

**ADDU CORAL MINING / BEACH EROSION
STUDY**

30 JANUARY - 1 FEBRUARY 1990

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Fig 11 - Areas where aggregate is collected.

ADDU CORAL MINING/BEACH EROSION STUDY

EXECUTIVE SUMMARY

OBJECTIVES OF THE STUDY

- 1 to assess the seriousness of beach erosion and its link, if any, with coral mining.
- 2 to propose possible sites and alternatives for building materials for use by the population.

1 ADDU - MINING FOR CONSTRUCTION MATERIAL

1.1 - Coral mining

- 1 Coral mining is not the major cause of beach erosion in Addu. The link is only obvious at Hithadhoo Corte (fig.1, plate 1) which is uninhabited.
- 2 Continuing coral mining on the reef flat, lagoon and open ocean side of house reefs, will give rise to increasing environmental problems because it will:-
 - i reduce the level of protection afforded to beaches from wave action.
 - ii reduce the capacity of reefs to grow, provide additional beach material, and respond to projected sea-level rise.
- 3 Population increase and the expanding economy are likely to maintain demand for coral if alternatives are not used.
- 4 For these reasons, and until alternative building materials are readily available coral mining in Addu should be restricted to the areas identified on the accompanying map (fig. 2).
- 5 Artificial restoration of the reef areas that have already been mined is not practical.
- 6 The eroded beach at Hithadhoo Corte should be left to stabilise to the new wave regime created by mining.

1.2 - SAND MINING

- 1 Sand mining from beaches is widespread and is a significant general cause of beach erosion in Addu. It will become increasingly significant if it is not managed properly.
- 2 There are huge deposits of sand in shallow water at various locations in Addu atoll. For these reasons sand mining should not occur on beaches and should be restricted to the areas identified on the accompanying maps (figs. 3-5).

A facility to provide sand from these deposits is also a recommendation of the ODA report. (Report on Addu Atoll causeways ^{appraisal} - Maldives, 1989)

1.3 - AGGREGATE MINING

- 1 Aggregate mining from beaches is a localised cause of beach erosion on the west shore of Hithadhoo (plate 1) and parts of the east shore of Meedhoo (fig. 6, plate 2). Beach erosion will become increasingly significant if beach mining is not restricted.
- 2 For this reason aggregate mining in Addu should be restricted to the area 20m behind the beach lines on Hithadhoo between Corte and Hithadhoo village (fig. 7).

2 ADDU - RELATED ENVIRONMENTAL PROBLEMS

2.1 - CAUSEWAY CONSTRUCTION

- 1 The most serious reason for beach erosion on Fedu, Maradu, Hankada, and the southeastern end of Hithadhoo is the presence of solid causeways (fig. 8, plate 3-4).
- 2 The environmental problems associated with these solid causeways have already been the subject of a preliminary investigation undertaken in September 1989 and entitled 'Report on Addu Atoll Causeways Appraisal - Maldives'.
- 3 The recommendations of that study are endorsed by this team and should be pursued as a matter of urgency. They are that:-
 - i. a programme of beach replenishment be initiated to replace material which is now being carried away by long-shore drift (report paragraphs 3.20-3.24).
 - ii. there should be a survey of the existing beachlines (report paragraph 3.25).
 - iii. there should be initial opening of only one causeway - the Gan-Fedu Causeway (report paragraph 4.2).
 - iv. It may prove beneficial and prograde (advance) the beach where it is eroding on the lagoonside of the Fedu end of the Fedu-Maradu causeway by positioning a detached breakwater offshore.
- 4 The Maradu end of the Fedu-Maradu causeway is in serious danger of undercutting and collapse (plate 4) and the bank should be shored up.
- 5 The two (approximately 3ft bore) pipes under the Gan-Fedu Causeway should be removed and replaced with boxed culverts.

2.2 - CHANNEL OPENING BETWEEN HULHUDHOO and HERETHERE

- 1 Beach erosion between Hulhudhoo and Herethere has resulted from the opening of a channel between the two islands in the late 40's (fig.6, plates 5,6).
- 2 The rate of erosion will probably reduce as the channel gets wider though exceptional storms and tidal surges may temporarily increase this rate.
- 3 The team sees no objection to the local plan to reconnect the two islands except to warn:-

- i that the sand will not return in the short term unless the sand is replaced there artificially.
- ii the resulting lack of water-flow through the gap may adversely effect sea-water quality in the vicinity of Hulhudhoo village.

Provision of a boxed culvert in the centre of the causeway may limit this problem.

3 - NATIONWIDE - RELATED ENVIRONMENTAL PROBLEMS

The environmental problems facing Addu are mirrored throughout the Maldives. To some extent some general recommendations can be made. They are that:-

- 1 A long-term management plan be introduced to reduce the use of mined coral for construction purposes throughout the Maldives:-
 - i No coral mining on house reefs (note 1).
 - ii No sand mining on beaches
 - iii Identification of suitable sites for sand and coral mining in each atoll (note 2).
 - iv Tax concessions on imported aggregates.
 - v Sand/cement/imported aggregate blocks be used for all aid funded, government, and tourism sector, projects.
 - vi Boundary walls to be constructed from cement blocks.
- 2 Each case for solid causeway or jetty removal in the Maldives should be individually considered since resulting erosion may be severe and alternative forms of mitigation more effective.
- 3 The costings and specifications should be obtained for a small-scale facility to provide piling for open causeways and jetties on local islands.
- 4 Serious consideration should be given to undertaking an aerial photographic survey of the entire Maldives archipelago for comparison with the 1969 set and to act as a baseline for any future surveys.

Note 1 : See the letter dated 23 January 1990 reference 1-A/84/90/28 at Appendix 10.

Note 2 : The results of the ODA/Ministry of Public Works and Labour mining feasibility study will be relevant to North and South Male' Atoll.

BEACH EROSION SURVEY

TERMS OF REFERENCE

- 1 To visit Addu atoll, identify the seriousness of beach erosion and its link, if any, with coral mining.
- 2 To propose possible sites and alternatives for building materials for use by the population.

INTRODUCTION

The beach erosion survey was initiated by letter reference 1-A/100/89/373 dated 4th December 1990 from the Presidents Office to Ministry of Planning and Environment. A rough translation of the letter is as follows:-

Do you
mean
1989?

quote

'Possible degradation and major beach erosion has been reported to the Presidents Office due to unmanaged coral and sand mining for housing and other purposes in the inhabited islands of Addu Atoll.

A team has been appointed by the presidents Office to determine any possible effects due to the above activities and includes the following Ministries:-

- 1 Ministry of Planning and Environment.
- 2 Ministry of Atolls Administration.
- 3 Ministry of Fisheries and Agriculture
(Marine Research Section).

A preliminary report has to be presented to the Presidents Office by this team within two months identifying these effects if any.'

unquote

The concern that coral mining may cause beach erosion is a real one. Coral rock, in the intertidal and immediate sublittoral, reduces the level of wave energy incident upon the shore which, in turn, determines the shape of the beach. Removal of this coral, whether living, or dead, can alter the wave regime and hence the form of the beach. This alteration is manifested as erosion or deposition.

Coral rock carried from the reef front in severe storms forms the rubble rampart on atoll rims. This rampart is consolidated by calcareous algae to form reef bedrock which can sustain the pounding surf and reduce the wave energies crossing the reef top and entering the atoll lagoon. Any rubble carried nearer to the shore is consolidated into bedrock or is eventually broken down to form beach sand. This sequence of processes is likely to be the major mitigator of projected sea-level rise and the increase in incidence of storms. This sequence also creates and maintains the present form of the islands. It is therefore important that coral is not mined from the outside edge of the atoll, near to any islands, and that coral rubble, and live coral, is not taken from the reef top near to islands.

PERSONNEL

Three representatives from various Ministries and one expatriate seconded to MRS visited Addu for three days from 30th January 1990 to 01 February 1990. They were:-

- | | |
|-------------------------|--|
| Hussain Shihab (Leader) | - Ministry of Planning and Environment |
| Mr Nizam | - Atolls Administration |
| Hassan Maniku Maizan | - Marine Research Section, Ministry of Fisheries and Agriculture |
| Dr Alec Dawson Shepherd | - Marine Research Section, Ministry of Fisheries and Agriculture |

ITINERARY

30 January

- 0800 Depart Male' for Addu
- 1100 Arrive Addu
- 1200 Meet Atoll Chief Mohamed Ibrahim Didi
- 1400 Visit causeways and Corte
- 1600 Interview with coral collector at Atoll Office

31 January

- 0900 Depart Gan for Hulhudhoo
- 0930 Meet baifishermen at reef site
- 1030 Meet Island Chief of Hulhudhoo
Visit site of beach erosion due to creation of channel between Hulhudhoo and Herethere
- 1200 Meet Island Chief of Meedhoo
- 1230 Visit sites of beach erosion on north and east shores of Meedhoo Interview with coral collectors of Meedhoo
- 1400 Depart Hulhudhoo for Gan
- 1500 Arrive Gan
- 1600 Visit Gan-Fedu, Fedu-Maradu, Maradu-Hankada, Hankada-Hittadu causeways at high tide
- 1730 Return Gan

01 February

- 0900 Visit causeways and Corte at low tide
- 1130 Concluding meeting with Atoll Chief
- 1200 Return to Gan
- 1400 Depart Gan for Male'
- 1530 Arrive Male'

DESCRIPTION OF VISIT

- Appendix 1 - Meeting with atoll chief
- Appendix 2 - Existing and potential building demand
- Appendix 3 - Chits issued by Atoll Office for collecting coral from Hithadhoo.

