

Investigation of a Large Sandbar at Raglan, New Zealand: Project Overview and Preliminary Results

D.J. Phillips¹ and S.T. Mead²

¹Department of Civil Engineering,
Unitec NZ, Private Bag 92025, Auckland, New Zealand.
dphillips@unitec.ac.nz

²ASR Ltd, PO Box 67, Raglan, New Zealand.
s.mead@asrltd.co.nz

ABSTRACT

An investigation is being undertaken to study a large sandbar located offshore at the Raglan Headland on the west coast of the North Island, New Zealand. The present study is aimed at measuring and tracking the movement of this large sand deposit down the headland. Once the field work is complete, volumetric comparison of the sequential surveys and numerical modelling will be undertaken to assess the migration of the sand bar and the impacts on the surfing breaks, respectively. Data has been recorded using a series of quarterly bathymetric surveys, and aerial photographs to visually confirm the location of the breaking waves at the headland. The preliminary results indicate that a large sand bar was located offshore of Indicators in December 2005. The subsequent surveys show that this sand bar had moved east and reduced in size by March 2006, and was almost undiscernable by June 2006.

ADDITIONAL INDEX WORDS: *Sandbar, Surfing, Bathymetric Surveying, Headland.*

INTRODUCTION

Background (West Coast)

The New Zealand coast arguably contains a greater range of beach and nearshore environments within close proximity than any coastline in the world (BRANDER, *et al.*, 2003). Brander describes that a comprehensive understanding of the New Zealand coast is yet to be realised, with large areas of the New Zealand coast remaining unstudied. This is due to a lack of data and research motivated by management issues in regions of high population, economic and recreational value. In general the west coast has been studied far less extensively than the east coast of the country (HUME *et al.*, 1992; HUME *et al.*, 1997), due to a distinct difference in the wave climates of the respective coasts (i.e. it is very exposed). The lack of technical data and a comprehensive understanding of the coastal processes is now an issue on the west coast with increased coastal development (subdivisions), significant erosion at places such as Muriwai (Figure 1) which is affecting beach access and recreational value, the increased popularity of surfing and proposed large-scale projects such as sand mining.



Figure 1: Erosion at Muriwai Beach, west of Auckland
(Source: PHILLIPS, 2006)

THE PROJECT

The project is focused on fundamental coastal processes on the North Island's west coast, and will provide much needed new knowledge that will direct decision-making, as well as inform and change current practice in the profession. Aside from a large multi-faceted study by PHILLIPS *et al.*, (e.g. 1999; 2001; 2003) investigating the sediment dynamics and seabed characteristics, there have been limited investigations in this area (none the same as that proposed). As mentioned a number of very topical issues associated with this research outcome, are at the forefront of public interest. These include a number of proposals to mine the "black sand" from Taranaki to the Kaipara Harbour, coastal erosion that is occurring all along this coast including Mokau, Marokopa, Raglan, Kariotahe and Muriwai Beaches, selection of marine reserves and the impacts that these events can have on natural amenities (e.g. the fishing activity on adjacent reefs, quality of the surf, etc). Tangata Whenua and local Iwi have voiced their concerns about sand mining and other seabed issues and how such activities will impact on the natural system of which they are custodians in their role as kaitiaki.

At the study site (Raglan) a large quantity of sand (possibly $>1,000,000 \text{ m}^3$) has been visually identified adjacent to the headland, providing anecdotal evidence of a sandbar or "slug" of sand moving along the coast. This sand bar is having large impacts on the coastal processes and no previous accounts of such a phenomenon have been reported or exist as local knowledge. Understanding both the size, and the temporal and spatial change of this sandbar, as well as the effect the sand has on the ecology will assist in providing vital knowledge to scientists, engineers, local iwi, regulators and decision makers who will decide on the viability of projects such as the proposed offshore mining and coastal protection strategies.

The project aims to:

- Gain a comprehensive understanding of the characteristics and variation of the migration of large sand bars on the West Coast;
- Identify the impact on surfing wave quality and the ecology of the area;
- Provide increased knowledge into the dynamics of west coast sediment transport and assist in filling the knowledge void that presently exists;
- Change the way decisions are made in relation to the west coast and advance current industry practice.

