody>
</table>

The nearest suitable stone located is at Yelgun about six miles from the entrance. This is basalt. A detailed search, however, may locate a closer quarry site.

There is stone within a mile of the entrance near the bridge over the middle arm but this is a schist which does not appear suitable for breakwater construction.

If funds are not available for construction of the full scheme, it would be possible to make the entrance safer by removing the three rocks referred to previously, although this would not improve the bar or make the entrance workable for any greater number of days per year.

The internal channels could be improved and additional anchorage space obtained by constructing the training wall shown on Fig. 6. The inward movement of sand would still continue, however, without breakwaters.

Sufficient detail is not available to estimate the cost of removing the rocks but it would probably be about £3,000, though this would depend largely on weather conditions. Cost of construction/
construction of the training wall would be very much higher than if done in conjunction with breakwaters - probably about £30,000 total cost.

(d) Evans Head:

The Evans River enters the ocean to the north of a rocky headland. The entrance which is 120 to 150 feet wide and 7 feet deep (within the bar) is confined between the headland and a rock outcrop which is usually almost covered by the beach sand.

The river has a tidal compartment of about 820 acres. Freshes and flood flow depend upon flow from the Richmond river over Tuckombil Weir rather than on local rainfall. The catchment below the weir is about 30 sq. miles, a large portion of which is flat and sandy.

Internal channels are ample for manoeuvring and anchorage of the 38 boats using the port. There is, however, a large movement of marine sand into the river and a large shoal forms on the north side which interferes with access to the jetty. If a long drought period occurred, this shoal would probably seriously hinder movement of boats in the river, as happened prior to the 1953 flood. The shoal, of recent years, has been periodically removed by floods but it reforms rapidly. Aerial photographs show that, following removal by a flood, it reformed in six weeks.

Outside the entrance a bar forms which is usually 3 to 4 feet below low water but may be as little as one foot or less. A study of aerial photographs and information supplied by fishermen, indicate that the direction of the outer channel may vary from nearly due east to north. Sometimes a shoal forms directly opposite the channel and the channel runs parallel to the beach for about 800 feet. Boats are then forced to enter a narrow channel through the breakers and make a right angle turn when almost on the beach, and entry is only possible in good weather. Of recent years an average of one boat per year has been lost trying to enter or leave the port. The average cost of a boat is about £2,500.

To provide a reasonably satisfactory port, it would be necessary to stabilise the entrance, prevent the formation of a bar with less than six feet depth at low water and also reduce the movement of sand into the river.

Wave refraction diagrams show that ocean waves from the north
east would move sand along the beach towards the entrance. Waves from the east would have only slight effect in moving sand along the beach but would move sand from the bar into the entrance. Waves from the south east would have a slight tendency to move sand along the beach and away from the entrance.

Aerial photographs show large quantities of sand off the headland and indicate a northerly sand movement. Fishermen also claim that there is a large movement of sand to the north past the headland. The manner in which the bar forms and the tendency of the channel to swing to the north also indicate a sand movement in this direction. Following a flood or a fresh, the bar is removed and the channel runs approximately north east for a period. The bar then reforms and eventually a shoal or spit forms based on the headland and extends northward forcing the channel to follow the beach. Photographs show this process repeating three times during the period of investigation.

Although a single breakwater to the north of the entrance would probable be sufficient to stabilise the entrance and provide the depth of bar needed, two breakwaters, as shown in fig. 8, are considered necessary to reduce the inward movement of sand.

The minimum works required to make a reasonably satisfactory port are:

- Eastern Breakwater: 600 lin.ft.
- Northern Breakwater: 800 sq. ft.

The Eastern Breakwater would need to be 15 feet above low water and the Northern about 10 feet. Stone of 4 ton weight would be required.

The estimated cost of the work is:

- Breakwaters: 53,000 tons stone @ £2
- Establishment and plant L.S.: £60,000
- Total: £166,000
- Say: £170,000

Internal maintenance dredging should only be required at long intervals with reduced inward movement of sand.
Subject to test, suitable breakwater stone appears to be available at the base of the Eastern Breakwater. There are other likely sources within about five miles on the north side of the Evans River.

Present conditions are such that dredging of the entrance shoal could not be expected to maintain the channel in a satisfactory direction and condition. Only a small dredge could be used and then only in perfect weather conditions and removal of sand would not exceed the build up.

CONCLUSIONS:

Of the three proposals to make a port at or near Byron Bay, one only, Brunswick Heads, appears to offer possibilities at a reasonable cost.

