

Port of Hastings 2013 Description Report - Hydrodynamics

Port of Hastings Development Project
Preliminary Base Case Phase

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Prepared for Port of Hastings Development
Authority

December 2013

In May 2016 the Special Minister of State asked Infrastructure Victoria to provide advice on the future capacity of Victoria's commercial ports. Specifically, the Minister has asked for advice on when the need for a second container port is likely to arise and which variables may alter this timeline. The Minister has also asked for advice on where a second container port would ideally be located and under what conditions, including the suitability of, and barriers to investing in, sites at the Port of Hastings and the Bay West location.

In undertaking this task, Infrastructure Victoria reviewed work that was completed as part of the Port of Hastings development project before it was cancelled in 2014. This document forms part of the initial work undertaken for the proposed port development at Hastings. Infrastructure Victoria considers that much of the previous Hastings work, although preliminary in nature, is relevant and suitable for informing a strategic assessment. Therefore, Infrastructure Victoria has made the reports previously commissioned for the development project part of the evidence base on which Infrastructure Victoria will use in providing the Minister with advice.

The opinions, conclusions and any recommendations in this document are based on conditions encountered and information reviewed at the date of preparation of the document and for the purposes of the Port of Hastings Development Project.

Infrastructure Victoria and its consultants have used the information contained in these reports as an input but have not wholly relied on all the information presented in these reports.

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Executive Summary

A review of historic and contemporary data was undertaken to gather the most up to date information for calibration of the preliminary models. Although many data sources are available, there are still some data gaps that will require filling before detailed modelling of port design options can be undertaken. Therefore, the preliminary and scenario modelling will establish a basic understanding of the hydrodynamic regime based on existing available data, and will:

- provide preliminary hydrodynamic outputs;
- allow for concept options testing of various port configurations; and
- specify the most appropriate locations for further data acquisition campaigns.

A number of previous reports and environmental review documents were reviewed to ensure an up to date knowledge of the coastal and estuarine geomorphology and processes in Western Port Bay.

Bathymetric survey data shows a deep wide channel through the Phillip Island entrance that splits at the south western corner of French island. The main channel stays deep through the Lower North Arm segment past Hastings, turns to the east around the north of French Island and splits into a number of dendritic channels and tidal flats. The eastern channel passes Rhyll north of Phillip Island and then runs north around the eastern end of French Island to meet the northern arm near Lang Lang. This area is the tidal divide and is a sediment deposition zone characterised by expanses of shallow intertidal sand and mudflats and seagrass vegetation.

Water levels within the bay are dictated by water levels within Bass Strait, and influenced by the bathymetry and tidal fluctuations. Tidal range increases with distance from the entrance and this is confirmed through comparison of Stony Point and Tooradin tide gauge data. Mean sea-levels are increasing the rate of increase is also increasing. Over the last 20 years, the average rate of increase at Stony Point is 3.7 mm/yr. Tidal range, storm surge and sea-level rise have been combined to provide preliminary estimates of the design sea-levels for the proposed port area.

Currents are dominated by the tidal movements which follow the divided channels around French Island and meet at the tidal divide in the north east of the bay. Net circulation is thought to be in a clockwise direction around French Island, however this remains to be confirmed. The circulation direction is consistent with present knowledge of the patterns of sediment transport and redistribution within the bay. Early sediment studies compared to more recent studies show the movement of fine grain sediments from the northern reaches of the bay to the east. Sediment inputs into the bay via riverine sources are well documented; however marine source volumes are uncertain as well as volumes of sediment being exported out of the bay.

Measured wave data is not available within Western Port Bay. The nearest measured wave data is from Point Nepean near the Port Phillip Bay entrance. Swell from Bass Strait penetrates the Western Arm as far as Sandy Point, and waves within the remainder of the bay are primarily wind generated.

Water quality within the bay is generally good, and is regularly monitored to ensure adherence to state water quality thresholds.

After review of the data and previous reports, a number of data gaps are evident, as well as uncertainties in the current hydrodynamic understanding. Although the existing data is sufficient to calibrate the preliminary modelling, detailed modelling for port design will require a comprehensive data acquisition campaign to be carried out to gather the appropriate data to ensure greater levels of confidence and certainty. The findings of the preliminary modelling will aid in dictating the direction of the data acquisition campaign by determining the most appropriate locations to deploy instrumentation and identifying additional data gaps.

A detailed assessment of data requirements to support numerical modelling and related project investigations is presented in the “Hydrodynamics Framework” (Cardno, 2013b)

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1 Introduction

1.1 General

The Port of Hastings Development Authority (the Authority) is responsible for the management and operation of the Port of Hastings and the facilitation of the development of the Port of Hastings into a world-class competitive container port. The Port of Hastings Development Project (the "Project") includes all the activities which will be required to achieve the proposed development of the port. As part of the Project, the Authority has appointed a team of consultants to conduct scoping studies and establish project planning tools to support the Project's development.

Cardno has been appointed to undertake the works required in the Hydrodynamics Work Package.

1.2 Background

Taken from the documents accompanying the tender specification for the consultancies.

The Port of Hastings Development Project will include all activities required to investigate, evaluate, plan, assess, permit, procure, construct and operate an expanded Port of Hastings to meet forecast demand for trade, in line with the legislated and business objectives of the Authority.

The Port of Hastings Development Project will commence in 2012-13 with a series of studies with the aim of preparing a Preliminary Business Case and Port Development Strategy and establishing project planning tools to guide project development activities over coming years.

Potential port expansion and operations

The Port of Hastings Development Project will establish container handling facilities with an ultimate throughput of up to 9 million TEU (Twenty-foot container Equivalent Units) per year, plus capacity for bulk and break-bulk trades where there is a justifiable business case.

Options for the use and development of the Long Island Point and Crib Point precincts will be assessed as part of the scope of the project and consideration will also be given to the short and long term use of the Stony Point Jetty and port operations areas.

The Authority envisages that the port's future business will come from some or all of:

- > International container trades
- > Existing and future liquid bulk trades
- > New bulk and break-bulk trades (including motor vehicles)
- > Bass Strait trade
- > Trans-shipment to other Australian or New Zealand ports
- > Intermodal transfer of freight, that is to and from the land transport network
- > Land-lord or other revenues from the operation of freight and logistics uses within the Port Zone or Special Use zone

To fulfil the Authority's vision and provide for future trade demand, it is anticipated the port expansion and other infrastructure development would include:

- > Dredging of new or deepened shipping channels, berth pockets, swing basins and anchorages
- > Beneficial re-use of dredged materials, or disposal to an existing or new dredged material ground inside or outside Western Port
- > Construction of wharves and shipping berths, including the potential for land reclamation and provision for significant areas of hard stand
- > New terminal facilities, including container stacking areas and equipment

- > Port and logistics related developments in the port environs, including road and rail circulation within the port environs
- > New land use and development associated with the ongoing operation of the port
- > Upgrade of the arterial road network outside the port environs to increase capacity consistent with the increase in trade
- > Construction of a new rail line between the port and the existing rail network

1.3 Scope of this report

This report is part of the hydrodynamics work package and reviews the previous coastal process and hydrodynamic studies undertaken in and around Western Port. It also reviews the most up to date information and data available that will be incorporated into the Preliminary and Scenario hydrodynamic models. This will build a contemporary understanding of the coastal, estuarine and geomorphologic processes in the vicinity of the proposed development and the wider Western Port area.

The study area and place names used in this report are shown in Figure 1-1.

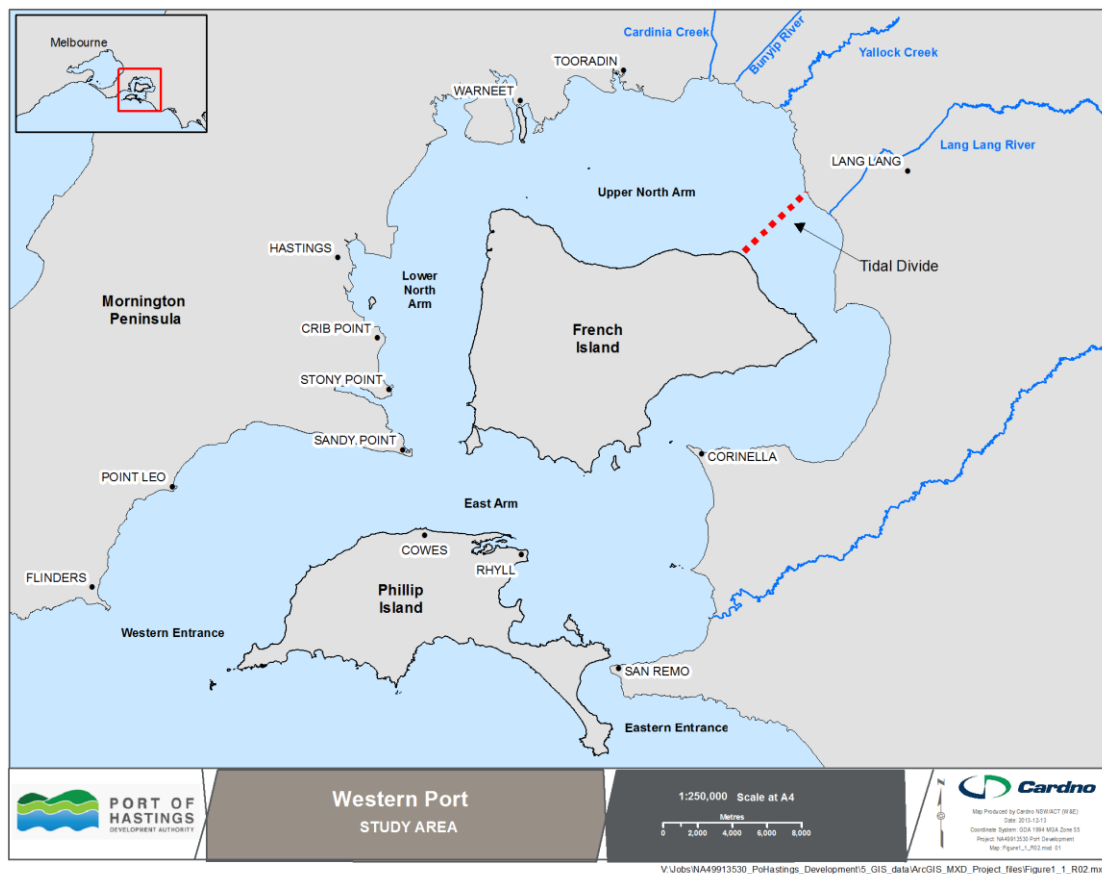


Figure 1-1 Western Port, showing the study area and place names.

Section 1 introduces the project (this section). Section 2 reviews the available data and studies and notes how relevant information will be incorporated to achieve the project goals. Section 3 gives information about the latest data acquisition campaign. Section 4 is a commentary of the current understanding of the coastal and estuarine processes and hydrodynamics of Western Port, with a general summary and indication of data gaps and further data requirements in Section 5.

Additional related information can be found in the “Preliminary Current Measurements” (Cardno, 2013a) and “Hydrodynamics Framework” (Cardno, 2013b) which are referred to below.

2 Review of existing studies and data

2.1 Available reports and data

A suite of technical studies exists for the Western Port area. These studies were reviewed by AECOM (2009) as part of the former Port of Hastings Corporation's Port Land Use and Transport Strategy in 2009 (PLUTS). The AECOM review will form the basis of the current review; the report "Review of Hydrodynamic and Water Quality Data and Analysis" provides a relatively thorough account of the previous studies up to 2009, as well as the historic and current understanding of the hydrodynamics within the Western Port area. Any additional information, data or reports available since 2009 will be incorporated into this review to further develop the understanding.

Table 2-1 presents the data and reports available for the Western Port area which have been reviewed and how this information will contribute to model development required as part of the Preliminary Business Case phase. This information has been assessed to determine relevance and usefulness, and in combination with the data from the preliminary measurement campaign will be used to establish a contemporary understanding of the processes and hydrodynamics within the bay.

The hydrodynamic models which have been developed for Western Port date back to the late 1970's; these are discussed in Section 2.2.

Some preliminary measurements have been undertaken as part of this project and details are in Section 3.

2.1.1 Westernport Bay Environmental Study

The most extensive study carried out within the bay was undertaken in the mid-1970s. This was the Westernport Bay Environmental Study (1973-1974), also known as the Shapiro Report (1975). This was primarily an environmental assessment to determine baseline conditions in the bay area in the face of large scale development and an increase in heavy-industry. The study looked at all facets of environmental appraisal including land-use, geology and soils, morphology, hydrodynamics, sediments, biology and ecology, geochemistry, groundwater, social surveys, amongst others. A suite of reports were prepared which each detail an aspect of the environmental assessment, with a project overview report (Shapiro, 1975). These reports were reviewed and are referred to within this report.

2.1.2 Contemporary studies

Other more recent studies have been undertaken in Western Port Bay, however nothing as broad or detailed as the Westernport Bay Environmental Study.

There was a report by the EPA (1996), however, we have been unable to obtain a copy.

Western Port Condition Report -2009, a publication of EPA (2011) examined the long-term trends in water quality of Western Port Bay from 1984 to 2009 and assessed data against the environmental quality objectives from the State Environment Protection Policy.

In the early 2000s, a number of sediment studies were carried out to determine sediment transport patterns, sediment sources, input volumes and composition. These are summarised in Table 2-1, and have informed the commentary of sediment dynamics in Section 4.2.

A consortium of local companies, fronted by Melbourne Water, produced a holistic review of the Western Port environment in the report - *Understanding the Western Port Environment (2011)*. This report presents a summary of the current knowledge and priorities for future research. It contains an overview of the hydrodynamics of the bay, based on the aforementioned studies and those within Table 2-1, and although it is mostly focussed on the ecosystem health rather than physical processes, it does give a good overview of the processes.

Table 2-1 Available information summary

Theme	Type	Author/Title	Summary and relevance
Bathymetry	Data	Admiralty charts AUS150, AUS151, AUS152	Historic bathymetric data is available from the regions Admiralty charts. Chart information will be used to fill gaps where other more recent data sources are unavailable.
		Annual surveys at the Steel Industry Berths, Crib Pt. berths, Long Island Liquids berths.	Hydrographic survey data has been gathered annually. The survey extents are near the vessel berths and approach channels. A table of the areas surveyed each year since 2004 is contained in Appendix A
		Annual/biannual surveys of the sand wave field between No. 19 & 20 buoys 1995-2001.	This is the baseline data for the Lawson and Treloar Sand Waves Study (2002) – refer below.
		LADS bathymetric survey – DSE 2007.	The LADS survey covers most of the shallow areas of Western Port, however due to turbidity issues; there are some gaps, particularly in the north eastern section of the bay. There is also a data gap west of Sandy Point. The data are available on a 2.5 m grid and also a 20 m grid.
		High resolution multi-beam survey data (Fugro LADS, 2010).	In conjunction with the LADS survey, a multi-beam echo-sounder survey of the deeper areas of Western Port was undertaken. The data are available on a 2.5 m grid
	Reports	Marsden & Mallet (1974). Morphology and Sediment Distribution, Westernport Bay – Part of the Western Port Environmental Study	This report describes the general setting of the bay in terms of historic morphological development and sediment processes. The assessment used sediment samples and a series of historic aerial photos. The author states that the morphological complexity of the bay can be attributed to the distribution of bedrock, rather than sediment deposition. The lack of freshwater inputs to the bay has limited the seaward transport of sediment. The clearing of the Koo Wee Rup swamp and local forest clearing contributed to significant changes in sedimentation patterns within the bay and contributed to the excess of fine grain sediments and increased turbidity.
		Public Works Dept. (1975). Investigation of Hydrodynamic Characteristics of Western Port Bay - Part of the Western Port Environmental Study	The primary aim of the bathymetry section of the study was to collect and collate topographic and bathymetric data through a data acquisition campaign supplemented with historic Admiralty charts and aerial photos. Cross-sections at a number of locations were produced to inform other aspects of the Western Port Environmental Study. The data was used to input into an early hydrodynamic model.
		Lawson and Treloar (2002). Western Port Sand Waves. Report prepared for Toll Western Port.	A brief report was prepared to investigate the behaviour of the sand waves in the Western Port channel, between buoys 19 and 20. The area was surveyed six monthly and Lawson and Treloar analysed data from 1995 to 2001. Contour plots and difference plots (between surveys) were presented. Plots show a relatively uniform progression of the sand waves in a southerly direction. Understanding the bathymetry changes and sediment transport in this area will aid in planning of channel dredging and determining maintenance dredge requirements.
		Western Port Bathymetry Project (2009/10) – Fugro LADS Corporation	A large-scale bathymetric survey was commissioned by DSE as part of the Future Coasts Project. Multi-beam echo sounding data was collected between June and November of 2010. This report gives detail of the survey area, the instruments used, calibrations, processing,

Theme	Type	Author/Title	Summary and relevance
			coverage, accuracy and limitations. The data will form the basis for bathymetry for subsequent modelling.
Sediments (bed and suspended)	Data	Ministry for Conservation Victoria - Westernport Bay Environmental Study (1973-1974) - Sediment Mapping of near surface bed sediment.	Figure maps are presented within the Westernport Bay Environmental Study report which show the distribution of different grain sizes around the bay.
		CSIRO bed sediment maps (Hancock et al., 2001)	These provide updated versions of the near surface sediment maps noted previously. Discussed in more detail in Section 4.2, Figure 4-3.
		Suspended sediment concentrations – EPA monitoring locations (quarterly/monthly)	Suspended solids are measured regularly as part of a fixed site water quality monitoring program within the bay. Records are from 1984 to 2009 for six locations, although only three have data spanning the full time period. This data will contribute to the sediment transport modelling, as well as the water quality modelling. The data set also contains many other water quality measurements including Chlorophyll A,B,C, dissolved oxygen, nitrites and nitrates, phosphorus, pH, salinity and temperature. This information will contribute to the water quality modelling.
	Reports	Ministry for Conservation Victoria - Westernport Bay Environmental Study (1973-1974)	This report is a detailed account of the general environmental condition of Western Port and hinterland from 1973 to 1974. It includes the coastal physical processes, as well as the geology, soils, land-use, ecology and chemistry. The report was intended to provide a thorough understanding of the environment as a whole, to develop guidelines for future management of the area. The report details the types, sizes, sources and distribution of sediments within the bay.
		Hancock G., Olley J.M. & Wallbrink P.J. (2001). <i>Sediment transport and accumulation in Western Port. Report on Phase 1 of a study determining the sources of sediment to Western Port</i> . Technical report no 47/01. CSIRO Land and Water - Environmental Hydrology	This report looks at sediment transport and accumulation in Western Port. This was done by examining the hydrodynamic regime within the bay, and estimating rates of sedimentation. The sediment transport was enumerated by looking at the spatial distribution of various sediment particle sizes and estimating suspended particle residence time. The accumulation rates were determined from sediment chronologies. These were determined through radiometric/isotope dating, Pinus pollen and optically stimulated luminescence dating (OSL) of the sediment. This report provides a good background into the sediment dynamics in the bay. Although the focus areas are the north, east and south of the bay rather than the port development area, it gives good detail about the general transport patterns within the bay as well as suspended sediment concentrations and grain size distribution within the bay. This information will contribute to the sediment transport modelling, as well as the water quality modelling.
		Wallbrink, P.J., Olley, J.M. & Hancock, G., (2003). <i>Tracer assessment of catchment sediment contributions to Western Port, Victoria</i> . Technical Report 8/03, CSIRO Land and Water.	This study traced the source of sediments into the bay via local river systems. Samples from each river draining into the bay were taken. These were geochemically analysed to compare against grab samples taken within the bay to determine origin. This information will be useful as it gives detail about sediment grain size, composition and volumes of the fine riverine sediment inputs and their distribution in the bay. It does not give information on marine sediment sources.

Theme	Type	Author/Title	Summary and relevance
		Wallbrink, P. J., Hancock, G. J., Olley, J. M., Hughes, A., Prosser, I. P., Hunt, D., Rooney, G., Coleman, R., Stevenson, J. (2003b). <i>The Western Port Sediment Study</i> . CSIRO Consultancy report, Highett.	<p>This study gives a general overview of the sediment dynamics within Western Port Bay with respect to sediment sources, suspended sediments, deposition patterns and the implications of these on the bay environment.</p> <p>Findings show that there has been a substantial redistribution of fine grain sediment from the northern reaches of the bay to the south east. This is consistent with the findings of Hancock <i>et al.</i> (2001) that net transport within the bay is in a clockwise direction and is predominantly tidal and wind driven. Mixing and re-suspension of sediments has been noted to depths of between 12 and 24 cm depending on location. This has led to significant and persistent turbidity in the north and east of the bay. This information will contribute to the sediment transport and water quality modelling.</p>
		Hughes A.O., Prosser I.P., Wallbrink P.J. & Stevenson J. (2003). <i>Suspended sediments and bed load budgets for the Western Port Bay Basin</i> . Technical Report 4/03, CSIRO Land and Water.	<p>This report looks at terrestrial sediment sources and freshwater and marine sinks, i.e. the amount of sediment that is delivered from land to water to inform land management practices. The report also focuses more on gully erosion, sediment pathways and suspended sediment yield and the implications for water quality such as increased nutrients, turbidity and habitat sediment inundation.</p> <p>Whilst the report gives the potential sediment supply into the rivers that drain the catchment, there is little information enumerating rates of transport into the marine environment. It estimated that 60% of sediment passing through the catchments river networks flows through to the marine environment.</p> <p>The information within this report may have some use for the sediment transport modelling by providing some estimates for additional sediment input volumes. The information will also be used to determine riverine supply of suspended sediment to inform the water quality modelling.</p>
Dredging	Data	Port of Hastings dredging records for Western Port	Dredging records within AECOM (2009) adapted from EPA (1996) describe large capital and maintenance dredging campaigns from 1921 to the present day.
Water levels	Data	Tide gauge data at Western Port (Stony Point)	Stony Point tide gauge data – downloaded from BoM website -1993-2012. This data set provides most thorough water level information for Western Point, at 1 hour and 6 minute intervals. The data set also contains some wind information, direction, gusts and speed at Stony Point. Analysis has identified an issue with the gauge for very high water-levels where the data “flat-lines”, apparently due to the sensor being set too low (BoM, Pers. Comm.).
		Tide gauge data at Tooradin (Melbourne Water)	A comparison between this and the Stony Point data reveals significant differences between the water levels. Previous studies of extreme water-levels have used Stony Pt. water-level data and made assumptions from that to determine levels and extremes at Tooradin; however this measured data set has shown the previous assumptions, and predicted extremes, to be incorrect. This difference will need consideration in further assessments and the measured data will contribute to the calibration of the hydrodynamic model in that area of the bay. It will also allow recalculation of the extremes near Tooradin.
	Reports	Port of Melbourne Corporation (PoMC) Victoria Tide Tables, include tidal planes at Stony Point	Tide tables are available every year from the PoMC. The latest edition (88 th) is available for 2013. This provides the general tidal levels for Stony Point in Western Port Bay in m AHD and m CD as well as tidal predictions for the year and adjustments for secondary locations within the bay.

Theme	Type	Author/Title	Summary and relevance
Climate change and sea-level rise	Data	Australian Baseline Sea Level Monitoring Project data (ABSLMP) – National Tidal Centre, BoM	This water level data set dates back to the early 1990s for Stony Point, thus providing a thorough contemporary (although relatively short) record of water level trends for the area. From this, sea level rise trends are updated monthly. (See note above on issues with recording very high sea levels)
	Reports	CSIRO (2008) – Effect of Climate Change on Extreme Sea Levels in the Western Port Region.	This report gives storm tide levels for a range of scenarios for Stony Point and Tooradin; however values for both locations were determined using the Stony Point water-level data. Analysis of water level data at the two locations reveals a significant difference in water levels, thus, extreme tide values for Tooradin given in this report require further investigation to confirm the actual values.
		ABSLMP Reports - National Tidal Centre, BoM	Based on the tidal data noted above, brief data analysis reports are prepared monthly which note the updated sea level rise estimates for each tide gauge location. Yearly reports are prepared which consolidate the previous year's data analysis and provide an overall yearly sea-level rise trend.
Tidal Currents & Circulation	Data	Westernport Bay Environmental Study (1973-1974) tidal gauging experiment	A report of the data used is available, however the actual data not available in electronic form for analysis. Sampling and calibration methodologies are presented as well as data sources, assumptions and limitations. This data report can be reviewed for basic comparison and checking against the modelling, rather than in-depth analysis. The report gives the velocity profiles for a number of locations which may be useful to determine changes to current regimes through the bay.
	Reports	Sternberg & Marsden (1976). Seabed Drifter Studies of Bottom Currents of Westernport Bay and Inner Bass Strait - Part of the Western Port Environmental Study.	Seabed drifters were deployed to collect data pertaining to the patterns of bottom water circulation near the entrance of Western Port Bay and the wider bay area. The study emphasis was on the flood and ebb dominated tidal streams within the channels that form sediment transport paths that dictate the overall sedimentation patterns within the bay. This study also served to supplement the morphological and sediment transport studies done as part of the Western Port Environmental Study. Approximately 2000 seabed drifters were released, approximately a quarter of them were retrieved. Findings showed that the dominant bottom drift direction for the inner Bass Strait was eastwards and seemed to move parallel to the shore. Drifters were released to the west and outside the Western Port entrance channel. All moved into the bay with the flood tide inflow along the western channel through the entrance. Drifters released within the entrance showed similar patterns. Ebb movement was along the eastern channels. Dominant direction of movement within the bay was clockwise around French Island. No drifters were found in the Hastings area.

Theme	Type	Author/Title	Summary and relevance
		Harris & Robinson (1979) – Circulation in Western Port, Victoria, as deduced from salinity and reactive-silica distributions	Analysis of hydrochemical parameters, particularly the salinity and reactive-silica distributions, aided in understanding the circulation patterns within Western Port. Similar to other findings, this study determined that the water moves predominantly in a clock-wise direction, with some 'recycling' near Tortoise Head to form a complete loop. There is some weaker anti-clockwise movement around Rhyll near the Rhyll inlet. The salinity sampling determined spatial salinity gradients were influenced by high rainfall, thus, increased freshwater flow and evaporation during dry periods.
Freshwater inflow & Water quality	Data	Fixed site water quality data – EPA monitoring locations (quarterly/monthly)	Suspended solids and other water quality measurements such as Chlorophyll A,B,C, dissolved oxygen, nitrites and nitrates, phosphorus, pH, salinity etc. are measured regularly as part of a fixed site water quality monitoring program within the bay. Records are from 1984 to 2008 for six locations. This data will contribute to the water quality modelling and subsequent environmental assessments. Data is available from 1984 to 2007. Bacterial water quality data (E.Coli) is also available from 1992 to 2007.
		Westernport Bay Environmental Study (1973-1974) tidal gauging experiment	A report of the data is available, however the actual data not likely to be available in electronic form for analysis.
	Reports	EPA (2007) – Beach Water Quality Summary 2005-2007	Samples are taken regularly from the bay and tested. Summary reports are produced to present the results. This report found that generally water quality was good during periods of fine weather. The quality lessened after large rainfall events, thus it was recommended swimming not occur near storm water outlets.
Wind	Data	BoM wind stations – Rhyll, Cerberus, Phillip Island Penguin Reserve, Stony Point and Wonthaggi.	The most complete wind data sets available are from Rhyll and Cerberus. The data sets are from 1990 and 1987 respectively to the present day. Wind direction, speed and gusts data is available from the Stony Point tide gauge; however the record is not as complete as the BOM anemometer records. This data will be processed for use in the hydrodynamic modelling as forcing conditions.
		Industrial site in the Hastings region	Wind data have been recorded at a site close to the water in the Hastings region. The data have been provided, but the operator does not wish to be identified..
Waves	Data	No measured wave data is available within Western Port.	
		PoMC Wave measurement buoy south of Point Nepean	Measured wave data is available from the PoMC for a location south east of Point Nepean from 2003 to present.
		PoMC Wave data from a deployment near Cape Schanck	There are some records from a Waverider buoy deployed near Cape Schanck, however the location of the buoy is not known which limits the use of these data.
		BoM operational model	Wave parameters are available from the BoM operational model. This model is known to overestimate wave conditions at other locations in Bass Strait prior to 2010. The data may be useful in providing long-term data for statistical (extreme value) analysis. BoM also has a model run using reanalysis winds spanning 30 years, results from this run may be obtained from the BoM.

Theme	Type	Author/Title	Summary and relevance
General	Report	Melbourne Water (2011) Understanding the Western Port Environment - A summary of current knowledge and priorities for future research	<p>This report provides a very thorough of the entire bay as a holistic system. Contributing authors came from a number of disciplines such as coastal/estuarine processes and hydrodynamics, water quality, water column biota, ecological systems (marine, intertidal and terrestrial), exposure pathways and threats and research priorities.</p> <p>This provides a good understanding of the hydrodynamics, however does not present any new information that would contribute to development of the new models, as it is a summary of the studies already noted above. However, it can aid in comparing any new findings with the previous work.</p>

2.2 Previous Models

Table 2-2 shows previous modelling information that will contribute to the current studies. There are four hydrodynamic models that have been developed previously within Western Port Bay dating back to the late 1970s, Hinwood, Harrison and Zigic. A basic oil spill dispersion simulation was developed for the Westernport & Peninsula Protection Council (WPPC) in 1993; this has also been reviewed briefly. Asia-Pacific Applied Science Associates (2013) updated the oil spill in the Western Port Bay for Victorian National Parks Association and Western Port and Peninsula Protection Council, this report has also been reviewed.

Table 2-2 Previous Western Port Models

Models	
Hinwood & O'Brien (1974)	Calibrated hydrodynamic and sediment transport models were developed as part of the Western Port Environmental Study (1973-1974). Although the initial model was part of a wider water quality model (Hinwood, 1974), a general purpose of the exercise was to further the understanding of the physical characteristics of the bay (MFC, 1975). This was a low resolution two-dimensional tide and wind driven model to determine pollutant dispersion patterns (Melbourne Water, 2011). The model showed that with only tidal forcing, flow through the main channel split around French island, with the addition of flow through the secondary entrance east of Phillip Island. The flow met at a tidal divide in the north east of the bay. With wind data incorporated, the net result was clock-wise circulation around French Island (AECOM, 2009; Melbourne Water, 2011).
Hinwood (1979) "Hydrodynamic and Transport Models of Western Port, Victoria". Marine Geology 30: 117-130	
Harrison, Lee, Bosserelle and Black (2007)	This was a joint agreement between EPA Victoria and Melbourne Water to develop an integrated Water Quality Improvement Plan (WQIP) for Port Phillip Bay, Western Port and the surrounding rivers and creeks of the region.
Port Phillip and Western Port receiving water quality modelling: hydrodynamics. ASR technical report 2007-EPA1. Published as EPA publication No. 1377.	A 3D temperature and salinity stratified numerical model was set up and calibrated to allow long term simulations of several years for Port Phillip Bay and Western port. This was undertaken by ASR Ltd., using their 3DD suite of modelling software. Model boundary conditions and inputs included a wide range of variables, e.g. bathymetric data from nautical charts (digitised), tidal data from the Lorne tide gauge, river inputs, wind, atmosphere and heat exchange data (humidity, pressure, air temperature, solar radiation, sea surface temperature and cloud cover. The model was used to drive subsequent models. One simulating the dispersal of pathogens, total suspended solids, toxicants and litter and the other a primary production model.
Zigic (2005) - Quantifying the Potential Benefit of Using Dispersant for an Oil Spill in Western Port, Victoria.	Zigic developed a hydrodynamic model (HYDROMAP) and pollutant transport model (SIMAP) of Western Port to investigate oil spills. This model has not been calibrated or validated, therefore will only be reviewed for information.
Greilach (1993) - Simulation of possible oil spill trajectories from three sites in Westernport Bay.	This simulation looked at realistic oil spill scenarios in conjunction with the Port of Hastings. The results identified areas within the bay that would be impacted during certain meteorological conditions. The results also give the amount of time it would take for oil to reach the coast under each of the scenarios. The results and trends were consistent with previous modelling with circulation being in a clock-wise direction.
Asia-Pacific Applied Science Associates (2013)	Oil spill modelling of Western Port was carried out for the Victorian National Parks Association and Western Port and Peninsula Protection Council and examined the potential impact points for oils from a shipping incident in Western Port. Includes background on oil spills.

It is unlikely that any of the existing models can meet the requirements of the Project; however the results provide useful background and checks on project modelling results.

2.3 Other Information

A number of other reports and documents are available to contribute to the background review. Much of the information focusses on port operations and the requirements of future data acquisition campaigns, as well as what information would be required to carry out the detailed option analysis of potential port development each site. In terms of the overall project, the reports in Table 2-3 are relevant; however, there is not

significant new information in terms of data and process understanding that can contribute to the hydrodynamic modelling. A brief summary of each is provided for information. This information will be more useful for assessment of port configuration options subsequent to model development.

Table 2-3 Additional Information

Date	Author	Title	Summary
August 2009	Consulting Environmental Engineers (CEE)	Port of Hastings Stage 1 Development Marine Ecosystem Preliminary Considerations	This report considers the implications for the local marine ecosystems in relation to the three previously identified port configuration scenarios from Stage 1 of the PLUTS (Port of Hastings Corporation (2009). It characterises the existing marine ecosystem, identifies key ecosystem components, potential issues due to development and dredging and mitigation measures.
April 2011	AECOM/GHD	Basis of Design	This report gives a brief overview of the hydrodynamics and the design conditions as relevant to the design basis parameters. This is a summary of the AECOM (2009) hydrodynamics information.
April 2012	Major Projects Victoria (MPV)	Port of Hastings: Scoping Phase Overview and Forward Strategy	The report consolidates key learning's from previous studies, provides and analysis of major issues, and suggests a prioritised road-map to facilitate delivery of the project. The report provides an integrated analysis of the major issues and risks to the project, and recommendations on how these should be managed.
May 2012	Major Projects Victoria (MPV)	Approach to Environmental Impact Assessment of the Port of Hastings Development	This report gives a brief summary of the environmental issues related to the port development, as well as reiterating some of the previously identified project risks directly relating to the environmental investigations. It describes the proposed framework required to facilitate the delivery of future environmental assessments, through a prioritised program of data collection and collation of baseline data. Gives an indication of how the hydrodynamic data will contribute to the environmental assessments, thus should be considered when setting up models and interpreting modelling results. The governance framework is also discussed and the necessary environmental approvals.
June 2012	Major Projects Victoria (MPV)	Forward Program for Project Planning and Development	This report gives an overview of the program for the entire project, spilt into stages. It presents the timeline of the project and a generalised framework that builds an understanding of the steps involved to delivering the overall project.