- Appendix 4 - Interview with coral miner
- Appendix 5 - Interview with Hulhudho Kathib
- Appendix 6 - Interview with Meedhoo Kathib
- Appendix 7 - Status of causeways
- Appendix 8 - Status of beaches
- Appendix 9 - Terms of reference letter
- Appendix 10 - Coral and sand mining notification

SUMMARY OBSERVATIONS AND RECOMMENDATIONS

The team found that beach erosion was of critical concern only around the Fedu-Maradu-Hankada causeways and was generally not due to coral mining. The team supports the explanation of the ODA report 'Report on Addu Atoll Causeways appraisal - Maldives' that erosion on Fedu and Maradu is a consequence of causeway construction. It is advised that the recommendations of that report are followed-up as a matter of urgency. They are that:-

- i. a programme of beach replenishment be initiated to replace material which is now being carried away by long-shore drift (report paragraphs 3.20-3.24).
- ii. there should be a survey of the existing beachlines (report paragraph 3.25).
- iii. there should be initial opening of only one causeway - the Gan-Fedu Causeway (report paragraph 4.2).
- iv. It may prove beneficial and prograde (advance) the beach where it is eroding on the lagoonside of the Fedu end of the Fedu-Maradu causeway by positioning a detached breakwater offshore.

In the meantime it should be noted that the Maradu end of the Fedu-Maradu causeway is in serious danger of undercutting and collapse (plate 4) and the bank should be shored up.

The laying of two (approximately 3ft bore) pipes under the Gan-Fedu causeway serves only one limited purpose - to increase water circulation and so reduce the smell near the Gan end of the causeway. The works require urgent improvement or subsidence might occur. They should involve the removal of the existing works and replacement with re-inforced sulphate cement concrete slabs to produce boxed culverts. The boxed culverts should be longer than the width of the causeway and the openings should be faced with cement and regularly maintained to prevent erosion.

Only one site near Hithadhoo Corte (fig. 1, plate 1) shows any link between coral mining and beach erosion. Dead coral in the intertidal and immediate sublittoral has been removed resulting in increased wave energy reaching the shore. The problem is not significant and the area is not inhabited. Further deterioration will occur but will be reduced (unless there is a severe storm) if further mining is stopped in this region.

Minor beach erosion on the north east shore of Meedhoo (fig. 6, plate 2) is due to a number of factors.

- 1 Aggregate is directly mined from the beach.
- 2 Coral rubble has been removed from the reef rampart resulting in increased wave energy reaching the shore.
- 3 Severe storms have caused short term erosion.

The rate of erosion will be reduced if aggregate mining and rubble collection are banned and the reef remains healthy.

The present and future demands of coral, coral aggregate, and coral sand are substantive and, without regulation, there is likely to be deterioration of beaches and reefs that will cause increased beach erosion and reduced reef capacity to respond to projected sea-level rise.

There are substantial sublittoral sand deposits that can meet projected demands for sand if they are exploited. The location of deposits is shown in the accompanying map (fig.3 southeast from Hithadhoo Jetty, fig.4 off the Gan-Fedu and Fedu-Maradu Causeways, fig.5 off Meedhoo Jetty). Substantial deposits of aggregate exist behind beach lines at Corte, Hithadhoo (fig.7) and could be exploited in the short (10 year term). Imported aggregate might be needed after this time.

Removal of live coral and coral rubble in the vicinity of islands should be prohibited (see letter at appendix 10). Efforts to minimise the use of coral for building should be introduced. The locations of areas for coral mining to meet special needs, and as a short-term measure, are shown in the accompanying map (fig. 2). Coral mining should not be allowed anywhere else in the atoll.

In the longer term there is a need to encourage a reduction in the use of mined coral for construction purposes throughout the Maldives. A framework for achieving this is recommended below:-

- i No coral mining on house reefs.
- ii No sand mining on beaches.
- iii Identification of suitable sites for sand and coral mining in each atoll.
- iv Tax concessions on imported aggregates.
- v Sand/cement/imported aggregate blocks be used for all aid funded, government, and tourism sector, projects.
- vi Boundary walls to be constructed from cement blocks.

Beach erosion between Hulhudhoo and Herethere (fig.6, plates 5,6) has resulted from the opening of a channel between the two islands about 40 years ago. The rate of erosion will probably reduce as the channel gets wider though exceptional storms and tidal surges may temporarily increase the rate of erosion. The team sees no objection to the local plan to reconnect the two islands except to warn:-

- 1 that the sand will not return in the short term unless the sand is replaced there artificially.
- 2 the resulting lack of water-flow through the gap may adversely effect sea-water quality in the vicinity of Hulhudhoo village. The provision of a boxed culvert in the centre of the causeway may alleviate this problem.

The lesson of increased erosion associated with creating a channel between Hulhudhoo and Herethere re-inforces the cautionary approach to causeway removal identified in the ODA report. The team strongly recommends that each case for solid causeway or jetty removal be individually considered since resulting erosion may be severe and alternative forms of mitigation more effective.

APPENDIX 1

Meeting with Atoll Chief

Areas where coral is mined are shown in figure 9 and include:-

- Inner reef extending eastwards from the northern half of Hithadhoo almost in front of Hithadhoo jetty.
- Outer reef flat and reef front of the same area.

Coral used to be collected from reef flats of all inhabited islands. This collecting has been banned by the atoll office since last year.

Areas where sand is collected are shown in figure 10 and include:-

- Lagoonside beaches of inhabited islands.

Areas where collection is allowed are determined by the Atoll and island offices.

Areas where aggregate is collected are shown in figure 11 and include:-

- Corte and Fenmuli.

According to the Atoll chief these areas are extensively used for dead elkhorn and porites collection.

APPENDIX 2

Existing and potential building demand as of Dec 1989

	Popn	Number Housing Plots	Houses finished	House being built	Houses partly const.	Balance
Meedhoo	1944	310	284	2	24	0
Hulhudhoo	2832	407	378	8	67	- 46
Feydhoo	3517	509	498	8	26	- 23
Maradhoo/ Feydhoo	1112	180	155	3	21	+ 1
Vadhoo	2490	305	268	25	38	- 26
Hithadhoo	9831	1461	1265	115	134	- 53
Total	21726	3172	2848	161	310	-147

Apart from domestic housing there are significant public works:-

Hithadhoo

Atoll Office - Community School - Islamic School * - Secondary School* - STO Shop #137
- RYVTC - STO Cinema - Regional Hospital.

Feydhoo

STO shop #123 - Big Mosque * funded by private external organisation - Island Office.

Hithadhoo/Meedhoo

Island School - Health Center*

* Under construction or planned for 1990

Appendix 3 - Chits (for single trips) issued by Atoll Office for collecting coral at Corte - Hithadhoo.

Month	Year	Pick-up	Tractor	Lorry	Dumper
May	1988				3
July	1988		2		
August	1988		6		
September	1988			2	6
October	1988		3	2	5
November	1988		2		
December	1988		1		2
January	1989			1	17
February	1989		2	3	19
March	1989	2	2	3	4
April	1989	1		2	4
May	1989			9	4
June	1989			2	2
July	1989				
August	1989		4	1	
September	1989			3	6
October	1989		3	1	20
November	1989		1	3	1
December	1989			7	10
January	1990		1	3	8
TOTAL		3	27	42	11

Appendix 4 Interview with coral miner

Name: Abdulla Hussein. Hithadhoo 'Glory'
 In business for 5 years
 Three persons working with him
 Areas used for mining: Kandehey Falhu inner and outer reef and Kanduhuraa area.
 Does not mine in baitfishing areas to maintain good relations with fishermen.
 Works 8-10 days a month depending on tides and weather.
 At present working near Kuda Kanda channel.
 Mines down to a maximum depth of 10m on the outer rim.
 Mines down to 1-1.2m on the inner reef.
 Mines both live and dead Elkhorns and Porites.

Costs/quantities:

2'x5'x10' cube/boat/day = 4 dumper loads for Rf160
 Paying Rf25 working day to boat owner.
 Boat unmechanised 14x27" length.

Appendix 5 Interview with Hulhudho Kathib Ahmed Shafeeq

No chits are issued for coral. Sand is always mined on the beach. It has been mostly carried out on the south western side of the island for the last ten years and 12ft has eroded from this region. Hulhudhoo was separated from the uninhabited island Herethere about 40 years ago by a 10ft channel. Erosion has taken place since then, particularly from the Hulhudhoo side of the channel and the channel is now at 200-300ft wide (plate 5,6). Only three dhoni loads of coral were mined in the last half of 1989 and 24 dhoni loads in the first half.