The proposed breakwater harbour at Cape Byron is not feasible because it would shoal. The Belongil Creek scheme, though possible, would be very expensive to construct and would require frequent dredging.

Brunswick Heads could be developed to make a reasonably satisfactory port at a cost of about £232,000. Maintenance dredging should only be required at long intervals. It seems that if a port were made at least thirty boats could be expected to use it and that the annual catch would be upwards of 750,000 lbs. of fish and prawns, with a value of about £70,000.

Evans Head, although well-established as a fishing port, is frequently difficult and at times dangerous to enter. The entrance would be made reasonably safe and internal shoaling reduced at a cost of about £170,000.

At present 38 boats are based at Evans Head and the annual catch is about 1,600,000 lbs. of fish and prawns, having a value of about £200,000.

The two ports serve different fishing grounds and existing nearest ports of Tweed Heads and Ballina are not close enough for the type of boats in use.

The works proposed for both Evans Head and Brunswick Heads
are such that they could be constructed with a minimum of special plant. If necessary they could be carried out over a number of years with a yearly expenditure of, say, £50,000.

The approximate annual interest and repayment cost for the proposals would be £9,300 for Evans Head and £12,700 for Brunswick Heads. With annual maintenance charges these figures would probably be about £10,500 and £14,000 per year respectively.

At Evans Head the present value of production is about £900,000 per year and one boat per year, with an average value of £2,500 is lost because of the entrance conditions. Therefore, an increase of £8,000 or 4% on present production would justify the cost of the necessary entrance works.

The present production at Byron Bay is worth about £34,000 per year and it appears that it would increase to about £70,000 per year with a harbour at Brunswick Heads. This increase in value of production would be nearly three times the annual cost of works necessary to provide a port.

The Chief Secretary's Department has been consulted with regard to present conditions, requirements, probable future trends and possible benefits to be derived from the proposed improvements. It appears that sufficient prawns are available to permit doubling the present catch and that although at present untouched, pilchard and tuna fishing could be developed. Interest is also growing in catching "banana" prawns off the Queensland coast for export to America although this applies only to ports from Evans Head North. To fully exploit the potentialities of the far north coast fisheries safe harbours at close intervals are required as boats will have to venture farther from their home ports. Development of Brunswick Heads and Evans Head would help and it seems that increased production at least equal to and probably greater than required for economic justification of the proposed improvements could be expected.
In deputations to the Minister, the Byron Bay fishermen have indicated that they would be prepared to pay 3d. per lb. on all fish sold as a contribution towards the cost of constructing a harbour. This would probably amount to about £1,500 per year.

The Maritime Services Board does not charge fishing boats any fees, other than nominal mooring fee, and unless special provision is made no return would be obtained from that direction.

Should it be decided to make funds available to improve facilities for fishing boats on the North Coast, it is recommended that Brunswick Heads and Evans Head be improved.
NOTES
Soundings taken by Mr. E. M. Beach in November, 1955.
Field Book No. 2413-6, Level Book No. 3427.
Soundings and Levels are in feet reduced to zero of Tide Gauge (approx. L.S.W.)
which is 12.9 feet below B.M. Ed. cut on S.E. car Railway Bridge over Belongil Creek.
Azimuth from Mr. G. Brooks' survey of 1926.

R 49/22 from Sale
R 49/23 from Lease
generally for Public
Recreation and
Preservation of Native
Flora.
Notified 30th July, 1913.

FIG. 2
DEPARTMENT OF PUBLIC WORKS N.S.W.
BYRON BAY
PROPOSED BREAKWATER.
SOUNDINGS

D 298
64/105
SCALE: 300 FT. TO AN INCH.

J. M. MAIN
DIRECTOR PUBLIC WORKS

R. G. Caroll

PRINCIPAL SURVEYOR

PRINCIPAL ENGINEER HARBOURS & RIVERS
4-5-56
Showing -
Wave refraction around inner cape
and sand shoals west of inner cape.
Sand to north and east of Cape Byron
following a storm.

10-9-56
Showing -
Sand west of inner cape.
Sand shoal at eastern extremity
of Cape Byron.

BYRON BAY
AERIAL PHOTOGRAPHS

FIG 3
Belongil Creek closed by sand.
Sand shoals moving north along beach.

Belongil Creek open.
Sand shoals moving north.

Other photographs not included show entrance varying in position from that shown on 10-9-56 to near dunes to south - entrance was open on six occasions but always as narrow gutter.

**BELONGIL CREEK AERIAL PHOTOGRAPHS**

**FIG. 5**
BRUNSWICK HEADS DESIGN AND CONSTRUCTION.

REFERENCE: Chart Datum.