3 Data Collection

To further the understanding of the hydrodynamics and aid in calibration of the hydrodynamic modelling, two Acoustic Doppler Current Profilers (ADCPs) were deployed for about four weeks offshore of the proposed development site in December 2012. The southern ADCP site was located between the BlueScope Steel Wharf and the Long Island Wharf, approximately 1km offshore at a depth of 15.5 m. The northern ADCP site was approximately 4 km north east of the southern ADCP site in the centre of the channel at a depth of 9.5 m (Figure 3-1).

Continuous one-minute average current data was collected in one metre vertical bins at the two sites. At the southern site, the maximum depth-average current speed was 1.00 m/s, and the mean speed was 0.44 m/s. At the northern site the maximum depth-average current speed was 0.85 m/s, and the mean speed was 0.42 m/s.

On-minute pressure data was also gathered and converted to water levels for tidal analyses to be carried out to determine the tidal constituents, although the deployments were not long enough to provide high accuracy constituents.

Details of the measurements and analysis are presented in Cardno (2013a).

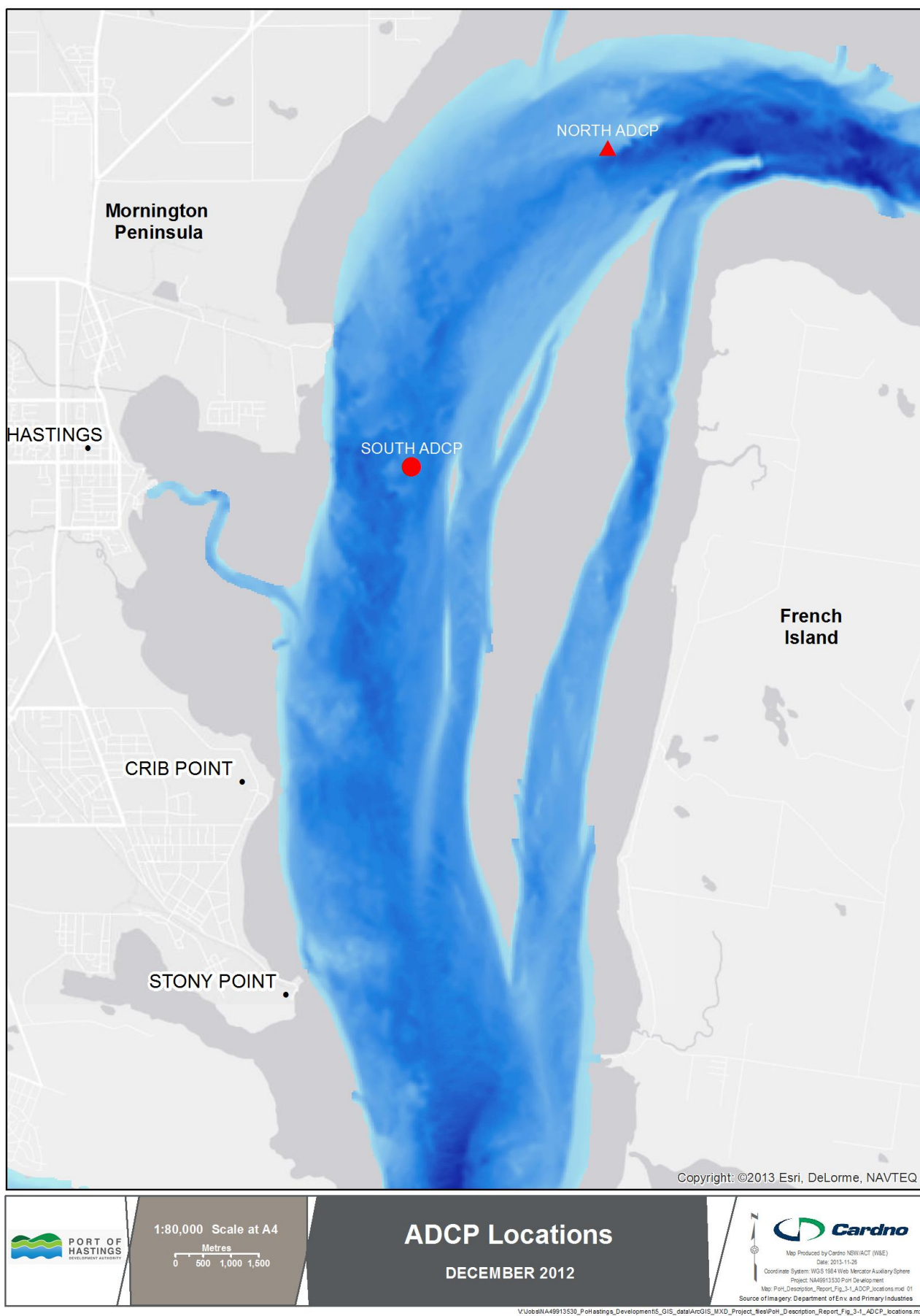


Figure 3-1 Preliminary current measurements - ADCP locations December 2012

4 Understanding of Existing Conditions

A suite of previous studies exists which has built a comprehensive understanding of the processes operating within Western Port Bay. Some additional data acquisition was carried out at the end of 2012. This section compiles previous and contemporary information to formulate a thorough picture of the coastal processes and hydrodynamics that will have an effect on the proposed port development site. This will provide the basis from which future port option configurations will be compared against to evaluate the resultant changes to the hydrodynamics.

4.1 Bathymetry

Western Port Bay is a large shallow embayment. The bay entrance to Bass Strait is separated into two channels due to the presence of Phillip Island. French Island is positioned in the centre of Western Port Bay. The western channel is the dominant entrance, with the eastern channel very narrow and shallow in comparison (AECOM, 2009).

The bay can be divided into five sections based on their physical characteristics, as described in Marsden *et al.* (1979), with the addition of the confluence area (Figure 4-1).

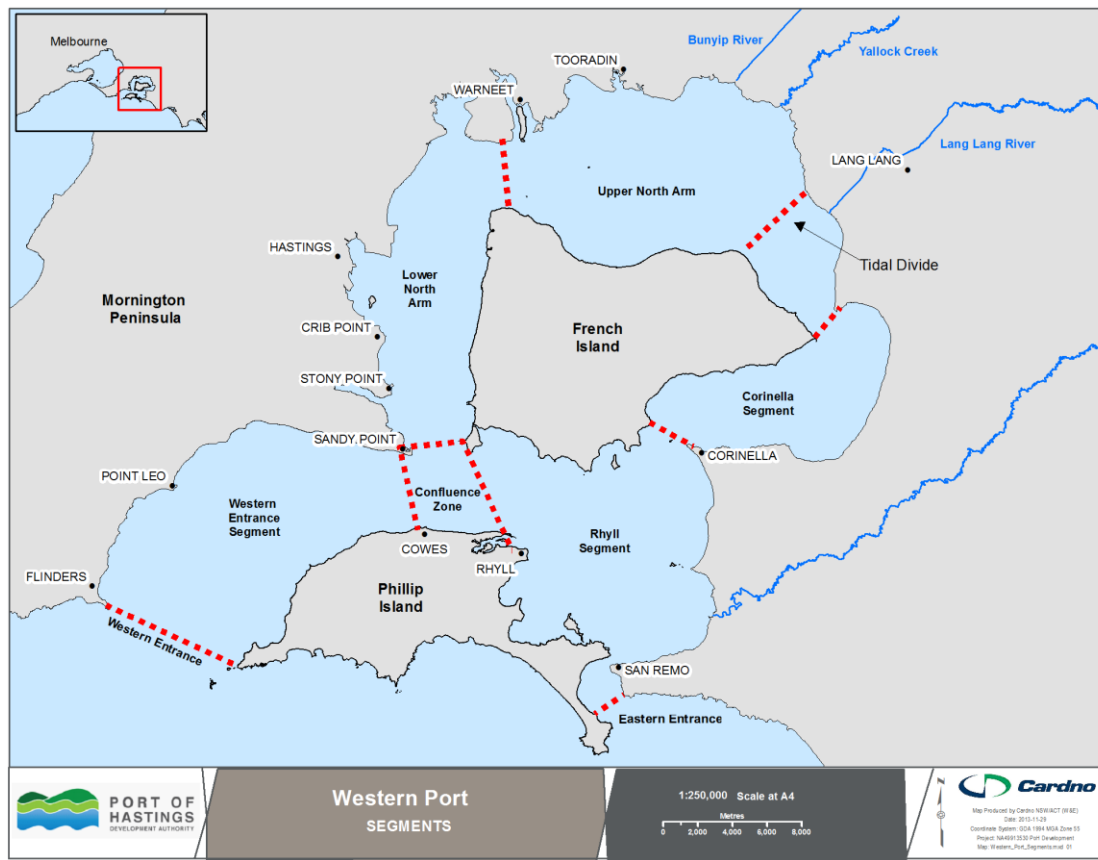


Figure 4-1 Segments of Western Port, following Marsden *et al.* (1979)

The Western Entrance and Lower North Arm sections are deep channel areas that extend up to the braided intertidal channels of the Upper North Arm. To the east the Corinella segment is a depositional area with an expanse of shallow sand bars and 270 km² of intertidal mudflats (Melbourne Water, 2011). According to Marsden *et al.* (1974) the morphology of Western Port is complex and varied, with much of the complexity attributed to the distribution of bedrock rather than the sedimentary processes, not typical of an estuary/barrier-lagoon system.

Previous studies have used admiralty charts and limited survey data to determine the bathymetry; however, more thorough survey data has been made available recently as part of the Future Coasts program by the

DSE, which merges Laser Airborne Depth Sounding (LADS) survey of the shallow areas with multi-beam echo-sounder hydrographic survey data. There are some areas not covered by either of these surveys possibly due to shallow depths or turbidity. Most of these are intertidal flats, with the exception of the dendritic low water channels through the Upper Northern Arm and Corinella segment. There are also some isolated areas which have not been covered, however most of these can be incorporated in an interpolation process.

Data for some of the unsurveyed areas were filled in with values taken from Navigation Charts AUS 150, 151 & 152. The charts depths are relative to Chart Datum, approximately the level of Lowest Astronomical Tide (LAT). The depths were converted to Australian Hydrographic Datum (AHD) using the relationship at Stony Point AHD which is +1.69 m above LAT (Victorian Tide Table, 2013). This process may not be strictly correct as the tidal range, and hence LAT varies around the bay. Incorporating all these data enabled a more bathymetry to be determined sufficient for the numerical modelling. However, more detailed survey of the north-eastern portion of the bay is required for accurate modelling and geomorphic analysis. There is also a small gap in the data coverage of the intertidal zone in the proposed port development area which is not important for modelling as the existing data can be interpolated, but may require infill survey for other purposes.

The data sources used for the model bathymetry are indicated in Figure 4-2.

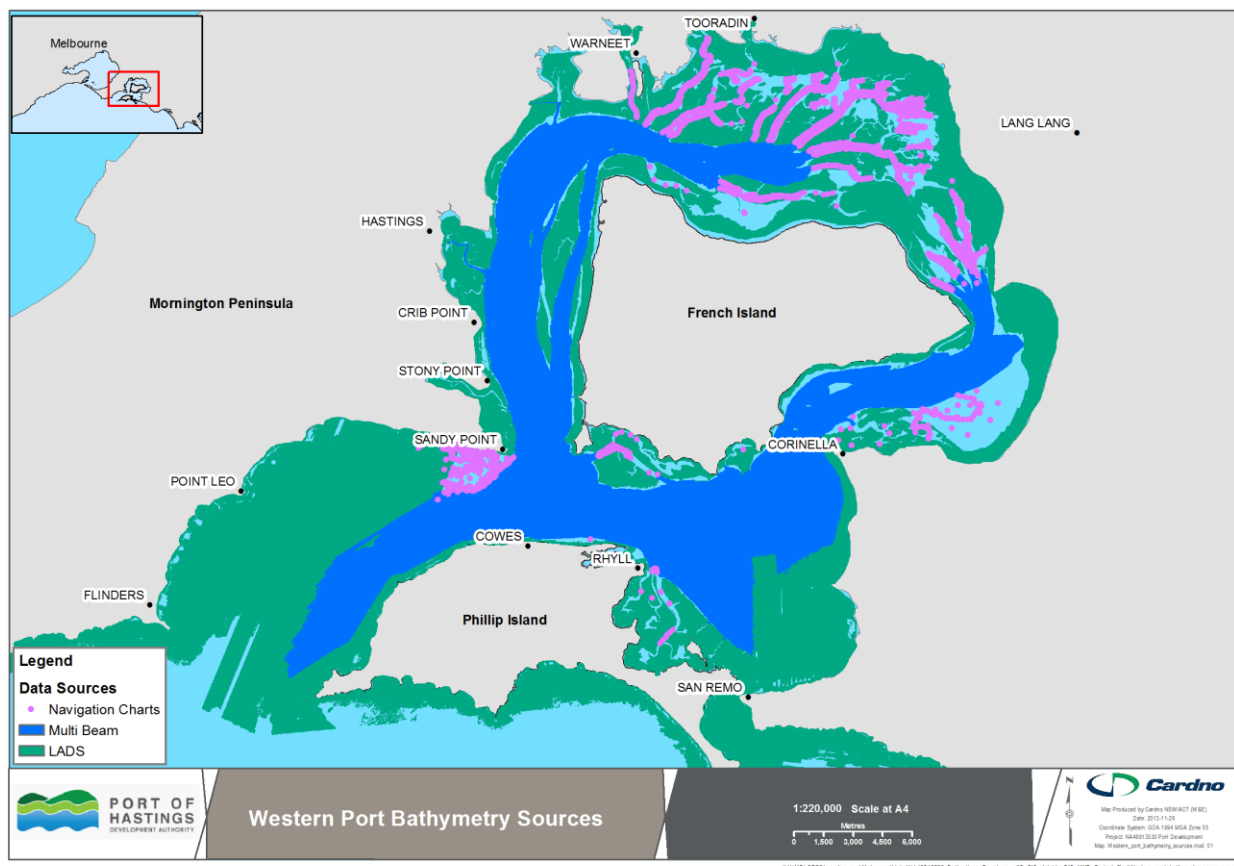


Figure 4-2 Sources of data used to construct the model bathymetries.

Additional data for water depths in Bass Strait was taken from navigation charts and Geoscience Australia Australian Bathymetry and Topography Grid, June 2009 which has a resolution of 9 arc seconds (about 250 m at the equator), www.ga.gov.au.

Although there are some gaps within the resulting data set for Western Port, it gives a detailed picture of the channel depths, and shallow intertidal areas. There is a significant gap south west of Sandy Point. There is a large gap on the far eastern side of the bay north east of Corinella and various low-water channel areas in the north of the bay near Warneet and Tooradin. The final bathymetry used for modelling is presented in Figure 4-3.

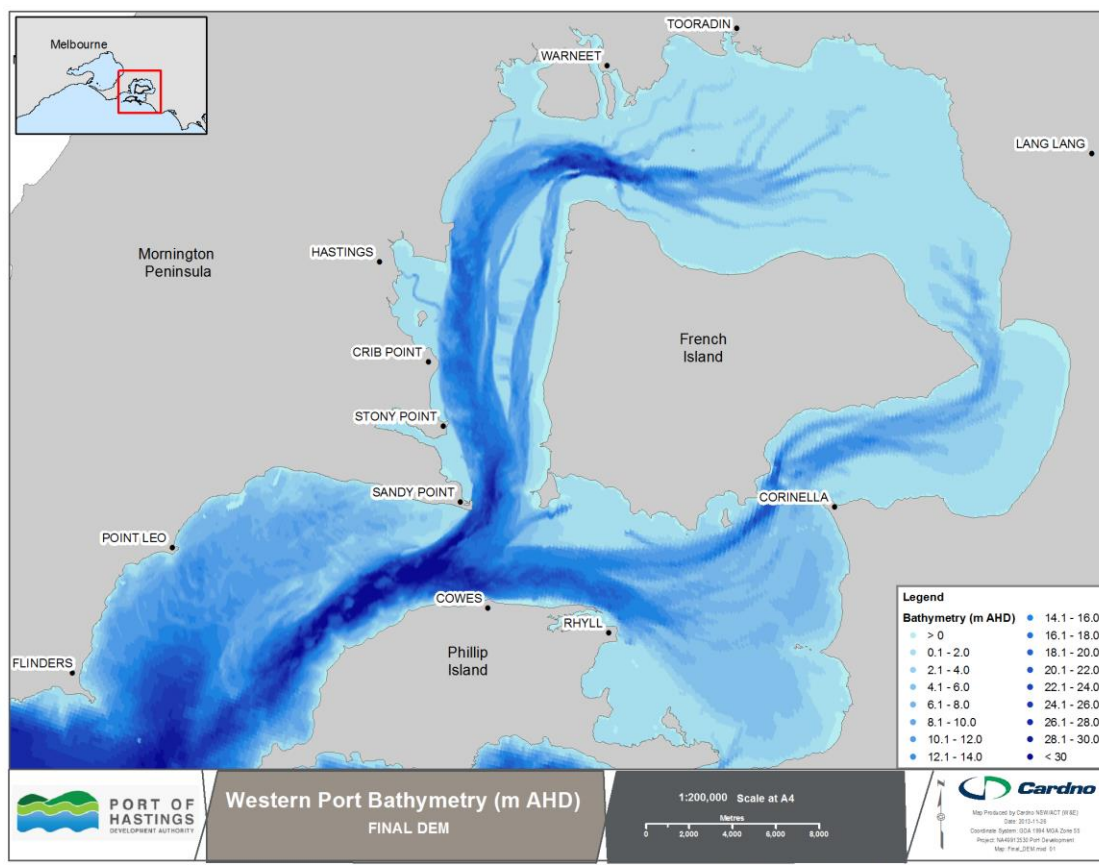


Figure 4-3 Bathymetry of Western Port used for modelling, combining data as shown in Figure 4-2.

Bathymetric survey has been undertaken by 3D Marine Mapping for Patrick Ports, and previously Toll Ports, in the operational areas of the port from 2004 to 2013 to monitor changes in the seabed in relation to the declared depths. These data, however, have not been included in the bathymetry used for modelling as they were not available at the time of this report. The survey record is presented in Appendix A.

4.2 Sediments

The majority of the bay consists of soft unvegetated sediments. As the bay changes from a higher energy environment (west and south), to a lower energy environment (north and east), sediments become finer, that is coarse/medium sands grade to finer sands then silts and clay. Intertidal mud flats cover approximately 40% of the bay area, primarily within the eastern portion (Melbourne Water, 2011).

Sediments within Western Port Bay originate from three sources: via water shed catchment erosion, wave generated erosion banks and coastal sediment transport processes (AECOM, 2009). Sediments can be redistributed within Western Port Bay in a suspended form through the water column or as bed-load.

Re-suspension of sediments causes a reduction in light penetration and deposition of sediment can cause smothering of benthic communities. Both can be detrimental to seagrass health. Bed sediments may also contain nutrients and contaminants and their disturbance through dredging can expose or redistribute these to other sensitive areas within the bay.

Sediment properties are important in predicting plume intensity and extent from dredging operations. Sediment remobilisation is also an important factor in the ecology of the bay.

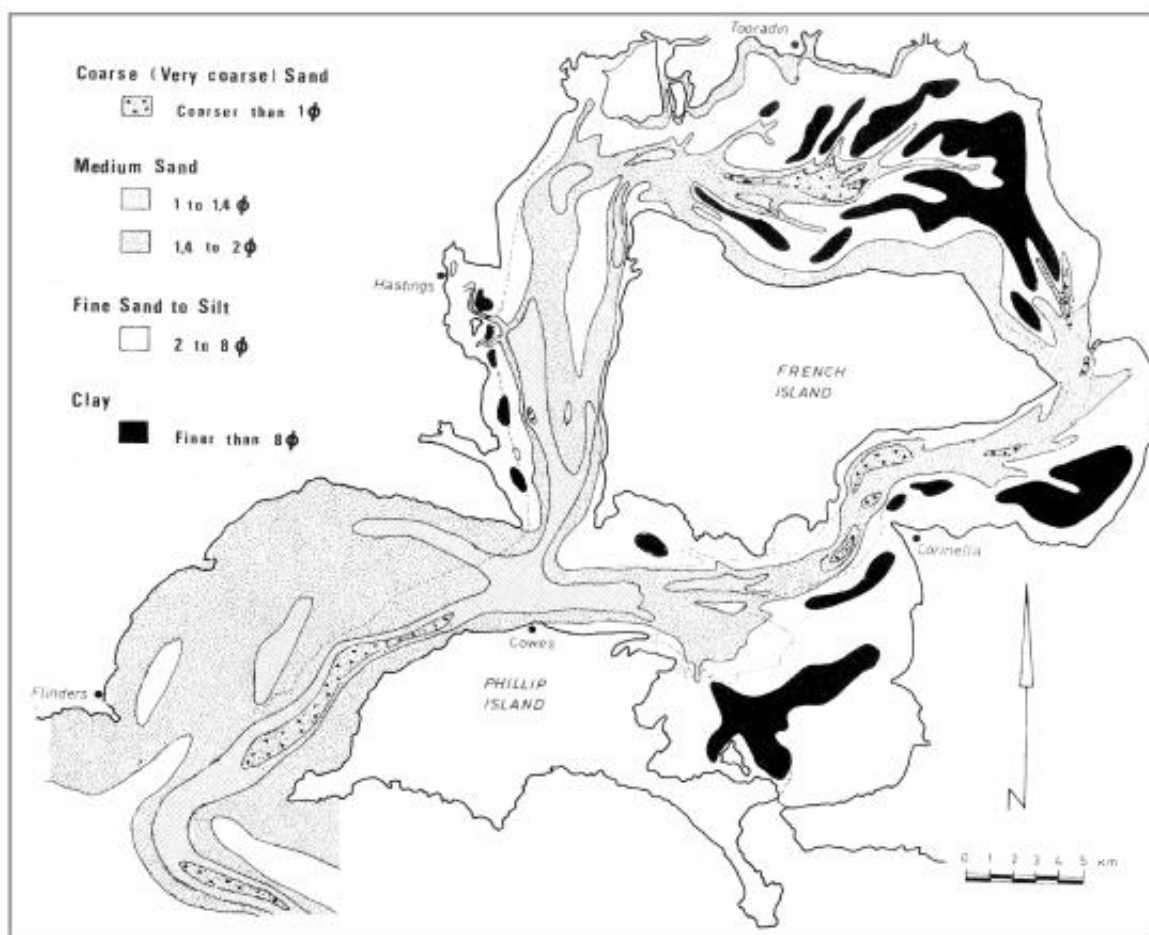
4.2.1 Bed Sediments

Bed sediments were mapped as part of the Western Port Environmental Study 1973-74 (Shapiro, 1975). The study provides an assessment of the distribution of the mean grain size of the near-bed sediment as presented in Table 4-1 and study observed that the most frequently occurring mean size in the bay is the

medium sand. The grain size distribution was also mapped in these studies (Marsden *et al.* 1979, cited AECOM, 2009, Figure 4-4).

Table 4-1 Distribution of mean grain sizes, based on sand plus silt fractions (Shapiro 1975)

Grain Size	All Samples	Percentage of Samples
Granule	1	<1%
Sand		
Very Coarse	2	>1%
Coarse	22	15%
Medium	62	42%
Fine	36	24%
Very Fine	19	13%
Silt	7	>1%
Total Sample	149	



Note units: phi scale, particle diameter = $2^{-\phi}$ mm

Figure 4-4 Western Port seabed sediments (Source: Marsden *et al.* 1979)

An updated set of sediment distribution map are also provided within Hancock *et al.* (2001) are also presented in Figure 4-5. Some of this distribution matches that mapped by Marsden *et al.* (1979), although the clay (<4 μ m) fractions offshore from Bunyip Drain and Cardinia Creek are no longer present and also the appearance of clay deposits offshore of eastern Phillip Island south of Rhyll. The coarsest size fraction

(>500 μm) is present in the lobes offshore of Cardinia and Bunyip. The silt, fine and medium sand fractions (4-250 μm) are the dominant size in the bay as reported in both the studies.

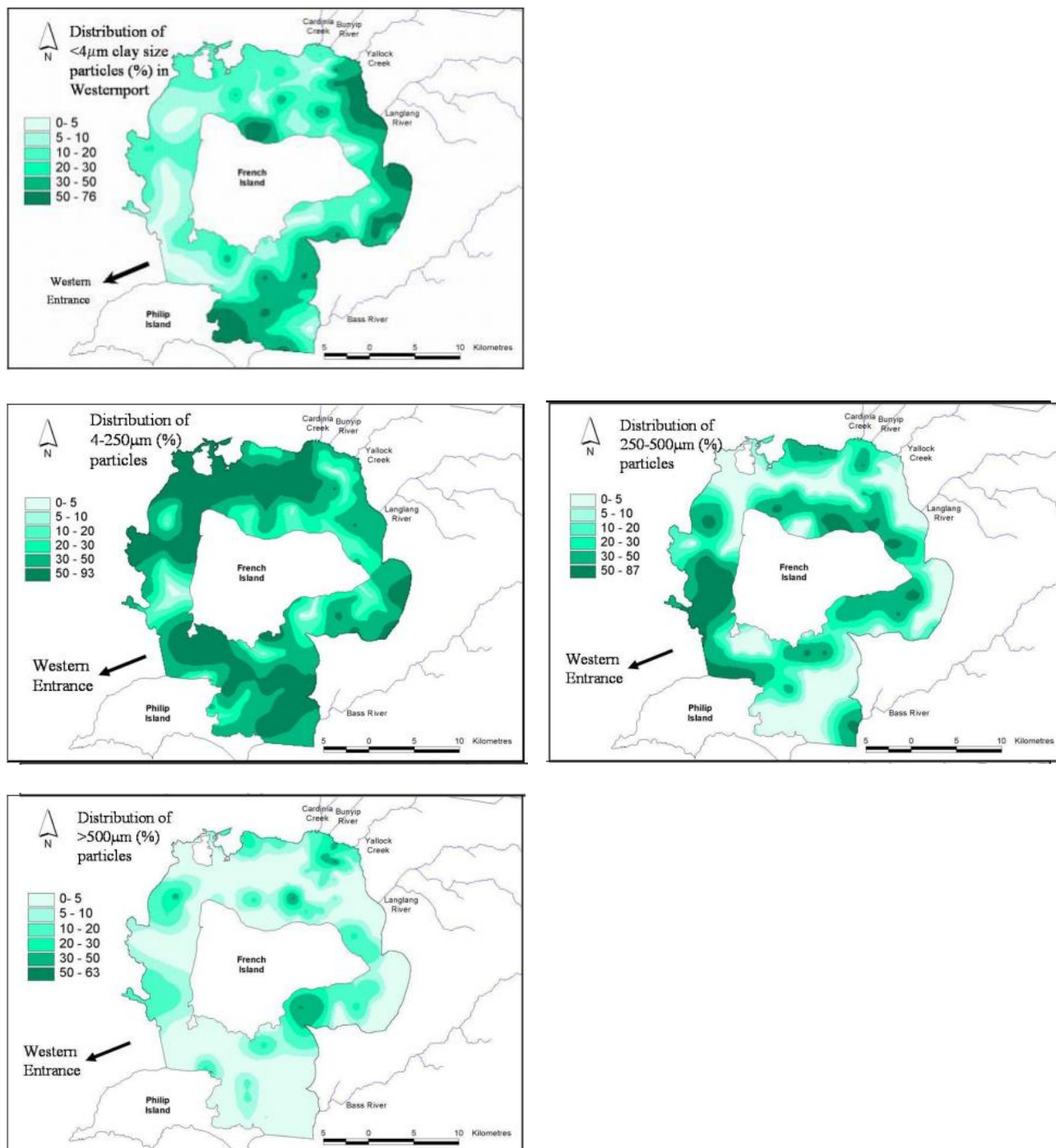


Figure 4-5 Sediment particle distribution – percentage of bed sediment (Source: Hancock *et al.* 2001)

4.2.2 Suspended Sediment Concentration

Anecdotal evidence suggests that the water was a lot clearer in the 1960's, turbidity increased through the 1970's, and improved in the 1990's. Previous studies have shown that increases in the loss of seagrass habitat may related to this increased turbidity as wind and waves are more easily able to resuspend bed sediments (EPA, 1996; cited in AECOM, 2009).

Hughes *et. al.* (2003) determined the mean annual suspended sediment load exported to the bay by calculating the amount of bank, gully and river bank erosion, then removing assumed volumes of sediment

that are deposited in upstream/up-catchment areas before reaching the bay. It was calculated that approximately 96 kilotonnes of sediment is exported into the bay every year, one third as bed load, two thirds as suspended sediment. The majority of the suspended sediment inputs by yield are coming from the Lang Lang and Bass Rivers.

EPA monitored suspended sediment concentrations within Western Port from 1984 to 2008 by collecting water samples at the surface on a quarterly to monthly basis (EPA, 2009). Due to changes in analysis methods and lack of quality assurance, the report included data from 1990 to 2009 collected at three locations, Hastings, Barrallier Island (north-west corner of French Island) and Corinella.

The analysis of the study showed that the sites are characterized by very different environment. The Hastings and Barrallier sites have similar levels of suspended sediment. The Corinella site has significantly higher suspended sediment concentration at Corinella.

Figure 4-6 shows the time series of the suspended solids measurements from 1984 to 2008. Apart from elevated levels in the first two years, and there may be changes in analysis techniques associated with the earliest data, there is no obvious change over time.

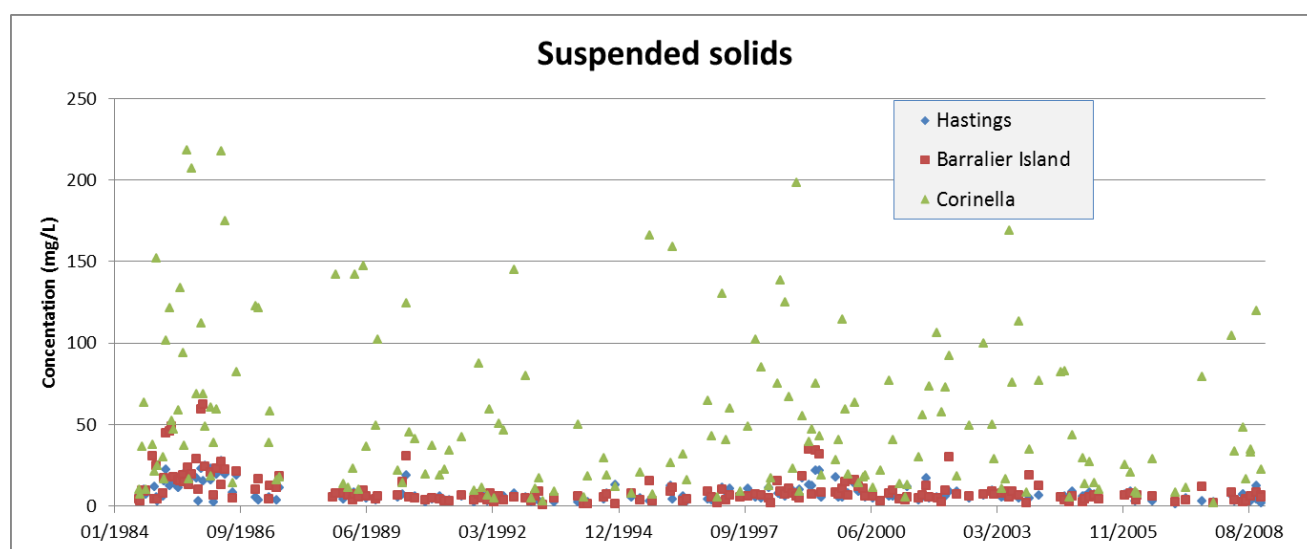


Figure 4-6 Time series of measured suspended solids concentrations from EPA data (EPA(2009))

Figure 4-7, taken from EPA (2009) shows the monthly medians of the measured data for the period from 1990 to 2008. Corinella shows a marked seasonal cycle which may be associated with rainfall and run-off, whereas the other sites show very similar values with no marked seasonal cycle.

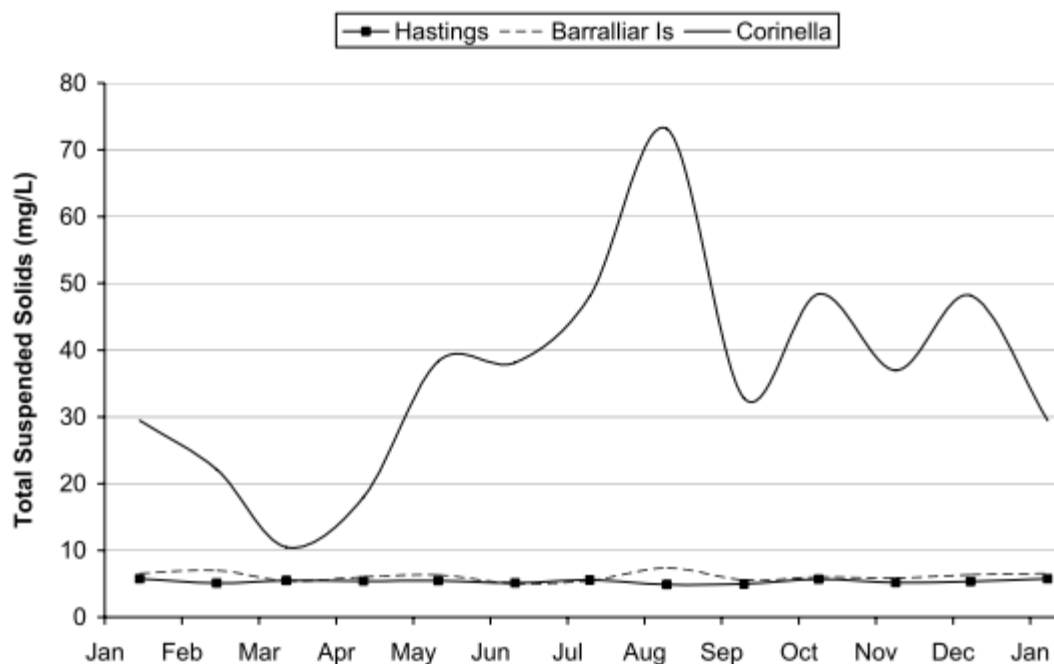


Figure 4-7 Median of monthly total suspended solids measurements from 1990 to 2008 at the Hastings, Barralliar Island and Corinella sites. (Source: EPA, 2009)

4.2.3 Sediment Source

The sediment sources were investigated in Wallbrink *et al.* (2003). Samples were taken from around the bay and from possible sources in local rivers. No marine sources were analysed for comparison. The geochemistry of the samples was analysed to estimate each sources contribution to the bay. Proportional contributions from each source to sediments to the North Bay and South Bay as investigated in Wallbrink *et al.* (2003) is presented in Table 3-1. These regions are defined as being to the North and South of the tidal divide (Figure 1-1). North Bay contains sediment from the upper North arm and South Bay includes the Corinella and Rhyll segments.