OBJECTIVES OF THE PROJECT

The objectives of the study to be undertaken at the Raglan headland are to:

- Quantify the size and temporal and spatial variation of the large sandbar off the Raglan headland, including any change due to seasonal variation in wave climate;
- Identify the effect of the sandbar on local ecology (impact assessment);
- Identify the effect of the sandbar on hydrodynamic processes and wave transformation through numerical modelling;
- Identify through the use of hindcast wave data (last 20 years) on the west coast, and through a literature review whether any theory can be developed related to climate change factors and other longer term climatic forcings (e.g. El Nino/La Nina, the Inter-decadal Pacific Oscillation (IPO), etc).

STUDY LOCATION - RAGLAN

Raglan headland is located on the North Island's west coast of New Zealand, approximately 2 hours south of Auckland (Figure 2). The headland is large in scale (13 km from Ruapuke Beach in the south to the Raglan Harbour entrance), and surrounds Mount Karioi. It is known as a world-class surfing headland that has consistent peeling waves breaking down the headland (Figure 3). Basaltic Andesite boulders armour the shoreline of the headland, with a titanite-magnetite "black sand" found on the seabed. This sand is finer grained and denser than quartz sand found on New Zealand's east coast.



Figure 2: Location of Raglan (Source: TUMONZ, 2006)



Figure 3: The Raglan Headland with waves and lagoon visible (ASR, 2006).

PROJECT METHODOLOGY

The investigation includes a number of bathymetric surveys of the seabed over a pre-determined time period to determine the size, and spatial and temporal variation of the massive sand “slug”. Numerical computer modelling of the headland will be undertaken, which would be driven by wave data from the World-Wide Wave model and nested within the Raglan MetOcean sub-grid, with aerial photos to validate the study.

Specifically the methodology includes:

- **Literature Review:**

All the existing literature applicable to sediment transport, stability of the reef/sand interface, erosion hotspots, etc, on the NZ West Coast will be collated. In addition, international searches will be undertaken to locate any similar research that is applicable to the current project.

- **Hindcast Wave Data Assessment:**

ASR own 20 year hindcast data for more than 50 sites around the NZ coast, as well as 9-12 years of nowcast data for the entire world from NOAA’s world wave model. These data can be transformed into the study via a nested model set-up, with a sub-grid of the Raglan bathymetry already set up by ASR for local wind and wave predictions.

- **Bathymetric Surveys:**

Bathymetric surveys will track the movement of the sand bar. Surveys will be undertaken from beyond the offshore extent of the sandbar (Outside Indicators) to approximately 1 km inshore (Whale Bay), to include areas of possible migration. A Lowrance 200Khz survey system will be utilised, with an Aquadopp wave/current meter being deployed for tidal corrections. Runlines will be mainly shore normal.

- **Remote video transects:**

Remote video transects will be recorded on the day of the bathymetry surveys to assess the rock/sand boundary and impacts on the local ecology. Remote video transects is a technique that is used for rapid data gathering of subtidal habitats. Live video is fed back to an onboard video recorder and selected segments are recorded and then later written to DVD to compile ‘clickable’ maps of the subtidal area.

- **Numerical Modelling:**

ASR’s 3DD suite of numerical models will be used to simulate waves, currents and sediment transport in the region of the sandbar. This will enable the identification of local impacts and driving factors. Models will relate hourly hindcast wave climate data to the movement and evolution of the massive sand bar, with the bathymetric surveys for calibration and aerial photographs to validate results.

- **Aerial Photographs:**

Aerial photographs will be taken during the next wave event after each bathymetry survey to verify and validate the bars position and the results of numerical modelling.