Appendix 6 Interview with Meedhoo Kathib Mohamed Naseem.

There is only one professional coral miner operating out of Meedhoo. He is called Abdula Ibrahim Didi - 'Paris', Meedhoo. He mines coral using his own boat and charges Rf180-200. Earlier he could mine from a depth of 1m but now he has to go down to about 2.5m in certain places. Large quantities of dead coral are thrown-out in storms about once in ten years. People mine this coral right at the beach on northeastern Meedhoo near the site of the 1942 RAF gun emplacement (plate 2). This is done without the permission of the island office. Coral is mined on all reefs except for the outer western side of the Island.

Sand is mined from the shallow lagoon during low tide. The site is called 'Medhafushi'. Sand mining chits are issued.

Appendix 7 - Status of causeways

The status of the four causeways between Gan and Hithadhoo were assessed during the Atolls Administration/UK Overseas Development Administration visit in September 1989. It was felt that the causeways only required minor repairs to keep them operating.

GAN-FEDU CAUSEWAY

Two discharge pipes have been added since September. No other significant change was evident. The discharge pipes help to flush the area on the lagoon side of the Gan end of the bridge and so reduce the smell. However, there is little additional benefit. There is a need to upgrade the works since there is a possibility of subsidence.

FEDU-MARADU CAUSEWAY

The lagoonside shore at the Fedu end of the Fedu-Maradu causeway continues to erode back (plate 3) and continuing efforts are being made to protect the shoreline with coral.

MARADU-HANKADA CAUSEWAY

Some (? seasonal) erosion has taken place on the lagoonside of the causeway and particularly at the Maradu end (plate 4). The causeway in this region is in danger of subsidence and needs to be shored-up.

HANKADA-HITHADHOO CAUSEWAY

No significant change evident.

Appendix 8 - Status of beaches

Beach material varied in grain size from fine sands to rubble and depended on the degree of exposure to wave action. All grain sizes are used in the construction industry so that there is collection of these materials from beaches is widespread.

Limited beach erosion was widespread. Sand and aggregate collection was observed at a number of beach locations and there is little doubt that long-term collection at reported rates will contribute to this. Causeway construction has locally increased erosion particularly on the lagoonside at the Fedu end of the Fedu-Maradu causeway. If materials are moved up the shoreline by longshore drift and are not replaced the beaches will erode. There was no evidence in January 1990 any reversal of the direction of longshore drift observed in September 1989.

Appendix 9 - Terms of Reference letter

Appendix 10 - Coral mining notification

Quote

From : President's Office
To : Minister of Atolls Administration
Ref : 1-A/84/90/28
Dtd : 23 January 1990

The President is aware that coral mining is a major activity on the main reefs of some islands and due to this, beach erosion has become a problem on these islands and, on his visit last year December to Male' Atoll; this month to Mulaku Atoll and Felidu Atoll he had discussed with the islanders the damages being caused to the islands because of coral mining.

So coral mining from house reefs is now prohibited and it's his request to inform all inhabited islands about this regulation.

Unquote

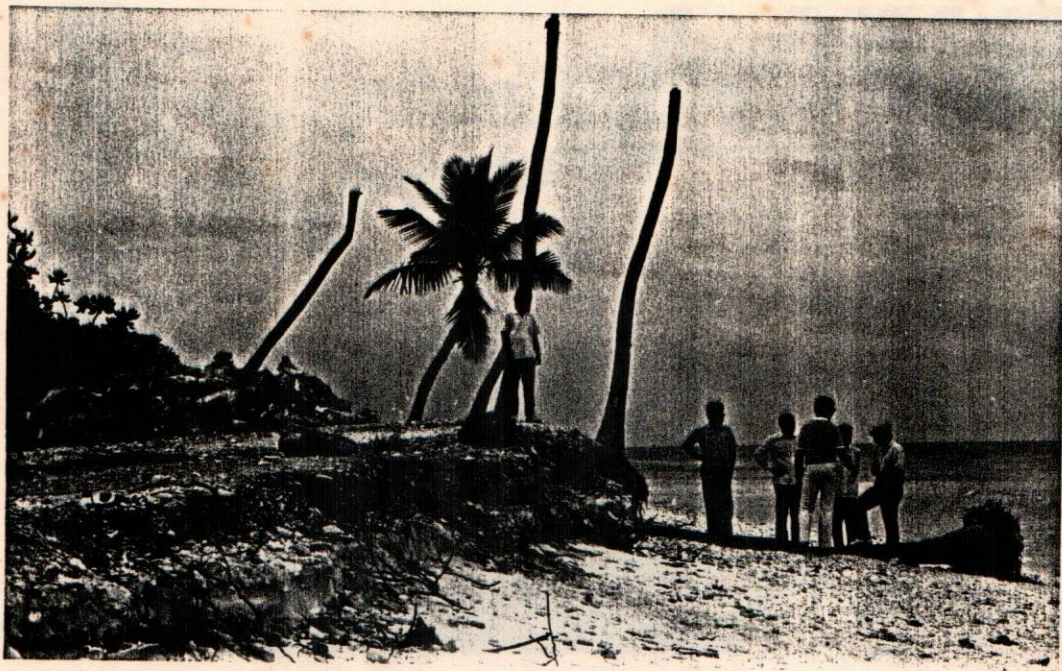


Plate 1 - The only beach erosion that could be due to coral mining was observed at Hithadhoo Corte (fig. 1).



Plate 2 - Beach erosion at the RAF gun emplacement on Meedhoo (fig. 6) is due to several factors including aggregate mining, coral rubble removal from the reef rampart, and storms.

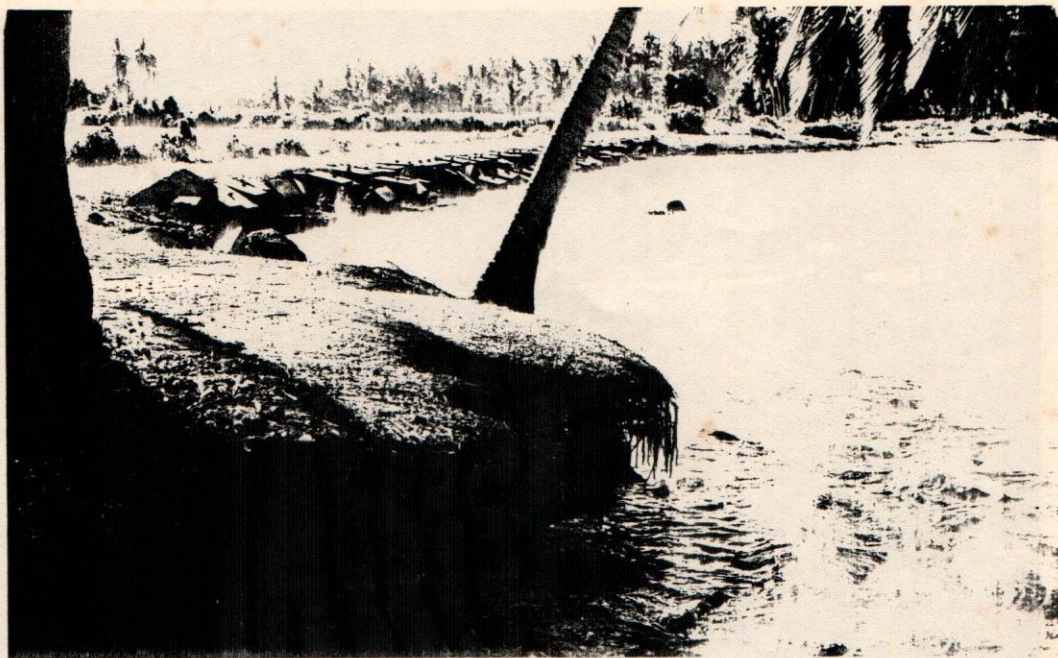


Plate 3 - Solid causeway construction has led to severe beach erosion at the Fedu end of the Fedu-Maradu causeway (fig. 8).



Plate 4 - The Maradu end of the Maradu-Hankada causeway is in serious danger of undercutting and collapse and the bank should be shored up.