The study found that the dominant catchment source of the fine sediment is subsoil from channel and gully erosion of the Bunyip and Lang Lang river systems. The fine grained sediments in the north of the bay (Lower and Upper North Arm) were from local eroding clay banks, the Bunyip River, Cardinia Creek and the Lang Lang River. The South Bay (Rhyll Segment) fine sediments were made up from similar sources with the addition of inputs from the Bass River.

Table 4-2 Percentage contribution from each source to <4 µm sediment in the North and South Bays (relative to the tidal divide). (Wallbrink *et al.*, 2003)

Source	North Bay (%)	South Bay (%)
Clay cliffs	0	0
Clay banks	32	30
Cardinia River	21	20
Bunyip River	27	26
Yallock River	0	0
Lang Lang River	18	17
Bass River	0	5±4
Unsealed Roads	2	2

4.2.4 **Changes in sediment characteristics**

Studies exist that document the sediment transport pathways and patterns within the bay. These were mostly undertaken in the 1970's, with bed load sediment transport rates calculated. The Westernport Bay Environmental Study (1973-1974) was first to present modelled rates of sediment transport and translate the results (and sediment sampling results) into sediment maps. This study found that the grain size reduced moving east through the bay and the lack of a significant freshwater input was limiting any further seaward movement of sediment within the eastern regions of the bay. At the time of the study, the sediment dynamics were changing due to clearing of the Koo Wee Rup Swamp.

Significant changes to the hinterland have occurred since the late 1970's. The sediment studies undertaken by Hancock *et al.* (2001) capture some of these differences. The sediment transport was defined by looking at the spatial distribution of various sediment particle sizes and estimating suspended particle residence time. The accumulation rates were determined from sediment chronologies. These were determined through radiometric/isotope dating, Pinus pollen and optically stimulated luminescence dating (OSL) of the sediment. Results showed that suspended sediment residence times are generally less than one day, which reflects the dynamic and turbulent conditions within the bay.

Surface sediments in intertidal areas in the Upper North Arm are getting progressively coarser, moving from mud to sand grain size fractions (Edgar *et al.*, 1994; cited in Wallbrink *et al.*, 2003). The distribution of fine sediments led to the conclusion that the sediment transport is in a clockwise direction, similar to the 1974 findings. Comparison between the studies showed a decrease in fine grained sediment in the upper north reaches of the bay over time. An updated set of sediment distribution maps are also provided within Hancock *et al.* (2001) and presented in Figure 4-8. This describe the redistribution of mud grain sized fractions (<4 µm) since the 1970s studies due to hydrodynamic processes (Hancock *et al.*, 2001). This was consistent with sediment cores taken within the study area. A simple 2-layer mixing model was established to determine the accumulation rates. A rate of 0.48 cm/year was calculated for the eastern basin of the bay. The southern bay near Corinella had an accumulation rate of 0.21 cm/year. It is noted that there are changes noted in Hastings Bight and Middle Spit and these may need to be investigated further to ascertain whether it is a real change of a difference in sampling between the two studies.

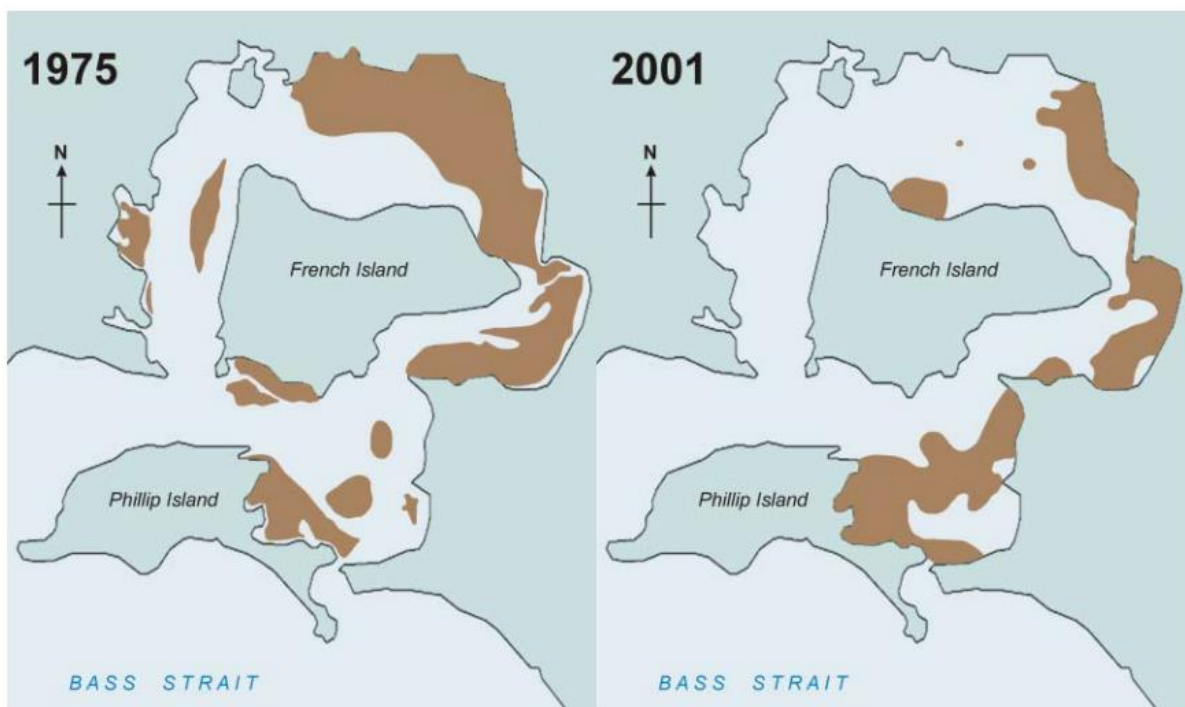


Figure 4-8 **Redistribution of finer grain sizes (<4 µm) from 1975 to 2001 (Hancock *et al.*, 2001)**

4.3 Geomorphology

The Geomorphology of Western Port has been described in detail by Marsden & Mallet (1975), Bird & Barson (1975), Bird (1993) and Rosengren (1984, 2009). Much of the existing knowledge has been summarized in Melbourne Water (2011).

The geology of Western Port is up to 60 million years old and the configuration of the bay broadly determined by northeast trending fault lines. Bounded by the Mornington Peninsula on the west and Strzelecki Ranges to the east lies a broad central area of subsidence (Rosengren, 2009).

Marsden and Mallet (1975) report a *varied and complex morphology which directly reflects the complexity of the processes operating with the bay*. Western Port features a number of shorelines types. Mangrove and salt marsh fringed coast are predominant, in particular in the north and north east. Inside the bay, cliffed and sand sectors are developed where conditions restrict mangrove growth, or are recently developed where there has been disturbance to the mangrove fringe. Active and relict coastal cliffs and bluffs and sand and gravel beaches with foredunes and beach ridges are predominant on the higher energy ocean-facing coast of Phillip Island and between Flinders and Sandy Point (Rosengren, 2009). Locations of geological and geomorphological significance are documented in Rosengren (1984) and available in mapped form from the Victorian Resources Online Website of the Department of Primary Industries (http://vro.dpi.vic.gov.au/dpi/vro/map_documents.nsf/pages/pp_sig_wport_reg).

Bird (1993) divided Westernport Bay and its islands into a number of segments and discussed those in some detail. These are based on their geography and are: Flinders to Somers, Somers to Sandy Point, Western shores, Northern shores, French Island and Phillip Island.

Long Island Point forms the northern edge of the shallow embayment of Hastings Bight. The southern edge is the headland at Crib Point. Sandstone Island in Hastings Bight is a low ridge of Silurian sedimentary rock surrounded by tidal channels and sand and mud flats. This is the only area of Western Port where there is a Palaeozoic rock outcrop. Both Long Island Point and Crib Point are developed on a bedrock base of sandstone and basalt with a covering of remnant deeply weathered basalt overlain by weathered ferruginous sandstone. Late Quaternary sediments of tidal and nearshore origin form the surface and shallow sub-surface cover (Rosengren 2009).

4.4 Wind

The wind climate around Western Port was assessed using BoM wind data from the anemometers at Rhyll and Cerberus, with some additional wind data taken from an industrial site near Hastings (wishes to remain anonymous) and the tide gauge at Stony Point. Determination of the wind climate will be essential in the modelling of waves and currents.

Data from 2000 to the present day was processed into matrices of wind against direction for the four locations (See Appendix B) annually and seasonally. The dominant wind direction for the data period for Cerberus and Rhyll is generally from the north (Figure 4-9). Stony Point and Long Island Point have more even distributions of directions over the time period. The seasonal wind roses are presented in Figure 4-10 and Figure 4-11. The seasonal trends for Cerberus and Rhyll show that the summer months are dominated by southerlies and northerlies in winter. Rhyll appears to have stronger northerly than other sites and this could reflect a more exposed location for the anemometer at this location for winds coming from the north.

Stony Point and Long Island Point are slightly different, the dominant directions during summer months are south-southwest, turning northwest during the winter months. It is likely that these differences also reflect differences in the exposure of the anemometers and the surrounding landscape. Appendix B presents the full time period and seasonal wind matrices for all locations.

A Bureau of Meteorology wind station was operated at Tooradin between 1947 and 1974. AECOM (AECOM, 2009) compared the wind rose at the Tooradin and wind roses at the Cerberus and Rhyll and demonstrated that there are variation in wind direction and magnitude at Tooradin with that of Cerberus and Rhyll. The Tooradin data indicates regular north westerly and easterly components while Cerberus and Rhyll are dominated by winds from the north. However, it is difficult to be certain as there are not coincident time series available.

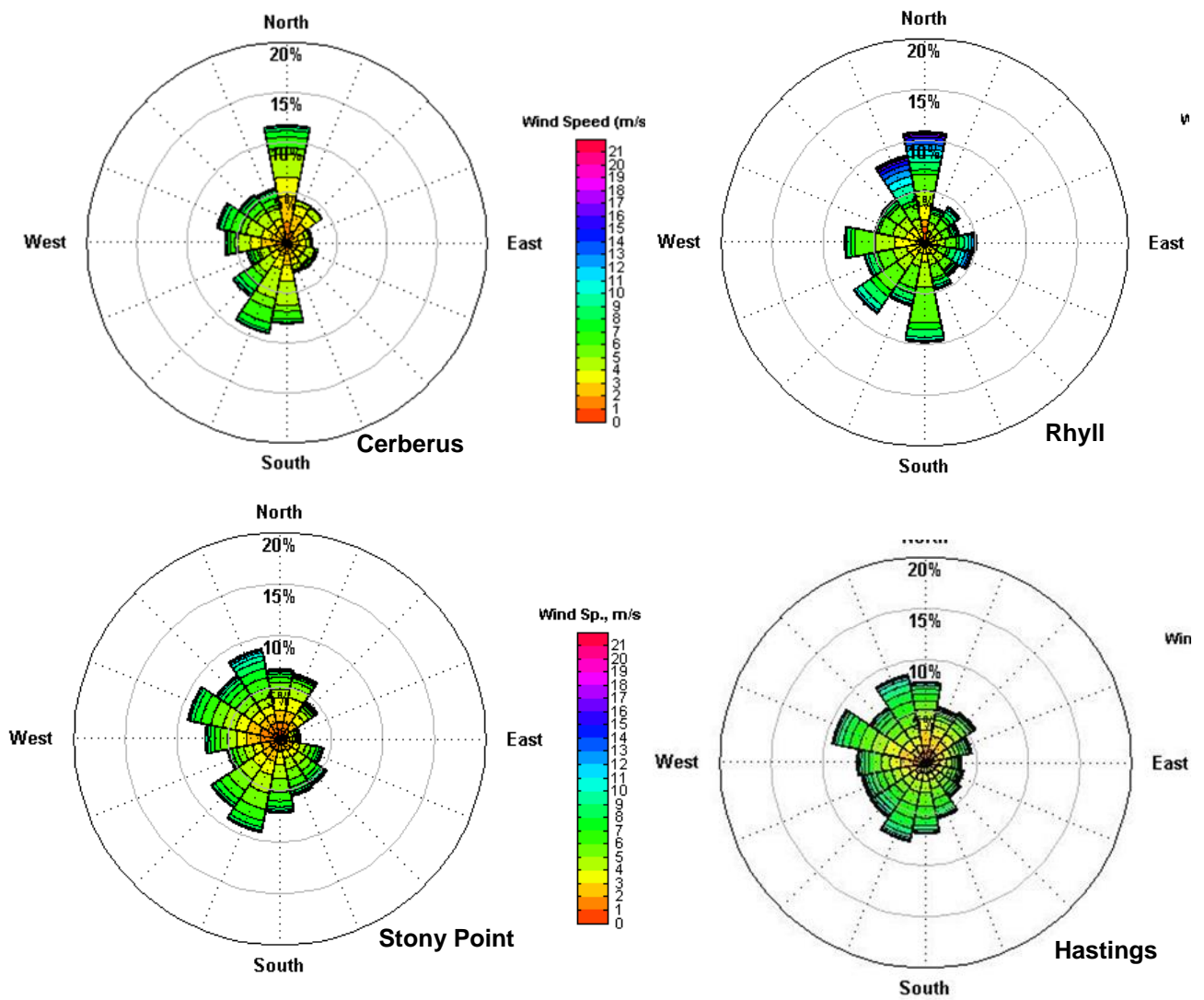


Figure 4-9 Annual wind roses for Cerberus, Rhyll, Stony Point (BoM) and an industrial site in the Hastings region for 2000-2013

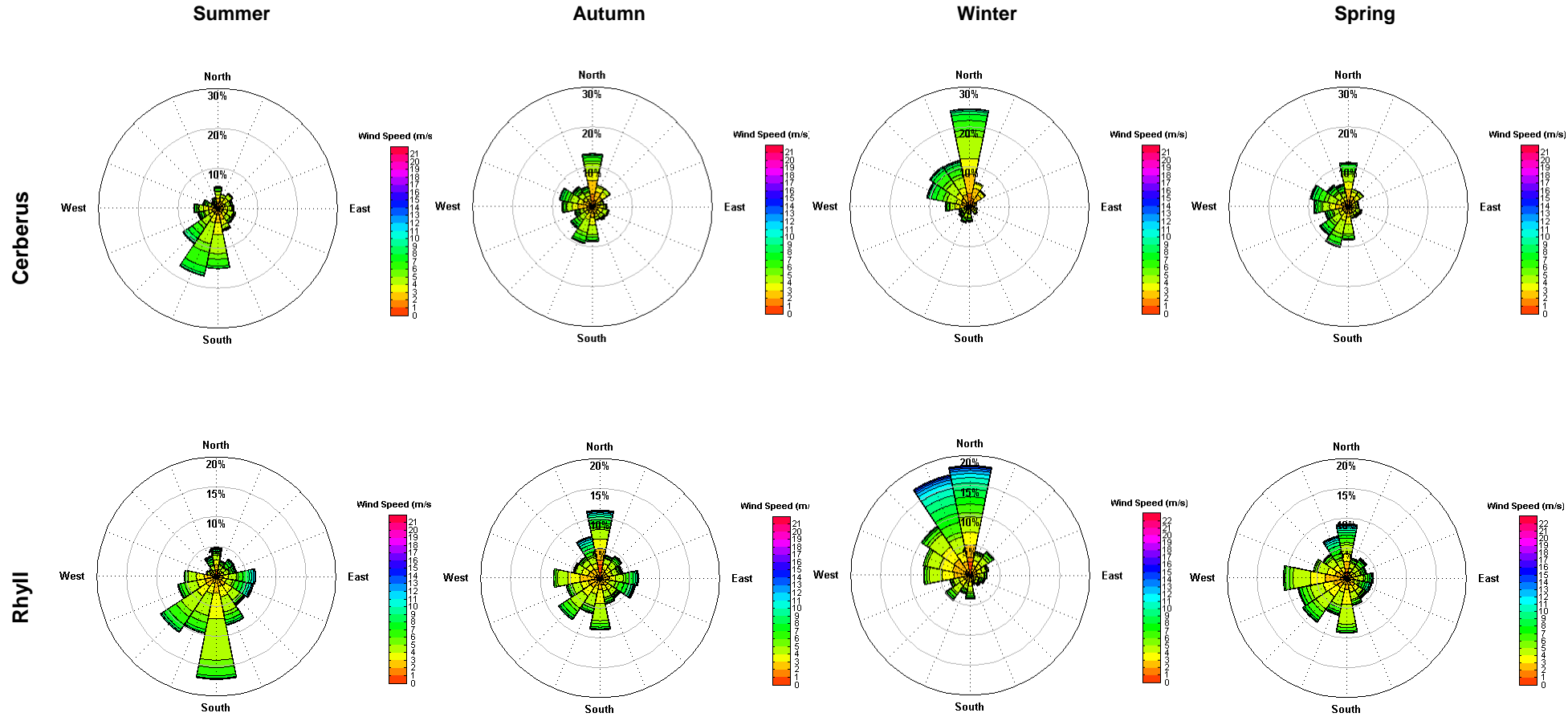


Figure 4-10 Seasonal Wind Trends for Cerberus and Rhyll (Data from BoM, 2000-2013)

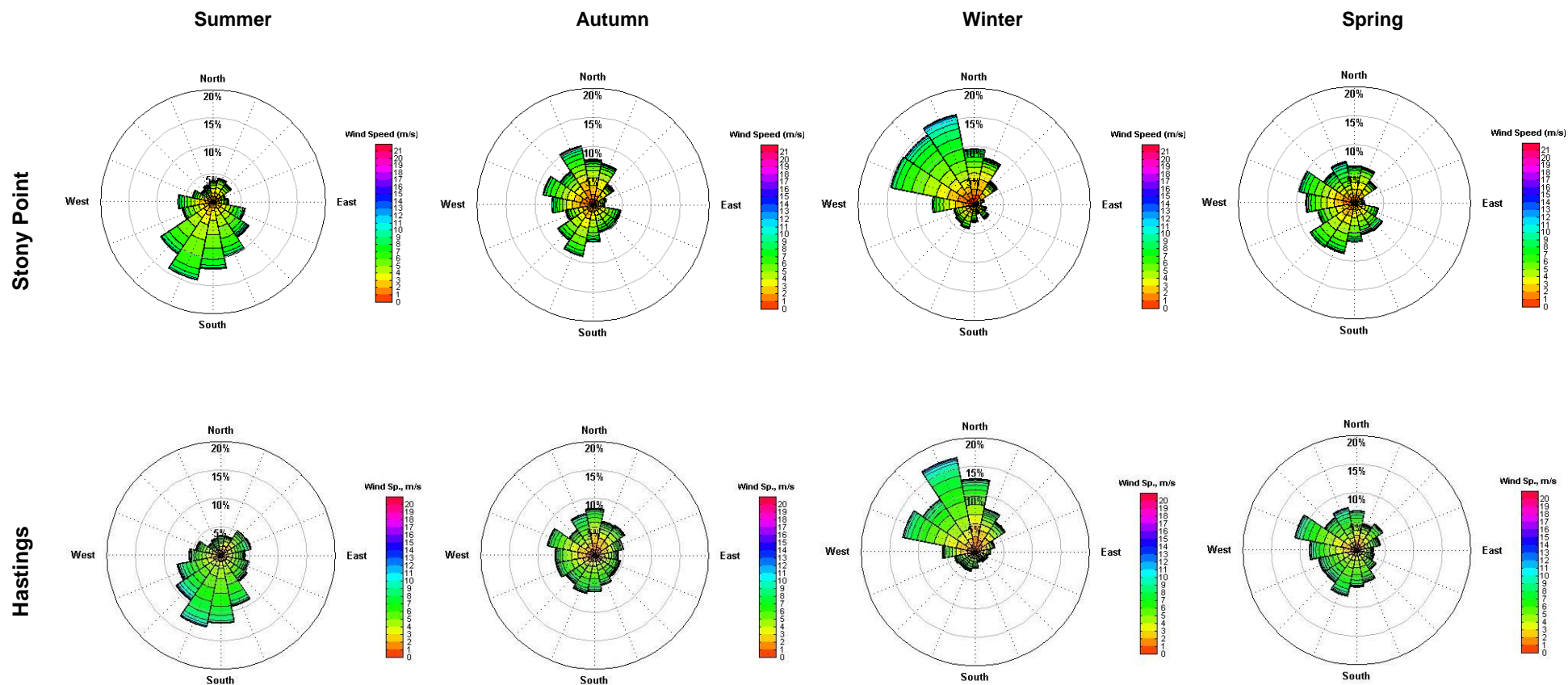


Figure 4-11 Seasonal wind roses for Stony Point (BoM) and an industrial site in the Hastings region for 2000-2013.

In order to ascertain downtime for port operations, including vessel manoeuvring and crane operations, the wind records from the Hastings industrial site were analysed to determine some relevant statistics. The values are shown in Table 4-3. This table indicates the percentage of time that the 10 minute average wind speed exceeds given levels and then the frequency of occurrence of duration for the exceedance. For example, the wind speed exceeds 25 knots 1.2% of the time, if it exceeds 25 knots, then for 19% of the time the duration of the exceedance will be at least 2 hours.

Table 4-3 Wind speed exceedance and non-exceedance and durations for the industrial site near Hastings.

Wind Speed (knots)		15	20	25	33	40
% time wind is above		19.9	5.7	1.2	0.1	0.0
% of time the wind exceedance duration lasts for at least	10 min	100.0	100.0	100.0	100.0	100.0
	20 min	87.0	78.5	70.0	53.9	33.3
	30 min	78.6	66.6	55.6	39.0	6.7
	60 min	63.1	47.4	35.0	22.6	0.0
	2 hours	45.8	29.6	19.0	8.6	0.0
	6 hours	16.9	7.8	3.4	0.0	0.0
	12 hours	4.9	1.8	0.0	0.0	0.0
	1 day	0.8	0.1	0.0	0.0	0.0
	2 days	0.0	0.0	0.0	0.0	0.0
	3 days	0.0	0.0	0.0	0.0	0.0
	> 3 days	0.0	0.0	0.0	0.0	0.0
% time wind is below		80.1	94.3	98.8	99.9	100.0
% of time that the wind is below threshold for a minimum of	10 min	100.0	100.0	100.0	100.0	100.0
	20 min	96.8	98.7	99.6	100.0	100.0
	30 min	94.5	97.8	99.4	100.0	100.0
	60 min	89.7	95.8	98.8	99.9	100.0
	2 hours	83.2	93.0	97.8	99.8	100.0
	6 hours	66.3	85.1	95.0	99.6	100.0
	12 hours	49.4	76.0	91.3	99.1	99.9
	1 day	30.6	62.3	85.0	98.3	99.9
	2 days	15.2	43.4	73.9	96.7	99.8
	3 days	8.5	31.2	64.5	95.1	99.7
	> 3 days	8.4	31.1	64.5	95.1	99.7

4.5 Sea level

4.5.1 Astronomical Tide

Tides within Western Port Bay are semi-diurnal with a strong lunar semi-diurnal component. The tidal range increases with distance from the entrance, as does the tidal lag. The mean tidal range which is the difference between Mean High Water Spring (MHWS) and Mean Low Water Spring (MLWS) calculated at Flinders, Stony Point and Tooradin based on the methods described in ANTT (2013) using tidal constituents from

analysis of measured data. Shapiro (1975) reported the tidal lag between Flinders and Tooradin is about two hours. The tidal amplification and phase lags relative to Flinders Jetty taken from Shapiro is presented in Table 4-4 along with the tidal range calculated for this study.

Table 4-4 Measured amplification and lag relative to Flinders (Shapiro, 1975)

Station	Tidal range (MHWS-MLWS) (m)	Tidal Amplification	Tidal Phase relative to Flinders	
			Low water (minutes)	High Water (minutes)
Flinders	2.0	1	0.0	0.0
Stony Point	2.2	1.147	52.9	56.4
Cowes		1.076	45.3	43.4
Tooradin	2.6	1.26	119.3	96.3

The tidal elevation within Bass Strait is the predominant driver of currents within Western Port Bay (AECOM, 2009); therefore it is essential that accurate water level data is incorporated in model development.

An operational tide gauge is located at Stony Point. This gauge was first commissioned in 1963 and has essentially operated continuously since 1981. Since 1993, the tide gauge has used an acoustic sensor that records at intervals of 6 minutes. The data from the gauge is reported by the National Tidal Centre as part of the Australian Baseline Sea Level Monitoring Project. As noted in Table 2-1 there are issues with the recording of very high sea-levels at Stony Point. The problem can be dealt with by specific data processing, however occurrences are likely to become more frequent as sea level rises. Tidal planes at Stony Point, based on the Victorian Tide Tables (PoMC, 2013) are presented in Table 4-5.

Table 4-5 Tide levels for Western Port (Stony Point) from Victorian Tide Tables (PoMC, 2013)

Tidal level	Height (m AHD)	Height (m CD)
Highest recorded tide (06/06/88)*	2.09	3.78
Highest astronomical tide (HAT)	1.72	3.31
Mean High Water Spring (MHWS)	1.15	2.84
Mean High Water Neap (MHWN)	0.70	2.39
Australia Height Datum	0.00	1.69
Mean Low Water Neap (MLWN)	-0.63	1.06
Mean Low Water Spring (MLWS)	-1.08	0.61
Lowest astronomical tide (LAT)	-1.69	0.00
Lowest recorded tide (27/11/03)	-1.975	-0.285

*Note potential errors in recording of highest tide levels since 1993

Tidal data is also available for Tooradin from Melbourne Water. This is a relatively short data set spanning two years, however it provides an insight into the tidal differences within the bay. Figure 4-12 shows the measured sea levels at Tooradin and Stony Point. It can be seen that the tidal range at Tooradin is greater than at Stony Point, as indicated in Table 4-4. There are occasions when the water level at Stony Point is lower than that at Tooradin, but none where it exceeds the value at Tooradin. These differences must be considered when setting design water levels such as Chart Datum for the port and deck levels.

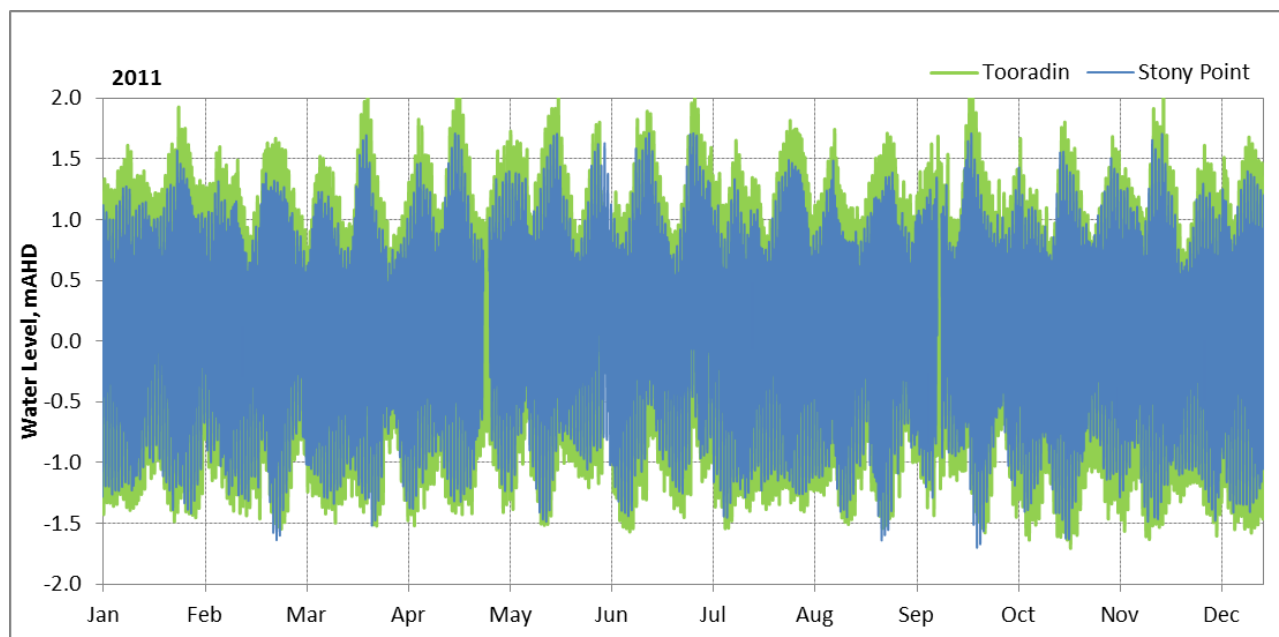


Figure 4-12 Measured sea level at Stony Point and Tooradin for 2011

4.5.2 Sea level rise & storm surge

A critical issue for design of port facilities is the extreme sea levels which might occur under storm conditions, called storm surge. The surge is added to the astronomical tide to produce the storm tide levels and it is these which set the design levels for reclamation and deck levels. When projecting storm tide levels into the future, it is necessary to include the effects of climate change. These effects include sea-level rise and potential changes in the wind climate. There are two major reports into the effects of climate change on extreme sea levels in Western Port, McInnes et al. (2008) and McInnes et al. (2009). These reports used slightly different methodologies and produced slightly different results. McInnes (2008) included values for a number of locations in Western Port, whereas McInnes et al. (2009) only had values for Stony Point within Western Port. Both are discussed below.

McInnes et al. (2008) presents sea level rise estimates, storm surge and tides for Stony Point and Tooradin. Tide gauge data from Stony Point was used in these assessments, and assumptions and adjustments were made to enable calculation of the Tooradin storm surge and tides. Further analysis and comparison with modelled data showed that there may be some issues with the Tooradin values. The values should be higher than Stony Point, Figure 4-12; however, as shown in Table 4-6, the quoted values are lower. Analysis of Tooradin tide-gauge data from Melbourne Water confirms this, and shows that there are significant differences between the water levels at Stony Point (allowing for the issues with recording very high water level noted in Table 2-1) and Tooradin. It is recommended that the Tooradin surge and storm tide values are recalculated using the appropriate water levels.

Table 4-6 The 100 year ARI storm surge and storm tide height under 1990, 2030 and 2070 scenarios (m AHD) for Stony Pt. and Tooradin (McInnes et al., 2008).

		Current climate (1990)	2030			2070		
			low	mid	high	low	mid	high
Storm Surge	Stony Pt.	0.85	0.86	0.97	1.07	0.84	1.15	1.51
	Tooradin	0.7	0.72	0.81	0.91	0.7	0.99	1.33
Storm Tide	Stony Pt.	2.08	2.09	2.19	2.27	2.13	2.43	2.72
	Tooradin	1.98	2.02	2.09	2.17	2.05	2.33	2.61

The analysis of McInnes et al. (2009) assesses the sea-levels under a range of climate change scenarios, and values are provided for Stony Point for 1990, 2030, 2070 and 2100. These values are presented in Table 4-7

Table 4-7 Storm surge and storm tide height under the various scenarios (m AHD) for Stony Point (McInnes et al., 2009).

	ARI	Current climate (1990)		2030			2070			2100			
				1	2	3	1	2	3	1	2	3	4
Storm Surge	10	0.74	±0.05	0.89	0.95	0.94	1.21	1.40	1.44	1.56	1.84	1.84	2.14
	20	0.77	±0.05	0.92	0.98	0.97	1.24	1.44	1.47	1.59	1.88	1.87	2.17
	50	0.80	±0.06	0.95	1.01	1.00	1.27	1.48	1.50	1.62	1.92	1.90	2.20
	100	0.82	±0.06	0.97	1.04	1.02	1.29	1.50	1.52	1.64	1.95	1.92	2.22
Storm Tide	10	1.62	±0.19	1.77	1.83	1.82	2.09	2.25	2.32	2.44	2.68	2.72	3.02
	20	1.79	±0.20	1.94	2.00	1.99	2.26	2.40	2.49	2.61	2.85	2.89	3.19
	50	1.94	±0.21	2.09	2.17	2.14	2.41	2.61	2.64	2.76	3.00	3.04	3.34
	100	2.08	±0.22	2.23	2.30	2.28	2.55	2.73	2.78	2.9	3.14	3.18	3.48

The National Tide Centre (BoM) regularly reports data trends from the ABSLMP to determine the actual rises in sea level over the data time period (approximately 20 years). The most recent monthly (October 2013) report has calculated the actual sea level rise since the instruments were installed. The values for Stony Point and Lorne are shown in Table 4-8. There is some variability in the rates, but the overall trend is for an increase in the rate of sea-level rise.

Table 4-8 Measured sea-level rise for Stony Point and Lorne from Jan 1993 to October 2013 (ABSLMP-BoM)

Station	Installation date (start of data set)	October 2013
		Sea level trend (mm/yr)
Stony Point	Jan 1993	+3.7
Lorne	Jan 1993	+3.8

The Draft Victorian Coastal Strategy 2013 has “three suggestions for sea level rise planning benchmarks for Victoria:

- to plan for not less than 0.2 metres by 2040
- to plan for not less than 0.4 metres by 2070
- to plan for not less than 0.8 metres by 2100.”

These levels need to be incorporated into planning for the proposed port.