SANDBAR (ANECDOTAL EVIDENCE)

In May 2004, a series of storms resulted in a radical change to the surfing breaks on the Raglan points, namely Indicators and Outside Indicators. Following the series of extreme events, waves no longer broke at Outsides and broke very wide at Indicators. This phenomenon was enhanced at low tide, with some waves still breaking at Outsides on the full tide - Raglan point breaks are known to be influenced by the tide, with smaller waves breaking at high tide than at low tide, especially when the swell tends towards a southerly direction. This is due to the process of refraction, with more wave energy being able to refract round the points when the water depth is lower (i.e. low tide), and has been identified at other locations with large headlands such as Cape St Francis in South Africa and Great Western Bay in England (MEAD, 2000; BLACK *et al.*, 2002; PHILLIPS, 1999; MEAD *et al.*, 2006).



Figure 4: Waves shoaling wide at Indicators in 2005 (Source: MEAD, 2005).

By the end of winter, the points had returned to their normal breaking patterns, with the summer of 2004/2005 producing some of the best surfing conditions in a decade. However, the following May (2005), the onset of the winter storms resulted in similar conditions as the previous winter (Figure 4). This time the impacts on both breaks (Indicators and Outsides) was more severe and received comment in the New Zealand Surfing Magazine “Kiwisurf”: “We had a quite good swell at Indicators. It's been weird though [...] It's changed the whole set-up at Indies. There was no Outsides, but the take off spot for Indies was in line with the Outsides take off spot” (HUGHES, 2005). It was evident that a large sand bar was now present offshore of Indicators that 'robbed' Outsides of wave height and resulted in wide breaking waves at Indicators in most conditions (termed 'fat' by surfers because they broke with low intensity on the low gradient sand, rather than the steep reef (e.g. MEAD and BLACK, 2001)(Figure 5).



Figure 5: A wave shoaling wide at indicators in 2006
(Source: MEAD, 2006)

The appearance of this large sand deposit off Indicators coincides with the periodic sand inundations recently measured in the Lagoon adjacent to Indicators (Figure 3). Time series aerial photographs dating back to 1944 indicate that large sand influxes into the lagoon occur every 20 to 30 years with the last influx occurring some 20 years ago (SHAND, 2006).

Indeed, anecdotal evidence indicates that there is a large volume of sand presently inside the lagoon, although large fluctuations inside the lagoon are observed on a regular basis (pers. obs.).

The present study is aimed at measuring and tracking the movement of this large sand deposit down the Raglan Headland. Several coastal oceanographers have previously commented on these large sand deposits, or 'slugs' of sand, that move up the west coast between Taranaki and Cape Reinga (e.g. GIBB, 1979; McCOMB, 2001; DAHM, 2002; PHILLIPS, 2005). However, this study provides measurements of such an event, allowing us to estimate the volumes of sediment involved and the speed of migration.

PRELIMINARY RESULTS

The preliminary results indicate that a large sand bar was located offshore of Indicators in December 2005 (Figure 6). The subsequent surveys show that this sand bar had moved east and reduced in size by March 2006 (Figure 7), and was almost undiscernable by June 2006 (Figure 8). Photographs of the breaking waves in May 2006 confirm the dispersal of the bar from the Indicators surf break at the headland (Figure 9). "In addition, local surfers have commented that Outsides is again breaking on a regular basis."