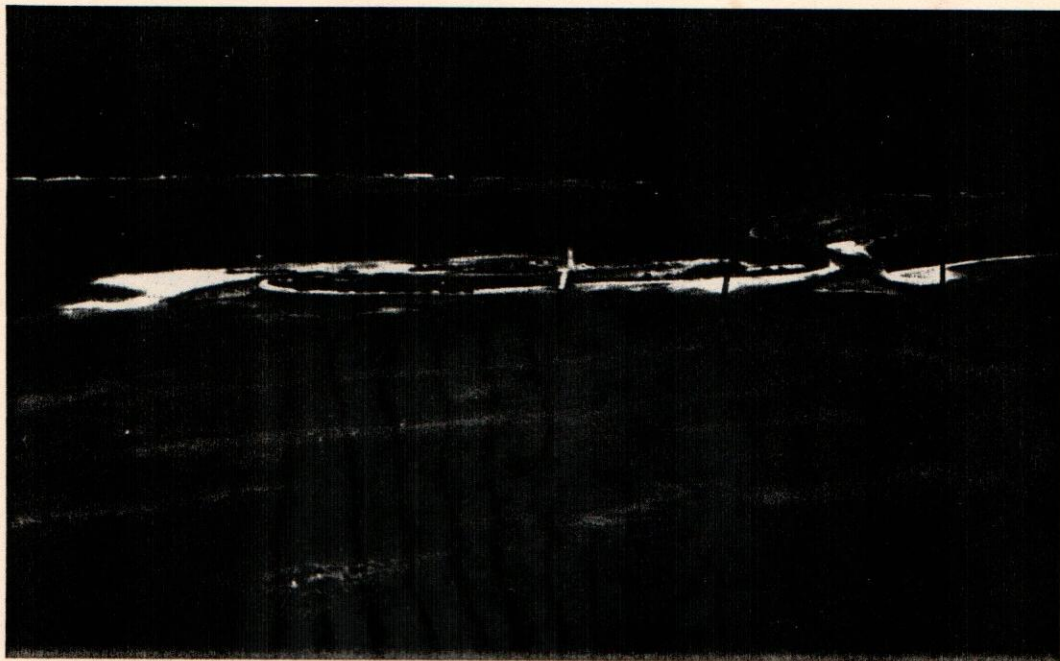


Plate 5 - A narrow channel opened between Hulhudhoo and Herethere forty years ago (fig. 6-B) has widened considerably. The widening suggests a cautionary approach to any plan to open-up solid causeways at other locations.



Plate 6 - Efforts to limit beach erosion using groynes in the widening channel between Hulhudhoo and Herethere have proved largely ineffectual (fig. 6-B). Complete blockage of the channel is being considered.

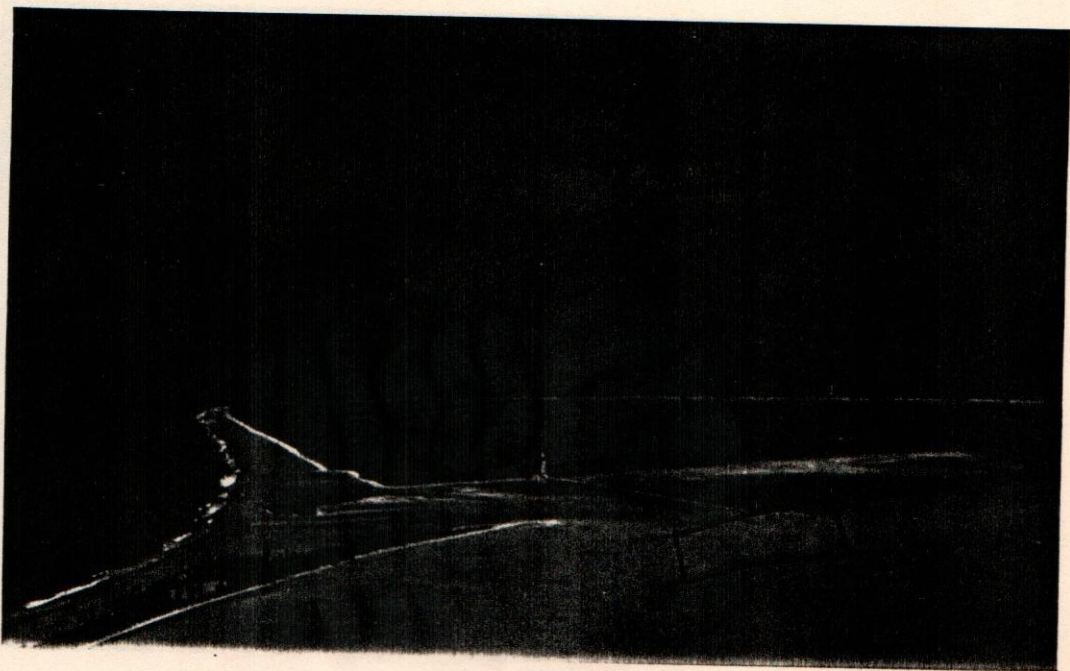


Plate 7 - Current and proposed sand mining area (from air) at 'Medhafushi' off Meedhoo jetty.



Plate 8 - Sand and aggregate collection off beaches (here at Hithadhoo Corte) is wide spread and directly leads to beach erosion. It is recommended that these activities are prohibited on beaches.

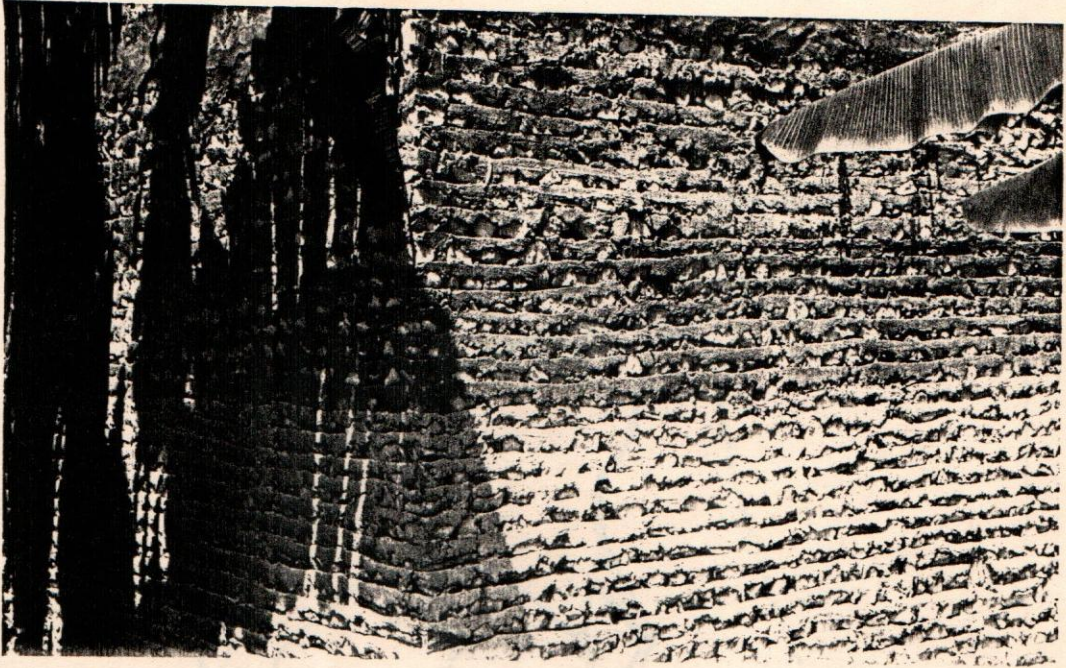


Plate 9 - Construction using coral is still widespread and popular. However, the cost of using this material can be beach erosion and dead reefs that cannot grow.

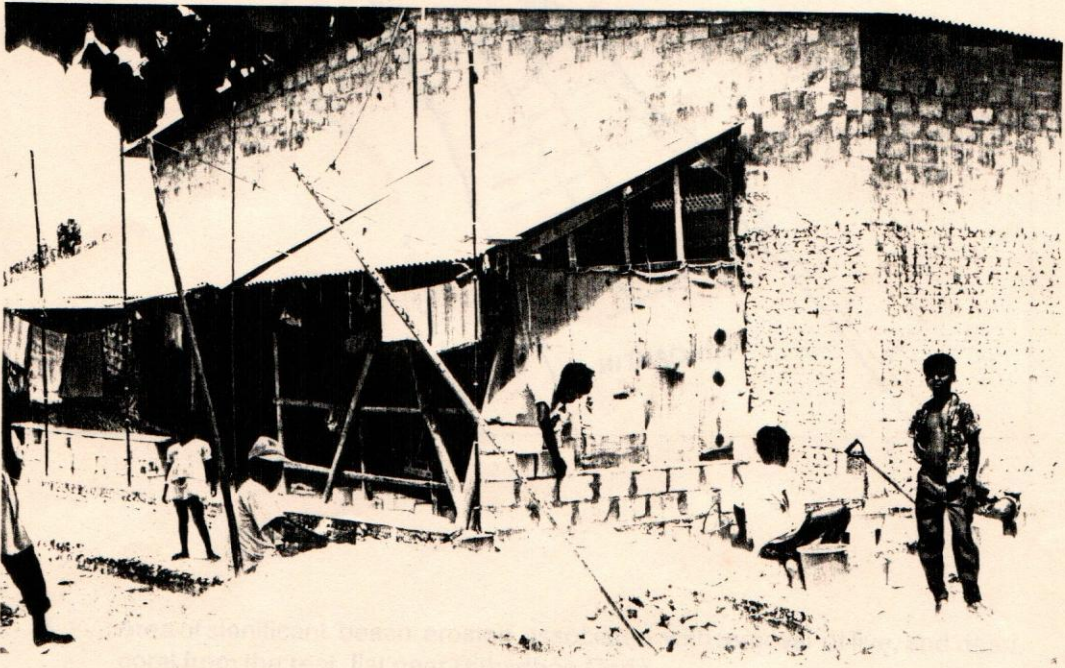


Plate 10 - Supplies of sand in atoll lagoons are large. The use of sand for sand/cement blocks from designated areas in these lagoons should be encouraged