Preliminary estimates of the sea levels for design purposes have been developed for the port area, taken as 13 km north of Stony Point following the alignment of the channel, the northern edge of the proposed development area. A number of steps were performed:

- > Correct the measured data (1994 to 2013) from the Stony Point tide gauge to remove the effects of the “flat-lining”;
- > Carry out extreme value analysis on the corrected measured sea-levels to determine the levels for various exceedance probabilities (ARI) for Stony Point;
- > Based on model results, add a factor to allow for the increase in storm surge north of Stony Point;

- > Based on model results, add a factor to allow for the increase in tidal range north of Stony Point; and
- > Add an allowance for sea-level rise following the Draft Victorian Coastal Strategy.

The results of this process are shown in Table 4-9.

Table 4-9 Preliminary estimates for port area design sea-levels (m AHD)

ARI	AEP	Stony Point (1990)			Proposed Port Area			
		McInnes et al. (2009)	Re-analysis of corrected Stony Point data		Current (1990)	2040	2070	2100
				95% confidence limits				
1	100%		1.67	1.64 - 1.71	1.84	2.04	2.24	2.64
10	10%	1.62	1.91	1.83 - 1.98	2.08	2.28	2.48	2.88
100	1%	2.08	2.09	1.94 - 2.23	2.26	2.46	2.66	3.06

It can be seen from the values in Table 4-9, that the McInnes et al. (2009) value for the 1% AEP event at Stony Point are very close to those from the present study, but the more frequent events are much lower.

It should be noted that the values are relative to AHD. A separate exercise will be required to determine the most appropriate chart datum for the proposed development.

4.6 Tidal Currents

The Western Port Bay Environmental Study (1973-1974) investigated tidal currents and circulation within the bay. Current meters were deployed to determine flow speed and direction. The net volume flux for each metered location was merged to determine the net circulation for a 'standard tide'. Hinwood & O'Brien (1974) generated a numerical model which showed that water enters through the two entrances separated by Phillip Island, flows around French Island in both directions to a tidal divide in the north east of the bay.

Tidal currents were also modelled as part of the Western Port Receiving Water Quality Modelling (Harrison *et al.*, 2007). Residual flows calculated (Figure 4-13) in the study showed that the circulation patterns are complex, with clockwise and anticlockwise flows along each arm. Periodic flooding and draining at the Embayment head, as well as the regular extension and retraction of other intertidal areas due to tidal fluctuations were also noted from the model result. There remains some uncertainty surrounding the current regime, in particular the details of the net circulation.

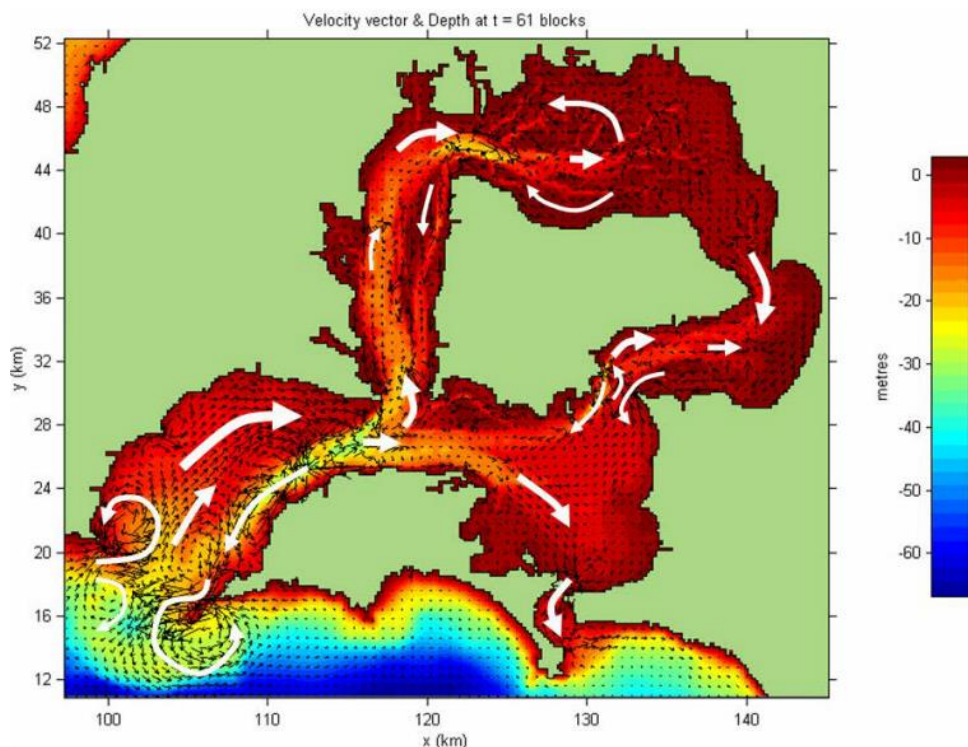


Figure 4-13 Residual water circulation showing dominant tidal driven currents in the absence of wind based on model results (Harrison *et al.* 2007)

The preliminary measurements in December 2012 (Cardno, 2013a) gathered information that has furthered the understanding of the flows in the vicinity of the proposed development. This information will contribute to the hydrodynamic modelling. The data showed that the dominant flow direction at the northern ADCP site (see Figure 3-1 for locations) was along a north-east/south-west axis. The mean flow speed for the one month deployment was 0.42 m/s, with a maximum of 0.85 m/s. At the southern ADCP site, flow direction was along a north/south axis, with mean flow speeds of 0.44 m/s and a maximum of 1.0 m/s. This is consistent with the morphology of the area, as the channel is slightly more constricted in the south. The current speed and direction occurrence is presented in Table 4-1 (northern site) and Table 4-2 (southern site).

Table 4-1 Northern site current matrix – current speed (m/s) vs. direction (going to)

Current Speed and Direction - Percentage occurrence

Current data (depth average) at Northern Site, 38°16.05'S 145°15.80'E, from 17 December 2012 to 15 January 2013 at 1 minute intervals

Direction (°) (going to)		Current Speed (m/s)									Total (%)
		0.00+	0.10+	0.20+	0.30+	0.40+	0.50+	0.60+	0.70+	0.80+	
N	348.75 - 11.25	0.07	-	-	-	-	-	-	-	-	0.07
NNE	11.25 - 33.75	0.24	0.01	-	-	-	-	-	-	-	0.25
NE	33.75 - 56.25	0.96	1.31	1.72	2.39	2.86	3.29	2.78	1.02	0.05	16.38
ENE	56.25 - 78.75	1.66	3.09	3.78	5.48	6.85	7.11	5.19	0.87	0.01	34.06
E	78.75 - 101.25	0.55	0.03	-	-	-	-	-	-	-	0.58
ESE	101.25 - 123.75	0.30	-	-	-	-	-	-	-	-	0.30
SE	123.75 - 146.25	0.17	-	-	-	-	-	-	-	-	0.17
SSE	146.25 - 168.75	0.18	-	-	-	-	-	-	-	-	0.18
S	168.75 - 191.25	0.24	-	-	-	-	-	-	-	-	0.24
SSW	191.25 - 213.75	0.48	0.04	-	-	-	-	-	-	-	0.51
SW	213.75 - 236.25	1.63	2.25	2.02	2.12	2.85	3.10	1.95	0.74	0.02	16.67
WSW	236.25 - 258.75	1.22	2.03	2.82	4.21	5.99	7.04	5.47	1.32	0.02	30.13
W	258.75 - 281.25	0.28	-	-	-	-	-	-	-	-	0.28
WNW	281.25 - 303.75	0.09	-	-	-	-	-	-	-	-	0.09
NW	303.75 - 326.25	0.05	-	-	-	-	-	-	-	-	0.05
NNW	326.25 - 348.75	0.05	-	-	-	-	-	-	-	-	0.05
Bin Totals (%)		8.15	8.76	10.34	14.20	18.56	20.55	15.39	3.95	0.10	100.00
Exceedence (%)		100.00	91.85	83.09	72.75	58.55	39.99	19.44	4.05	0.10	

Number of records in time series: 42192

Summary of Statistics

Mean Current Speed = 0.42 m/s

Maximum Current Speed = 0.85 m/s

Table 4-2 Southern site current matrix – current speed (m/s) vs. direction (going to)

Current Speed and Direction - Percentage occurrence

Current data (depth average) at Southern Site, 38°17.90'S 145°14.26'E, from 17 December 2012 to 13 January 2013 at 1 minute intervals

Direction (°) (going to)	Current Speed (m/s)											Total (%)
	0.00+	0.10+	0.20+	0.30+	0.40+	0.50+	0.60+	0.70+	0.80+	0.90+	1.00+	
N 348.75 - 11.25	1.18	0.55	0.14	0.13	0.07	0.02	0.01	-	-	-	-	2.11
NNE 11.25 - 33.75	1.74	4.31	5.60	8.07	9.68	9.45	6.50	1.38	0.09	-	-	46.83
NE 33.75 - 56.25	0.45	0.07	0.02	-	-	-	-	-	-	-	-	0.54
ENE 56.25 - 78.75	0.17	-	-	-	-	-	-	-	-	-	-	0.17
E 78.75 - 101.25	0.10	-	-	-	-	-	-	-	-	-	-	0.10
ESE 101.25 - 123.75	0.08	-	-	-	-	-	-	-	-	-	-	0.08
SE 123.75 - 146.25	0.12	-	-	-	-	-	-	-	-	-	-	0.12
SSE 146.25 - 168.75	0.18	-	-	-	-	-	-	-	-	-	-	0.18
S 168.75 - 191.25	0.76	0.24	0.06	0.01	-	-	-	-	-	-	-	1.08
SSW 191.25 - 213.75	1.88	3.81	4.38	4.93	6.14	7.85	7.81	6.42	2.82	0.80	-	46.84
SW 213.75 - 236.25	0.78	0.11	0.01	-	-	-	-	-	-	-	-	0.90
WSW 236.25 - 258.75	0.26	-	-	-	-	-	-	-	-	-	-	0.26
W 258.75 - 281.25	0.16	-	-	-	-	-	-	-	-	-	-	0.16
WNW 281.25 - 303.75	0.15	-	-	-	-	-	-	-	-	-	-	0.15
NW 303.75 - 326.25	0.14	-	-	-	-	-	-	-	-	-	-	0.14
NNW 326.25 - 348.75	0.33	0.01	-	-	-	-	-	-	-	-	-	0.34
Bin Totals (%)	8.49	9.10	10.20	13.14	15.90	17.32	14.33	7.80	2.92	0.80	0.00	100.00
Exceedence (%)	100.00	91.51	82.41	72.21	59.07	43.17	25.85	11.52	3.72	0.80	0.00	

Number of records in time series: 38674

Summary of Statistics

Mean Current Speed = 0.44 m/s

Maximum Current Speed = 1.00 m/s

4.7 Waves

The wave climate within the bay varies markedly. In the Western Arm, swell from Bass Strait is the major source of wave energy. However, the penetration of swell into the bay is limited by the topography and north

of Sandy Point and east of Cowes, there is very little swell activity and locally-generated wind waves become the dominant wave activity.

Wave data are not available within Western Port and immediately offshore. The Port of Melbourne operates a directional wave measurement buoy south east of Point Nepean, approximately 40 km north-west of the Western Port entrance channel. The data covers from 2000 to present and the wave rose for this site, Figure 4-14, provides a basis for the wave climate offshore from Western Port.

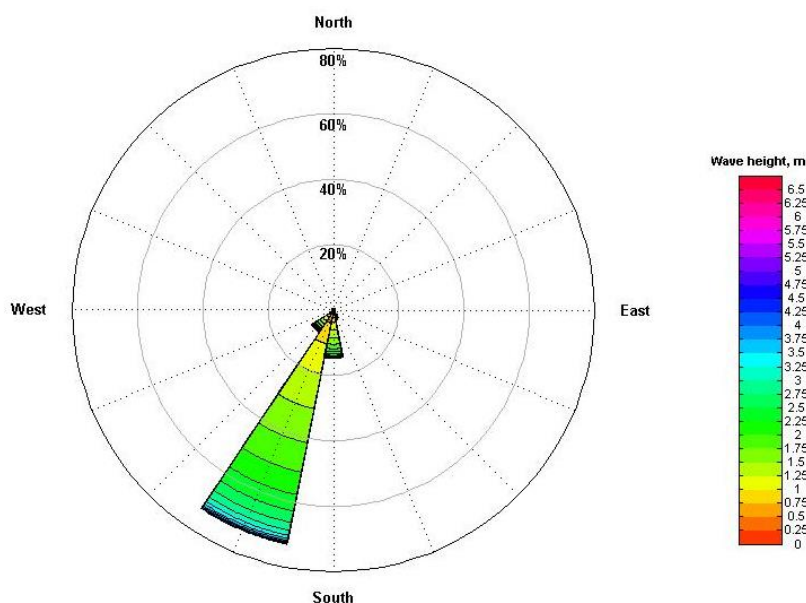


Figure 4-14 Wave rose at Point Nepean (significant wave height vs. direction) based on measured data 2000-2012

The dominant wave conditions at this location are governed by swell, often arising from waves generated in the Southern Ocean. The presence of King Island and Tasmania restrict the access of swell of swell from the Southern Ocean into this region. This means that, depending on the direction of wave propagation, some swell waves will be completely blocked while others will be refracted (modified) as they enter the shallower waters of Bass Strait. Hence, waves offshore Western Port will be a combination of oceanic swell, wind waves generated from within Bass Strait and locally derived wind waves. The swell will have a relatively narrow directional spread.

Results extracted from modelling of the wave climate in Bass Strait indicates that the swell waves off the entrance to Western Port are very similar to those at Point Nepean, with an increase in wave height by a factor of 18%. The frequency of occurrence of significant wave height and spectral peak period at Point Nepean is shown in Table 4-10.

Table 4-10 Frequency of occurrence for significant wave height and spectral peak period for the PoMC wave buoy south east of Point Nepean.

Wave Height and Peak Period - Percentage occurrence

Wave data from Point Nepean Wave Buoy Location, January 2003 to December 2010 at 30 minute intervals

For wave conditions at the entrance to Western Port increase wave heights by 18%

Wave Period Tp (s)	Wave Height , Hs (m)													Total (%)
	0.0 +	0.5 +	1.0 +	1.5 +	2.0 +	2.5 +	3.0 +	3.5 +	4.0 +	4.5 +	5.0 +	5.5 +	6.0 +	
0.0 +	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
2.0 +	0.01	0.06	0.01	-	-	-	-	-	-	-	-	-	-	0.09
4.0 +	0.01	0.34	0.78	0.43	0.05	-	-	-	-	-	-	-	-	1.62
6.0 +	0.01	0.21	0.81	1.48	1.00	0.39	0.08	0.01	-	-	-	-	-	3.99
8.0 +	0.03	0.65	1.29	1.04	0.80	0.54	0.26	0.15	0.06	0.01	-	-	-	4.85
10.0 +	0.38	4.46	8.15	5.67	2.49	0.84	0.41	0.15	0.07	0.05	0.01	0.01	-	22.70
12.0 +	0.44	5.34	9.26	8.70	4.98	1.91	0.66	0.22	0.06	0.02	0.01	-	-	31.60
14.0 +	0.24	4.22	6.79	6.93	4.94	2.75	1.14	0.47	0.15	0.06	0.01	0.01	-	27.71
16.0 +	0.02	0.72	1.25	1.05	0.68	0.48	0.35	0.22	0.08	0.02	0.01	-	-	4.88
18.0 +	0.01	0.39	0.57	0.36	0.21	0.18	0.10	0.07	0.03	0.02	-	0.01	-	1.94
20.0 +	0.01	0.11	0.18	0.12	0.05	0.02	0.02	-	-	-	-	-	-	0.52
22.0 +	-	0.01	0.04	0.03	-	-	-	-	-	-	-	-	-	0.08
24.0 +	-	-	-	-	-	-	-	-	-	-	-	-	-	0.01
26.0 +	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
28.0 +	0.01	-	-	-	-	-	-	-	-	-	-	-	-	0.02
Bin Totals (%)	1.18	16.52	29.14	25.81	15.21	7.11	3.03	1.29	0.46	0.18	0.05	0.02	0.01	100.00
Exceedence (%)	100.00	98.82	82.30	53.16	27.36	12.15	5.04	2.01	0.72	0.26	0.08	0.03	0.01	

Number of records in time series: 137517

Summary of Statistics

Mean Significant Wave Height = 1.7 m
Maximum Significant Wave Height = 6.4 m
Mean Peak Wave Period = 12.8 s

4.8 Water Quality

Water quality is monitored regularly at a number of locations within Western Port by EPA (EPA, 2011). This provides an assessment of the overall health of the system, as well as tracing pollutants. Water quality can be an issue due to nutrient runoff, sewerage and storm water discharges, and is influenced by hydrodynamics. Increases in phosphorus and nitrogen, amongst others, can trigger algal blooms which can be detrimental to marine organisms as well as human health. High concentrations of suspended solids (including sediment) can also have an effect on water quality by increasing turbidity which can affect water borne organisms.

Nutrient inputs into Western Port Bay are relatively low, especially in comparison to Port Phillip Bay (Melbourne Water, 2011). This is consistent with the findings of the Westernport Bay Environmental Study (1973-1974). The study concluded that for the 17 streams discharging into the bay, the total nutrient and pesticide input into the bay was relatively low. However, this is related to the freshwater inflow volume, approximately 1100 ML/day, which is very low compared to the volume of the bay.

Water quality testing to satisfy the state quality objectives shows that the water quality has generally been 'good' (EPA, 2011) and levels of two key indicators, enterococci and E.coli, have been within state guideline levels for the bay. A recent Western Point condition report (EPA, 2011) noted that there have been some elevations in nutrients, heavy metals, salinity and pH at the Corinella site, which did not meet state guideline levels. It was determined that the increases were more likely attributed to the system processes, i.e. sediment transport and re-suspension of sediment, rather than an influx of pollutants from catchment sources.

Data from EPA (2011) for a number of water quality parameters are presented in Appendix C which also contains a list of the measured parameters.

5 Summary

A review of historic and contemporary data was undertaken to gather the most up to date information for calibration of the preliminary models. Although many data sources are available, there are still some data gaps that will require filling before detailed modelling of port design options can be undertaken. Therefore, the preliminary and options modelling will establish a basic understanding of the hydrodynamic regime based on existing available data, and will:

- provide preliminary hydrodynamic outputs;
- allow for concept options testing of various port configurations; and
- specify the most appropriate locations for further data acquisition campaigns.

A number of previous reports and environmental review documents were reviewed to ensure an up to date knowledge of the coastal and estuarine geomorphology and processes in Western Port Bay.

Bathymetric survey data shows a deep wide channel through the Phillip Island entrance that splits at the south western corner of French island. The main channel stays deep through the Lower North Arm segment past Hastings, turns to the east around the north of French Island and splits into a number of dendritic channels and tidal flats. The eastern channel passes Rhyll north of Phillip Island and then runs north around the eastern end of French Island to meet the northern arm near Lang Lang. This area is the tidal divide and is a sediment deposition zone characterised by expanses of shallow intertidal sand and mudflats and seagrass vegetation.

Water levels within the bay are dictated by water levels within Bass Strait, and influenced by the bathymetry and tidal fluctuations. Tidal range increases with distance from the entrance and this is confirmed through comparison of Stony Point and Tooradin tide gauge data. Mean sea-levels are increasing the rate of increase is also increasing. Over the last 20 years, the average rate of increase at Stony Point is 3.7 mm/yr. Tidal range, storm surge and sea-level rise have been combined to provide preliminary estimates of the design sea-levels for the proposed port area.

Currents are dominated by the tidal movements which follow the divided channels around French Island and meet at the tidal divide in the north east of the bay. Net circulation is thought to be in a clockwise direction around French Island, however this remains to be confirmed. The circulation direction is consistent with present knowledge of the patterns of sediment transport and redistribution within the bay. Early sediment studies compared to more recent studies show the movement of fine grain sediments from the northern reaches of the bay to the east. Sediment inputs into the bay via riverine sources are well documented; however marine source volumes are uncertain as well as volumes of sediment being exported out of the bay.

Measured wave data is not available within Western Port Bay. The nearest measured wave data is from Point Nepean near the Port Phillip Bay entrance. Swell from Bass Strait penetrates the Western Arm as far as Sandy Point, and waves within the remainder of the bay are primarily wind generated.

Water quality within the bay is generally good, and is regularly monitored to ensure adherence to state water quality thresholds.

5.1 Data gaps and recommendations for further work

After review of the data and previous reports, a number of data gaps are evident, as well as uncertainties in the current hydrodynamic understanding. Although the existing data is sufficient to calibrate the preliminary modelling, detailed modelling for port design will require a comprehensive data acquisition campaign to be carried out to gather the appropriate data to ensure greater levels of confidence and certainty. The findings of the preliminary modelling will aid in dictating the direction of the data acquisition campaign by determining the most appropriate locations to deploy instrumentation and identifying additional data gaps.

A detailed assessment of data requirements to support numerical modelling and related project investigations is presented in the "Hydrodynamics Framework" (Cardno, 2013b)

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Port of Hastings
Development Project
Preliminary Base Case
Phase

APPENDIX A
HYDROGRAPHIC
SURVEYS





Record of Surveys

[illegible]

Port of Hastings
Development Project
Preliminary Base Case
Phase

APPENDIX B
WIND ANALYSIS



Table B 1 Cerberus – All Years (2000-2013)

Wind Speed and Direction - Percentage occurrence																										
Wind data at Cerberus All data 2000-2012																										
Direction (°)		Wind Speed (m/s)																						Total (%)		
		0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+		22.00+	
N	11.25	0.38	1.94	3.05	2.08	1.75	1.58	1.22	0.73	0.34	0.18	0.08	0.04	0.01	0	0	0	0	-	-	-	-	-	-	-	13.38
NNE	33.75	0.18	1.2	1.88	1.11	0.42	0.11	0.03	0.01	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	4.94
NE	56.25	0.13	0.79	1.68	1.32	0.64	0.24	0.05	0.01	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	4.86
ENE	78.75	0.11	0.42	0.8	0.68	0.41	0.28	0.15	0.04	0.01	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	2.90
E	101.25	0.12	0.48	0.81	0.7	0.42	0.24	0.14	0.06	0.01	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	2.98
ESE	123.75	0.12	0.38	0.74	0.94	0.78	0.42	0.19	0.05	0.01	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	3.63
SE	146.25	0.1	0.4	0.74	0.83	0.64	0.43	0.29	0.15	0.05	0.01	0	0	0	0	0	0	0	-	-	-	-	-	-	-	3.64
SSE	168.75	0.13	0.6	1.14	0.71	0.44	0.26	0.14	0.07	0.02	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	3.51
S	191.25	0.25	0.79	1.47	1.9	1.85	1.55	0.9	0.32	0.1	0.04	0.02	0.01	0	0	0	0	0	-	-	-	-	-	-	-	9.20
SSW	213.75	0.17	0.51	0.87	1.53	2.15	2.37	1.71	0.79	0.28	0.11	0.03	0.02	0	0	0	0	0	-	-	-	-	-	-	-	10.54
SW	236.25	0.12	0.42	0.72	0.97	1.2	1.28	1.08	0.77	0.48	0.24	0.09	0.03	0.01	0.01	0	0	0	-	-	-	-	-	-	-	7.42
WSW	258.75	0.15	0.52	0.77	0.72	0.69	0.63	0.5	0.35	0.2	0.11	0.04	0.02	0.01	0	0	0	0	-	-	-	-	-	-	-	4.71
W	281.25	0.2	1	1.7	1.31	0.98	0.72	0.54	0.35	0.17	0.08	0.03	0.01	0	0	0	0	0	-	-	-	-	-	-	-	7.09
WNW	303.75	0.11	0.59	1.15	1.11	1.18	1.29	1.13	0.8	0.47	0.19	0.09	0.04	0.01	0.01	0	0	0	-	-	-	-	-	-	-	8.17
NW	326.25	0.11	0.59	0.91	1.01	1.05	0.97	0.88	0.55	0.31	0.15	0.06	0.03	0	0	0	0	0	-	-	-	-	-	-	-	6.62
NNW	348.75	0.15	0.67	1.1	0.88	0.79	0.84	0.77	0.56	0.29	0.16	0.08	0.04	0.02	0	0	0	0	-	-	-	-	-	-	-	6.35
Bin Totals (%)		2.55	11.3	19.54	17.82	15.38	13.19	9.72	5.61	2.74	1.28	0.54	0.23	0.07	0.03	0	0	0	-	-	-	-	-	-	-	100
Exceedence (%)		100	97.45	86.15	66.61	48.79	33.41	20.22	10.50	4.89	2.15	0.87	0.33	0.10	0.03	0.00	0.00	0.00	-	-	-	-	-	-	-	
Number of records in time series:		201993																								
Summary of Statistics																										
Maximum wind speed	=	16.94 m/s																								
Mean wind speed	=	4.09 m/s																								

Table B 2 Rhyll - All Years (2000-2013)

Wind Speed and Direction - Percentage occurrence																										
Wind data at Rhyll All data 2000-2012																										
Direction (°)		Wind Speed (m/s)																						Total (%)		
		0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+			22.00+
N	11.25	0.12	0.61	1.52	1.52	1.17	0.92	0.8	0.65	0.6	0.51	0.41	0.32	0.22	0.15	0.05	0.1	0.02	0.01	0.01	0	0	0	0	0	9.71
NNE	33.75	0.07	0.36	0.81	0.82	0.64	0.44	0.27	0.15	0.06	0.02	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	3.65
NE	56.25	0.06	0.3	0.67	0.77	0.73	0.68	0.48	0.32	0.18	0.1	0.03	0.01	0.01	0	0	0	0	0	0	0	0	0	0	0	4.34
ENE	78.75	0.06	0.3	0.67	0.75	0.62	0.43	0.29	0.19	0.12	0.07	0.04	0.02	0.01	0	0	0	0	0	0	0	0	0	0	0	3.57
E	101.25	0.08	0.38	0.77	0.82	0.76	0.65	0.52	0.43	0.3	0.22	0.16	0.09	0.05	0.02	0	0	0	0	0	0	0	0	0	0	5.25
ESE	123.75	0.06	0.26	0.54	0.55	0.59	0.66	0.64	0.51	0.41	0.32	0.2	0.12	0.06	0.04	0.01	0.01	0.01	0	0	0	0	0	0	0	4.99
SE	146.25	0.07	0.46	0.95	0.92	0.69	0.44	0.29	0.16	0.1	0.06	0.02	0.01	0	0	0	0	0	0	0	0	0	0	0	0	4.17
SSE	168.75	0.06	0.35	0.84	1.1	0.99	0.68	0.44	0.25	0.13	0.06	0.03	0.01	0.01	0	0	0	0	0	0	0	0	0	0	0	4.95
S	191.25	0.09	0.49	1.44	2.53	2.67	1.62	0.76	0.3	0.12	0.06	0.03	0.02	0.01	0	0	0	0	0	0	0	0	0	0	0	10.14
SSW	213.75	0.05	0.27	0.83	1.3	1.55	1.31	0.69	0.33	0.14	0.07	0.02	0.01	0	0	0	0	0	0	0	0	0	0	0	0	6.57
SW	236.25	0.05	0.4	1.31	1.7	1.69	1.47	1.05	0.6	0.26	0.11	0.04	0.01	0	0	0	0	0	0	0	0	0	0	0	0	8.69
WSW	258.75	0.06	0.47	1.39	1.36	1.13	0.87	0.55	0.29	0.1	0.05	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	6.28
W	281.25	0.08	0.78	2.16	2	1.55	0.97	0.43	0.14	0.04	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8.16
WNW	303.75	0.07	0.59	1.34	1.31	1.06	0.58	0.2	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5.18
NW	326.25	0.07	0.53	1.26	1.3	0.95	0.62	0.34	0.15	0.07	0.02	0.01	0.01	0	0	0	0	0	0	0	0	0	0	0	0	5.33
NNW	348.75	0.05	0.34	1	1.07	0.98	0.9	0.89	0.83	0.78	0.69	0.53	0.39	0.23	0.14	0.05	0.09	0.03	0.01	0.01	0	0	0	0	0	9.01
Bin Totals (%)		1.1	6.87	17.5	19.79	17.78	13.23	8.64	5.31	3.42	2.37	1.57	1.01	0.61	0.37	0.12	0.2	0.06	0.02	0.02	0	0	0	0	0	100
Exceedence (%)		100	98.89	92.02	74.52	54.73	36.95	23.72	15.08	9.77	6.35	3.98	2.41	1.40	0.79	0.42	0.30	0.10	0.04	0.02	0.00	0.00	0.00	0.00	0.00	
Number of records in time series:				223067																						
Summary of Statistics																										
Maximum wind speed		=	22.22 m/s																							
Mean wind speed		=	4.6 m/s																							

Table B 3 Stony Pt – All Years (2000-2013)

Wind Speed and Direction - Percentage occurrence																										
Wind data at Stony Pt All data 2000-2012																										
Direction (°)		Wind Speed (m/s)																						Total (%)		
		0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+		22.00+	
N	11.25	0.77	0.75	1.17	1.16	0.89	0.68	0.51	0.36	0.24	0.14	0.07	0.04	0.02	0.01	0	0	0	0	0	0	0	0	0	0	6.81
NNE	33.75	0.75	0.74	1.16	1.31	1.01	0.64	0.35	0.19	0.12	0.08	0.05	0.04	0.03	0.02	0	0.01	0	0	0	0	0	0	0	0	6.50
NE	56.25	0.42	0.62	0.87	0.83	0.61	0.36	0.25	0.13	0.1	0.08	0.06	0.04	0.03	0.01	0.01	0.01	0	0	0	0	0	0	0	0	4.43
ENE	78.75	0.22	0.3	0.34	0.32	0.29	0.23	0.14	0.07	0.05	0.03	0.01	0.01	0.01	0	0	0	0	0	0	0	0	0	0	0	2.02
E	101.25	0.21	0.31	0.34	0.31	0.26	0.17	0.17	0.09	0.05	0.04	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	1.96
ESE	123.75	0.24	0.45	0.63	0.64	0.58	0.54	0.49	0.33	0.22	0.12	0.05	0.03	0.02	0.02	0	0	0	0	0	0	0	0	0	0	4.36
SE	146.25	0.22	0.41	0.63	0.79	0.88	0.78	0.6	0.4	0.28	0.21	0.13	0.09	0.04	0.03	0.01	0	0	0	0	0	0	0	0	0	5.50
SSE	168.75	0.19	0.31	0.56	0.81	1.04	1.06	0.75	0.44	0.25	0.14	0.07	0.05	0.03	0.01	0	0	0	0	0	0	0	0	0	0	5.71
S	191.25	0.2	0.36	0.64	1.14	1.4	1.29	0.95	0.59	0.29	0.17	0.08	0.06	0.02	0.02	0.01	0	0	0	0	0	0	0	0	0	7.22
SSW	213.75	0.34	0.73	1.06	1.3	1.77	1.64	1.21	0.65	0.33	0.15	0.05	0.03	0.02	0.01	0	0	0	0	0	0	0	0	0	0	9.29
SW	236.25	0.42	0.69	0.91	1.15	1.45	1.35	1.01	0.62	0.3	0.11	0.04	0.02	0.01	0	0	0	0	0	0	0	0	0	0	0	8.08
WSW	258.75	0.31	0.63	0.79	0.89	0.92	0.73	0.48	0.23	0.14	0.08	0.03	0.02	0.01	0.01	0	0	0	0	0	0	0	0	0	0	5.27
W	281.25	0.51	1.21	1.4	1	0.87	0.74	0.6	0.43	0.27	0.16	0.06	0.03	0.01	0	0	0	0	0	0	0	0	0	0	0	7.29
WNW	303.75	0.67	1.21	1.27	1.16	1.23	1.18	1.01	0.72	0.42	0.17	0.08	0.02	0.01	0	0	0	0	0	0	0	0	0	0	0	9.15
NW	326.25	0.58	0.79	0.91	0.94	0.93	0.93	0.8	0.64	0.43	0.24	0.14	0.07	0.03	0.01	0	0	0	0	0	0	0	0	0	0	7.44
NNW	348.75	0.59	0.87	0.92	0.82	0.85	0.93	0.98	0.96	0.73	0.52	0.34	0.19	0.12	0.05	0.04	0.01	0.01	0	0	0	0	0	0	0	8.97
Bin Totals (%)		6.66	10.36	13.61	14.57	14.97	13.23	10.31	6.83	4.26	2.43	1.26	0.73	0.41	0.21	0.09	0.04	0.01	0.01	0.01	0	0	0	0	0	100
Exceedence (%)		100	93.34	82.98	69.37	54.80	39.83	26.60	16.29	9.46	5.20	2.77	1.51	0.78	0.37	0.16	0.07	0.03	0.02	0.01	0.00	0.00	0.00	0.00	0.00	
Number of records in time series:		89998																								
Summary of Statistics																										
Maximum wind speed	=	21.3 m/s																								
Mean wind speed	=	4.48 m/s																								

Table B 4 Near Hastings – All Years (2000-2013)