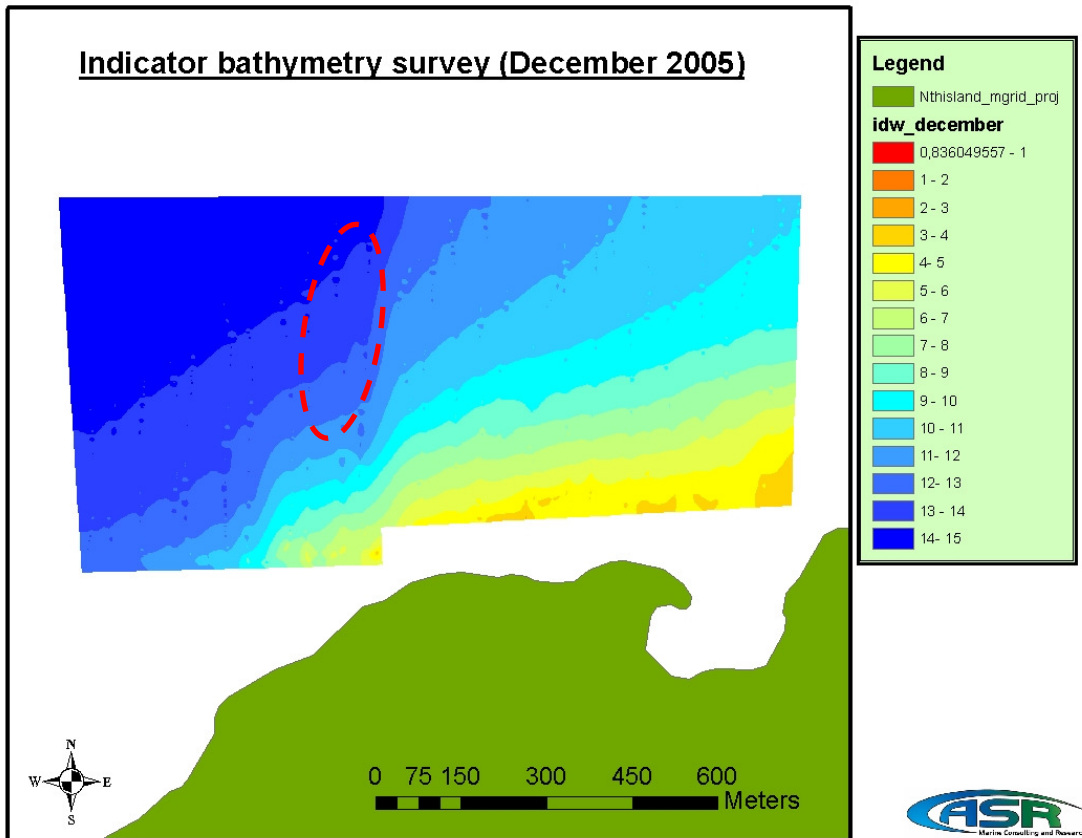


Figure 6: Bathymetric Map of the survey in December 2005.