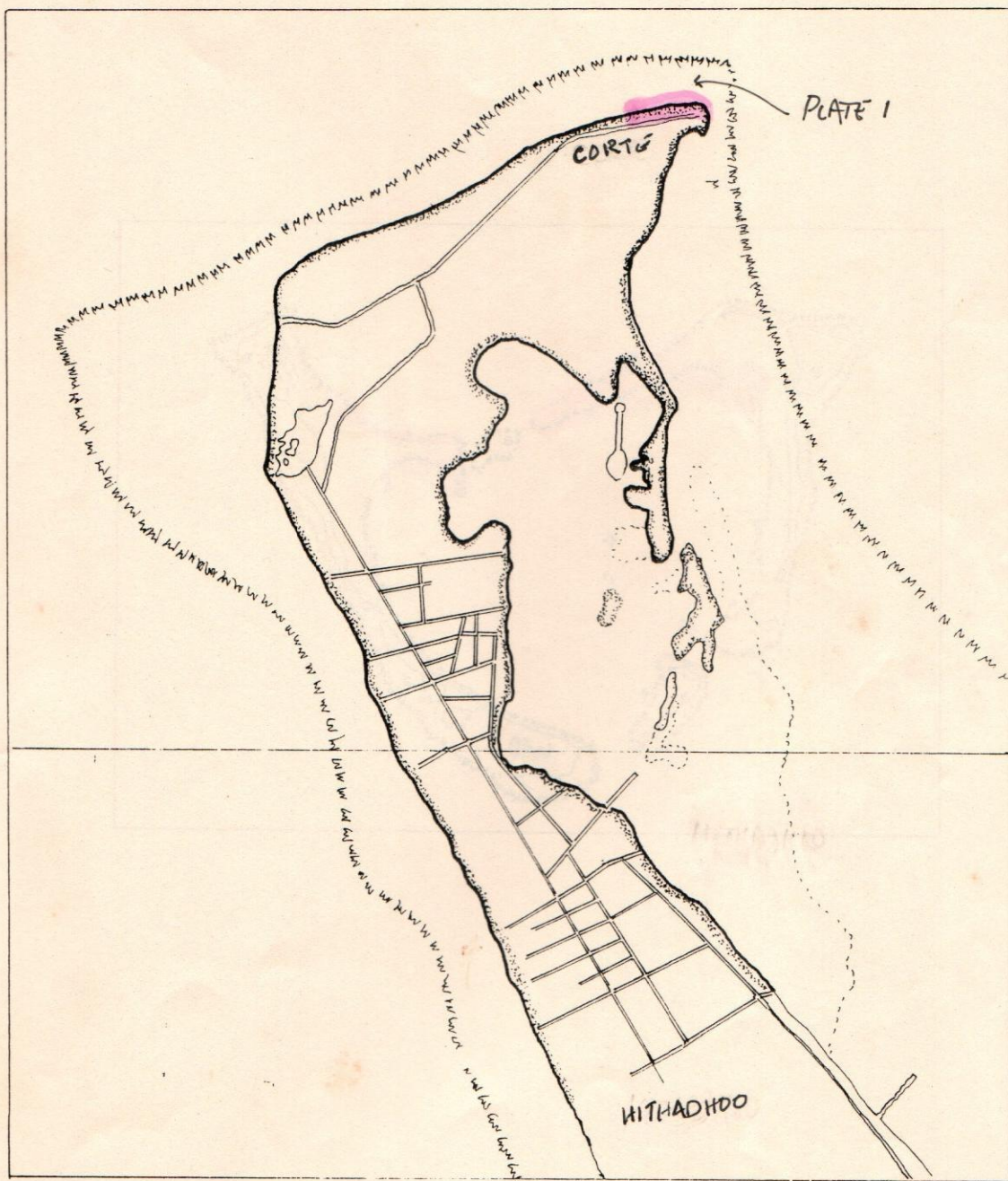


Fig. 1 - Area of significant beach erosion associated with removal of live, and dead, coral from the reef flat near Hithadhoo Corte.

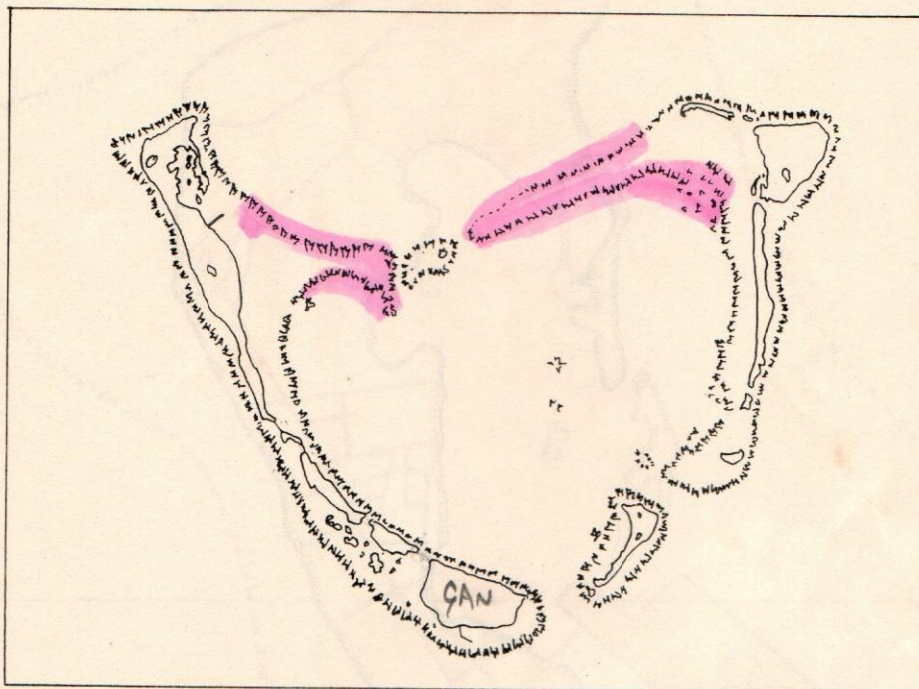


Fig. 2 - Areas to which coral mining should be restricted (at least 1km from any beach).