Wind Speed and Direction - Percentage occurrence																										
Wind data Long Island Point - All years 2000-2013																										
Direction (°)		Wind Speed (m/s)																						Total (%)		
		0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+		22.00+	
N	11.25	0.35	1.32	1.54	1.04	0.93	0.83	0.68	0.51	0.34	0.18	0.1	0.06	0.02	0.01	0	0	0	0	0	0	0	0	0	0	7.91
NNE	33.75	0.29	1.02	1.37	0.98	0.63	0.4	0.27	0.2	0.16	0.12	0.06	0.03	0.01	0.01	0	0	0	0	0	0	0	0	0	0	5.55
NE	56.25	0.45	0.83	1.17	0.95	0.78	0.62	0.47	0.28	0.16	0.09	0.04	0.02	0.01	0	0	0	0	0	0	0	0	0	0	0	5.87
ENE	78.75	0.2	0.67	0.94	0.71	0.48	0.39	0.34	0.31	0.26	0.16	0.08	0.04	0.02	0	0	0	0	0	0	0	0	0	0	0	4.60
E	101.25	0.19	0.51	0.7	0.66	0.45	0.34	0.22	0.16	0.1	0.08	0.05	0.03	0.01	0.01	0	0	0	0	0	0	0	0	0	0	3.51
ESE	123.75	0.15	0.4	0.58	0.65	0.53	0.43	0.35	0.25	0.18	0.13	0.09	0.04	0.01	0	0	0	0	0	0	0	0	0	0	0	3.79
SE	146.25	0.15	0.37	0.55	0.57	0.65	0.6	0.47	0.31	0.21	0.12	0.08	0.04	0.01	0	0	0	0	0	0	0	0	0	0	0	4.13
SSE	168.75	0.14	0.31	0.5	0.72	0.92	1.02	0.84	0.53	0.3	0.16	0.07	0.04	0.01	0	0	0	0	0	0	0	0	0	0	0	5.56
S	191.25	0.14	0.3	0.5	0.84	1.17	1.33	1.11	0.76	0.44	0.18	0.07	0.04	0.02	0.01	0.01	0	0	0	0	0	0	0	0	0	6.92
SSW	213.75	0.14	0.29	0.51	0.84	1.15	1.32	1.27	1.01	0.6	0.32	0.2	0.11	0.05	0.03	0.01	0	0	0	0	0	0	0	0	0	7.85
SW	236.25	0.21	0.4	0.6	0.71	0.82	0.87	0.82	0.68	0.53	0.36	0.23	0.13	0.07	0.03	0.02	0.01	0	0	0	0	0	0	0	0	6.49
WSW	258.75	0.24	0.58	0.82	0.9	0.87	0.79	0.68	0.51	0.4	0.27	0.16	0.09	0.05	0.02	0.01	0.01	0	0	0	0	0	0	0	0	6.40
W	281.25	0.27	0.9	1.26	1.02	0.83	0.71	0.56	0.41	0.31	0.21	0.12	0.06	0.03	0.02	0.01	0	0	0	0	0	0	0	0	0	6.72
NNW	303.75	0.29	0.81	1.59	1.46	1.29	1.18	0.96	0.73	0.47	0.28	0.15	0.07	0.02	0.01	0	0	0	0	0	0	0	0	0	0	9.31
NW	326.25	0.29	0.54	0.76	1.04	1.09	0.95	0.73	0.51	0.32	0.17	0.09	0.03	0.01	0	0	0	0	0	0	0	0	0	0	0	6.53
NNW	348.75	0.29	0.66	0.81	0.86	1.1	1.19	1.17	0.98	0.72	0.48	0.26	0.14	0.07	0.03	0.01	0	0	0	0	0	0	0	0	0	8.77
Bin Totals (%)		3.8	9.91	14.19	13.94	13.68	12.98	10.95	8.14	5.49	3.31	1.85	0.98	0.44	0.19	0.09	0.04	0.01	0	0	0	0	0	0	0	100
Exceedence (%)		100	96.19	86.28	72.09	58.15	44.47	31.49	20.54	12.40	6.91	3.60	1.75	0.77	0.33	0.14	0.05	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Number of records in time series:		670547																								
Summary of Statistics																										
Maximum wind speed	=	20.15 m/s																								
Mean wind speed	=	4.85 m/s																								

Table B 5 Cerberus – Summer All Years (2000-2013)

Wind Speed and Direction - Percentage occurrence																										
Wind data at Cerberus Summer 2000-2012																										
Direction (°)		Wind Speed (m/s)																						Total (%)		
		0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+		22.00+	
N	11.25	0.2	0.9	1.49	0.74	0.53	0.54	0.54	0.27	0.16	0.09	0.02	0.01	0	0	-	-	-	-	-	-	-	-	-	-	5.49
NNE	33.75	0.11	0.56	1.22	1.01	0.52	0.12	0.03	0.01	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-	3.58
NE	56.25	0.08	0.47	1.17	1.42	0.86	0.44	0.11	0.02	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-	4.57
ENE	78.75	0.08	0.34	0.82	0.87	0.77	0.55	0.31	0.07	0.02	0.01	0	0	0	0	-	-	-	-	-	-	-	-	-	-	3.84
E	101.25	0.09	0.45	0.92	1.02	0.74	0.45	0.27	0.14	0.02	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-	4.10
ESE	123.75	0.06	0.27	0.87	1.2	1.14	0.67	0.29	0.08	0.02	0.01	0.01	0	0	0	-	-	-	-	-	-	-	-	-	-	4.62
SE	146.25	0.09	0.39	0.82	1.15	0.86	0.6	0.42	0.19	0.1	0.03	0	0	0	0	-	-	-	-	-	-	-	-	-	-	4.65
SSE	168.75	0.17	0.79	2.01	1.29	0.76	0.45	0.23	0.1	0.03	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-	5.83
S	191.25	0.25	1.05	2.31	3.02	3.15	2.96	1.71	0.52	0.12	0.03	0.01	0.01	0	0	-	-	-	-	-	-	-	-	-	-	15.14
SSW	213.75	0.11	0.45	1.11	2.03	3.23	4.3	3.65	1.67	0.55	0.16	0.04	0.01	0.01	0.01	-	-	-	-	-	-	-	-	-	-	17.33
SW	236.25	0.14	0.43	0.9	1.19	1.53	1.85	1.74	1.31	0.86	0.47	0.18	0.06	0.02	0.01	-	-	-	-	-	-	-	-	-	-	10.69
WSW	258.75	0.15	0.57	0.86	0.8	0.76	0.67	0.58	0.36	0.25	0.13	0.04	0.02	0.01	0	-	-	-	-	-	-	-	-	-	-	5.20
W	281.25	0.18	0.82	1.42	1.19	0.8	0.6	0.49	0.32	0.15	0.08	0.02	0	0	0	-	-	-	-	-	-	-	-	-	-	6.07
WNW	303.75	0.06	0.42	0.67	0.56	0.53	0.59	0.49	0.34	0.15	0.1	0.03	0.01	0	0	-	-	-	-	-	-	-	-	-	-	3.95
NW	326.25	0.03	0.25	0.41	0.32	0.29	0.28	0.27	0.16	0.09	0.05	0.03	0.01	0	0	-	-	-	-	-	-	-	-	-	-	2.19
NNW	348.75	0.08	0.32	0.51	0.26	0.25	0.34	0.41	0.32	0.15	0.06	0.06	0.01	0	0	-	-	-	-	-	-	-	-	-	-	2.77
Bin Totals (%)		1.89	8.49	17.5	18.07	16.71	15.42	11.51	5.87	2.66	1.22	0.45	0.15	0.04	0.02	-	-	-	-	-	-	-	-	-	-	100
Exceedence (%)		100	98.11	89.62	72.12	54.05	37.34	21.92	10.41	4.54	1.88	0.66	0.21	0.06	0.02	-	-	-	-	-	-	-	-	-	-	
Number of records in time series:				55043																						
Summary of Statistics																										
Maximum wind speed		=		13.89 m/s																						
Mean wind speed		=		4.29 m/s																						

Table B 6 Rhyll - Summer All Years (2000-2013)

Wind Speed and Direction - Percentage occurrence																									
Wind data at Rhyll Summer 2000-2012																									
Direction (°)		Wind Speed (m/s)																						Total (%)	
		0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+		22.00+
N	11.25	0.05	0.32	0.78	0.89	0.64	0.4	0.29	0.2	0.17	0.12	0.13	0.08	0.05	0.03	0.01	0.01	0	0	0	-	-	-	-	4.17
NNE	33.75	0.03	0.22	0.48	0.58	0.5	0.43	0.29	0.13	0.06	0.02	0.01	0	0	0	0	0	0	0	0	-	-	-	-	2.75
NE	56.25	0.03	0.21	0.46	0.49	0.52	0.49	0.48	0.42	0.26	0.16	0.05	0.03	0.01	0	0	0	0	0	0	-	-	-	-	3.61
ENE	78.75	0.03	0.22	0.48	0.62	0.61	0.48	0.37	0.27	0.19	0.12	0.06	0.03	0.01	0.01	0	0	0	0	0	-	-	-	-	3.50
E	101.25	0.06	0.3	0.75	0.91	0.94	0.78	0.75	0.61	0.49	0.4	0.37	0.2	0.1	0.03	0	0.01	0	0	0.01	-	-	-	-	6.71
ESE	123.75	0.05	0.29	0.65	0.73	0.72	0.75	0.79	0.65	0.6	0.46	0.32	0.2	0.11	0.08	0.03	0.02	0.02	0	0	-	-	-	-	6.51
SE	146.25	0.05	0.51	1.26	1.45	1.11	0.77	0.38	0.16	0.12	0.09	0.03	0.02	0	0	0	0	0	0	0	-	-	-	-	5.95
SSE	168.75	0.04	0.38	1.22	1.91	1.87	1.33	0.8	0.5	0.28	0.1	0.05	0.01	0.01	0	0	0	0	0	0	-	-	-	-	8.50
S	191.25	0.06	0.47	2.26	4.46	5.07	3.22	1.39	0.44	0.14	0.04	0.01	0.01	0.01	0.01	0	0	0	0	0	-	-	-	-	17.59
SSW	213.75	0.04	0.25	0.97	1.74	2.49	2.54	1.19	0.49	0.18	0.05	0.01	0.01	0.01	0	0	0	0	0	0	-	-	-	-	9.97
SW	236.25	0.06	0.44	1.58	1.99	2.15	2.07	1.59	0.99	0.35	0.19	0.06	0.02	0	0	0	0	0	0	0	-	-	-	-	11.49
WSW	258.75	0.06	0.53	1.42	1.38	1.13	0.98	0.69	0.36	0.12	0.06	0.02	0.01	0	0	0	0	0	0	0	-	-	-	-	6.76
W	281.25	0.07	0.58	1.42	1.3	1.05	0.63	0.29	0.1	0.02	0.01	0	0	0	0	0	0	0	0	0	-	-	-	-	5.47
WNW	303.75	0.05	0.22	0.42	0.4	0.39	0.2	0.09	0.02	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	1.79
NW	326.25	0.03	0.17	0.41	0.46	0.22	0.16	0.09	0.02	0.02	0	0	0	0	0	0	0	0	0	0	-	-	-	-	1.58
NNW	348.75	0.03	0.11	0.39	0.61	0.51	0.49	0.44	0.32	0.21	0.21	0.12	0.07	0.04	0.03	0.01	0	0	0	0	-	-	-	-	3.59
Bin Totals (%)		0.74	5.23	14.98	19.93	19.93	15.72	9.92	5.69	3.22	2.02	1.26	0.69	0.34	0.2	0.05	0.04	0.02	0	0.01	-	-	-	-	100
Exceedence (%)		100	99.25	94.02	79.04	59.11	39.18	23.46	13.54	7.85	4.63	2.61	1.35	0.66	0.32	0.12	0.07	0.03	0.01	0.01	-	-	-	-	
Number of records in time series:		57041																							
Summary of Statistics																									
Maximum wind speed		=	18.61 m/s																						
Mean wind speed		=	4.64 m/s																						

Table B 7 Stony Pt – Summer All Years (2000-2013)

Wind Speed and Direction - Percentage occurrence																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															</
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Table B 8 Near Hastings – Summer All Years (2000-2013)

Wind Speed and Direction - Percentage occurrence																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
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Table B 9 Cerberus – Autumn All Years (2000-2012)

Wind Speed and Direction - Percentage occurrence																												
Wind data at Cerberus Autumn 2000-2012																												
Direction (°)		Wind Speed (m/s)																						Total (%)				
		0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+		22.00+			
N	11.25	0.5	2.68	3.46	1.95	1.52	1.37	0.92	0.48	0.25	0.14	0.05	0.03	0	0	0	0	-	-	-	-	-	-	-	-	13.35		
NNE	33.75	0.24	1.46	2.14	1.18	0.36	0.08	0.02	0	0.01	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	5.49		
NE	56.25	0.17	0.88	2	1.44	0.72	0.21	0.03	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	5.45		
ENE	78.75	0.12	0.45	0.85	0.79	0.36	0.28	0.13	0.02	0.01	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	3.01		
E	101.25	0.18	0.58	1.09	0.9	0.48	0.2	0.15	0.06	0.01	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	3.65		
ESE	123.75	0.12	0.43	0.94	1.22	0.95	0.36	0.18	0.08	0.01	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	4.29		
SE	146.25	0.15	0.44	0.86	0.96	0.77	0.41	0.29	0.16	0.04	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	4.08		
SSE	168.75	0.15	0.68	1.07	0.7	0.48	0.3	0.13	0.03	0.01	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	3.55		
S	191.25	0.28	0.82	1.52	1.86	1.78	1.31	0.75	0.3	0.11	0.03	0.01	0	0	0	0	0	-	-	-	-	-	-	-	-	8.77		
SSW	213.75	0.19	0.57	0.91	1.63	2.15	2.08	1.1	0.5	0.18	0.09	0.03	0.02	0	0	0	0	-	-	-	-	-	-	-	-	9.45		
SW	236.25	0.14	0.45	0.71	0.98	1.17	1.22	0.86	0.6	0.35	0.13	0.04	0.01	0.01	0	0	0	-	-	-	-	-	-	-	-	6.67		
WSW	258.75	0.18	0.61	0.77	0.73	0.66	0.61	0.46	0.34	0.16	0.09	0.02	0.01	0.01	0	0	0	-	-	-	-	-	-	-	-	4.65		
W	281.25	0.25	1.19	2.13	1.41	1.04	0.7	0.49	0.25	0.12	0.05	0.02	0	0	0	0	0	-	-	-	-	-	-	-	-	7.65		
WNW	303.75	0.18	0.73	1.46	1.4	1.25	1.18	0.89	0.69	0.45	0.16	0.07	0.02	0.01	0.01	0.01	0	-	-	-	-	-	-	-	-	8.51		
NW	326.25	0.13	0.65	1.06	1.04	1.01	0.76	0.63	0.45	0.24	0.1	0.04	0.01	0.01	0	0	0	-	-	-	-	-	-	-	-	6.13		
NNW	348.75	0.19	0.77	1.08	0.75	0.61	0.62	0.56	0.36	0.16	0.11	0.03	0.01	0	0	0	0	-	-	-	-	-	-	-	-	5.25		
Bin Totals (%)		3.17	13.42	22.06	18.93	15.31	11.67	7.6	4.31	2.1	0.92	0.33	0.12	0.05	0.01	0.01	0	-	-	-	-	-	-	-	-	100		
Exceedence (%)		100	96.84	83.42	61.36	42.43	27.12	15.45	7.85	3.54	1.44	0.52	0.19	0.07	0.02	0.01	0.00	-	-	-	-	-	-	-	-			
Number of records in time series:				49505																								
Summary of Statistics																												
Maximum wind speed		=	15.83 m/s																									
Mean wind speed		=	3.77 m/s																									

Table B 10 Rhyll - Autumn All Years (2000-2012)

Wind Speed and Direction - Percentage occurrence																										
Wind data at Rhyll Autum 2000-2012																										
Direction (*)		Wind Speed (m/s)																						Total (%)		
		0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+		22.00+	
N	11.25	0.16	0.91	1.87	1.73	1.22	0.82	0.71	0.63	0.47	0.42	0.27	0.21	0.13	0.1	0.03	0.03	0	0	0	0	0	0	0	-	9.71
NNE	33.75	0.08	0.45	1.06	0.96	0.71	0.4	0.23	0.12	0.06	0.03	0.01	0	0	0	0	0	0	0	0	0	0	0	0	-	4.11
NE	56.25	0.09	0.48	1.85	0.97	0.8	0.64	0.39	0.27	0.16	0.06	0.02	0	0.01	0	0	0	0	0	0	0	0	0	0	-	4.64
ENE	78.75	0.07	0.31	0.9	0.89	0.71	0.44	0.26	0.17	0.09	0.09	0.04	0.03	0.02	0	0	0	0	0	0	0	0	0	0	-	4.02
E	101.25	0.13	0.47	1.01	1.03	0.93	0.89	0.66	0.66	0.39	0.27	0.13	0.07	0.05	0.03	0.01	0	0	0	0	0	0	0	0	-	6.73
ESE	123.75	0.09	0.31	0.63	0.6	0.76	0.93	0.94	0.74	0.55	0.33	0.16	0.13	0.09	0.05	0.01	0.01	0	0	0	0	0	0	0	-	6.33
SE	146.25	0.09	0.45	1.04	0.94	0.76	0.37	0.25	0.18	0.09	0.07	0.03	0.01	0	0	0	0	0	0	0	0	0	0	0	-	4.28
SSE	168.75	0.08	0.38	0.82	1.03	0.88	0.63	0.45	0.22	0.09	0.06	0.01	0.01	0.01	0	0	0	0	0	0	0	0	0	0	-	4.67
S	191.25	0.11	0.56	1.41	2.35	2.26	1.29	0.6	0.3	0.13	0.05	0.05	0.02	0.01	0	0	0	0	0	0	0	0	0	0	-	9.14
SSW	213.75	0.07	0.36	0.99	1.47	1.52	1	0.54	0.24	0.12	0.06	0.01	0	0	0	0	0	0	0	0	0	0	0	0	-	6.38
SW	236.25	0.06	0.49	1.41	1.84	1.77	1.43	0.93	0.52	0.24	0.08	0.01	0	0	0	0	0	0	0	0	0	0	0	0	-	8.78
WSW	258.75	0.06	0.54	1.54	1.36	1.05	0.76	0.43	0.22	0.08	0.02	0.01	0	0	0	0	0	0	0	0	0	0	0	0	-	6.07
W	281.25	0.1	0.9	2.55	2.12	1.3	0.8	0.32	0.08	0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	8.19
WNW	303.75	0.09	0.68	1.36	1.15	0.84	0.5	0.17	0.02	0.01	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	-	4.83
NW	326.25	0.11	0.55	1.23	1	0.68	0.5	0.29	0.12	0.04	0.01	0.01	0	0	0	0	0	0	0	0	0	0	0	0	-	4.54
NNW	348.75	0.07	0.39	1.14	1.05	0.84	0.65	0.61	0.63	0.63	0.5	0.42	0.28	0.14	0.07	0.02	0.03	0	0	0.01	0	0	0	0	-	7.48
Bin Totals (%)		1.47	8.15	19.8	20.5	17.04	12.06	7.8	5.12	3.17	2.05	1.18	0.78	0.45	0.27	0.07	0.07	0.01	0	0.01	0	0	0	0	-	100
Exceedence (%)		100	98.53	90.38	70.58	50.08	33.04	20.98	13.18	8.06	4.89	2.84	1.66	0.88	0.43	0.16	0.09	0.02	0.01	0.01	0.00	0.00	0.00		-	
Number of records in time series:				54995																						
Summary of Statistics																										
Maximum wind speed		=	21.67 m/s																							
Mean wind speed		=	4.34 m/s																							

Table B 11 Stony Pt – Autumn All Years (2000-2012)

Wind Speed and Direction - Percentage occurrence																																					
Wind data at Stony Pt Autumn 2000-2012																																					
Direction (*)		Wind Speed (m/s)																						Total (%)													
		0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+		22.00+												
N	11.25	0.89	0.82	1.49	1.34	1.21	0.77	0.5	0.28	0.2	0.11	0.14	0.04	0.02	0.02	0.01	0	0	-	-	-	-	-	-	-	7.84											
NNE	33.75	0.68	0.79	1.31	1.57	1.18	0.73	0.41	0.26	0.16	0.1	0.05	0.04	0.02	0.01	0	0	0	-	-	-	-	-	-	-	7.31											
NE	56.25	0.35	0.59	0.95	0.89	0.58	0.28	0.22	0.09	0.09	0.07	0.06	0.05	0.07	0.02	0.02	0.01	0	-	-	-	-	-	-	-	4.34											
ENE	78.75	0.21	0.35	0.39	0.33	0.37	0.28	0.17	0.06	0.06	0.07	0.02	0.01	0.03	0.01	0	0	0	-	-	-	-	-	-	-	2.36											
E	101.25	0.23	0.33	0.42	0.34	0.22	0.22	0.12	0.08	0.06	0.02	0.01	0	0	0	0	0	0	-	-	-	-	-	-	-	2.05											
ESE	123.75	0.18	0.49	0.7	0.77	0.69	0.67	0.51	0.39	0.19	0.11	0.08	0.06	0.04	0.02	0	0	0	-	-	-	-	-	-	-	4.90											
SE	146.25	0.18	0.42	0.55	0.82	0.81	0.8	0.5	0.34	0.27	0.21	0.11	0.05	0.01	0.01	0	0	0	-	-	-	-	-	-	-	5.08											
SSE	168.75	0.15	0.4	0.54	0.76	0.9	0.85	0.51	0.41	0.15	0.11	0.08	0.02	0.01	0	0	0	0	-	-	-	-	-	-	-	4.89											
S	191.25	0.22	0.44	0.69	1.13	1.15	1.1	0.61	0.44	0.24	0.19	0.11	0.07	0.03	0.03	0	0	0	-	-	-	-	-	-	-	6.45											
SSW	213.75	0.31	0.87	1.24	1.57	1.67	1.42	1	0.56	0.25	0.12	0.04	0.02	0.02	0.01	0	0	0	-	-	-	-	-	-	-	9.10											
SW	236.25	0.4	0.76	0.95	1.11	1.33	1.13	0.78	0.54	0.25	0.08	0.04	0.01	0.01	0	0	0	0	-	-	-	-	-	-	-	7.39											
WSW	258.75	0.34	0.68	0.8	0.78	0.79	0.58	0.42	0.22	0.11	0.09	0.05	0.06	0.02	0.02	0	0	0	-	-	-	-	-	-	-	4.96											
W	281.25	0.49	1.61	1.46	0.91	0.7	0.62	0.45	0.34	0.32	0.17	0.04	0.02	0.01	0	0	0	0	-	-	-	-	-	-	-	7.14											
WNW	303.75	0.69	1.25	1.33	1.18	1.03	1.08	0.94	0.68	0.45	0.14	0.05	0	0.02	0.01	0	0	0	-	-	-	-	-	-	-	8.85											
NW	326.25	0.58	0.95	1.08	1.1	0.85	0.74	0.58	0.48	0.31	0.16	0.04	0.05	0.02	0.01	0	0	0	-	-	-	-	-	-	-	6.95											
NNW	348.75	0.78	1.74	1.6	1.09	0.91	0.91	0.98	0.91	0.57	0.37	0.23	0.13	0.07	0.02	0.02	0.01	0.01	-	-	-	-	-	-	-	10.35											
Bin Totals (%)		6.66	12.49	15.51	15.69	14.4	12.18	8.69	6.07	3.67	2.14	1.15	0.62	0.41	0.21	0.07	0.02	0.01	-	-	-	-	-	-	-	100											
Exceedence (%)		100	93.33	80.84	65.33	49.64	35.24	23.06	14.37	8.30	4.63	2.49	1.34	0.72	0.31	0.10	0.03	0.01	-	-	-	-	-	-	-												
Number of records in time series:				21764																																	
Summary of Statistics																																					
Maximum wind speed		=	16.8 m/s																																		
Mean wind speed		=	4.24 m/s																																		

Table B 12 Near Hastings – Autumn All Years (2000-2012)

Wind Speed and Direction - Percentage occurrence																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
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Table B 13 Cerberus – Winter All Years (2000-2012)

Wind Speed and Direction - Percentage occurrence																										
Wind data at Cerberus Winter 2000-2012																										
Direction (°)		Wind Speed (m/s)																						Total (%)		
		0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+		22.00+	
N	11.25	0.53	2.75	4.86	3.97	3.73	3.33	2.43	1.57	0.72	0.37	0.19	0.1	0.02	0.01	0	0	-	-	-	-	-	-	-	-	24.58
NNE	33.75	0.24	1.9	2.62	1.15	0.3	0.07	0.02	0.01	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	6.31
NE	56.25	0.2	1.33	2.1	1	0.23	0.03	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	4.89
ENE	78.75	0.15	0.52	0.83	0.31	0.06	0.03	0.02	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	1.92
E	101.25	0.09	0.39	0.49	0.27	0.12	0.04	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	1.40
ESE	123.75	0.18	0.46	0.52	0.45	0.24	0.14	0.03	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	2.02
SE	146.25	0.1	0.34	0.6	0.5	0.38	0.25	0.15	0.06	0.01	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	2.39
SSE	168.75	0.06	0.28	0.33	0.19	0.15	0.1	0.06	0.07	0.01	0.01	0	0	0	0	0	0	-	-	-	-	-	-	-	-	1.26
S	191.25	0.2	0.45	0.53	0.69	0.64	0.52	0.36	0.18	0.11	0.09	0.06	0.01	0	0	0	0	-	-	-	-	-	-	-	-	3.84
SSW	213.75	0.19	0.41	0.44	0.69	0.8	0.68	0.47	0.26	0.12	0.06	0.03	0.01	0	0	0	0	-	-	-	-	-	-	-	-	4.16
SW	236.25	0.08	0.26	0.39	0.45	0.57	0.53	0.39	0.28	0.19	0.1	0.03	0.01	0	0	0	0	-	-	-	-	-	-	-	-	3.28
WSW	258.75	0.1	0.33	0.49	0.46	0.42	0.39	0.28	0.19	0.09	0.04	0.02	0	0	0	0	0	-	-	-	-	-	-	-	-	2.81
W	281.25	0.17	0.84	1.47	1.11	0.91	0.65	0.45	0.27	0.13	0.05	0.01	0.01	0	0	0	0	-	-	-	-	-	-	-	-	6.07
WNW	303.75	0.13	0.66	1.3	1.35	1.57	1.8	1.78	1.21	0.72	0.27	0.12	0.06	0.01	0	0	0	-	-	-	-	-	-	-	-	10.98
NW	326.25	0.21	0.89	1.34	1.78	1.89	2.01	1.9	1.07	0.62	0.29	0.09	0.04	0	0	0	0	-	-	-	-	-	-	-	-	12.13
NNW	348.75	0.22	1.02	1.91	1.79	1.65	1.7	1.41	1.05	0.57	0.31	0.12	0.1	0.05	0	0	0	-	-	-	-	-	-	-	-	11.90
Bin Totals (%)		2.86	12.84	20.22	16.15	13.68	12.25	9.76	6.22	3.28	1.58	0.68	0.35	0.1	0.02	0	0.01	-	-	-	-	-	-	-	-	100
Exceedence (%)		100	97.14	84.30	64.08	47.93	34.25	22.00	12.24	6.02	2.74	1.16	0.48	0.13	0.03	0.01	0.01	-	-	-	-	-	-	-	-	
Number of records in time series:		48725																								
Summary of Statistics																										
Maximum wind speed	=	15.83 m/s																								
Mean wind speed	=	4.1 m/s																								

Table B 14 Rhyll - Winter All Years (2000-2012)

Wind Speed and Direction - Percentage occurrence																									
Wind data at Rhyll Winter 2000-2012																									
Direction (°)		Wind Speed (m/s)																						Total (%)	
		0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+		22.00+
N	11.25	0.19	0.81	2.21	2.13	1.84	1.59	1.43	1.27	1.31	1.1	0.92	0.72	0.52	0.35	0.14	0.27	0.07	0.03	0.04	0	0	0	0	16.94
NNE	33.75	0.12	0.53	1.03	0.95	0.72	0.48	0.23	0.13	0.04	0.1	0.01	0	0	0	0	0	0	0	0	0	0	0	0	4.24
NE	56.25	0.1	0.41	0.88	1	0.88	0.86	0.5	0.24	0.1	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	5.00
ENE	78.75	0.1	0.4	0.76	0.82	0.57	0.38	0.17	0.07	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.30
E	101.25	0.09	0.38	0.62	0.59	0.51	0.34	0.23	0.15	0.05	0.02	0.01	0	0	0	0	0	0	0	0	0	0	0	0	2.99
ESE	123.75	0.07	0.19	0.31	0.34	0.4	0.41	0.32	0.25	0.18	0.1	0.07	0.02	0	0	0	0	0	0	0	0	0	0	0	2.66
SE	146.25	0.08	0.33	0.42	0.4	0.32	0.26	0.19	0.1	0.08	0.04	0.02	0	0	0	0	0	0	0	0	0	0	0	0	2.24
SSE	168.75	0.07	0.28	0.37	0.27	0.23	0.14	0.11	0.06	0.03	0.04	0.04	0.02	0.01	0.01	0	0	0	0	0	0	0	0	0	1.68
S	191.25	0.09	0.42	0.68	0.75	0.66	0.57	0.43	0.25	0.12	0.11	0.06	0.01	0.01	0	0	0	0	0	0	0	0	0	0	4.16
SSW	213.75	0.04	0.17	0.59	0.66	0.61	0.54	0.36	0.21	0.08	0.04	0.02	0.01	0	0	0	0	0	0	0	0	0	0	0	3.33
SW	236.25	0.04	0.22	0.79	1.11	1.07	0.84	0.59	0.34	0.16	0.07	0.03	0.01	0	0	0	0	0	0	0	0	0	0	0	5.27
WSW	258.75	0.03	0.29	0.87	0.86	0.71	0.47	0.26	0.12	0.05	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	3.67
W	281.25	0.07	0.66	2.07	2.05	1.72	0.97	0.4	0.13	0.04	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	8.12
WNW	303.75	0.09	0.8	2.25	2.32	1.67	0.87	0.3	0.05	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8.36
NW	326.25	0.08	0.93	2.36	2.6	1.97	1.18	0.62	0.29	0.15	0.05	0.03	0.01	0.01	0	0	0	0	0	0	0	0	0	0	10.28
NNW	348.75	0.07	0.59	1.78	1.72	1.8	1.62	1.74	1.65	1.64	1.5	1.22	0.92	0.57	0.38	0.14	0.26	0.08	0.02	0.03	0.01	0	0	0	17.74
Bin Totals (%)		1.33	7.41	17.99	18.57	15.66	11.5	7.9	5.29	4.08	3.14	2.42	1.72	1.12	0.75	0.28	0.53	0.15	0.05	0.07	0.01	0	0	0	100
Exceedence (%)		100	98.64	91.23	73.24	54.67	39.01	27.51	19.61	14.32	10.24	7.10	4.68	2.96	1.84	1.09	0.81	0.28	0.13	0.08	0.01	0.00	0.00	0.00	
Number of records in time series:				55376																					
Summary of Statistics																									
Maximum wind speed		=	22.22 m/s																						
Mean wind speed		=	4.87 m/s																						

Table B 15 Stony Pt – Winter All Years (2000-2012)

Wind Speed and Direction - Percentage occurrence																										
Wind data at Stony Pt Winter 2000-2012																										
Direction (°)		Wind Speed (m/s)																						Total (%)		
		0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+		22.00+	
N	11.25	1.47	1.07	1.47	1.28	1.02	1	0.77	0.63	0.41	0.26	0.09	0.06	0.03	0.02	0	0	0	0	0	0	0	0	0	0	9.58
NNE	33.75	1.59	0.94	1.67	1.51	0.92	0.59	0.36	0.2	0.14	0.12	0.07	0.05	0.03	0.01	0.01	0.01	0	0	0	0	0	0	0	0	8.22
NE	56.25	0.69	0.65	0.97	0.91	0.53	0.27	0.23	0.13	0.14	0.1	0.07	0.05	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0	0	0	0	0	4.85
ENE	78.75	0.3	0.25	0.28	0.28	0.29	0.18	0.1	0.06	0.02	0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.78
E	101.25	0.2	0.2	0.25	0.18	0.2	0.09	0.05	0.04	0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.23
ESE	123.75	0.4	0.29	0.32	0.33	0.26	0.17	0.05	0.06	0.06	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.21
SE	146.25	0.36	0.31	0.28	0.38	0.42	0.39	0.39	0.21	0.09	0.08	0.04	0.05	0.03	0.05	0.02	0.01	0	0	0	0	0	0	0	0	3.11
SSE	168.75	0.31	0.19	0.22	0.25	0.16	0.14	0.1	0.08	0.06	0.04	0.03	0.03	0.05	0.01	0	0	0	0	0	0	0	0	0	0	1.67
S	191.25	0.22	0.29	0.3	0.37	0.37	0.37	0.39	0.29	0.14	0.11	0.1	0.1	0.03	0.02	0.01	0	0	0	0	0	0	0	0	0	3.11
SSW	213.75	0.41	0.53	0.54	0.62	0.87	0.53	0.4	0.19	0.1	0.08	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	4.30
SW	236.25	0.45	0.47	0.58	0.79	0.66	0.36	0.28	0.19	0.1	0.04	0.01	0.01	0	0.01	0	0	0	0	0	0	0	0	0	0	3.95
WSW	258.75	0.37	0.49	0.62	0.63	0.61	0.42	0.23	0.11	0.09	0.05	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	3.63
W	281.25	0.82	1	1.33	1.09	1.01	0.68	0.69	0.3	0.2	0.11	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	7.24
WNW	303.75	1.14	1.64	1.75	1.97	2.3	2.11	1.67	1.16	0.65	0.19	0.08	0.04	0.02	0	0	0	0	0	0	0	0	0	0	0	14.72
NW	326.25	1	1.22	1.31	1.58	1.96	2.06	1.94	1.46	0.85	0.51	0.29	0.18	0.09	0.02	0	0.01	0	0	0	0	0	0	0	0	14.48
NNW	348.75	1.07	0.95	0.99	1.23	1.54	1.75	1.98	2.03	1.62	1.08	0.69	0.43	0.23	0.11	0.1	0.02	0	0	0	0	0	0	0	0	15.82
Bin Totals (%)		10.8	10.49	12.87	13.4	13.13	11.22	9.75	7.14	4.69	2.86	1.52	1	0.54	0.29	0.18	0.06	0.03	0.02	0.01	0	0	0	0	0	100
Exceedence (%)		100	89.20	78.71	65.84	52.44	39.31	28.09	18.34	11.20	6.51	3.65	2.13	1.13	0.59	0.30	0.12	0.06	0.03	0.01	0.00	0.00	0.00	0.00	0.00	
Number of records in time series:					21033																					
Summary of Statistics																										
Maximum wind speed		= 19.5 m/s																								
Mean wind speed		= 4.4 m/s																								

Table B 16 Near Hastings – Winter All Years (2000-2012)

[illegible]

Table B 17 Cerberus – Spring All Years (2000-2012)

