

ANNEX 5

Prediction of oil spill movement and behaviour

It is necessary to determine the type, characteristic, quantity and location of a spill and to incorporate a number of environmental factors, in order to determine as accurate as possible a prediction on the spill's movement; including changes in characteristics due to weathering, and the prediction of the coastal marine areas potentially at risk. Predictions of the movement of oil should be made at the following intervals after location of the spill has been determined: 1 hour, 3 hours, 6 hours, 12 hours, 24 hours and 48 hours. These predictions must be updated following each new weather forecast.

The spill will need to be constantly monitored and any changes in the spill's appearance noted. This will enable the accuracy of the movement and weathering predictions to be assessed and updated.

Oil spill reports should be provided to the ROSC at regular intervals. These reports should contain as much information as possible, including the location of the spill on a map, along with updated weather and tidal information. A **SITREP** (situation report) format can be found in WEBEOC.

Movement of spilled oil

In accurately predicting the direction of movement of an oil spill, a knowledge of tides, currents and wind speed and direction is essential. Oil will normally move at 100% of water speed (current) and approximately 3% of the wind speed. The figure on the next page indicates how this information can be used for this purpose.

Some tidal stream and current information is contained on hydrographic charts of the area and should be used in conjunction with tide tables for the appropriate day. Locations of maps reflecting tidal stream directions and rates for the Taranaki bite and adjacent areas are at the end of this Annex.

Wind speed and direction may be obtained from the person first reporting the spill, local residents or fishing/recreational boats in the area. Additionally, weather forecasts can be obtained from the Meteorological Office, phone 04-4700 700. In addition, Taranaki Regional Council has a real time telemetry system that includes information on wind direction and strength and is accessed through the Council's computer systems (Hydrotel or Hilltop). The Council's Hydrology duty officer can provide specific advice on conditions.

Port Taranaki runs data platform 'EnView', it displays both real-time and historical environmental information. The port has recording instruments in four positions around the harbour; two on the wave tower, one on Moturoa wharf and one on NKTT wharf - these devices record wave, wind, sea and swell. Access to this system is through Port Taranaki. To request data please contact the harbourmaster or duty pilot. EnView is supported by John Cristini of Bimaris, New Plymouth.

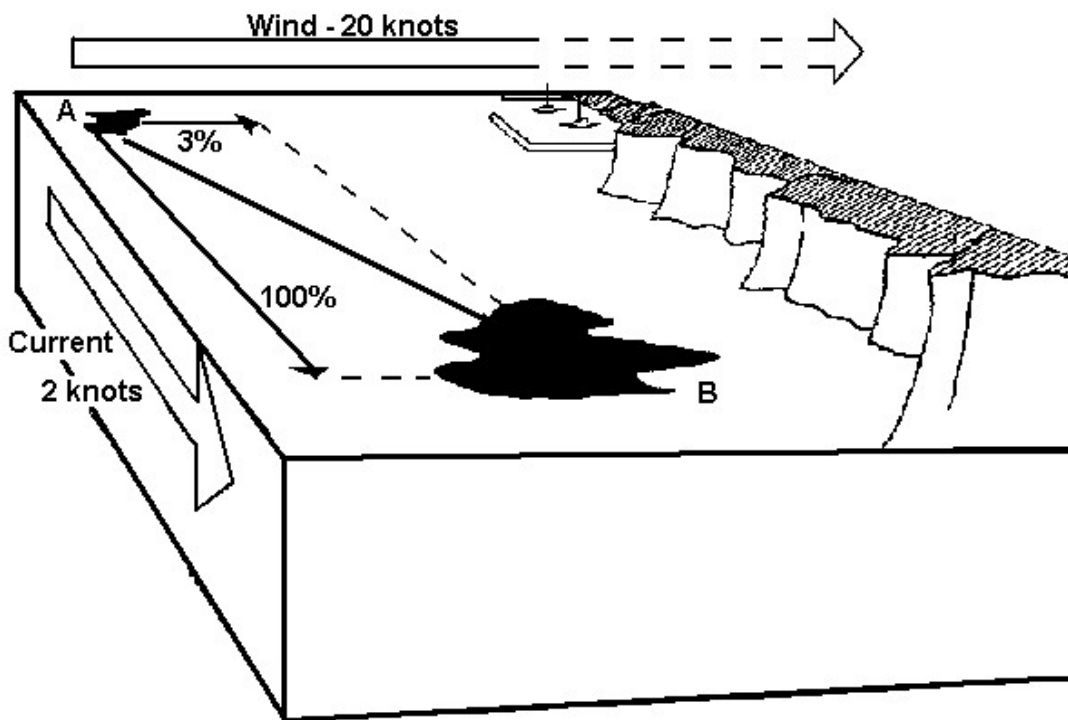
Modelling

Oilmap oil spill trajectory modelling is available on request via the MNZ Oil Spill Duty Officer (OSDO).