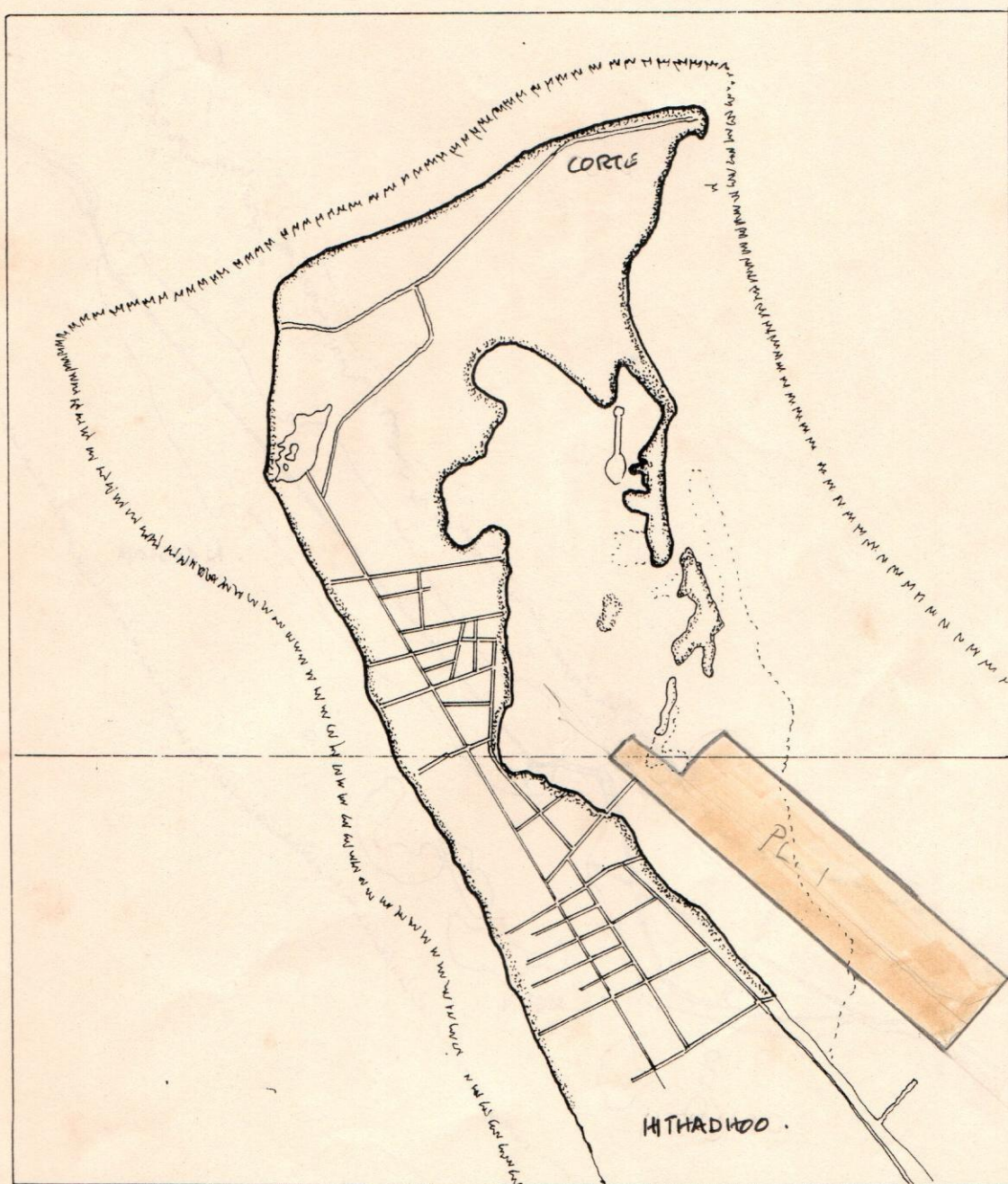
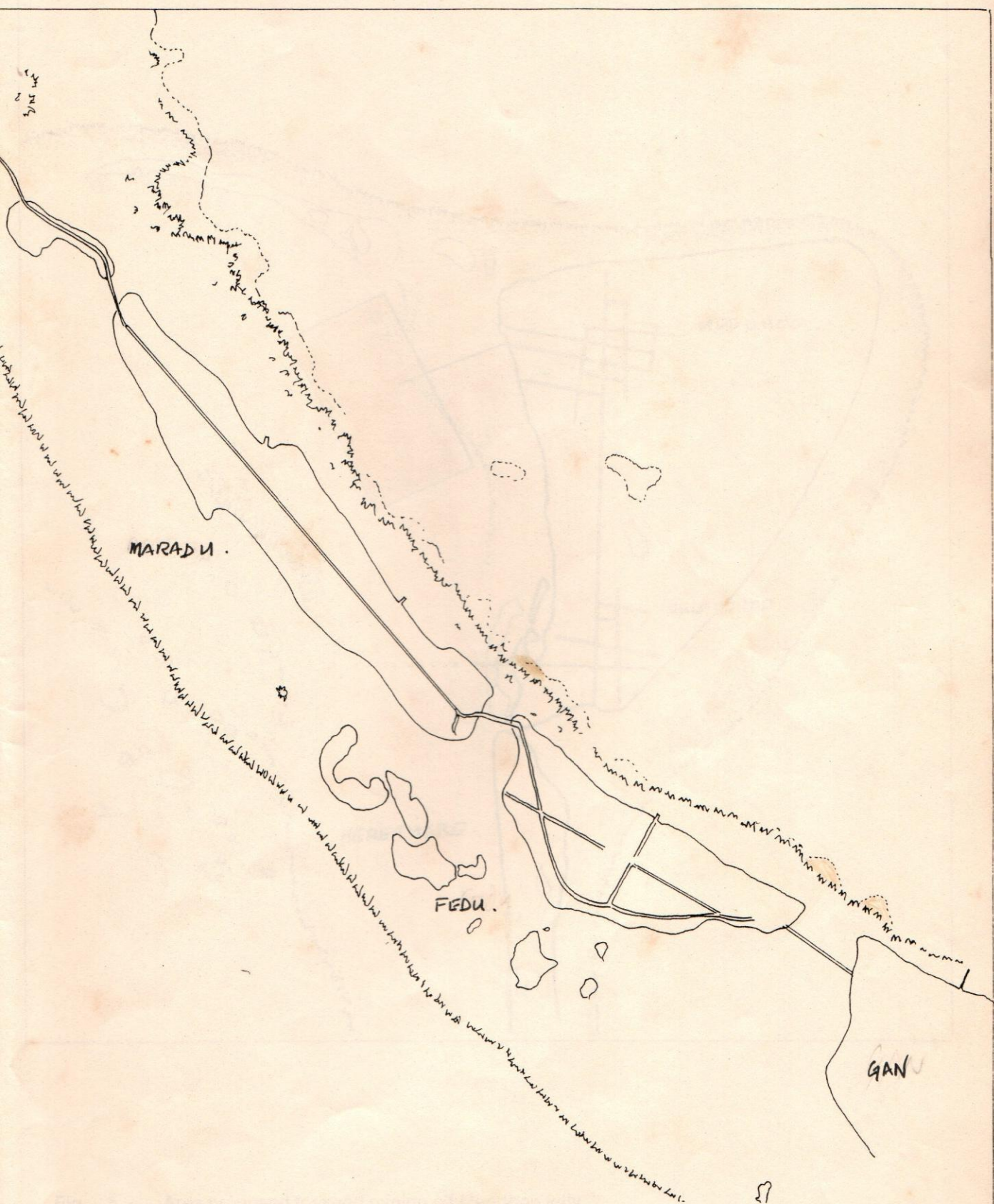


Fig. 3 - Area proposed for sand mining in the lagoon off, and to the southeast of, Hithadhoo jetty.



g. 4 - Area proposed for sand mining off the Gan-Fedu, and Fedu-Maradu, causeways.

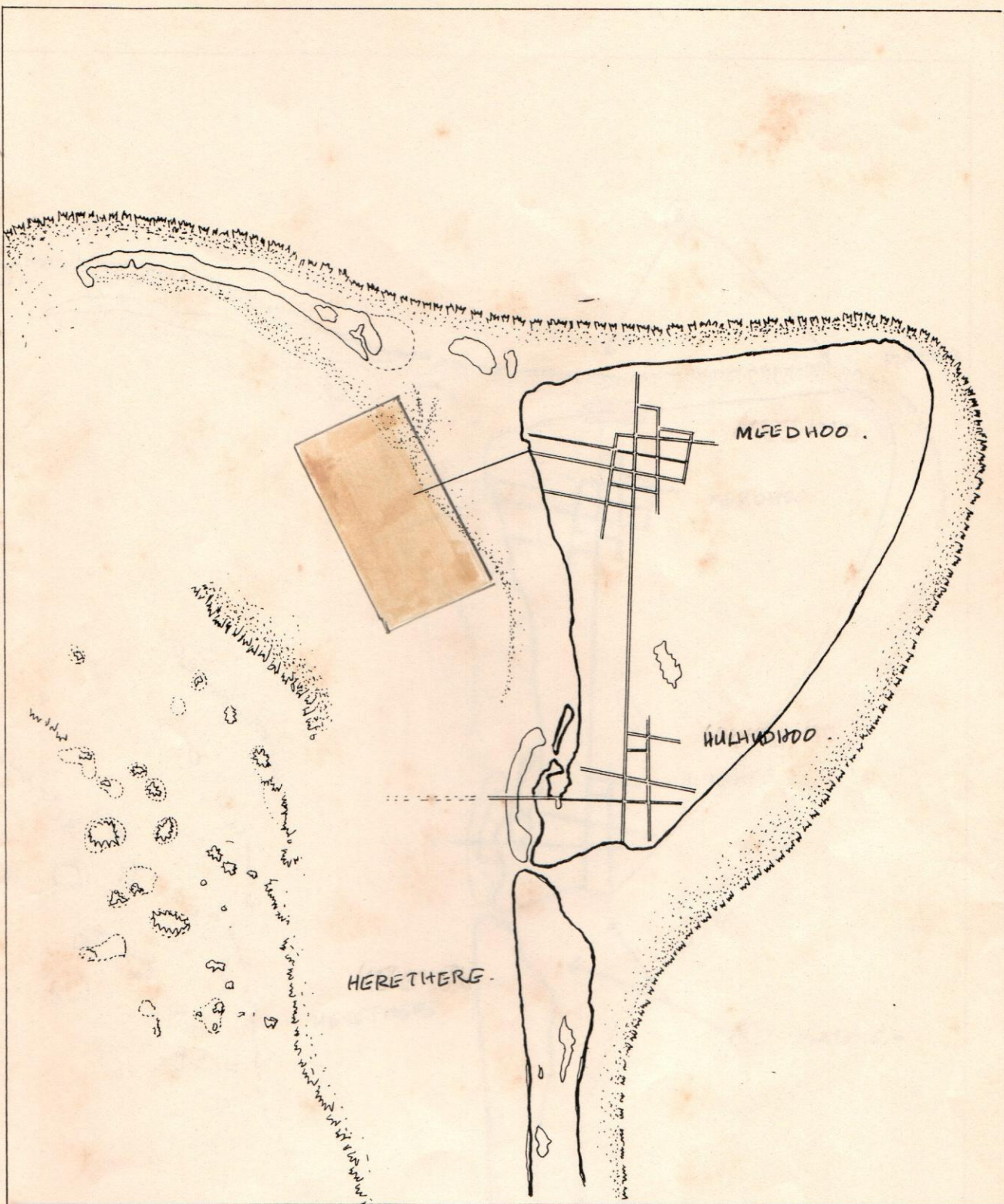


Fig. 5 - Area proposed for sand mining off Meedhoo jetty.