Wind Speed and Direction - Percentage occurrence																										
Wind data at Cerberus Spring 2000-2012																										
Direction (°)		Wind Speed (m/s)																						Total (%)		
		0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+		22.00+	
N	11.25	0.27	1.55	2.59	1.85	1.39	1.21	1.1	0.67	0.26	0.13	0.06	0.02	0.01	0	0	0	0	-	-	-	-	-	-	-	11.11
NNE	33.75	0.15	0.94	1.62	1.13	0.51	0.15	0.05	0.01	0.01	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	4.57
NE	56.25	0.08	0.54	1.53	1.42	0.71	0.26	0.06	0.01	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	4.61
ENE	78.75	0.08	0.38	0.7	0.72	0.4	0.2	0.11	0.04	0.01	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	2.64
E	101.25	0.14	0.49	0.72	0.57	0.29	0.24	0.14	0.02	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	2.61
ESE	123.75	0.13	0.36	0.61	0.87	0.75	0.47	0.25	0.05	0.02	0.01	0	0	0	0	0	0	0	-	-	-	-	-	-	-	3.52
SE	146.25	0.07	0.42	0.66	0.68	0.51	0.42	0.29	0.19	0.04	0.02	0	0	0	0	0	0	0	-	-	-	-	-	-	-	3.30
SSE	168.75	0.14	0.63	1.02	0.59	0.31	0.18	0.12	0.06	0.03	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	3.08
S	191.25	0.26	0.8	1.42	1.9	1.67	1.23	0.69	0.27	0.07	0.02	0.02	0	0	0	0	0	0	-	-	-	-	-	-	-	8.35
SSW	213.75	0.21	0.61	0.99	1.69	2.27	2.16	1.39	0.63	0.25	0.13	0.02	0.04	0	0	0	0	0	-	-	-	-	-	-	-	10.39
SW	236.25	0.13	0.54	0.86	1.22	1.49	1.47	1.25	0.84	0.49	0.22	0.11	0.05	0.01	0.02	0	0	0	-	-	-	-	-	-	-	8.70
WSW	258.75	0.15	0.57	0.95	0.91	0.9	0.83	0.66	0.51	0.29	0.18	0.08	0.04	0.02	0	0	0	0	-	-	-	-	-	-	-	6.09
W	281.25	0.21	1.17	1.8	1.57	1.19	0.97	0.73	0.55	0.29	0.15	0.07	0.02	0.02	0.01	0	0	0	-	-	-	-	-	-	-	8.75
WNW	303.75	0.1	0.57	1.24	1.19	1.45	1.68	1.45	1.05	0.58	0.23	0.15	0.08	0.01	0.01	0	0	0	-	-	-	-	-	-	-	9.79
NW	326.25	0.09	0.6	0.9	1	1.11	0.91	0.79	0.56	0.32	0.19	0.08	0.05	0	0	0	0	0	-	-	-	-	-	-	-	6.60
NNW	348.75	0.11	0.59	0.98	0.78	0.73	0.77	0.74	0.54	0.29	0.16	0.11	0.03	0.01	0.01	0	0	0	-	-	-	-	-	-	-	5.85
Bin Totals (%)		2.33	10.78	18.6	18.09	15.68	13.15	9.82	6.01	2.95	1.44	0.7	0.32	0.08	0.05	0.01	0	0	-	-	-	-	-	-	-	100
Exceedence (%)		100	97.68	86.90	68.30	50.21	34.53	21.38	11.56	5.55	2.60	1.16	0.46	0.14	0.06	0.01	0.00	0.00	-	-	-	-	-	-	-	
Number of records in time series:		48655																								
Summary of Statistics																										
Maximum wind speed	=	16.94 m/s																								
Mean wind speed	=	4.18 m/s																								

Table B 18 Rhyll - Spring All Years (2000-2012)

Wind data at Rhyll Spring 2000-2012																									
Direction (°)		Wind Speed (m/s)																						Total (%)	
		0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+		22.00+
N	11.25	0.07	0.43	1.25	1.36	1.01	0.89	0.77	0.51	0.48	0.4	0.34	0.27	0.19	0.13	0.04	0.08	0.03	0	0	-	-	-	-	8.25
NNE	33.75	0.03	0.24	0.69	0.78	0.65	0.46	0.32	0.21	0.08	0.03	0.03	0.01	0.01	0	0	0	0	0	-	-	-	-	-	3.54
NE	56.25	0.04	0.19	0.49	0.63	0.73	0.73	0.55	0.33	0.21	0.15	0.05	0.01	0.01	0	0	0	0	0	0	-	-	-	-	4.12
ENE	78.75	0.05	0.26	0.56	0.68	0.6	0.43	0.36	0.25	0.17	0.07	0.04	0.02	0.02	0	0	0	0	0	0	-	-	-	-	3.51
E	101.25	0.05	0.34	0.7	0.76	0.67	0.58	0.43	0.3	0.28	0.21	0.13	0.08	0.04	0.02	0	0	0	0	0	-	-	-	-	4.59
ESE	123.75	0.02	0.26	0.52	0.51	0.48	0.53	0.49	0.4	0.33	0.37	0.25	0.11	0.05	0.02	0.01	0.01	0.01	0	0	-	-	-	-	4.37
SE	146.25	0.05	0.52	1.09	0.87	0.58	0.36	0.33	0.19	0.11	0.06	0.02	0.01	0	0	0	0	0	0	0	-	-	-	-	4.19
SSE	168.75	0.04	0.36	0.93	1.14	0.95	0.6	0.4	0.23	0.11	0.03	0.01	0.01	0	0	0	0	0	0	0	-	-	-	-	4.81
S	191.25	0.08	0.5	1.39	2.49	2.62	1.35	0.59	0.22	0.07	0.05	0.02	0.01	0.01	0	0	0	0	0	0	-	-	-	-	9.40
SSW	213.75	0.04	0.29	0.79	1.32	1.56	1.13	0.65	0.36	0.19	0.1	0.05	0.02	0.01	0	0	0	0	0	0	-	-	-	-	6.51
SW	236.25	0.04	0.46	1.45	1.83	1.74	1.53	1.05	0.53	0.28	0.11	0.06	0.01	0	0	0	0	0	0	0	-	-	-	-	9.09
WSW	258.75	0.09	0.52	1.72	1.81	1.62	1.26	0.81	0.45	0.14	0.09	0.02	0	0	0	0	0	0	0	0	-	-	-	-	8.53
W	281.25	0.09	0.97	2.61	2.53	2.14	1.46	0.73	0.23	0.07	0.02	0	0	0	0	0	0	0	0	0	-	-	-	-	10.85
WNW	303.75	0.07	0.65	1.33	1.41	1.36	0.77	0.24	0.04	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	5.87
NW	326.25	0.06	0.46	1.07	1.15	0.95	0.63	0.38	0.16	0.05	0.02	0.01	0.01	0	0	0	0	0	0	0	-	-	-	-	4.95
NNW	348.75	0.03	0.29	0.7	0.9	0.79	0.84	0.78	0.72	0.65	0.58	0.38	0.3	0.19	0.1	0.02	0.07	0.02	0.01	0	-	-	-	-	7.37
Bin Totals (%)		0.87	6.74	17.3	20.17	18.44	13.57	8.88	5.14	3.21	2.29	1.42	0.86	0.53	0.28	0.07	0.17	0.05	0.01	0.01	-	-	-	-	100
Exceedence (%)		100	99.14	92.40	75.10	54.93	36.49	22.92	14.04	8.90	5.69	3.40	1.98	1.12	0.59	0.31	0.24	0.07	0.02	0.01	-	-	-	-	
Number of records in time series:		55651																							
Summary of Statistics																									
Maximum wind speed	=	18.61 m/s																							
Mean wind speed	=	4.56 m/s																							

Table B 19 Stony Pt – Spring All Years (2000-2012)

Wind Speed and Direction - Percentage occurrence																									
Wind data at Stony Pt Spring 2000-2012																									
Direction (°)		Wind Speed (m/s)																						Total (%)	
		0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+		22.00+
N	11.25	0.52	0.69	1.03	1.29	0.18	0.64	0.58	0.35	0.26	0.16	0.03	0.05	0.02	0.01	0	0	0	0	0	-	-	-	-	6.43
NNE	33.75	0.62	0.7	1	1.21	1.14	0.78	0.41	0.16	0.1	0.07	0.05	0.04	0.03	0.03	0	0.01	0	0	0	-	-	-	-	6.35
NE	56.25	0.45	0.58	0.95	0.86	0.76	0.38	0.26	0.15	0.08	0.06	0.05	0.03	0.01	0	0	0	0	0	0	-	-	-	-	4.62
ENE	78.75	0.2	0.23	0.31	0.28	0.23	0.12	0.11	0.07	0.04	0.02	0	0	0	0	0	0	0	0	0	-	-	-	-	1.61
E	101.25	0.21	0.26	0.28	0.28	0.22	0.15	0.16	0.08	0.05	0.03	0	0	0	0	0	0	0	0	0	-	-	-	-	1.72
ESE	123.75	0.21	0.52	0.63	0.61	0.53	0.58	0.55	0.32	0.2	0.09	0.01	0	0	0	0	0	0	0	0	-	-	-	-	4.25
SE	146.25	0.25	0.41	0.82	0.93	1.01	0.7	0.42	0.42	0.33	0.28	0.15	0.09	0.01	0.01	0.01	0	0	0	0	-	-	-	-	5.84
SSE	168.75	0.23	0.34	0.68	0.89	1.08	0.98	0.58	0.33	0.22	0.17	0.09	0.05	0.03	0	0	0	0	0	0	-	-	-	-	5.67
S	191.25	0.25	0.37	0.63	1.18	1.48	1.16	0.68	0.42	0.24	0.2	0.08	0.03	0.02	0	0	0	0	0	0	-	-	-	-	6.74
SSW	213.75	0.44	0.71	1.08	1.32	1.72	1.47	0.91	0.64	0.36	0.14	0.04	0.05	0.03	0.02	0	0	0	0	0	-	-	-	-	8.93
SW	236.25	0.57	0.82	1.1	1.23	1.8	1.56	1.11	0.65	0.26	0.08	0.01	0.03	0.01	0	0	0	0	0	0	-	-	-	-	9.23
WSW	258.75	0.33	0.68	1.06	1.14	1.18	0.96	0.63	0.3	0.17	0.08	0	0	0	0	0	0	0	0	0	-	-	-	-	6.53
W	281.25	0.48	1.24	1.74	1.19	1.05	1.01	0.71	0.5	0.27	0.11	0.09	0.03	0	0	0	0	0	0	0	-	-	-	-	8.42
WNW	303.75	0.63	1.32	1.44	1.13	1.23	1.17	1.16	0.77	0.44	0.28	0.17	0.04	0.01	0	0	0	0	0	0	-	-	-	-	9.79
NW	326.25	0.6	0.71	0.82	0.89	0.74	0.73	0.55	0.48	0.42	0.26	0.16	0.07	0.03	0.03	0	0	0	0	0	-	-	-	-	6.49
NNW	348.75	0.46	0.47	0.66	0.7	0.7	0.84	0.79	0.79	0.72	0.52	0.36	0.14	0.11	0.04	0.02	0.01	0	0	0	-	-	-	-	7.33
Bin Totals (%)		6.44	10.03	14.23	15.12	15.66	13.23	9.63	6.44	4.17	2.54	1.3	0.66	0.32	0.16	0.04	0.03	0	0.01	0	-	-	-	-	100
Exceedence (%)		100	93.57	83.54	69.31	54.19	38.53	25.30	15.67	9.23	5.06	2.52	1.22	0.56	0.24	0.08	0.04	0.01	0.01	0.00	-	-	-	-	
Number of records in time series:				23790																					
Summary of Statistics																									
Maximum wind speed		= 18.3 m/s																							
Mean wind speed		= 4.43 m/s																							

Table B 20 Near Hastings – Spring All Years (2000-2012)

[illegible]

Wind Speed and Direction - Percentage occurrence																										
Wind data at Cerberus January 2000-2013																										
Direction (°)		Wind Speed (m/s)																						Total (%)		
		0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+	22.00+		
N	11.25	0.21	0.82	1.45	0.76	0.52	0.46	0.48	0.22	0.15	0.14	0.04	0.01	0.00	0.00	-	-	-	-	-	-	-	-	-	-	5.26
NNE	33.75	0.14	0.65	1.19	0.92	0.39	0.10	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	-	-	-	-	-	-	-	-	-	-	3.43
NE	56.25	0.09	0.50	1.27	1.32	0.67	0.37	0.14	0.01	0.01	0.00	0.00	0.00	0.00	0.00	-	-	-	-	-	-	-	-	-	-	4.38
ENE	78.75	0.07	0.26	0.77	0.79	0.76	0.60	0.27	0.02	0.00	0.00	0.00	0.00	0.00	0.00	-	-	-	-	-	-	-	-	-	-	3.54
E	101.25	0.07	0.36	0.89	0.92	0.59	0.33	0.28	0.15	0.03	0.01	0.00	0.00	0.00	0.00	-	-	-	-	-	-	-	-	-	-	3.63
ESE	123.75	0.06	0.22	0.93	1.06	0.97	0.63	0.26	0.04	0.01	0.00	0.00	0.00	0.00	0.00	-	-	-	-	-	-	-	-	-	-	4.18
SE	146.25	0.12	0.50	0.81	1.01	1.05	0.72	0.34	0.16	0.01	0.00	0.00	0.00	0.00	0.00	-	-	-	-	-	-	-	-	-	-	4.72
SSE	168.75	0.19	0.88	2.17	1.47	0.92	0.48	0.21	0.14	0.03	0.00	0.00	0.00	0.00	0.00	-	-	-	-	-	-	-	-	-	-	6.49
S	191.25	0.23	1.05	2.57	3.08	3.22	2.85	1.78	0.50	0.10	0.02	0.00	0.00	0.00	0.00	-	-	-	-	-	-	-	-	-	-	15.40
SSW	213.75	0.14	0.45	1.07	2.46	3.74	4.76	3.96	1.86	0.61	0.15	0.04	0.01	0.00	0.00	-	-	-	-	-	-	-	-	-	-	19.25
SW	236.25	0.14	0.50	0.94	1.07	1.54	1.81	1.73	1.44	0.99	0.62	0.25	0.06	0.04	0.02	-	-	-	-	-	-	-	-	-	-	11.15
WSW	258.75	0.12	0.55	0.80	0.62	0.66	0.57	0.60	0.35	0.27	0.16	0.09	0.03	0.01	0.00	-	-	-	-	-	-	-	-	-	-	4.83
W	281.25	0.18	0.82	1.27	0.98	0.68	0.47	0.56	0.37	0.16	0.11	0.03	0.00	0.00	0.00	-	-	-	-	-	-	-	-	-	-	5.63
WNW	303.75	0.08	0.44	0.56	0.38	0.33	0.47	0.53	0.37	0.17	0.06	0.02	0.02	0.00	0.00	-	-	-	-	-	-	-	-	-	-	3.43
NW	326.25	0.03	0.22	0.38	0.27	0.24	0.28	0.30	0.20	0.09	0.04	0.02	0.03	0.00	0.01	-	-	-	-	-	-	-	-	-	-	2.11
NNW	348.75	0.07	0.27	0.46	0.25	0.30	0.32	0.38	0.30	0.20	0.14	0.04	0.05	0.03	0.01	-	-	-	-	-	-	-	-	-	-	2.65
Bin Totals (%)		1.94	8.49	17.53	17.36	16.58	15.22	11.85	6.16	2.77	1.35	0.54	0.19	0.06	0.04	-	-	-	-	-	-	-	-	-	-	100
Exceedence (%)		100	98.14	89.65	72.12	54.76	38.18	22.96	11.11	4.95	2.18	0.83	0.29	0.10	0.04	-	-	-	-	-	-	-	-	-	-	-
Number of records in time series:		19850																								
Summary of Statistics																										
Maximum wind speed		=																								

Wind Speed and Direction - Percentage occurrence																									
Wind data at Rhyll January 2000-2013																									
Direction (°)	Wind Speed (m/s)																						Total (%)		
	0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+		22.00+	
N	11.25	0.04	0.34	0.83	0.95	0.69	0.37	0.21	0.17	0.11	0.11	0.09	0.09	0.03	0	0	-	-	-	-	-	-	-	-	4.14
NNE	33.75	0.04	0.23	0.46	0.54	0.4	0.27	0.26	0.15	0.03	0.01	0	0	0	0	0	-	-	-	-	-	-	-	-	2.39
NE	56.25	0.02	0.23	0.4	0.52	0.54	0.38	0.36	0.4	0.21	0.1	0.01	0.03	0.01	0	0	0	-	-	-	-	-	-	-	3.21
ENE	78.75	0.03	0.21	0.45	0.65	0.61	0.47	0.31	0.23	0.21	0.11	0.06	0.01	0	0	0	0	-	-	-	-	-	-	-	3.35
E	101.25	0.08	0.32	0.86	0.9	0.9	0.76	0.67	0.47	0.33	0.26	0.3	0.21	0.07	0.01	0	0	-	-	-	-	-	-	-	6.14
ESE	123.75	0.06	0.29	0.69	0.69	0.69	0.77	0.77	0.61	0.52	0.4	0.27	0.26	0.1	0.03	0	0	-	-	-	-	-	-	-	6.15
SE	146.25	0.07	0.57	1.21	1.24	1.1	0.89	0.45	0.19	0.08	0.02	0.01	0	0	0	0	0	-	-	-	-	-	-	-	5.83
SSE	168.75	0.05	0.44	1.38	2.06	1.88	1.43	0.92	0.65	0.34	0.13	0.09	0.01	0	0	0	0	-	-	-	-	-	-	-	9.38
S	191.25	0.07	0.59	2.65	5.4	5.27	3.09	1.15	0.4	0.11	0.03	0	0	0	0	0	0	-	-	-	-	-	-	-	18.76
SSW	213.75	0.04	0.32	1.16	2.09	2.85	2.45	1.29	0.56	0.18	0.06	0	0	0	0	0	0	-	-	-	-	-	-	-	11.00
SW	236.25	0.04	0.43	1.62	1.93	2.33	2.04	1.72	1.13	0.39	0.23	0.06	0.04	0	0	0	0	-	-	-	-	-	-	-	11.96
WSW	258.75	0.04	0.45	1.33	1.24	0.96	1.01	0.65	0.4	0.2	0.09	0	0.01	0	0	0	0	-	-	-	-	-	-	-	6.38
W	281.25	0.06	0.57	1.18	0.82	0.88	0.63	0.31	0.13	0.02	0	0	0	0	0	0	0	-	-	-	-	-	-	-	4.60
WNW	303.75	0.05	0.17	0.34	0.3	0.33	0.2	0.05	0.01	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	1.45
NW	326.25	0.01	0.18	0.46	0.45	0.22	0.13	0.1	0.02	0.02	0	0	0	0	0	0	0	-	-	-	-	-	-	-	1.59
NNW	348.75	0.02	0.12	0.48	0.61	0.5	0.44	0.35	0.25	0.23	0.22	0.17	0.09	0.05	0.04	0	0	-	-	-	-	-	-	-	3.57
Bin Totals (%)		0.74	5.46	15.52	20.4	20.14	15.32	9.57	5.77	2.99	1.77	1.11	0.75	0.33	0.12	0.01	0	-	-	-	-	-	-	-	100
Exceedence (%)		100	99.26	93.80	78.28	57.88	37.74	22.42	12.85	7.08	4.09	2.32	1.21	0.46	0.13	0.01	0.00	-	-	-	-	-	-	-	-
Number of records in time series:				20435																					
Summary of Statistics																									
Maximum wind speed		=	15 m/s																						
Mean wind speed		=	4.56 m/s																						

Wind Speed and Direction - Percentage occurrence																										
Wind data at Stony Pt January 2000-2012																										
Direction (°)		Wind Speed (m/s)																						Total (%)		
		0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+		22.00+	
N	11.25	0.28	0.48	0.87	0.83	0.54	0.39	0.23	0.21	0.09	0.01	0.02	0.04	0.01	0.01	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	4.01
NNE	33.75	0.18	0.63	0.74	0.8	0.64	0.4	0.16	0.08	0.06	0.06	0.01	0.04	0	0.02	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	3.82
NE	56.25	0.18	0.62	0.54	0.55	0.49	0.33	0.22	0.14	0.08	0.04	0.02	0.02	0	0.01	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	3.24
ENE	78.75	0.22	0.35	0.36	0.36	0.28	0.3	0.22	0.07	0.08	0.01	0.02	0.04	0.01	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	2.32
E	101.25	0.19	0.43	0.33	0.44	0.46	0.25	0.35	0.15	0.11	0.09	0.07	0.04	0.01	0.04	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	2.96
ESE	123.75	0.16	0.41	0.74	0.75	0.76	0.61	0.53	0.37	0.34	0.15	0.09	0.06	0.01	0.04	0.02	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	5.04
SE	146.25	0.11	0.53	0.69	0.94	1.17	1.21	1.01	0.61	0.34	0.22	0.15	0.04	0.01	0.01	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	7.04
SSE	168.75	0.06	0.39	0.9	1.32	2	2.53	1.84	1.19	0.48	0.27	0.13	0.04	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	11.15
S	191.25	0.12	0.34	1.15	1.85	2.79	2.52	2.2	0.94	0.43	0.13	0.06	0.04	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	12.57
SSW	213.75	0.21	0.81	1.46	1.77	2.88	3.11	2.62	1.48	0.68	0.3	0.14	0.07	0.01	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	15.54
SW	236.25	0.3	0.78	0.74	1.17	1.79	2.21	1.8	1.15	0.62	0.3	0.15	0.07	0.05	0.01	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	11.14
WSW	258.75	0.2	0.71	0.63	0.94	0.9	0.97	0.61	0.36	0.18	0.14	0.05	0.02	0.02	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	5.73
W	281.25	0.25	0.9	0.97	0.66	0.59	0.82	0.89	0.63	0.33	0.27	0.09	0.01	0.01	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	6.42
WNW	303.75	0.23	0.74	0.41	0.32	0.28	0.56	0.36	0.34	0.16	0.05	0	0.01	0	0	0	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	3.47
NW	326.25	0.16	0.33	0.33	0.22	0.21	0.28	0.25	0.2	0.09	0.06	0.06	0.01	0.01	0	0.01	0.01	0.00	0.00	0.01	0.00	0.01	0.00	0.00	-	2.25
NNW	348.75	0.12	0.44	0.47	0.26	0.26	0.34	0.23	0.21	0.29	0.18	0.														

Table B 24 Cerberus – Feb (2000-2013)

Wind Speed and Direction - Percentage occurrence																										
Wind data at Cerberus February 2000-2013																										
Direction (°)		Wind Speed (m/s)																						Total (%)		
		0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+		22.00+	
N	11.25	0.24	0.94	1.44	0.64	0.46	0.53	0.6	0.31	0.19	0.04	0.02	0.01	0	0	-	-	-	-	-	-	-	-	-	5.42	
NNE	33.75	0.13	0.52	1.38	1.09	0.52	0.14	0.01	0.02	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	3.81	
NE	56.25	0.06	0.55	1.12	1.4	0.83	0.46	0.1	0.03	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	4.55	
ENE	78.75	0.08	0.35	0.95	0.95	0.78	0.57	0.36	0.13	0.04	0.02	0	0	0	0	-	-	-	-	-	-	-	-	-	4.23	
E	101.25	0.09	0.63	1.04	1.18	0.86	0.76	0.46	0.26	0.02	0	0	0	0	0	-	-	-	-	-	-	-	-	-	5.30	
ESE	123.75	0.09	0.34	0.92	1.53	1.31	0.8	0.38	0.19	0.04	0.03	0.02	0	0	0	-	-	-	-	-	-	-	-	-	5.65	
SE	146.25	0.06	0.33	1.06	1.47	0.95	0.59	0.39	0.16	0.11	0.04	0.01	0	0	0	-	-	-	-	-	-	-	-	-	5.17	
SSE	168.75	0.16	0.75	2.38	1.49	0.83	0.49	0.31	0.11	0.05	0.01	0	0.01	0	0	-	-	-	-	-	-	-	-	-	6.59	
S	191.25	0.32	1.1	2.37	3.74	3.83	3.86	2.2	0.68	0.23	0.05	0.03	0.03	0.01	0.01	-	-	-	-	-	-	-	-	-	18.46	
SSW	213.75	0.05	0.33	1.3	1.8	2.88	4.15	3.39	1.43	0.5	0.16	0.04	0.01	0.01	0.02	-	-	-	-	-	-	-	-	-	16.07	
SW	236.25	0.11	0.36	0.85	1.29	1.44	1.82	1.54	0.96	0.46	0.26	0.11	0.01	0	0	-	-	-	-	-	-	-	-	-	9.21	
WSW	258.75	0.12	0.59	0.82	0.91	0.87	0.55	0.45	0.25	0.13	0.06	0.01	0	0	0	-	-	-	-	-	-	-	-	-	4.76	
W	281.25	0.14	0.58	1.29	1.1	0.56	0.43	0.24	0.16	0.09	0.04	0.02	0	0	0	-	-	-	-	-	-	-	-	-	4.65	
WNW	303.75	0.02	0.27	0.61	0.53	0.31	0.31	0.12	0.11	0.04	0.05	0.01	0.01	0	0	-	-	-	-	-	-	-	-	-	2.39	
NW	326.25	0.04	0.16	0.28	0.21	0.18	0.15	0.12	0.08	0.05	0.02	0.02	0	0	0	-	-	-	-	-	-	-	-	-	1.31	
NNW	348.75	0.07	0.28	0.33	0.2	0.2	0.32	0.45	0.32	0.16	0.06	0.08	0.02	0	0	-	-	-	-	-	-	-	-	-	2.49	
Bin Totals (%)		1.78	8.08	18.14	19.53	16.81	15.93	11.12	5.20	2.11	0.84	0.37	0.10	0.02	0.03	-	-	-	-	-	-	-	-	-	-	
Exceedence (%)		100	98.28	90.20	72.06	52.53	35.72	19.79	8.67	3.47	1.36	0.52	0.15	0.05	0.03	-	-	-	-	-	-	-	-	-	-	100
Number of records in time series:		17030																								
Summary of Statistics																										
Maximum wind speed	=	13.89 m/s																								
Mean wind speed	=	4.21 m/s																								

Table B 25 Rhyll – Feb (2000-2013)

Wind Speed and Direction - Percentage occurrence																									
Wind data at Rhyll February 2000-2013																									
Direction (°)		Wind Speed (m/s)																						Total (%)	
		0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+		22.00+
N	11.25	0.06	0.3	0.84	0.95	0.6	0.33	0.31	0.2	0.23	0.11	0.15	0.07	0.01	0.02	0	0.01	0	0	0	-	-	-	-	4.19
NNE	33.75	0.02	0.23	0.51	0.68	0.57	0.53	0.27	0.11	0.07	0.02	0	0	0	0	0	0	0	0	0	-	-	-	-	3.01
NE	56.25	0.03	0.21	0.51	0.53	0.54	0.58	0.52	0.42	0.27	0.18	0.08	0.01	0	0	0	0	0	0	0	-	-	-	-	3.88
ENE	78.75	0.05	0.23	0.51	0.63	0.6	0.44	0.38	0.24	0.16	0.09	0.05	0.06	0.02	0.02	0.01	0.01	0.01	0	0	-	-	-	-	3.51
E	101.25	0.05	0.27	0.7	1.05	1.04	0.96	0.91	0.78	0.73	0.59	0.58	0.33	0.21	0.08	0.01	0.03	0.01	0.01	0.02	-	-	-	-	8.36
ESE	123.75	0.02	0.32	0.73	0.74	0.84	0.91	0.92	0.85	0.66	0.53	0.47	0.21	0.12	0.12	0.06	0.07	0.05	0	0	-	-	-	-	7.62
SE	146.25	0.03	0.42	1.23	1.68	1.32	0.88	0.4	0.19	0.13	0.06	0.01	0.01	0	0.01	0	0	0	0	0	-	-	-	-	6.37
SSE	168.75	0.06	0.31	1.15	1.94	2.33	1.64	0.88	0.55	0.37	0.14	0.07	0.02	0.02	0	0	0	0	0	0	0	-	-	-	9.48
S	191.25	0.03	0.48	2.42	4.53	5.83	4.19	1.91	0.6	0.24	0.06	0.03	0.03	0.02	0.03	0	0	0	0	0	-	-	-	-	20.40
SSW	213.75	0.03	0.22	0.89	1.44	2.44	2.46	1.05	0.44	0.19	0.03	0	0	0	0	0	0	0	0	0	-	-	-	-	9.19
SW	236.25	0.07	0.33	1.26	1.85	1.96	1.68	1.17	0.61	0.25	0.08	0.03	0.01	0	0	0	0	0	0	0	-	-	-	-	9.30
WSW	258.75	0.06	0.37	1.06	1.33	0.88	0.67	0.46	0.16	0.03	0.01	0	0	0	0	0	0	0	0	0	-	-	-	-	5.03
W	281.25	0.06	0.46	1.1	1.06	0.57	0.35	0.18	0.03	0.01	0.01	0	0	0	0	0	0	0	0	0	-	-	-	-	3.83
WNW	303.75	0.05	0.2	0.35	0.25	0.11	0.06	0.03	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	1.05
NW	326.25	0.04	0.15	0.29	0.31	0.12	0.08	0.05	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	1.04
NNW	348.75	0.05	0.14	0.4	0.66	0.55	0.63	0.42	0.3	0.16	0.21	0.11	0.05	0.02	0.02	0.01	0.01	0	0	0	-	-	-	-	3.74
Bin Totals (%)		0.72	4.63	13.96	19.62	20.32	16.39	9.86	5.5	3.5	2.12	1.57	0.8	0.42	0.3	0.08	0.12	0.07	0.01	0.02	-	-	-	-	
Exceedence (%)		100	99.29	94.66	80.70	61.08	40.76	24.37	14.51	9.01	5.51	3.39	1.82	1.02	0.60	0.30	0.22	0.10	0.03	0.02	-	-	-	-	100
Number of records in time series:		17672																							
Summary of Statistics																									
Maximum wind speed	=	18.61 m/s																							
Mean wind speed	=	4.76 m/s																							

Table B 26 Stony Pt – Feb (2000-2013)

Wind Speed and Direction - Percentage occurrence																									
Wind data at Stony Pt February 2000-2012																									
Direction (°)	Wind Speed (m/s)																							Total (%)	
	0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+	22.00+		
N	11.25	0.26	0.33	0.84	0.73	0.41	0.32	0.19	0.11	0.07	0.03	0.03	0.03	0	0.01	0	0	0	0	0	0.00	0.00	0.00	-	3.39
NNE	33.75	0.21	0.58	0.58	0.86	0.81	0.51	0.21	0.29	0.11	0.08	0.08	0.04	0.04	0	0	0	0	0	0	0.00	0.00	0.00	-	4.40
NE	56.25	0.29	0.66	0.63	0.76	0.55	0.58	0.36	0.19	0.17	0.22	0.12	0.07	0.01	0	0.01	0	0	0	0	0.00	0.00	0.00	-	4.62
ENE	78.75	0.14	0.34	0.59	0.48	0.4	0.52	0.29	0.07	0.1	0.01	0.01	0.01	0	0	0	0	0	0	0	0.00	0.00	0.00	-	2.96
E	101.25	0.22	0.47	0.44	0.54	0.5	0.34	0.48	0.23	0.12	0.14	0.06	0.01	0	0	0	0	0	0	0	0.00	0.00	0.00	-	3.55
ESE	123.75	0.19	0.54	0.95	0.77	0.92	0.79	0.95	0.94	0.61	0.33	0.11	0.14	0.07	0.08	0.01	0.01	0	0	0	0.00	0.00	0.00	-	7.41
SE	146.25	0.08	0.46	0.84	1.16	1.26	1.23	1.24	0.66	0.5	0.28	0.18	0.22	0.14	0.1	0	0.01	0	0	0	0.00	0.00	0.00	-	8.36
SSE	168.75	0.12	0.25	0.75	1.28	1.99	2.35	1.75	0.73	0.79	0.28	0.1	0.18	0.11	0.01	0	0	0	0.01	0	0.00	0.00	0.00	-	10.70
S	191.25	0.19	0.26	0.79	1.92	2.81	3.09	2.52	1.7	0.73	0.32	0.08	0.06	0	0.03	0.04	0.01	0	0	0	0.00	0.00	0.00	-	14.55
SSW	213.75	0.15	0.62	1.12	1.64	2.57	2.8	2.39	0.83	0.48	0.26	0.06	0.03	0.03	0	0.01	0	0	0	0	0.00	0.00	0.00	-	12.99
SW	236.25	0.15	0.51	1.08	1.72	2	2.12	1.63	1.03	0.54	0.17	0.08	0.01	0.04	0	0	0	0	0	0	0.00	0.00	0.00	-	11.08
WSW	258.75	0.22	0.36	0.75	1.01	0.81	0.79	0.47	0.15	0.21	0.01	0.07	0.01	0	0	0	0	0	0	0	0.00	0.00	0.00	-	4.86
W	281.25	0.29	0.81	0.97	0.59	0.62	0.34	0.36	0.37	0.29	0.15	0.08	0.04	0.01	0	0.03	0	0	0	0	0.00	0.00	0.00	-	4.95
WNW	303.75	0.3	0.47	0.46	0.34	0.19	0.19	0.04	0.11	0.08	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	-	2.18
NW	326.25	0.15	0.21	0.51	0.19	0.1	0.14	0.18	0.15	0.17	0.03	0.01	0	0	0	0.01	0	0	0	0	0.00	0.00	0.00	-	1.85
NNW	348.75	0.11	0.36	0.32	0.17	0.22	0.17	0.23	0.12	0.14	0.04	0.04	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.03	0.00	0.00	0.01	-	2.05
Bin Totals (%)		3.09	7.23	11.6	14.17	16.17	16.28	13.3	7.7	5.09	2.35	1.12	0.87	0.5	0.23	0.15	0.06	0.01	0.04	0.03	0.00	0.00	0.01	-	
Exceedence (%)		100	96.91	89.68	78.08	63.91	47.74	31.46	18.16	10.46	5.37	3.02	1.90	1.03	0.53	0.30	0.15	0.09	0.08	0.04	0.01	0.01	0.01	-	100
Number of records in time series:		7248																							
Summary of Statistics																									
Maximum wind speed		=	21.3 m/s																						
Mean wind speed		=	4.94 m/s																						