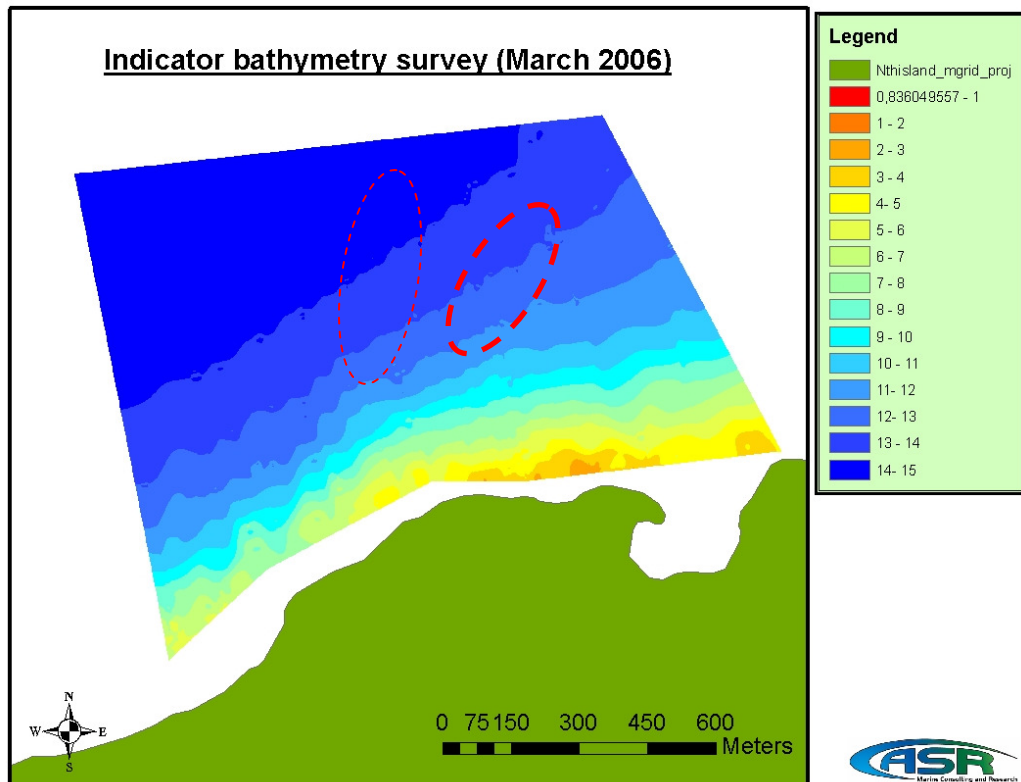


Figure 7: Bathymetric Map of the survey in March 2006.

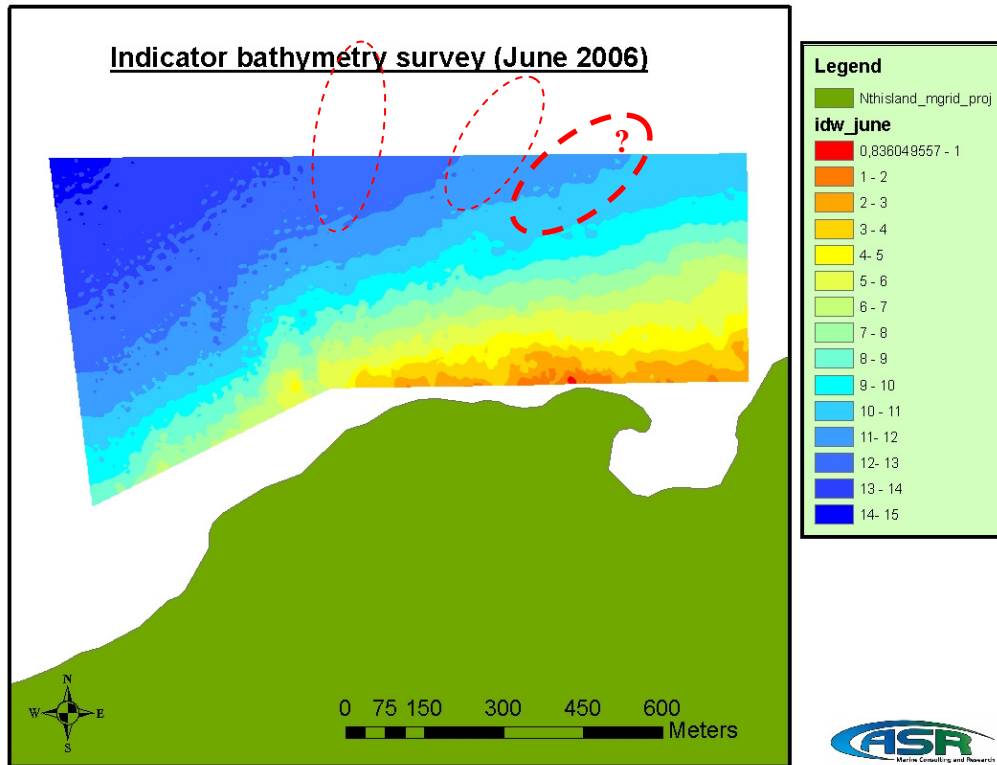


Figure 8: Bathymetric Map of the survey in June 2006.

Once the field work is complete, volumetric comparison of the sequential surveys and numerical modelling will be undertaken to assess the migration of the sand bar and the impacts on the surfing breaks, respectively.

SUMMARY

The preliminary results have shown that a large sandbar was located offshore at the Raglan headland in 2005/2006, confirming what was theorized from anecdotal evidence. The sandbar has effected how the waves break at the headland and compromised surfing wave quality. The results of the December 2005 survey clearly show the presence of the sandbar. The subsequent surveys show that this sand 'slug' had moved east and reduced in size by March 2006, and was almost indiscernible by June 2006. The results are strongly supported by the aerial photos which show waves shoaling on the sand bar in 2005, and having less effect by June 2006.