Metocean Solutions Ltd has offered the Council free access to coastal models to predict oil spill movement. The contact details for the Company are:

Metocean Solutions Ltd
3/17 Nobbs Line
New Plymouth
06-7585035 or 027-6853473 (Dr P McComb)

An indication of oil movement in relation to currents and winds is as follows:



The influence of 3% of the wind speed combined with 100% of the current speed results in the movement of oil from A to B

Note: Wind blows FROM the specified direction whereas currents flow TOWARDS the specified direction.

Local conditions

The assessment of the spill's movement should consider local variations to predict values. For example, inside Port Taranaki, the wind will generally have the greatest effect on the direction of travel of an oil slick. In the Cape Egmont area, strong tidal currents can substantially modify wind effects, and reference must be made to appropriate Hydrographic

Department nautical charts of the area for details. In other coastal areas, a combination of wind and tide will determine the direction of movement. The part which has a high risk of a spill has the following characteristics:

- The port experiences a high energy coastline exposed to southerly, westerly and northerly winds.
- The currents generally tend towards north and seaward. This should be taken into account when planning the method of recovery of a spill.

In a spill response, the use of ocean capable booms must be assessed on the day. However their use will become marginal when winds exceed 20 knots and wave heights reach one metre.

Mousse formation

ADIOS can be used to determine when mousse formation will occur.

Although computer modelling programs are preferable to manual calculations when modelling oil slick movement and predicting probable coastal impact sites, none of these are currently available in New Zealand. However, the ADIOS system can be combined with manual calculations. The ADIOS system will predict, under current forecast conditions, when/if the slick will become emulsified. **Predictions of the slick movement using the manual calculation method will be ineffective after emulsification.**

Predictions must be verified by surveillance at sea carried out by fixed-wing aircraft, helicopter or visual observation from sea-level.

Aerial surveillance will enable:

- determination of the size, quantity and location of the slick;
- determination of the movement of the slick;
- noting any changes in appearance and distribution of the slick;
- forecasting of coastal marine areas potentially at risk; and
- reporting effectiveness of response measures.

Reliable local knowledge, if available, is invaluable.

Manual volume calculation

This method is described in the Responders Aide Memoire. A guide to the relation between appearance, thickness and volume of floating oil is given in the following table:

Oil Type	Appearance	Approximate thickness (estimated from appearance)	Approximate volume (m ³ /km ²)
Oil sheen	silvery	>0.0001mm	0.1
Oil sheen	Iridescent	>0.0003mm	0.3
Crude and fuel oil	Black/dark brown	>0.1mm	100
Water-in-oil emulsions (mousse)	Brown/orange	>1mm	1000

Factors that should be considered when making detailed predictions of oil spill movement include:

- currents
- tides
- weather (including wind direction and speed)
- wave height (sea state)
- sea temperature, salinity
- spill size / volume (m³)
- spill thickness (estimated by colour, e.g. sheen, rainbow)
- type of oil spilled (viscosity, pour point, specific gravity, dispersion, evaporation)
- satellite imagery
- tidal current atlas
- local sources (spill responders, fishermen, recreational boats)
- aerial surveillance.

Environmental Data

Charts/maps of the Taranaki region

Hydrographic and aeronautical charts that cover the Taranaki region are listed below. Copies of these are held in the Inspectorate Office, by the Harbour Master and the Emergency Management Office. Charts can also be viewed at ISS McKay Ltd, Centennial Drive, New Plymouth.

Topographical maps

Detailed topographical maps of the Taranaki region showing access points, beach profiles etc can be obtained from the Taranaki Regional Council, phone 06-765 7127. Taranaki Regional Council also has a computerised mapping system which includes topographical maps and photographs.

Coastal resources

Supplementary information from which this summary was derived is contained in the *Regional Coastal Plan for Taranaki* (available from the Planning Section of the Taranaki Regional Council), and the Department of Conservation's *Coastal Resource Inventory* (copy available at Taranaki Regional Council library).

These, or the contributors to these documents, should be consulted as necessary.