Table B 27 Cerberus – Mar (2000-2012)

Wind Speed and Direction - Percentage occurrence																										
Wind data at Cerberus March 2000-2012																										
Direction (°)		Wind Speed (m/s)																						Total (%)		
		0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+		22.00+	
N	11.25	0.33	1.85	2.65	1.52	1.05	0.97	0.7	0.49	0.29	0.26	0.09	0.03	0.01	0	-	-	-	-	-	-	-	-	-	-	10.24
NNE	33.75	0.12	0.86	1.68	1.04	0.46	0.07	0	0.01	0.01	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-	4.25
NE	56.25	0.08	0.6	1.54	1.48	1.17	0.39	0.06	0.01	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-	5.33
ENE	78.75	0.09	0.31	0.82	0.82	0.6	0.46	0.25	0.05	0.02	0.01	0	0	0	0	-	-	-	-	-	-	-	-	-	-	3.43
E	101.25	0.2	0.53	0.99	1.11	0.68	0.35	0.29	0.13	0.03	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-	4.31
ESE	123.75	0.08	0.38	0.82	1.25	1.43	0.5	0.36	0.22	0.02	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-	5.06
SE	146.25	0.12	0.35	0.79	1.19	0.88	0.53	0.45	0.24	0.1	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-	4.65
SSE	168.75	0.15	0.66	1.32	1.18	0.72	0.52	0.25	0.04	0.01	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-	4.85
S	191.25	0.3	0.95	1.77	2.53	2.84	2.53	1.44	0.51	0.12	0.03	0	0	0	0	-	-	-	-	-	-	-	-	-	-	13.02
SSW	213.75	0.14	0.49	0.93	2.09	3.03	3.42	1.89	0.91	0.24	0.04	0	0	0	0	-	-	-	-	-	-	-	-	-	-	13.18
SW	236.25	0.18	0.47	0.82	1.04	1.57	1.84	1.16	0.83	0.52	0.22	0.06	0.01	0	0	-	-	-	-	-	-	-	-	-	-	8.72
WSW	258.75	0.14	0.48	0.71	0.77	0.67	0.63	0.56	0.4	0.2	0.1	0.03	0	0.01	0.01	-	-	-	-	-	-	-	-	-	-	4.71
W	281.25	0.19	1.07	2.07	1.12	0.94	0.58	0.56	0.3	0.16	0.06	0.03	0	0	0	-	-	-	-	-	-	-	-	-	-	7.08
WNW	303.75	0.15	0.51	0.97	0.68	0.74	0.65	0.54	0.52	0.41	0.1	0.04	0.01	0	0	-	-	-	-	-	-	-	-	-	-	5.32
NW	326.25	0.06	0.35	0.68	0.46	0.45	0.39	0.23	0.18	0.17	0.07	0.02	0.01	0	0	-	-	-	-	-	-	-	-	-	-	3.07
NNW	348.75	0.13	0.38	0.6	0.33	0.36	0.33	0.31	0.2	0.08	0.06	0.03	0.02	0	0	-	-	-	-	-	-	-	-	-	-	2.83
Bin Totals (%)		2.46	10.24	19.16	18.61	17.59	14.16	9.05	5.04	2.38	0.95	0.30	0.08	0.02	0.01	-	-	-	-	-	-	-	-	-	-	-
Exceedence (%)		100	97.59	87.35	68.19	49.58	31.99	17.83	8.78	3.74	1.36	0.41	0.11	0.03	0.01	-	-	-	-	-	-	-	-	-	-	-
Number of records in time series:		18129																								
Summary of Statistics																										
Maximum wind speed		=	13.33 m/s																							
Mean wind speed		=	4.04 m/s																							

Table B 28 Rhyll – Mar (2000-2012)

Wind Speed and Direction - Percentage occurrence																									
Wind data at Rhyll March 2000-2012																									
Direction (*)	Wind Speed (m/s)																							Total (%)	
	0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+	22.00+		
N	11.25	0.05	0.6	1.27	1.35	0.72	0.45	0.37	0.35	0.3	0.26	0.15	0.16	0.1	0.07	0.02	0.03	0	-	-	-	-	-	-	6.25
NNE	33.75	0.04	0.22	0.74	0.83	0.61	0.49	0.24	0.13	0.08	0.03	0.01	0	0	0	0	0	0	-	-	-	-	-	-	3.42
NE	56.25	0.06	0.25	0.62	0.74	0.74	0.68	0.43	0.34	0.26	0.12	0.02	0.01	0.02	0	0	0	0	-	-	-	-	-	-	4.29
ENE	78.75	0.04	0.22	0.66	0.74	0.64	0.58	0.31	0.17	0.11	0.12	0.01	0.07	0.05	0.01	0	0	0	-	-	-	-	-	-	3.75
E	101.25	0.07	0.35	1.02	1.01	0.93	0.92	0.76	0.89	0.52	0.37	0.25	0.15	0.11	0.09	0.02	0	0	-	-	-	-	-	-	7.46
ESE	123.75	0.08	0.3	0.69	0.56	0.74	1	0.99	0.71	0.74	0.44	0.28	0.28	0.2	0.12	0.04	0.01	0.01	-	-	-	-	-	-	7.19
SE	146.25	0.08	0.42	1.19	1.29	1.14	0.63	0.38	0.23	0.12	0.05	0.01	0	0	0	0	0	0	-	-	-	-	-	-	5.54
SSE	168.75	0.06	0.31	0.85	1.42	1.49	1.21	0.9	0.41	0.15	0.09	0.01	0	0	0	0	0	0	-	-	-	-	-	-	6.90
S	191.25	0.11	0.53	1.69	3.22	4.05	2.46	1.23	0.54	0.12	0.02	0	0	0	0	0	0	0	-	-	-	-	-	-	13.97
SSW	213.75	0.07	0.41	1.07	1.86	2.37	1.57	0.92	0.38	0.11	0.01	0	0	0	0	0	0	0	-	-	-	-	-	-	8.77
SW	236.25	0.09	0.66	1.49	2.09	2.18	1.86	1.08	0.69	0.34	0.11	0.02	0	0	0	0	0	0	-	-	-	-	-	-	10.61
WSW	258.75	0.07	0.61	1.38	1.32	1.16	0.95	0.55	0.32	0.09	0.04	0.01	0	0	0	0	0	0	-	-	-	-	-	-	6.50
W	281.25	0.1	0.83	1.86	1.48	1	0.79	0.38	0.1	0.04	0	0	0	0	0	0	0	0	-	-	-	-	-	-	6.58
WNW	303.75	0.1	0.28	0.66	0.57	0.47	0.44	0.14	0.01	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	2.67
NW	326.25	0.06	0.29	0.5	0.46	0.27	0.22	0.12	0.03	0.01	0	0.01	0	0	0	0	0	0	-	-	-	-	-	-	1.97
NNW	348.75	0.07	0.21	0.67	0.8	0.57	0.45	0.35	0.34	0.28	0.16	0.09	0.14	0.01	0.02	0.01	0	0	-	-	-	-	-	-	4.17
Bin Totals (%)		1.18	6.49	16.35	19.74	19.08	14.61	9.14	5.64	3.26	1.81	0.96	0.82	0.49	0.32	0.08	0.04	0.01	-	-	-	-	-	-	
Exceedence (%)		100	98.84	92.35	76.00	56.26	37.18	22.57	13.43	7.79	4.53	2.72	1.76	0.94	0.45	0.13	0.05	0.01	-	-	-	-	-	-	100
Number of records in time series:		18975																							
Summary of Statistics																									
Maximum wind speed	=	16.39 m/s																							
Mean wind speed	=	4.54 m/s																							

Table B 29 Stony Pt – Mar (2000-2012)

Wind Speed and Direction - Percentage occurrence																										
Wind data at Stony Pt March 2000-2012																										
Direction (°)		Wind Speed (m/s)																						Total (%)		
		0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+		22.00+	
N	11.25	0.46	0.66	1.39	1.08	0.79	0.44	0.3	0.12	0.08	0.09	0.13	0.03	0.01	0.01	0	0	0	-	-	-	-	-	-	-	5.59
NNE	33.75	0.23	0.59	0.88	1.16	1.21	0.88	0.34	0.2	0.12	0.08	0.04	0.01	0.01	0.01	0	0	0	-	-	-	-	-	-	-	5.76
NE	56.25	0.21	0.49	0.98	1.02	0.75	0.34	0.27	0.09	0.13	0.09	0.1	0.04	0.09	0.04	0	0	0	-	-	-	-	-	-	-	4.64
ENE	78.75	0.14	0.3	0.33	0.38	0.39	0.34	0.2	0.1	0.05	0.08	0.03	0.01	0.01	0	0	0	0	-	-	-	-	-	-	-	2.36
E	101.25	0.2	0.34	0.53	0.3	0.21	0.26	0.18	0.1	0.1	0.07	0.04	0	0	0	0	0	0	-	-	-	-	-	-	-	2.33
ESE	123.75	0.16	0.48	0.73	0.74	0.87	0.78	0.86	0.68	0.33	0.21	0.21	0.17	0.12	0.07	0	0	0	-	-	-	-	-	-	-	6.41
SE	146.25	0.18	0.35	0.61	0.95	1.05	1.33	0.81	0.64	0.48	0.44	0.23	0.13	0.03	0.03	0.01	0	0	-	-	-	-	-	-	-	7.27
SSE	168.75	0.08	0.31	0.53	0.91	1.39	1.57	0.99	0.92	0.4	0.3	0.22	0.05	0.03	0.01	0	0	0	-	-	-	-	-	-	-	7.71
S	191.25	0.09	0.38	0.79	1.65	1.97	2.07	1.24	0.88	0.47	0.29	0.13	0.12	0.05	0.08	0	0	0	-	-	-	-	-	-	-	10.21
SSW	213.75	0.13	0.88	1.26	1.77	2.55	2.38	1.82	1.02	0.33	0.17	0.07	0	0.01	0	0	0	0	-	-	-	-	-	-	-	12.39
SW	236.25	0.26	0.9	1.26	1.24	1.8	1.6	1.28	0.96	0.49	0.1	0.05	0.01	0.03	0	0	0	0	-	-	-	-	-	-	-	9.98
WSW	258.75	0.25	0.72	0.9	0.88	0.87	0.68	0.44	0.31	0.2	0.08	0.01	0	0	0	0	0	0	-	-	-	-	-	-	-	5.34
W	281.25	0.33	1.74	1.21	0.74	0.74	0.81	0.64	0.33	0.34	0.09	0.03	0.04	0.01	0	0	0	0	-	-	-	-	-	-	-	7.05
WNW	303.75	0.43	0.75	0.61	0.52	0.65	0.51	0.46	0.43	0.38	0.16	0.08	0.01	0	0	0	0	0	-	-	-	-	-	-	-	4.99
NW	326.25	0.23	0.65	0.62	0.46	0.39	0.25	0.25	0.21	0.2	0.09	0.03	0.03	0	0	0	0	0	-	-	-	-	-	-	-	3.41
NNW	348.75	0.31	0.79	0.96	0.66	0.35	0.4	0.29	0.25	0.21	0.07	0.08	0.08	0.03	0	0.01	0.01	0	-	-	-	-	-	-	-	4.58
Bin Totals (%)		3.68	10.35	13.61	14.46	15.99	14.64	10.35	7.24	4.29	2.39	1.47	0.73	0.48	0.27	0.01	0.01	0.01	-	-	-	-	-	-	-	100
Exceedence (%)		100	96.30	85.95	72.34	57.88	41.89	27.25	16.90	9.66	5.37	2.98	1.51	0.78	0.30	0.03	0.02	0.01	-	-	-	-	-	-	-	
Number of records in time series:				7684																						
Summary of Statistics																										
Maximum wind speed		=	16.4 m/s																							
Mean wind speed		=	4.65 m/s																							

Table B 30 Cerberus – Apr (2000-2012)

[illegible]

Table B 31 Rhyll – Apr (2000-2012)

Wind Speed and Direction - Percentage occurrence																										
Wind data at Rhyll April 2000-2012																										
Direction (°)		Wind Speed (m/s)																						Total (%)		
		0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+		22.00+	
N	11.25	0.16	1.05	2	1.86	1.13	0.82	0.74	0.64	0.31	0.3	0.24	0.17	0.1	0.09	0.03	0.01	0	0	0	0	0.01	0.01	0.01	-	9.68
NNE	33.75	0.08	0.47	1.12	0.98	0.89	0.4	0.28	0.13	0.05	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	-	4.41
NE	56.25	0.07	0.39	0.85	1.16	0.81	0.64	0.49	0.32	0.14	0.05	0.03	0	0	0	0	0	0	0	0	0	0	0	0	-	4.95
ENE	78.75	0.11	0.3	0.98	0.97	0.97	0.6	0.34	0.25	0.15	0.16	0.02	0	0	0	0	0	0	0	0	0	0	0	0	-	4.85
E	101.25	0.17	0.57	1.13	1.2	1.23	1.09	0.86	0.74	0.53	0.36	0.14	0.06	0.02	0.01	0	0	0	0	0	0	0	0	0	-	8.11
ESE	123.75	0.11	0.32	0.73	0.77	0.77	0.96	1.13	0.93	0.56	0.43	0.15	0.08	0.05	0.05	0	0	0	0	0	0	0	0	0	-	7.04
SE	146.25	0.1	0.65	1.22	0.78	0.6	0.3	0.24	0.24	0.09	0.06	0.06	0.03	0.01	0.01	0	0.01	0	0	0	0	0	0	0	-	4.40
SSE	168.75	0.14	0.45	0.95	1.01	0.68	0.57	0.38	0.23	0.1	0.07	0.03	0.01	0.02	0	0	0	0	0	0	0	0	0	0	-	4.64
S	191.25	0.12	0.64	1.4	2.64	1.83	0.98	0.39	0.29	0.22	0.1	0.1	0.04	0.01	0	0	0	0	0	0	0	0	0	0	-	8.76
SSW	213.75	0.07	0.31	0.94	1.38	1.3	0.75	0.35	0.15	0.15	0.1	0.03	0	0	0	0	0	0	0	0	0	0	0	0	-	5.53
SW	236.25	0.05	0.43	1.32	1.88	1.64	1.27	0.97	0.51	0.23	0.08	0.01	0.01	0	0	0	0	0	0	0	0	0	0	0	-	8.40
WSW	258.75	0.04	0.57	1.43	1.18	0.81	0.65	0.37	0.21	0.06	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	-	5.33
W	281.25	0.1	0.92	2.49	1.88	1.23	0.85	0.36	0.13	0.02	0.01	0.01	0	0	0	0	0	0	0	0	0	0	0	0	-	8.00
WNW	303.75	0.09	0.73	1.3	1.17	0.73	0.39	0.12	0.02	0.01	0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	-	4.58
NW	326.25	0.08	0.52	1.18	1.18	0.62	0.41	0.21	0.11	0.06	0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	-	4.39
NNW	348.75	0.03	0.5	1.19	1.18	0.95	0.66	0.51	0.48	0.44	0.42	0.27	0.15	0.12	0.07	0.01	0.01	0	0	0.01	0	0	0	0	-	7.00
Bin Totals (%)		1.51	8.8	20.24	21.22	16.19	11.33	7.75	5.38	3.12	2.19	1.09	0.55	0.32	0.22	0.05	0.03	0	0	0.01	0.01	0.01	0.01	0.01	-	
Exceedence (%)		100	98.52	89.72	69.48	48.26	32.07	20.74	12.99	7.61	4.49	2.30	1.21	0.66	0.34	0.12	0.07	0.04	0.04	0.04	0.03	0.02	0.01	-		100
Number of records in time series:					17598																					
Summary of Statistics																										
Maximum wind speed		=	21.67 m/s																							
Mean wind speed		=	4.26 m/s																							

Table B 32 Stony Pt – Apr (2000-2012)

Wind Speed and Direction - Percentage occurrence																										
Wind data at Stony Pt April 2000-2012																										
Direction (°)		Wind Speed (m/s)																						Total (%)		
		0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+		22.00+	
N	11.25	0.84	0.86	1.48	1.69	1.44	1.05	0.53	0.38	0.29	0.07	0.13	0.01	0.03	0.06	0.03	0	0	-	-	-	-	-	-	-	8.89
NNE	33.75	0.61	0.88	1.45	1.63	1.38	0.7	0.35	0.24	0.04	0.08	0.01	0.01	0.01	0	0	0	0	-	-	-	-	-	-	-	7.39
NE	56.25	0.4	0.81	1.17	1.1	0.61	0.35	0.25	0.11	0.07	0.07	0.04	0.08	0.07	0.01	0.04	0.01	0	-	-	-	-	-	-	-	5.19
ENE	78.75	0.21	0.45	0.63	0.4	0.4	0.31	0.25	0.08	0.11	0.13	0.03	0	0.07	0.04	0	0	0	0	-	-	-	-	-	-	3.11
E	101.25	0.2	0.38	0.59	0.57	0.36	0.28	0.14	0.14	0.06	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	2.72
ESE	123.75	0.2	0.71	0.93	1.06	0.85	0.89	0.46	0.42	0.2	0.13	0.03	0	0	0	0	0	0	0	-	-	-	-	-	-	5.88
SE	146.25	0.2	0.57	0.46	0.89	0.85	0.6	0.46	0.2	0.18	0.14	0.07	0	0	0	0	0	0	0	-	-	-	-	-	-	4.62
SSE	168.75	0.24	0.59	0.73	1.02	0.91	0.73	0.39	0.15	0.03	0.03	0	0	0	0	0	0	0	0	-	-	-	-	-	-	4.82
S	191.25	0.38	0.5	1	1.24	1.12	0.92	0.33	0.22	0.18	0.24	0.11	0.04	0.01	0	0	0	0	0	-	-	-	-	-	-	6.29
SSW	213.75	0.49	1.09	1.46	1.77	1.69	0.99	0.61	0.4	0.25	0.15	0.04	0.04	0.04	0	0	0	0	0	-	-	-	-	-	-	9.02
SW	236.25	0.49	0.68	0.77	1.31	1.31	1.05	0.67	0.42	0.15	0.1	0.01	0.01	0	0	0	0	0	0	-	-	-	-	-	-	6.97
WSW	258.75	0.35	0.64	0.78	0.53	0.53	0.66	0.42	0.06	0.04	0.06	0.03	0.04	0.04	0	0	0	0	0	-	-	-	-	-	-	4.18
W	281.25	0.54	1.23	1.16	0.71	0.6	0.61	0.31	0.38	0.32	0.26	0.06	0	0.01	0	0	0	0	0	-	-	-	-	-	-	6.19
WNW	303.75	0.53	1.07	1.05	0.95	0.92	1.02	0.95	0.56	0.28	0.1	0	0	0.06	0.03	0.01	0	0	0	-	-	-	-	-	-	7.53
NW	326.25	0.66	0.88	1.1	1.05	0.91	0.57	0.4	0.25	0.24	0.11	0.07	0.11	0.06	0.03	0	0	0.01	-	-	-	-	-	-	-	6.45
NNW	348.75	0.85	1.99	1.72	1.2	1.02	0.74	0.92	0.75	0.52	0.52	0.17	0.22	0.1	0.01	0.04	0.01	0.01	-	-	-	-	-	-	-	10.79
Bin Totals (%)		7.17	13.33	16.47	17.12	14.89	11.45	7.45	2.96	2.18	0.79	0.59	0.5	0.18	0.13	0.03	0.03			-	-	-	-	-	-	
Exceedence (%)		100	92.85	79.52	63.05	45.93	31.04	19.59	12.14	7.99	4.43	2.25	1.46	0.87	0.37	0.19	0.06	0.03			-	-	-	-	-	100
Number of records in time series:		7172																								
Summary of Statistics																										
Maximum wind speed		= 16.8 m/s																								
Mean wind speed		= 4.05 m/s																								

Table B 33 Cerberus – May (2000-2012)

Wind Speed and Direction - Percentage occurrence																										
Wind data at Cerberus May 2000-2012																										
Direction (°)		Wind Speed (m/s)																						Total (%)		
		0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+		22.00+	
N	11.25	0.67	3.4	3.76	2.76	2.47	2.16	1.31	0.55	0.17	0.09	0.06	0.04	0			-	-	-	-	-	-	-	-	-	17.44
NNE	33.75	0.45	2.08	2.39	1.02	0.21	0.09	0.04	0.01	0.01	0	0	0	0			-	-	-	-	-	-	-	-	-	6.30
NE	56.25	0.23	1.06	2.12	0.99	0.16	0.02	0	0	0	0	0	0	0			-	-	-	-	-	-	-	-	-	4.58
ENE	78.75	0.11	0.4	0.62	0.39	0.09	0.01	0	0	0	0	0	0	0			-	-	-	-	-	-	-	-	-	1.62
E	101.25	0.16	0.57	0.8	0.37	0.13	0.05	0.02	0.01	0	0	0	0	0			-	-	-	-	-	-	-	-	-	2.11
ESE	123.75	0.16	0.36	0.81	0.98	0.47	0.14	0.02	0	0	0	0	0	0			-	-	-	-	-	-	-	-	-	2.94
SE	146.25	0.26	0.55	0.78	0.88	0.61	0.24	0.15	0.06	0.01	0	0	0	0			-	-	-	-	-	-	-	-	-	3.54
SSE	168.75	0.19	0.67	0.67	0.34	0.21	0.05	0.01	0.01	0	0	0	0	0			-	-	-	-	-	-	-	-	-	2.15
S	191.25	0.18	0.58	1.05	1.17	0.75	0.37	0.17	0.09	0.01	0.03	0.02	0.01	0			-	-	-	-	-	-	-	-	-	4.43
SSW	213.75	0.15	0.58	0.86	1.23	1.15	0.9	0.48	0.22	0.13	0.04	0.02	0	0			-	-	-	-	-	-	-	-	-	5.76
SW	236.25	0.07	0.38	0.58	0.86	0.75	0.65	0.59	0.31	0.18	0.03	0.01	0	0.01			-	-	-	-	-	-	-	-	-	4.42
WSW	258.75	0.24	0.75	0.7	0.69	0.67	0.58	0.4	0.24	0.09	0.08	0.04	0.02	0			-	-	-	-	-	-	-	-	-	4.50
W	281.25	0.3	1.35	2.3	1.71	1.35	0.82	0.5	0.17	0.07	0.04	0.01	0.01	0			-	-	-	-	-	-	-	-	-	8.63
WNW	303.75	0.22	1.01	2.31	2.45	1.96	1.79	1.36	1	0.6	0.28	0.09	0.02	0.01			-	-	-	-	-	-	-	-	-	13.10
NW	326.25	0.17	1.02	1.58	1.85	1.69	1.23	1.21	0.92	0.38	0.12	0.01	0.01	0			-	-	-	-	-	-	-	-	-	10.19
NNW	348.75	0.24	1.09	1.61	1.25	0.95	1.1	1.01	0.66	0.24	0.17	0.05	0.01	0			-	-	-	-	-	-	-	-	-	8.38
Bin Totals (%)		3.82	15.83	22.94	18.93	13.6	10.17	7.27	4.25	1.89	0.88	0.3	0.11	0.01			-	-	-	-	-	-	-	-	-	
Exceedence (%)		100.00	96.18	80.35	57.41	38.48	24.88	14.71	7.44	3.19	1.30	0.42	0.12	0.01			-	-	-	-	-	-	-	-	-	100
Number of records in time series:				15167																						
Summary of Statistics																										
Maximum wind speed		=	12.22 m/s																							
Mean wind speed		=	3.61 m/s																							

Table B 34 Rhyll – May (2000-2012)

Wind Speed and Direction - Percentage occurrence																									
Wind data at Rhyll May 2000-2012																									
Direction (°)	Wind Speed (m/s)																							Total (%)	
	0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+	22.00+		
N	11.25	0.28	1.09	2.37	2	1.82	1.21	1.04	0.91	0.81	0.7	0.43	0.3	0.2	0.15	0.04	0.07	0.01	0.01	0.01	-	-	-	-	13.45
NNE	33.75	0.13	0.67	1.34	1.07	0.65	0.31	0.18	0.11	0.04	0.04	0.01	0.01	0	0	0	0	0	0	0	-	-	-	-	4.56
NE	56.25	0.14	0.51	1.08	1.02	0.85	0.59	0.26	0.15	0.08	0.02	0	0	0	0	0	0	0	0	0	-	-	-	-	4.70
ENE	78.75	0.08	0.43	1.07	0.98	0.54	0.23	0.14	0.09	0.01	0	0	0	0	0	0	0	0	0	0	-	-	-	-	3.57
E	101.25	0.14	0.51	0.9	0.89	0.63	0.66	0.37	0.33	0.12	0.07	0.01	0.01	0	0	0	0	0	0	0	-	-	-	-	4.64
ESE	123.75	0.07	0.3	0.47	0.48	0.77	0.84	0.71	0.59	0.34	0.12	0.03	0.03	0.01	0	0	0.01	0	0	0	-	-	-	-	4.77
SE	146.25	0.1	0.3	0.72	0.73	0.54	0.18	0.14	0.06	0.05	0.11	0.03	0.01	0	0	0	0	0	0	0	-	-	-	-	2.97
SSE	168.75	0.06	0.4	0.66	0.65	0.45	0.09	0.05	0.02	0.02	0	0	0.01	0.01	0.01	0.01	0	0	0	0	-	-	-	-	2.44
S	191.25	0.11	0.5	1.13	1.17	0.83	0.39	0.15	0.05	0.06	0.02	0.05	0.03	0.01	0	0	0	0	0	0	-	-	-	-	4.50
SSW	213.75	0.06	0.37	0.94	1.16	0.87	0.65	0.34	0.2	0.09	0.08	0.01	0	0	0	0	0	0	0	0	-	-	-	-	4.77
SW	236.25	0.05	0.38	1.41	1.55	1.49	1.13	0.74	0.35	0.14	0.04	0.01	0.01	0	0	0	0	0	0	0	-	-	-	-	7.30
WSW	258.75	0.08	0.45	1.81	1.57	1.17	0.68	0.36	0.12	0.1	0.02	0.01	0	0	0	0	0	0	0	0	-	-	-	-	6.37
W	281.25	0.09	0.96	3.31	3.02	1.67	0.78	0.22	0.03	0.01	0	0	0	0	0	0	0	0	0	0	-	-	-	-	10.09
WNW	303.75	0.07	1.05	2.14	1.72	1.32	0.66	0.27	0.04	0.01	0	0	0	0	0	0	0	0	0	0	-	-	-	-	7.28
NW	326.25	0.17	0.85	2.02	1.39	1.15	0.88	0.54	0.22	0.05	0.01	0.01	0.01	0.01	0	0	0	0	0	0	-	-	-	-	7.30
NNW	348.75	0.1	0.48	1.58	1.19	1.01	0.86	0.98	1.06	1.19	0.93	0.89	0.55	0.3	0.12	0.05	0.07	0.01	0	0.01	-	-	-	-	11.38
Bin Totals (%)	1.74	9.25	22.95	20.59	15.75	10.12	6.48	4.32	3.11	2.16	1.5	0.96	0.52	0.28	0.1	0.14	0.01	0.01	0.01	-	-	-	-	-	100
Exceedence (%)	100.00	98.26	89.01	66.06	45.47	29.72	19.60	13.12	8.80	5.69	3.53	2.03	1.07	0.55	0.27	0.17	0.03	0.02	0.01	-	-	-	-	-	
Number of records in time series:				18420																					
Summary of Statistics																									
Maximum wind speed		=	18.61 m/s																						
Mean wind speed		=	4.21 m/s																						

Table B 35 Stony Pt – May (2000-2012)

Wind Speed and Direction - Percentage occurrence																										
Wind data at Stony Pt May 2000-2012																										
Direction (°)		Wind Speed (m/s)																						Total (%)		
		0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+		22.00+	
N	11.25	1.43	0.96	1.62	1.27	1.42	0.84	0.68	0.38	0.25	0.17	0.16	0.07	0.01	0	0	0	-	-	-	-	-	-	-	-	9.26
NNE	33.75	1.25	0.91	1.64	1.95	0.93	0.58	0.56	0.35	0.33	0.14	0.1	0.1	0.04	0.03	0	0	-	-	-	-	-	-	-	-	8.91
NE	56.25	0.46	0.48	0.7	0.52	0.35	0.14	0.13	0.06	0.07	0.04	0.04	0.01	0.06	0	0.03	0.03	-	-	-	-	-	-	-	-	3.12
ENE	78.75	0.29	0.3	0.2	0.2	0.32	0.2	0.07	0	0.01	0	0	0.01	0	0	0	0	0	-	-	-	-	-	-	-	1.60
E	101.25	0.29	0.26	0.13	0.14	0.09	0.12	0.03	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	1.06
ESE	123.75	0.19	0.28	0.43	0.49	0.33	0.32	0.17	0.03	0.03	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	2.27
SE	146.25	0.17	0.35	0.56	0.59	0.51	0.42	0.19	0.16	0.12	0.03	0	0	0	0	0	0	0	-	-	-	-	-	-	-	3.10
SSE	168.75	0.13	0.32	0.35	0.33	0.33	0.17	0.1	0.1	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	1.83
S	191.25	0.19	0.45	0.26	0.45	0.29	0.22	0.19	0.16	0.04	0.03	0.09	0.04	0.03	0	0	0	0	-	-	-	-	-	-	-	2.44
SSW	213.75	0.32	0.64	0.97	1.14	0.67	0.78	0.48	0.2	0.16	0.03	0.01	0.01	0	0.03	0	0	0	-	-	-	-	-	-	-	5.44
SW	236.25	0.45	0.7	0.8	0.75	0.83	0.71	0.33	0.19	0.09	0.01	0.04	0.01	0.01	0.01	0.01	0	0	-	-	-	-	-	-	-	4.94
WSW	258.75	0.42	0.68	0.71	0.93	0.96	0.39	0.39	0.29	0.1	0.14	0.12	0.14	0.03	0.06	0.01	0	0	-	-	-	-	-	-	-	5.37
W	281.25	0.61	1.85	2.06	1.29	0.77	0.43	0.41	0.33	0.29	0.17	0.04	0.01	0.01	0.01	0	0	0	-	-	-	-	-	-	-	8.28
WNW	303.75	1.14	1.98	2.43	2.16	1.56	1.77	1.46	1.09	0.7	0.17	0.07	0	0	0	0	0	0	-	-	-	-	-	-	-	14.53
NW	326.25	0.88	1.35	1.58	1.87	1.32	1.46	1.13	1.01	0.51	0.28	0.03	0	0	0	0	0	0	-	-	-	-	-	-	-	11.42
NNW	348.75	1.23	2.52	2.2	1.46	1.43	1.65	1.82	1.81	1.01	0.56	0.46	0.09	0.04	0.03	0.01	0	0	-	-	-	-	-	-	-	16.32
Bin Totals (%)		9.46	14.02	16.64	15.57	12.09	10.21	8.15	6.15	3.71	1.8	1.17	0.52	0.25	0.17	0.07	0.03									
Exceedence (%)		100.01	90.55	76.53	59.89	44.32	32.23	22.02	13.87	7.72	4.01	2.21	1.04	0.52	0.27	0.10	0.03									100
Number of records in time series:		6906																								
Summary of Statistics																										
Maximum wind speed		=	15.5 m/s																							
Mean wind speed		=	3.99 m/s																							

Table B 36 Cerberus – June (2000-2012)

Wind Speed and Direction - Percentage occurrence																									
Wind data at Cerberus June 2000-2012																									
Direction (°)		Wind Speed (m/s)																						Total (%)	
		0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+		22.00+
N	11.25	0.57	2.99	5.23	3.82	3.76	2.92	2.07	1.47	0.61	0.44	0.2	0.13	0.04	0.02	0	0.01	-	-	-	-	-	-	-	24.28
NNE	33.75	0.31	2.22	3.19	1.25	0.3	0.06	0.01	0.01	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	7.35
NE	56.25	0.2	1.58	2.4	0.98	0.1	0.04	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	5.30
ENE	78.75	0.18	0.63	0.87	0.27	0.07	0.05	0.01	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	2.08
E	101.25	0.08	0.49	0.43	0.17	0.04	0.01	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	1.22
ESE	123.75	0.2	0.61	0.67	0.62	0.32	0.15	0.04	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	2.61
SE	146.25	0.12	0.39	0.82	0.77	0.48	0.36	0.28	0.1	0.03	0.01	0	0	0	0	0	0	-	-	-	-	-	-	-	3.36
SSE	168.75	0.1	0.42	0.3	0.25	0.19	0.12	0.09	0.16	0.04	0.02	0	0	0	0	0	0	-	-	-	-	-	-	-	1.69
S	191.25	0.23	0.65	0.7	0.84	0.7	0.63	0.41	0.35	0.27	0.2	0.12	0.03	0	0	0	0	-	-	-	-	-	-	-	5.13
SSW	213.75	0.21	0.37	0.49	0.77	0.85	0.67	0.44	0.33	0.19	0.1	0.03	0	0	0	0	0	-	-	-	-	-	-	-	4.45
SW	236.25	0.06	0.25	0.3	0.41	0.56	0.44	0.26	0.24	0.21	0.09	0.02	0.01	0	0	0	0.01	-	-	-	-	-	-	-	2.86
WSW	258.75	0.08	0.33	0.43	0.51	0.37	0.3	0.25	0.18	0.06	0.03	0.01	0	0	0	0	0	-	-	-	-	-	-	-	2.55
W	281.25	0.11	0.68	1.5	1.09	0.85	0.59	0.31	0.17	0.08	0.02	0.01	0.01	0	0	0	0	-	-	-	-	-	-	-	5.42
WNW	303.75	0.13	0.59	1.3	1.15	1.38	1.77	1.69	1.02	0.58	0.2	0.07	0.03	0.01	0	0	0	-	-	-	-	-	-	-	9.92
NW	326.25	0.24	0.77	1.36	1.57	1.78	1.95	1.85	0.87	0.56	0.32	0.08	0.06	0	0	0	0	-	-	-	-	-	-	-	11.41
NNW	348.75	0.22	0.98	1.91	1.59	1.4	1.26	1.14	0.88	0.49	0.3	0.09	0.07	0.07	0.01	0.01	0	-	-	-	-	-	-	-	10.42
Bin Totals (%)		3.04	13.96	21.91	16.08	13.16	11.32	8.82	5.77	3.1	1.73	0.62	0.37	0.12	0.03	0.01	0.01	-	-	-	-	-	-	-	100
Exceedence (%)		100	96.96	83.00	61.09	45.01	31.85	20.53	11.71	5.94	2.84	1.11	0.49	0.17	0.05	0.02	0.01	-	-	-	-	-	-	-	
Number of records in time series:		15765																							
Summary of Statistics																									
Maximum wind speed		=	15.00 m/s																						
Mean wind speed		=	3.98 m/s																						