Figure 9: Waves breaking at the headland in June 2006 and showing less evidence of breaking wide as previously seen at Indicators (Source: ASR, 2006).

ACKNOWLEDGEMENTS

The authors would like to thank Unitec New Zealand and ASR Ltd for funding assistance with the project.

REFERENCES

- BLACK, K. P., S. T. MEAD, P. MCCOMB, J. MATHEW and C. BLENKINSOPP, 2002. Developing a Surfing Reef at Newquay Bay: Feasibility Study. Report to Newquay Artificial Reef Association, May 2002.
- BRANDER, R.W., OSBORNE, P.D. and K. PARNELL., 2003. High-energy beach and nearshore processes. In: Goff, J.R, Nichol., S.L and H.L Rouse. (eds). *The New Zealand Coast – Te Tai O Aotearoa*. Dunmore Press, Palmerston North, New Zealand. 312 p.
- DAHM, J., 2002. Muriwai. Coastal Hazard Management Strategy. Report for Auckland Regional Council and Rodney District Council. 85 p.
- GIBB, J.G., 1979. Late Quaternary Shoreline Movements in New Zealand. Unpublished PhD Thesis, Victoria University of Wellington. 216 p.
- HUGHES, L. 2005. Barrel Bulletin. KIWISURF magazine.
- HUME, T.M., BELL, R.G., DE LANGE, W.P., HEALY, T.R. HICKS, D.M. and R.M. KIRK., 1992. Coastal Oceanography and Sedimentology in New Zealand, 1967-91. *New Zealand Journal of Marine and Freshwater Research*, 26, 1-36.
- HUME, T.M., BELL, R.G., PARNELL, K.E. and R.M. KIRK., 1997. Coastal physical sciences. In: Davey, F. and R. Pridmore. (eds). *The New Zealand Knowledge Base: Earth Sciences*. Ministry of Science and Technology, Wellington. pp. 52-58.
- MCCOMB, P., 2001. Coastal and Sediment Dynamics in a High Energy Rocky Environment. Unpublished PhD thesis. University of Waikato. 286 p.
- MEAD, S. T., 2000. Incorporating High-Quality Surfing Breaks into Multi-Purpose Reefs. Doctor of Philosophy in Coastal Oceanography and Surfing Reefs thesis. University of Waikato. Pp 209 + appendices.
- MEAD, S.T. and BLACK. K.P. 2001. Predicting the Breaking Intensity of Surfing Waves. Special Issue of the Journal of Coastal Research on Surfing p51-65.
- MEAD, S. T., BLACK, K. P., J. C. BORRERO, J. FRAZERHURST, D. ANDERSON, D. J. PHILLIPS and M. KRAMER, 2006. St Francis Bay Beach Project: Feasibility Study. Prepared for the St Francis Bay Beach Reef Trust, May 2006.
- PHILLIPS, D., BLACK, K., HUME, T., and T. HEALY., 1999. Sediment Dynamics Along a Surfing Headland. *Coasts and Ports 99*, Perth, Australia. Vol. 2, pp. 513-518.

- PHILLIPS, D.J., BLACK, K.P. and HEALY, T.R., 2001. Seabed Characteristics of a Dynamic Exposed Headland. *Coasts and Ports 2001*, Gold Coast, Australia. pp. 400-405.
- PHILLIPS, D.J., BLACK, K.P. and HEALY, T.R., 2003. Sandy Seafloor Volume Changes off a High Energy Headland Boulder Beach, Raglan, New Zealand. *Coasts and Ports 2003*. Auckland, New Zealand. CD Publication, Paper No. 115. 8 p. ISBN: 0-473-09832-6.
- PHILLIPS, D.J., 2005. Sediment Dynamics of a Shallow Exposed Surfing Headland. Unpublished PhD Thesis. University of Waikato. 269 p.
- SHAND, R., 2006. Hearing PRESENTATION TO THE WAIKATO DISTRICT COUNCIL. IN THE MATTER of the Resource Management Act 1991 AND IN THE MATTER An application for Land Use Consent by J Hemi, 108E Whaanga Rd, Raglan.