Hydrographic

The relevant hydrographic charts for the Taranaki Region are:

Chart No (NZ)	Title	Scale (1:x)	Published	Reprinted
43	Manukau Harbour to Cape Egmont	300 000	10-1980	10-1994
45	Cape Egmont to Rangitikei River	200 000	01-1989	04-1994
443	Approaches to Port Taranaki	150 000	10-1990	01-1993
4432	Taranaki Roads, Port Taranaki		01-1994	
	Taranaki Roads	25 000		
	Port Taranaki	8 000		

These charts are available at the Taranaki Regional Council library.

Hydrographic charts are available from:

ISS McKay Limited
Sub agent - Cape Shipping
30 Centennial Drive
New Plymouth
Telephone: 06-751 2300

ISS McKay are also agents for the purchase of charts from Trans Pacific Marine (overnight delivery)

Aeronautical - The relevant aeronautical charts are available from Aero clubs throughout the region. The main reference chart is the 'New Zealand Aeronautical Chart 1:500,000 Sheet 2 - Chart reference 6050-242-2'. A new edition is available every six months.

Water Temperature - Water temperatures in the region's coastal area average between 16° and 21°. To obtain up-to-date water temperatures, either contact Port Taranaki or data is available on their website www.porttaranaki.co.nz.

Wind direction and tide and barometric, wind speed and gust can also be obtained from the Port Taranaki website.

Weather - For the most accurate forecasts contact the Met Service on 04-4700 700 to speak with a Marine Forecaster and they will be able to give information as follows:

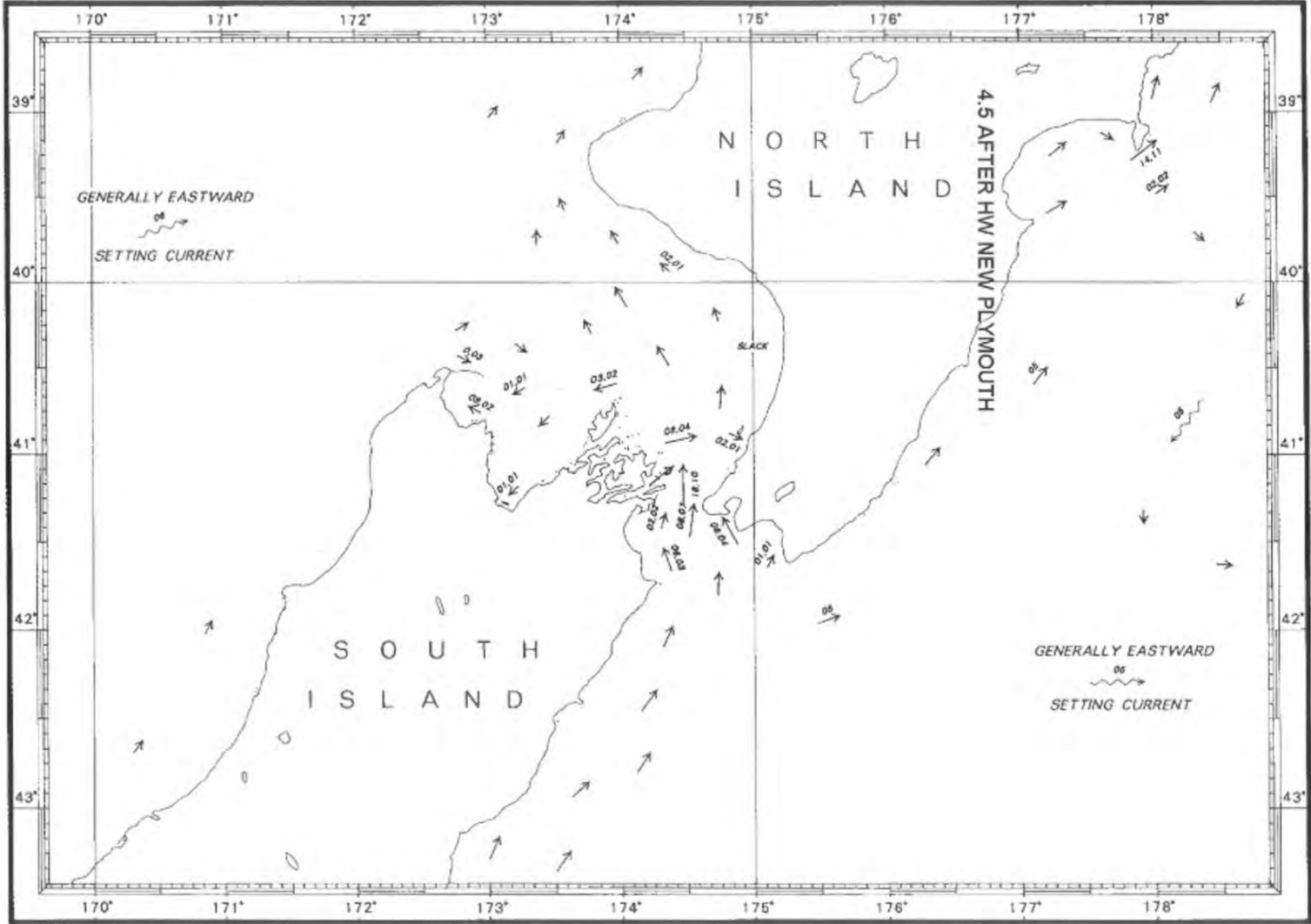
- Marine forecasts (up to 5 days out)
- Wind and sea conditions,
- Site specific forecast (wind values etc)