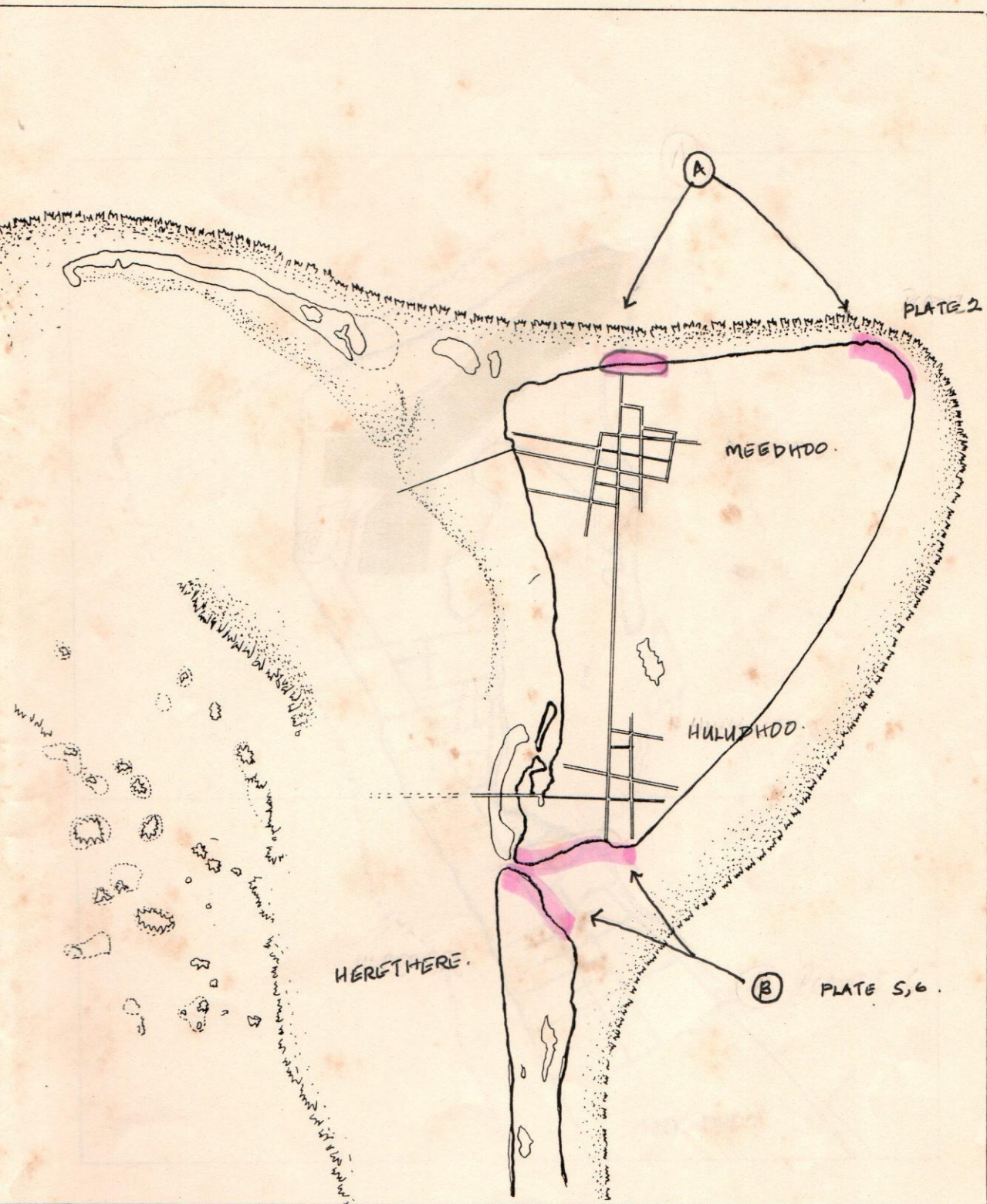


Fig. 6 - Areas of significant beach erosion associated with aggregate mining and storm damage (A) and from opening-up of a channel between Hulludhoo and Heretthere (B).

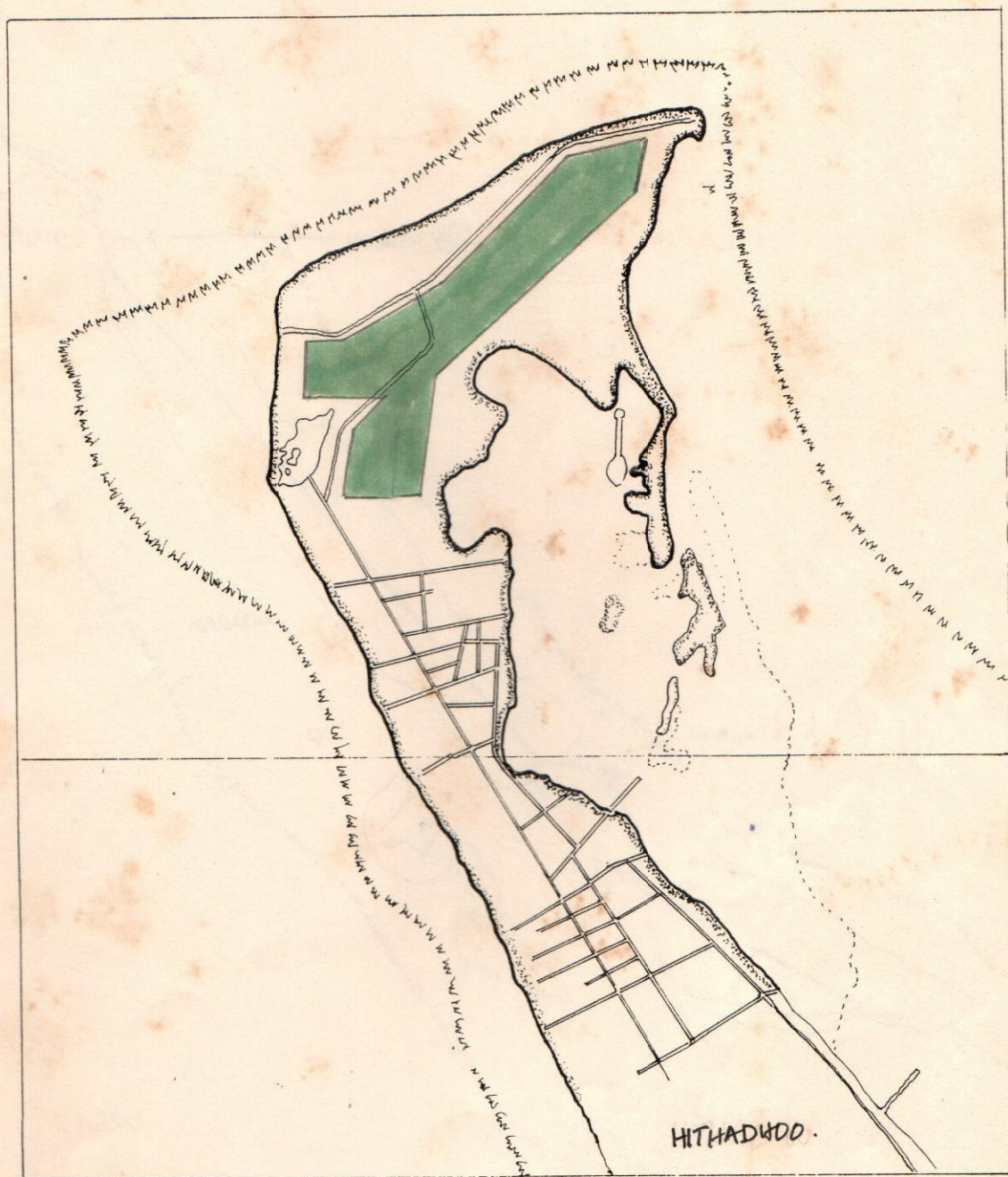
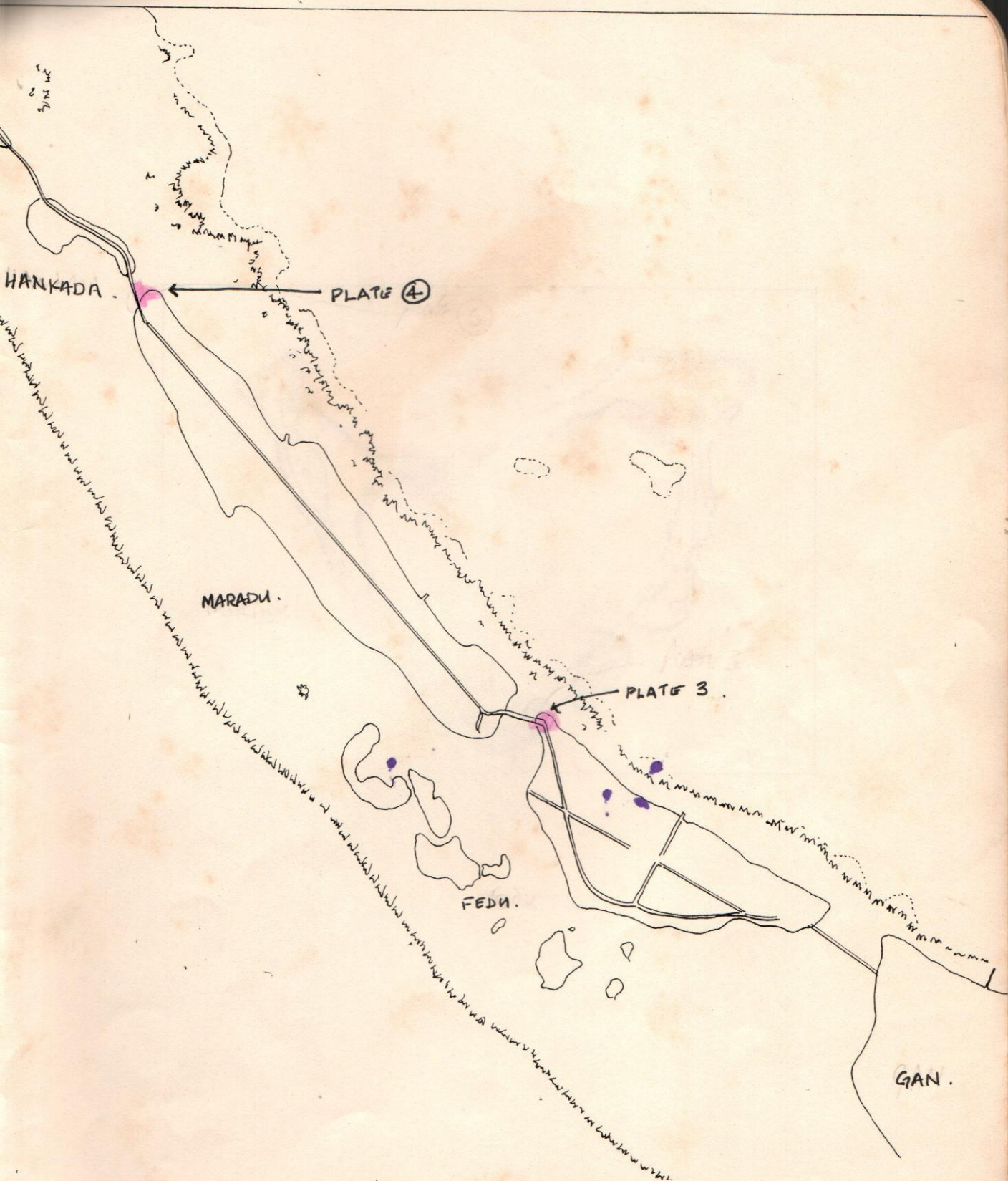