Mr. Engel has found that there are weaknesses in the existing method of calculating tidal gradients leading to inconsistencies in the method of transferring chart datum.

The original values obtained by Mr. E.M. Beach in 1956 are:
1. Bench Mark 2/B : RL 7.48
2. Chart Datum from the ocean to about the confluence of the South and Main Arms : RL 0.00
3. Chart Datum from the confluence to the bridge over the Main Arm : RL 1.00

The values obtained by Mr. Engel in 1964 are:
1. Bench Mark 2/B : RL 7.45
2. Chart Datum from the ocean to the confluence of the South and Main Arms : RL minus 1.11
3. Chart Datum from the confluence to the boatharbour : RL minus 0.66
4. Chart Datum from the boatharbour to the highway bridge : RL minus 0.32

The values as derived by Mr. Engel in 1965 should be adopted for all soundings but the above inconsistencies should be allowed for purposes of comparison between the two surveys.

Principal Surveyor.

2.12.65

District Engineer,
Eismore.

Min 457 has been discussed with Mr. R. Engel.

Mr. Engel states that the conflict between the two sets of figures is due to weakness in the method of calculating tidal gradients. It has been pointed out previously that the method in use does not give consistent results and needs review, there is no question as to the validity of either survey.

Regardless of the doubts on the tidal gradient the information shown on plans 165/82 is an accurate representation of conditions at Brunswick Heads during October - November 1964.

Minute 459 is recommended for issue in lieu of min 457.

Principal Surveyor.

[Signature]

Senior Surveyor.

[Signature]

Principal Engineer,
Harbour & Nares.

[Signature]

M. Nuline
4-5-56
Showing -
Internal shoal removed by flood
Main arm channel almost straight
Outer entrance channel swinging to south east

10-9-56
Showing -
Normal position of internal shoal forcing main arm to north
Inward movement of sand on southern spit
Outer channel ill defined - running slightly north of east
Rock pinnacle at southern edge of channel reef to north

Other photographs not included show that the outer channel varies between locations shown, but appears to favour position of 10-9-56

BRUNSWICK HEADS AERIAL PHOTOGRAPHS

FIG. 7
EVANS HEAD

Scale

Soundings taken by Mr. E. M. Beach during September and October 1955.
First Book No. 2403-1407, Land Book No. 1406.

TIDAL GRADIENT

Times and Mean High Water are recorded on the adjacent chart.

TIME GRADIENT

Times of Low Water are shown on the adjacent chart.

CO-ORDINATES

CO-ORDINATES

NOTES

Sounding are in feet and reduced to mean lower low water.

BENCH MARKS

Soundings are in feet and reduced to mean lower low water.

Proposed works shown in red.

Fig. 8
4-11-55
Showing:
Internal shoal on north side.
Outer channel running N.E.
Bar in form of spit based on headland starting IRonne
channel along beach.
Boats crossing bar at high tide.
Rock outcrop showing on beach.

March 1956
Showing:
Shallow secondary channel
stressed through internal shoal
by fresh in the river.
Outer channel not visible
(a later photograph shows a
deep secondary channel and
shoal almost removed following
a flood.)

14-6-56
Showing:
Internal shoal normal condition.
Outer channel running north along
beach - no definite entry point.
Fishing boats at anchor.

12-7-56
Showing:
Outer channel following beach
entry about 1000 ft. north of
headland.

Photographs not included show the entrance
in varying positions between those illustrated
- also sand movement around the eastern end
of the headland.

EVANS HEAD
AERIAL PHOTOGRAPHS

FIG. 9
NOTE
Dotted lines are fathom contours - 4 fathom intervals
Continuous lines are wave orthogonals (i.e. at right angles
to wave crests). Diverging orthogonals indicate a lengthening
wave period and reduced energy per unit length.
NOTE

Dotted lines are fathom contours - 4 fathom intervals.
Continuous lines are wave orthogonals (ie at right angles
to wave crests). Diverging orthogonals indicate a lengthening
wave crest and reduced energy per unit length.

FIG II.b

DEPARTMENT OF PUBLIC WORKS N.S.W.

HARBOURS & RIVERS BRANCH

EVANS HEAD

WAVE REFRACTION DIAGRAMS

WAVE PERIOD 10 SECONDS

J. M. MAIN
DIRECTOR OF PUBLIC WORKS

PRINCIPAL ENGINEER

DRAWN DATED: 2.2.55
TRACED: 12.2.55
CHECKED: 12.2.55

SCALE: 1:10000 ft to inch