Lots of information is also available on www.metservice.com or via one of their smart phone apps.

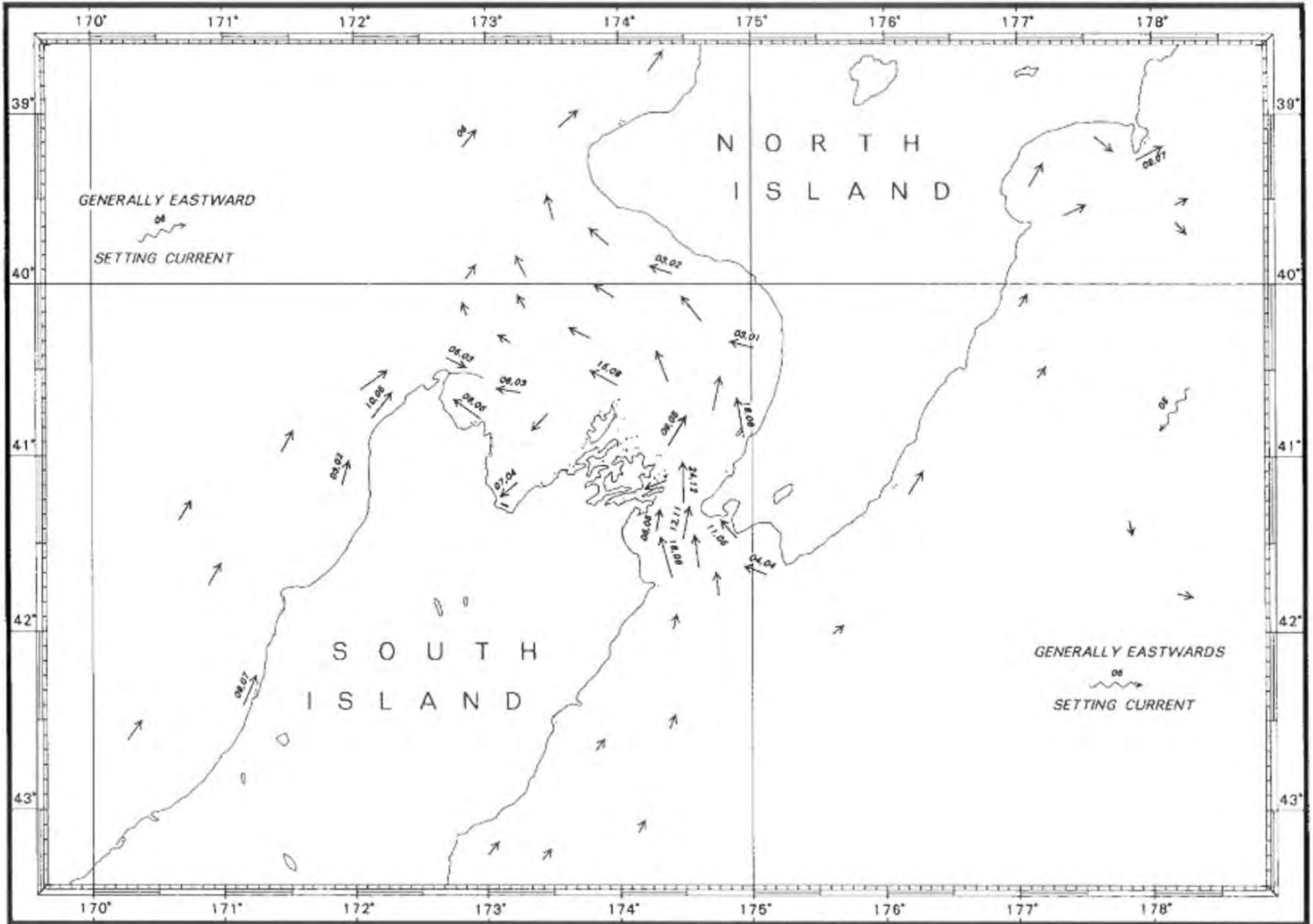
Coastal Currents and tidal flows