Fig. 7 - Area of aggregate deposits approved for mining.

~~storm damage (A) and from opening up of a channel between Hithudoo and Herethere (B).~~



g. 8 - Areas of significant beach erosion associated with solid causeway construction. Some beach erosion is evident along much of the shoreline of these islands.

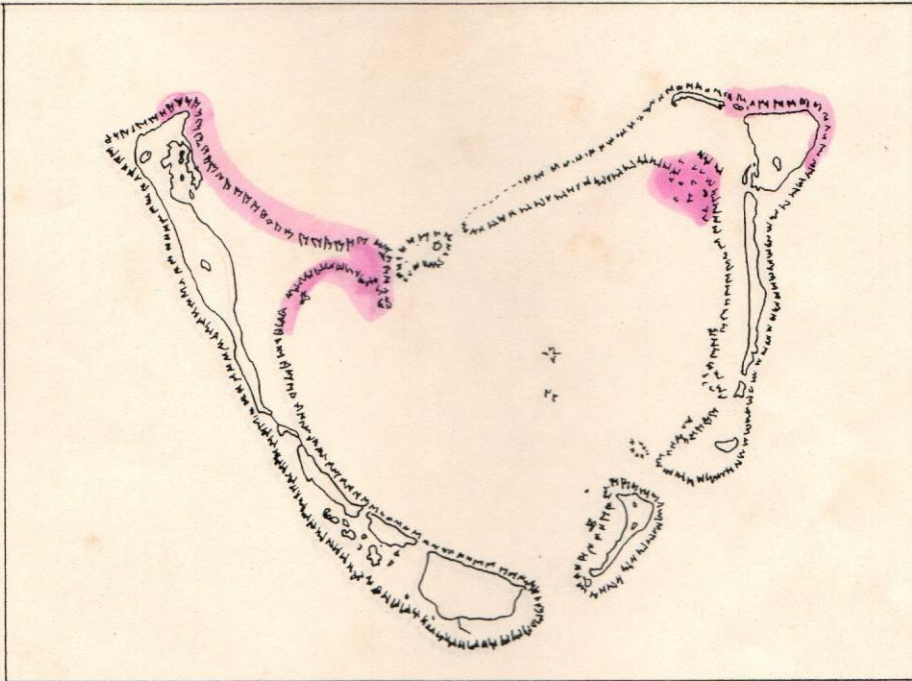


Fig. 9 - Areas where coral is currently mined.

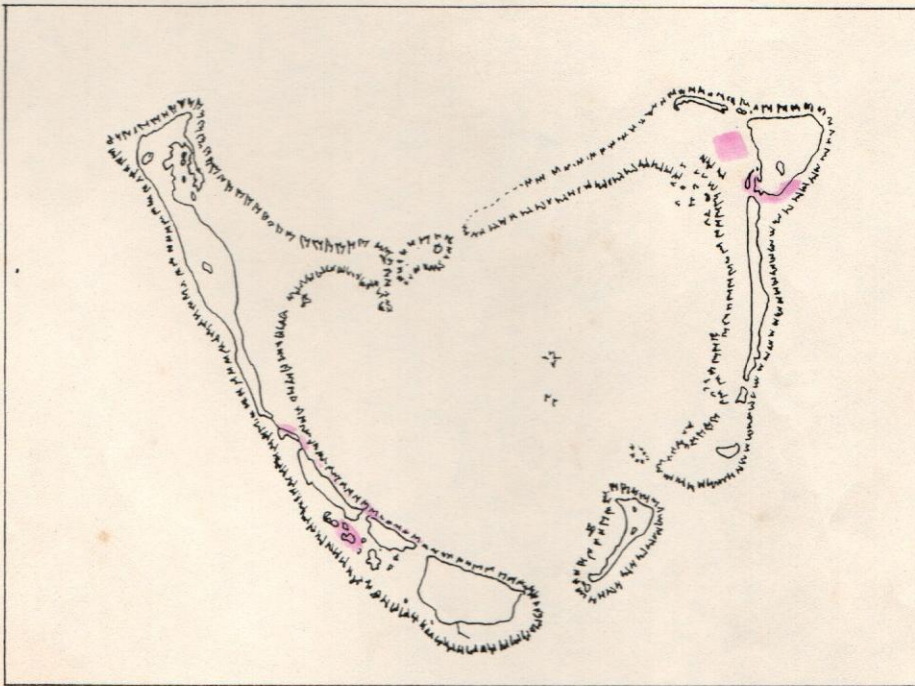


Fig. 10 - Areas where sand is currently mined.

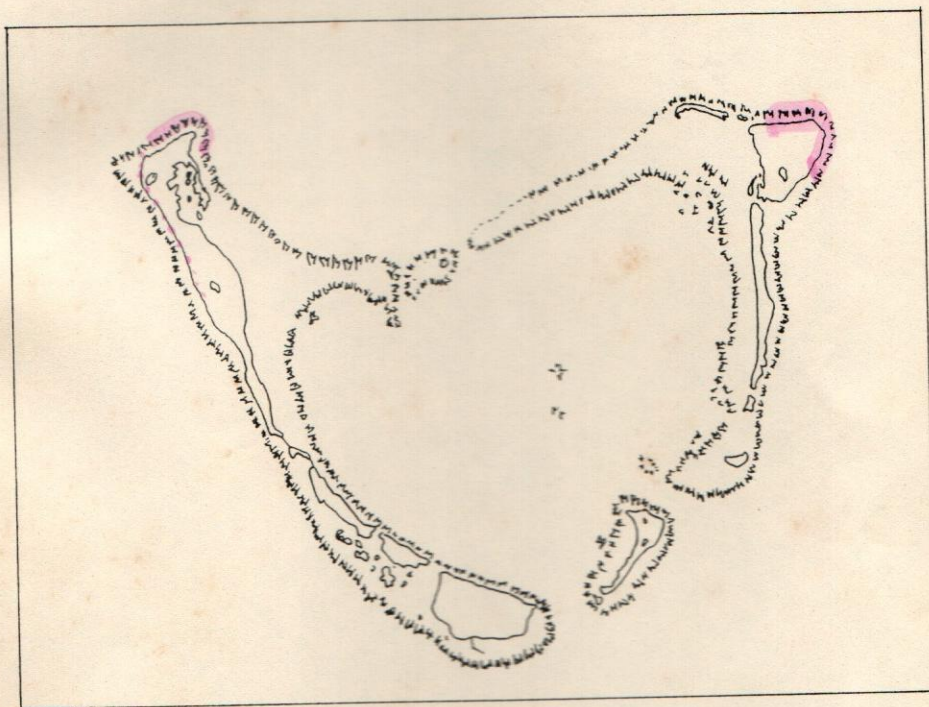


Fig. 11 - Areas where aggregate is collected.