The following pages show maps containing coastal currents and tidal flows for the region -

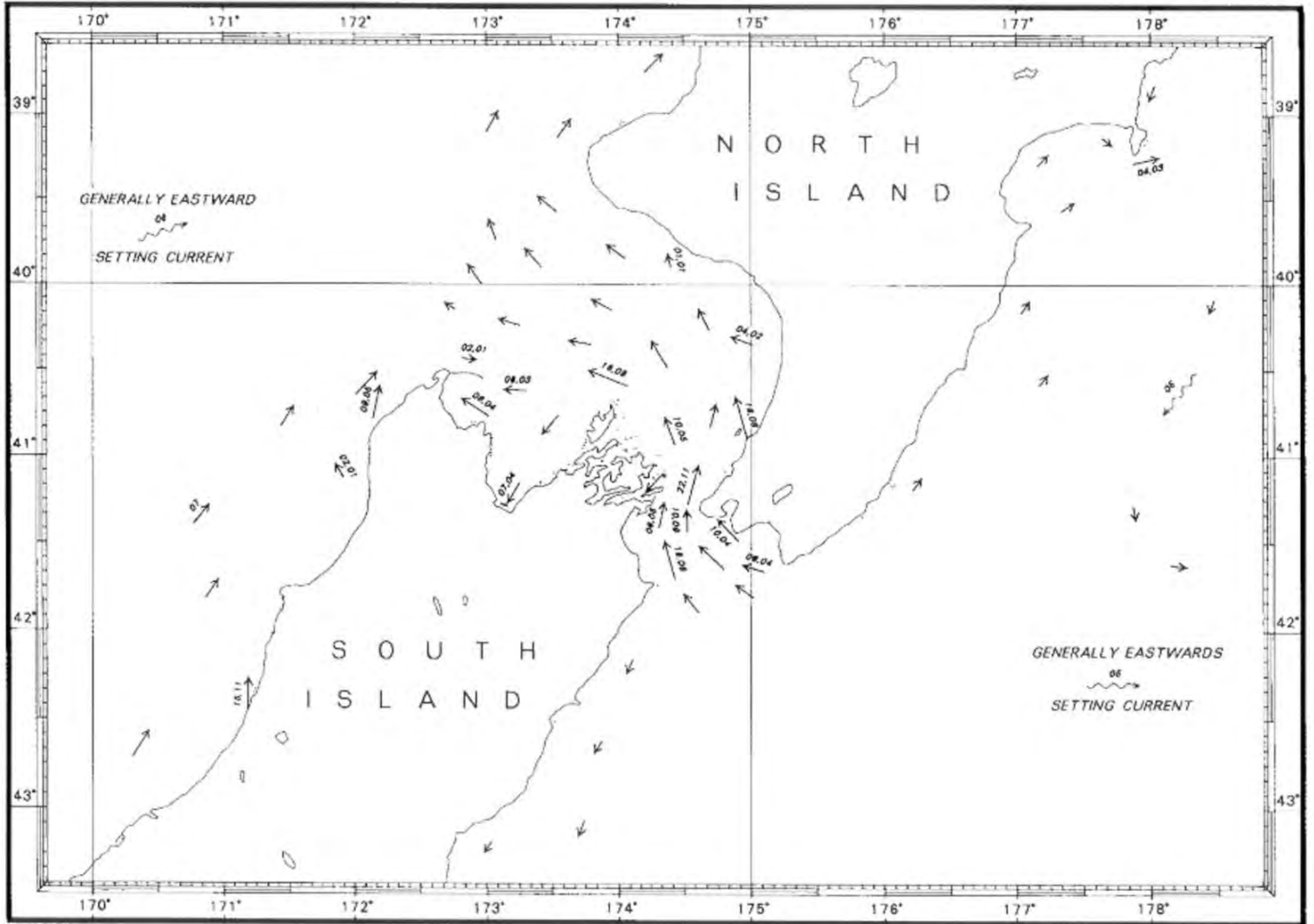
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HIGH WATER WELLINGTON



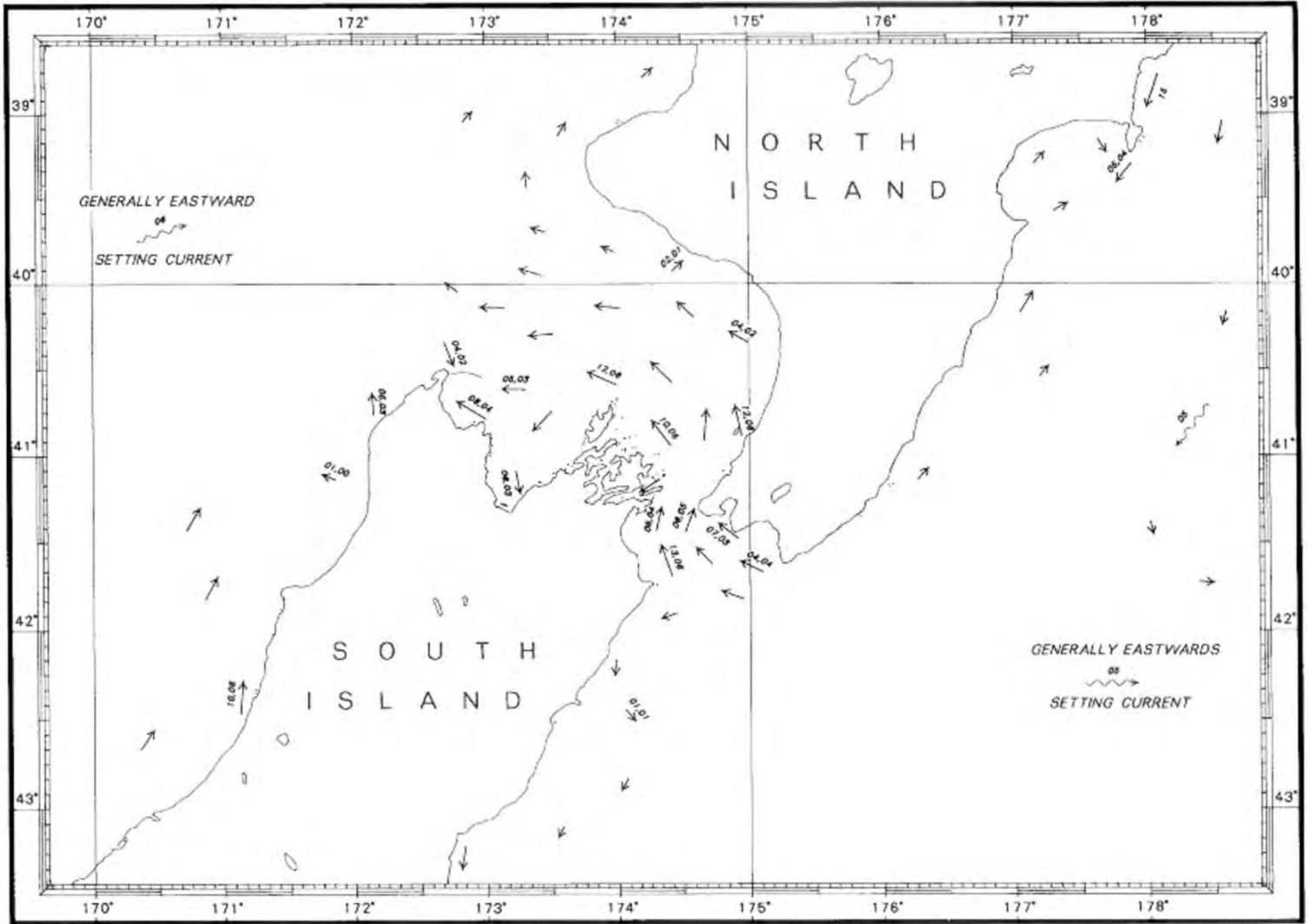
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2 HOURS AFTER HW WELLINGTON



4.5 BEFORE HW NEW PLYMOUTH
3 HOURS AFTER HW WELLINGTON



3.5 BEFORE HW NEW PLYMOUTH
4 HOURS AFTER HW WELLINGTON



2.5 BEFORE HW NEW PLYMOUTH
5 HOURS AFTER HW WELLINGTON