Table B 37 Rhyll – June (2000-2012)

Wind Speed and Direction - Percentage occurrence																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
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Table B 38 Stony Pt – June (2000-2012)

Wind Speed and Direction - Percentage occurrence																									
Wind data at Stony Pt June 2000-2012																									
Direction (°)	Wind Speed (m/s)																							Total (%)	
	0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+	22.00+		
N	11.25	1.51	1.39	1.58	1.29	0.94	0.96	0.69	0.42	0.28	0.03	0.04	0	0	0	0	0	-	-	-	-	-	-	-	9.35
NNE	33.75	1.59	1.18	1.73	1.48	0.77	0.61	0.45	0.29	0.13	0.16	0.12	0.04	0.01	0.03	0	0	0	-	-	-	-	-	-	8.59
NE	56.25	0.54	0.64	1.08	1.01	0.51	0.26	0.26	0.18	0.28	0.15	0.12	0.04	0.01	0	0	0	0	-	-	-	-	-	-	5.08
ENE	78.75	0.34	0.26	0.31	0.38	0.29	0.19	0.13	0	0.01	0	0	0	0	0	0	0	0	-	-	-	-	-	-	1.91
E	101.25	0.2	0.16	0.18	0.19	0.16	0.1	0.01	0.01	0.01	0	0	0	0	0	0	0	0	-	-	-	-	-	-	1.02
ESE	123.75	0.56	0.45	0.45	0.45	0.2	0.26	0.15	0.07	0.12	0.18	0.03	0	0	0	0	0	0	-	-	-	-	-	-	2.92
SE	146.25	0.31	0.45	0.41	0.66	0.75	0.64	0.45	0.19	0.1	0.01	0.07	0.09	0.09	0.16	0.06	0.03	0.01	-	-	-	-	-	-	4.48
SSE	168.75	0.25	0.18	0.25	0.32	0.18	0.12	0.09	0.1	0.12	0.03	0.06	0.1	0.15	0.04	0.01	0	0.01	-	-	-	-	-	-	2.01
S	191.25	0.16	0.35	0.25	0.31	0.45	0.41	0.39	0.47	0.23	0.2	0.22	0.13	0.09	0.07	0.03	0	0	-	-	-	-	-	-	3.76
SSW	213.75	0.41	0.57	0.47	0.56	0.86	0.53	0.44	0.2	0.07	0.13	0.06	0.01	0	0	0	0	0	-	-	-	-	-	-	4.31
SW	236.25	0.38	0.47	0.5	0.86	0.6	0.19	0.22	0.15	0.13	0.01	0	0	0	0.01	0	0	0	-	-	-	-	-	-	3.52
WSW	258.75	0.41	0.56	0.86	0.56	0.64	0.35	0.26	0.06	0.04	0.09	0	0	0	0	0	0	0	-	-	-	-	-	-	3.83
W	281.25	0.94	0.85	1.17	1.05	0.91	0.63	0.64	0.29	0.26	0.13	0	0	0	0	0	0	0	-	-	-	-	-	-	6.87
WNW	303.75	1.17	1.45	1.58	1.49	2.18	1.93	1.83	1.1	0.61	0.15	0.03	0.01	0	0	0	0	0	-	-	-	-	-	-	13.53
NW	326.25	1.04	1.51	1.24	1.55	1.8	1.94	1.83	1.39	0.85	0.38	0.09	0.18	0.1	0.01	0	0.01	0	-	-	-	-	-	-	13.92
NNW	348.75	1.24	1.13	1.21	1.37	1.27	1.52	1.61	1.83	1.37	0.75	0.64	0.41	0.25	0.07	0.15	0.01	0	-	-	-	-	-	-	14.83
Bin Totals (%)	11.04	11.59	13.26	13.52	12.51	10.66	9.46	6.75	4.63	2.59	1.46	1.07	0.7	0.41	0.25	0.06	0.03	0	-	-	-	-	-	-	100
Exceedence (%)	100	88.95	77.36	64.10	50.58	38.07	27.41	17.95	11.20	6.57	3.98	2.52	1.45	0.75	0.34	0.09	0.03	0	-	-	-	-	-	-	100
Number of records in time series:		6840																							
Summary of Statistics																									
Maximum wind speed	=	16.6 m/s																							
Mean wind speed	=	4.35 m/s																							

Table B 39 Cerberus – July (2000-2012)

Wind Speed and Direction - Percentage occurrence																										
Wind data at Cerberus July 2000-2012																										
Direction (°)		Wind Speed (m/s)																						Total (%)		
		0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+		22.00+	
N	11.25	0.54	2.79	4.86	4.3	3.73	3.73	2.82	1.57	0.66	0.26	0.22	0.14	0.03	0.01	-	-	-	-	-	-	-	-	-	-	25.66
NNE	33.75	0.3	2.3	2.62	1.1	0.3	0.08	0.01	0.01	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	6.72
NE	56.25	0.24	1.49	2.24	1.03	0.19	0.01	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	5.20
ENE	78.75	0.15	0.55	0.79	0.3	0.02	0.02	0.02	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	1.85
E	101.25	0.13	0.43	0.53	0.38	0.21	0.07	0.01	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	1.76
ESE	123.75	0.12	0.39	0.42	0.45	0.27	0.21	0.02	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	1.88
SE	146.25	0.12	0.37	0.59	0.54	0.51	0.34	0.11	0.06	0.01	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	2.65
SSE	168.75	0.06	0.26	0.42	0.14	0.18	0.1	0.08	0.02	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	1.26
S	191.25	0.22	0.41	0.49	0.56	0.59	0.57	0.41	0.07	0.05	0.05	0.03	0	0	0	0	-	-	-	-	-	-	-	-	-	3.45
SSW	213.75	0.18	0.41	0.42	0.59	0.76	0.82	0.51	0.25	0.05	0.04	0.01	0.01	0.01	0	0	-	-	-	-	-	-	-	-	-	4.06
SW	236.25	0.08	0.24	0.38	0.39	0.55	0.52	0.37	0.24	0.14	0.09	0.03	0.02	0	0	0	-	-	-	-	-	-	-	-	-	3.05
WSW	258.75	0.19	0.33	0.41	0.35	0.47	0.41	0.25	0.17	0.1	0.02	0.02	0	0	0	0	-	-	-	-	-	-	-	-	-	2.72
W	281.25	0.13	0.76	1.16	0.96	0.79	0.45	0.41	0.21	0.1	0.04	0.01	0.01	0	0.01	0	-	-	-	-	-	-	-	-	-	5.04
WNW	303.75	0.14	0.76	1.29	1.22	1.26	1.62	1.76	1.11	0.69	0.24	0.1	0.04	0	0	0	-	-	-	-	-	-	-	-	-	10.23
NW	326.25	0.29	1.13	1.28	1.78	2	2.12	2.1	1.1	0.61	0.24	0.05	0.02	0	0	0	-	-	-	-	-	-	-	-	-	12.72
NNW	348.75	0.27	1.15	1.75	1.86	1.77	1.58	1.34	1.02	0.52	0.28	0.14	0.11	0.03	0	0	-	-	-	-	-	-	-	-	-	11.82
Bin Totals (%)		3.15	13.76	19.64	15.95	13.59	12.66	10.2	5.83	2.93	1.26	0.62	0.34	0.07	0.02	0	-	-	-	-	-	-	-	-	-	100
Exceedence (%)		100	96.87	83.11	63.47	47.52	33.93	21.27	11.07	5.24	2.31	1.05	0.43	0.09	0.02	0	-	-	-	-	-	-	-	-	-	
Number of records in time series:		16530																								
Summary of Statistics																										
Maximum wind speed	=	13.89 m/s																								
Mean wind speed	=	4.04 m/s																								

Table B 40 Rhyll – July (2000-2012)[illegible]

Wind Speed and Direction - Percentage occurrence

Number of records in time series:	7461
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TABLE 1. The Composite Index

N	11.25	0.48	2.47	4.49	3.79	3.71	3.31	2.39	1.67	0.88	0.41	0.15	0.04	0.01	0	0	0	-	-	-	-	-	-
NNE	33.75	0.12	1.19	2.08	1.09	0.3	0.07	0.04	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
NE	56.25	0.15	0.93	1.67	0.99	0.4	0.03	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
ENE	78.75	0.13	0.38	0.85	0.37	0.09	0.04	0.04	0.01	0	0	0	0	0	0	0	0	-	-	-	-	-	-
E	101.25	0.07	0.27	0.49	0.26	0.11	0.05	0.01	0.01	0	0	0	0	0	0	0	0	-	-	-	-	-	-
ESE	123.75	0.21	0.39	0.48	0.27	0.13	0.07	0.02	0.01	0	0	0	0	0	0	0	0	-	-	-	-	-	-
SE	146.25	0.07	0.26	0.41	0.19	0.15	0.05	0.05	0.02	0.01	0	0	0	0	0	0	0	-	-	-	-	-	-
SSE	168.75	0.02	0.15	0.26	0.18	0.08	0.09	0.02	0.03	0	0	0	0	0	0	0	0	-	-	-	-	-	-
S	191.25	0.15	0.31	0.41	0.66	0.65	0.35	0.28	0.12	0.02	0.02	0.04	0	0.01	0	0	0	-	-	-	-	-	-
SSW	213.75	0.17	0.45	0.42	0.71	0.81	0.54	0.46	0.22	0.12	0.05	0.04	0.03	0.01	0	0	0	-	-	-	-	-	-
SW	236.25	0.11	0.3	0.47	0.54	0.6	0.61	0.53	0.37	0.22	0.13	0.04	0.01	0.01	0	0	0.01	-	-	-	-	-	-
WSW	258.75	0.04	0.33	0.61	0.51	0.43	0.44	0.35	0.23	0.12	0.06	0.04	0.01	0	0	0	0.01	-	-	-	-	-	-
W	281.25	0.28	1.06	1.74	1.27	1.08	0.91	0.63	0.43	0.19	0.07	0.02	0.02	0	0	0	0.01	-	-	-	-	-	-
WNW	303.75	0.12	0.65	1.31	1.68	2.05	2.02	1.88	1.48	0.89	0.38	0.19	0.11	0.02	0.01	0	0	-	-	-	-	-	-
NW	326.25	0.1	0.78	1.38	2	1.9	1.95	1.76	1.22	0.68	0.3	0.13	0.04	0.01	0.01	0	0.01	-	-	-	-	-	-
NNW	348.75	0.17	0.93	2.08	1.91	1.78	2.22	1.75	1.24	0.7	0.35	0.13	0.12	0.04	0	0	0	-	-	-	-	-	-
Bin Totals (%)		2.4	10.84	19.17	16.42	14.27	12.75	10.21	7.04	3.82	1.77	0.79	0.38	0.1	0.01	0	0.02	-	-	-	-	-	-
Exceedence (%)		100	97.59	86.75	67.58	51.16	36.89	24.14	13.93	6.89	3.07	1.30	0.51	0.13	0.03	0.02	0.02	-	-	-	-	-	-

Number of records in time series:	16428
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Summary of Statistics

Maximum wind speed	=	15.83 m/s
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Mean wind speed	=	4.28 m/s
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Table B 43 Rhyll – Aug (2000-2012)

Wind Speed and Direction - Percentage occurrence																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																</
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Table B 44 Stony Pt – Aug (2000-2012)

Wind Speed and Direction - Percentage occurrence																										
Wind data at Stony Pt August 2000-2012																										
Direction (°)		Wind Speed (m/s)																						Total (%)		
		0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+		22.00+	
N	11.25	1.56	0.71	1.2	1.34	1.25	1.19	0.88	0.86	0.62	0.39	0.21	0.1	0.07	0.04	0.01	0	-	-	-	-	-	-	-	-	10.43
NN	33.75	1.46	0.51	1.17	1.08	1.04	0.64	0.28	0.13	0.06	0.07	0.03	0	0	0	0	0	-	-	-	-	-	-	-	-	6.47
NE	56.25	0.62	0.59	0.55	0.65	0.45	0.19	0.09	0.03	0.06	0.07	0.01	0.03	0	0	0	0	-	-	-	-	-	-	-	-	3.34
ENE	78.75	0.28	0.18	0.27	0.22	0.28	0.12	0.04	0	0	0.01	0	0	0	0	0	0	-	-	-	-	-	-	-	-	1.40
E	101.25	0.21	0.25	0.22	0.15	0.22	0.03	0.04	0.01	0.01	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	1.14
ESE	123.75	0.16	0.18	0.22	0.22	0.13	0.1	0.15	0.03	0.06	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	1.25
SE	146.25	0.36	0.25	0.27	0.28	0.09	0.1	0.09	0.01	0	0	0	0.01	0	0	0	0	-	-	-	-	-	-	-	-	1.46
SSE	168.75	0.27	0.12	0.24	0.27	0.18	0.15	0.04	0.01	0.01	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	1.29
S	191.25	0.22	0.24	0.25	0.33	0.3	0.3	0.3	0.15	0.15	0.09	0.03	0.07	0.01	0	0	0	-	-	-	-	-	-	-	-	2.44
SSW	213.75	0.43	0.46	0.61	0.62	0.55	0.34	0.4	0.22	0.13	0.03	0	0	0	0	0	0	-	-	-	-	-	-	-	-	3.79
SW	236.25	0.48	0.52	0.62	0.86	0.92	0.49	0.36	0.27	0.13	0.07	0.03	0.03	0	0.01	0	0	-	-	-	-	-	-	-	-	4.79
WSW	258.75	0.37	0.55	0.65	0.77	0.8	0.65	0.22	0.12	0.12	0.03	0.03	0	0	0.01	0	0	-	-	-	-	-	-	-	-	4.32
W	281.25	0.82	1.34	1.66	1.1	1.29	0.76	0.77	0.43	0.3	0.16	0.01	0.01	0	0	0	0	-	-	-	-	-	-	-	-	8.65
WNW	303.75	1.22	2.05	2.11	2.18	2.33	2.54	2.04	1.49	0.86	0.34	0.18	0.1	0.06	0	0	0	-	-	-	-	-	-	-	-	17.50
NW	326.25	0.97	0.91	1.23	1.95	2.14	2.39	1.9	1.52	0.97	0.77	0.46	0.18	0.09	0.01	0	0	-	-	-	-	-	-	-	-	15.49
NNW	348.75	0.95	0.7	0.76	1.1	1.59	2.14	2.04	2.21	1.55	1.22	0.82	0.55	0.27	0.13	0.06	0.01	-	-	-	-	-	-	-	-	16.10
Bin Totals (%)		10.37	9.55	12.05	13.14	13.57	12.14	9.64	7.5	5.04	3.27	1.81	1.1	0.51	0.22	0.07	0.01	-	-	-	-	-	-	-	-	100
Exceedence (%)		100	89.62	80.07	68.02	54.88	41.31	29.17	19.53	12.03	6.99	3.72	1.91	0.81	0.30	0.08	0.01	-	-	-	-	-	-	-	-	
Number of records in time series:		6730																								
Summary of Statistics																										
Maximum wind speed	=	15.1 m/s																								
Mean wind speed	=	4.51 m/s																								

Table B 45 Cerberus – Sept (2000-2012)

Wind Speed and Direction - Percentage occurrence																										
Wind data at Cerberus September 2000-2012																										
Direction (°)		Wind Speed (m/s)																						Total (%)		
		0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+		22.00+	
N	11.25	0.29	1.54	3.34	2.86	2.22	1.94	1.63	1.27	0.51	0.31	0.11	0.04	0.01	0	0	0	0	-	-	-	-	-	-	-	16.07
NNE	33.75	0.19	0.99	1.79	1.2	0.55	0.18	0.06	0.01	0.01	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	4.98
NE	56.25	0.08	0.53	1.52	1.22	0.62	0.26	0.06	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	4.29
ENE	78.75	0.06	0.25	0.53	0.46	0.28	0.14	0.04	0.01	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	1.77
E	101.25	0.09	0.4	0.56	0.35	0.16	0.14	0.09	0.01	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	1.80
ESE	123.75	0.09	0.27	0.43	0.53	0.35	0.11	0.07	0.02	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	1.87
SE	146.25	0.11	0.38	0.51	0.35	0.31	0.14	0.1	0.08	0.01	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	1.99
SSE	168.75	0.09	0.36	0.45	0.29	0.11	0.06	0.01	0.01	0.02	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	1.40
S	191.25	0.14	0.5	0.82	0.82	0.5	0.29	0.11	0.02	0.01	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	3.21
SSW	213.75	0.28	0.56	0.75	1.1	1.16	0.87	0.49	0.29	0.12	0.05	0	0	0	0	0	0	0	-	-	-	-	-	-	-	5.67
SW	236.25	0.09	0.4	0.55	0.73	0.9	0.97	1	0.66	0.41	0.25	0.16	0.04	0	0	0	0	0	-	-	-	-	-	-	-	6.16
WSW	258.75	0.1	0.48	0.83	0.84	0.91	0.77	0.75	0.45	0.26	0.24	0.16	0.08	0.01	0	0.01	0	0	-	-	-	-	-	-	-	5.89
W	281.25	0.22	1.17	1.91	1.82	1.39	1.22	0.82	0.61	0.41	0.24	0.12	0.03	0.04	0.03	0.01	0	0	-	-	-	-	-	-	-	10.04
WNW	303.75	0.11	0.62	1.47	1.63	2.03	2.47	2.33	1.71	1.09	0.47	0.34	0.19	0.03	0.03	0.01	0	0	-	-	-	-	-	-	-	14.53
NW	326.25	0.12	0.85	1.33	1.47	1.9	1.44	1.27	0.99	0.7	0.38	0.21	0.13	0	0	0	0	0.01	-	-	-	-	-	-	-	10.80
NNW	348.75	0.18	0.86	1.6	1.31	1.19	1.09	1.18	0.96	0.56	0.26	0.23	0.07	0.03	0.03	0	0	0	-	-	-	-	-	-	-	9.55
Bin Totals (%)		2.25	10.14	18.39	16.99	14.57	12.08	10.01	7.09	4.11	2.21	1.33	0.59	0.12	0.09	0.02	0	0.01	-	-	-	-	-	-	-	100
Exceedence (%)		100	97.75	87.61	69.22	52.23	37.66	25.58	15.57	8.48	4.37	2.16	0.83	0.24	0.12	0.03	0.01	0.01	-	-	-	-	-	-	-	
Number of records in time series:				15934																						
Summary of Statistics																										
Maximum wind speed		=	16.94 m/s																							
Mean wind speed		=	4.4 m/s																							

Table B 46 Rhyll – Sept (2000-2012)[illegible]

Table B 47 Stony Pt – Sept (2000-2012)

Wind Speed and Direction - Percentage occurrence																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
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Table B 48 Cerberus – Oct (2000-2012)

Wind Speed and Direction - Percentage occurrence																										
Wind data at Cerberus October 2000-2012																										
Direction (°)		Wind Speed (m/s)																						Total (%)		
		0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+		22.00+	
N	11.25	0.26	1.57	2.51	1.56	1.24	0.98	0.98	0.46	0.16	0.07	0.06	0.02	0.01	0	0	-	-	-	-	-	-	-	-	-	9.88
NN	33.75	0.16	1.15	1.54	1.13	0.52	0.13	0.04	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	4.67
NE	56.25	0.1	0.61	1.6	1.47	0.82	0.21	0.03	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	4.84
ENE	78.75	0.09	0.46	0.63	0.68	0.3	0.11	0.11	0.01	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	2.39
E	101.25	0.2	0.56	0.76	0.57	0.18	0.12	0.05	0.02	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	2.46
ESE	123.75	0.18	0.4	0.65	0.9	0.62	0.26	0.2	0.04	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	3.25
SE	146.25	0.02	0.55	0.76	0.91	0.49	0.38	0.22	0.02	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	3.35
SSE	168.75	0.13	0.64	1.31	0.68	0.33	0.24	0.15	0.07	0.01	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	3.56
S	191.25	0.33	0.88	1.54	2.09	1.79	1.39	0.81	0.23	0.08	0	0.02	0	0	0	0	-	-	-	-	-	-	-	-	-	9.16
SSW	213.75	0.15	0.61	0.98	1.87	2.41	2.31	1.45	0.57	0.33	0.12	0.02	0.02	0	0	0	-	-	-	-	-	-	-	-	-	10.84
SW	236.25	0.16	0.63	0.94	1.21	1.68	1.48	1.23	0.87	0.52	0.2	0.08	0.05	0.03	0.04	0.01	-	-	-	-	-	-	-	-	-	9.13
WSW	258.75	0.16	0.47	0.86	0.88	0.92	0.89	0.74	0.6	0.31	0.21	0.07	0.02	0.03	0	0	-	-	-	-	-	-	-	-	-	6.16
W	281.25	0.22	1.27	1.78	1.63	1.35	1.01	0.77	0.73	0.29	0.18	0.08	0.02	0.01	0	0	-	-	-	-	-	-	-	-	-	9.34
WNW	303.75	0.1	0.56	1.4	1.26	1.54	1.82	1.42	1.04	0.48	0.17	0.08	0.01	0	0.01	0	-	-	-	-	-	-	-	-	-	9.89
NW	326.25	0.08	0.54	0.8	1.1	1	0.9	0.73	0.56	0.21	0.15	0.04	0.01	0.01	0	0	-	-	-	-	-	-	-	-	-	6.13
NNW	348.75	0.09	0.51	0.79	0.67	0.57	0.75	0.63	0.45	0.21	0.16	0.07	0.01	0	0	0	-	-	-	-	-	-	-	-	-	4.91
Bin Totals (%)		2.44	11.42	18.84	18.61	15.77	12.99	9.56	5.66	2.6	1.27	0.52	0.16	0.09	0.05	0.01	-	-	-	-	-	-	-	-	-	100
Exceedence (%)		100	97.55	86.13	67.29	48.68	32.91	19.92	10.36	4.70	2.10	0.83	0.31	0.15	0.06	0.01	-	-	-	-	-	-	-	-	-	
Number of records in time series:		16388																								
Summary of Statistics																										
Maximum wind speed		=	14.44 m/s																							
Mean wind speed		=	4.09 m/s																							

Table B 49 Rhyll – Oct (2000-2012)

Wind Speed and Direction - Percentage occurrence																										
Wind data at Rhyll October 2000-2012																										
Direction (°)		Wind Speed (m/s)																						Total (%)		
		0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+		22.00+	
N	11.25	0.1	0.62	1.33	1.43	0.87	0.82	0.74	0.44	0.34	0.4	0.28	0.18	0.13	0.04	0.01	0.03	0.02	0.01	-	-	-	-	-	-	7.79
NN	33.75	0.01	0.29	0.71	0.9	0.68	0.43	0.35	0.21	0.06	0.03	0.02	0.01	0.01	0	0	0	0	0	-	-	-	-	-	-	3.71
NE	56.25	0.04	0.21	0.55	0.54	0.86	0.7	0.52	0.35	0.28	0.21	0.07	0.01	0.02	0	0	0	0	0	-	-	-	-	-	-	4.36
ENE	78.75	0.05	0.31	0.55	0.72	0.49	0.38	0.42	0.24	0.17	0.06	0.04	0.01	0	0	0	0	0	0	-	-	-	-	-	-	3.44
E	101.25	0.04	0.34	0.7	0.82	0.71	0.57	0.35	0.28	0.21	0.11	0.07	0.04	0.01	0	0	0	0	0	-	-	-	-	-	-	4.24
ESE	123.75	0.01	0.22	0.57	0.58	0.5	0.61	0.43	0.39	0.26	0.29	0.14	0.07	0.02	0	0	0	0	0	-	-	-	-	-	-	4.09
SE	146.25	0.07	0.58	1.15	0.97	0.69	0.28	0.25	0.05	0.03	0.04	0.01	0	0	0	0	0	0	0	-	-	-	-	-	-	4.12
SSE	168.75	0.04	0.36	1.02	1.05	0.91	0.56	0.47	0.25	0.06	0.01	0.02	0.01	0.01	0.01	0	0	0	0	-	-	-	-	-	-	4.78
S	191.25	0.09	0.52	1.38	2.57	2.39	1.3	0.73	0.29	0.07	0.04	0.02	0.01	0.01	0	0	0	0	0	-	-	-	-	-	-	9.42
SSW	213.75	0.04	0.35	0.84	1.39	1.78	1.15	0.66	0.41	0.25	0.06	0.02	0.01	0.02	0.01	0	0	0	0	-	-	-	-	-	-	6.99
SW	236.25	0.04	0.47	1.54	1.65	2.12	1.64	1.22	0.67	0.29	0.12	0.06	0.01	0	0	0	0	0	0	-	-	-	-	-	-	9.83
WSW	258.75	0.13	0.53	1.77	2.03	1.9	1.42	0.99	0.56	0.15	0.11	0.01	0	0	0	0	0	0	0	-	-	-	-	-	-	9.60
W	281.25	0.09	1.02	2.68	2.83	2.38	1.45	0.71	0.3	0.07	0.03	0.01	0	0	0	0	0	0	0	-	-	-	-	-	-	11.57
WNW	303.75	0.05	0.57	1.3	1.45	1.5	0.79	0.18	0.02	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	5.86
NW	326.25	0.06	0.39	0.83	1.06	0.87	0.61	0.27	0.11	0.05	0.01	0	0	0.01	0.01	0	0	0	0	-	-	-	-	-	-	4.28
NNW	348.75	0.05	0.26	0.68	0.79	0.66	0.87	0.73	0.52	0.46	0.34	0.27	0.21	0.11	0.03	0	0.02	0	0	-	-	-	-	-	-	6.00
Bin Totals (%)		0.91	7.04	17.61	20.78	19.29	13.6	9.03	5.08	2.76	1.84	1.04	0.55	0.32	0.08	0.01	0.05	0.02	0.01	-	-	-	-	-	-	100
Exceedence (%)		100	99.11	92.07	74.46	53.68	34.39	20.79	11.76	6.68	3.92	2.08	1.04	0.49	0.17	0.09	0.08	0.03	0.01	-	-	-	-	-	-	
Number of records in time series:		18980																								
Summary of Statistics																										
Maximum wind speed	=	17.5 m/s																								
Mean wind speed	=	4.38 m/s																								

Table B 50 Stony Pt – Oct (2000-2012)

Wind Speed and Direction - Percentage occurrence																									
Wind data at Stony Pt October 2000-2012																									
Direction (°)	Wind Speed (m/s)																							Total (%)	
	0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+	22.00+		
N	11.25	0.44	0.67	1.04	1.26	0.73	0.67	0.44	0.21	0.07	0.09	0.02	0.01	0.01	0	0	0	-	-	-	-	-	-	-	5.66
NNE	33.75	0.48	0.7	0.76	1.16	1.22	0.82	0.25	0.02	0.04	0.02	0	0	0	0	0	0	-	-	-	-	-	-	-	5.47
NE	56.25	0.37	0.53	1.18	0.82	0.83	0.36	0.25	0.04	0.06	0.04	0.01	0.01	0	0	0	0	-	-	-	-	-	-	-	4.50
ENE	78.75	0.17	0.26	0.34	0.39	0.26	0.16	0.14	0.09	0.01	0.01	0	0	0	0	0	0	-	-	0.09	-	-	-	-	1.83
E	101.25	0.21	0.25	0.39	0.25	0.22	0.12	0.12	0.02	0.02	0.01	0	0	0	0	0	0	-	-	-	-	-	-	-	1.61
ESE	123.75	0.22	0.56	0.75	0.67	0.47	0.66	0.41	0.21	0.1	0.11	0.02	0	0	0	0	0	-	-	-	-	-	-	-	4.18
SE	146.25	0.27	0.37	0.85	0.92	1.17	0.82	0.42	0.35	0.26	0.22	0.06	0.07	0.01	0	0	0	-	-	-	-	-	-	-	5.79
SSE	168.75	0.22	0.46	0.81	0.8	1.01	0.95	0.57	0.46	0.31	0.2	0.06	0.02	0.02	0	0	0	-	-	-	-	-	-	-	5.89
S	191.25	0.3	0.37	0.58	1.28	1.44	1.33	0.96	0.47	0.2	0.12	0.02	0.05	0.01	0	0	0	-	-	-	-	-	-	-	7.13
SSW	213.75	0.44	0.85	1.04	1.57	1.87	1.59	0.95	0.63	0.26	0.06	0.01	0.01	0.01	0.01	0.01	0	-	-	-	-	-	-	-	9.31
SW	236.25	0.82	0.81	1.21	1.31	1.89	1.48	1.07	0.53	0.3	0.09	0.01	0.04	0.02	0	0	0	-	-	-	-	-	-	-	9.58
WSW	258.75	0.36	0.68	0.9	1.19	1.29	1.14	0.63	0.35	0.16	0.11	0	0	0	0	0	0	-	-	-	-	-	-	-	6.81
W	281.25	0.52	1.67	1.78	1.36	1.19	1.09	0.85	0.56	0.35	0.17	0.1	0.04	0	0	0	0	-	-	-	-	-	-	-	9.68
WNW	303.75	0.78	1.38	1.52	1.18	1.36	1.38	1.31	0.82	0.5	0.14	0.14	0.02	0.01	0	0	0	-	-	-	-	-	-	-	10.54
NW	326.25	0.65	0.76	0.71	0.86	0.8	0.66	0.41	0.4	0.3	0.2	0.14	0.01	0	0.01	0	0	-	-	-	-	-	-	-	5.91
NNW	348.75	0.41	0.36	0.53	0.67	0.55	0.75	0.58	0.67	0.47	0.46	0.34	0.09	0.07	0.05	0.01	0.01	-	-	-	-	-	-	-	6.02
Bin Totals (%)		6.68	10.68	14.37	15.67	16.3	13.99	9.35	5.84	3.42	2.06	0.95	0.39	0.17	0.02	0.01		-	-	-	-	-	-	-	100
Exceedence (%)		100	93.31	82.63	68.26	52.59	36.29	22.30	12.95	7.11	3.69	1.63	0.68	0.29	0.10	0.03	0.01		-	-	-	-	-	-	
Number of records in time series:				8042																					
Summary of Statistics																									
Maximum wind speed		=	15.6 m/s																						
Mean wind speed		=	4.26 m/s																						

Table B 51 Cerberus – Nov (2000-2012)

Wind Speed and Direction - Percentage occurrence																										
Wind data at Cerberus November 2000-2012																										
Direction (°)		Wind Speed (m/s)																						Total (%)		
		0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+		22.00+	
N	11.25	0.26	1.54	1.94	1.17	0.72	0.73	0.71	0.31	0.1	0.02	0	0	0	0	0	0	-	-	-	-	-	-	-	-	7.50
NNE	33.75	0.09	0.68	1.54	1.05	0.45	0.13	0.05	0.03	0.01	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	4.03
NE	56.25	0.06	0.48	1.46	1.56	0.68	0.32	0.08	0.02	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	4.66
ENE	78.75	0.09	0.41	0.94	1	0.64	0.34	0.18	0.12	0.02	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	3.74
E	101.25	0.14	0.51	0.83	0.77	0.54	0.45	0.27	0.03	0	0.01	0	0	0	0	0	0	-	-	-	-	-	-	-	-	3.55
ESE	123.75	0.13	0.41	0.75	1.16	1.28	1.03	0.49	0.08	0.05	0.03	0.01	0	0	0	0	0	-	-	-	-	-	-	-	-	5.42
SE	146.25	0.07	0.34	0.7	0.77	0.7	0.74	0.53	0.47	0.12	0.06	0.01	0	0	0	0	0	-	-	-	-	-	-	-	-	4.51
SSE	168.75	0.2	0.89	1.3	0.8	0.49	0.25	0.2	0.11	0.06	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	4.30
S	191.25	0.31	1.02	1.88	2.77	2.68	1.98	1.14	0.56	0.13	0.06	0.03	0.01	0	0	0	0	-	-	-	-	-	-	-	-	12.57
SSW	213.75	0.21	0.67	1.24	2.1	3.21	3.28	2.19	1	0.29	0.21	0.04	0.09	0.01	0	0	0	-	-	-	-	-	-	-	-	14.54
SW	236.25	0.15	0.59	1.08	1.7	1.87	1.93	1.51	1	0.53	0.21	0.1	0.04	0.01	0.01	0	0	-	-	-	-	-	-	-	-	10.73
WSW	258.75	0.18	0.75	1.16	1	0.88	0.83	0.5	0.48	0.31	0.09	0.02	0.01	0.02	0	0	0	-	-	-	-	-	-	-	-	6.23
W	281.25	0.18	1.07	1.71	1.28	0.83	0.68	0.6	0.31	0.17	0.04	0.02	0.02	0	0.01	0	0.01	-	-	-	-	-	-	-	-	6.93
WNW	303.75	0.09	0.54	0.85	0.69	0.78	0.75	0.62	0.41	0.18	0.06	0.04	0.02	0.01	0	0	0	-	-	-	-	-	-	-	-	5.04
NW	326.25	0.07	0.43	0.58	0.43	0.45	0.42	0.39	0.16	0.07	0.04	0	0	0	0	0	0	-	-	-	-	-	-	-	-	3.04
NNW	348.75	0.06	0.42	0.58	0.37	0.46	0.48	0.42	0.21	0.12	0.05	0.02	0.01	0.01	0	0	0	-	-	-	-	-	-	-	-	3.21
Bin Totals (%)		2.28	10.75	18.55	18.64	16.67	14.35	9.88	5.31	2.16	0.86	0.28	0.2	0.05	0.01	0	0.01	-	-	-	-	-	-	-	-	100
Exceedence (%)		100	97.72	86.97	68.42	49.78	33.11	18.76	8.88	3.57	1.41	0.55	0.27	0.07	0.02	0.01	0.01	-	-	-	-	-	-	-	-	
Number of records in time series:		16331																								
Summary of Statistics																										
Maximum wind speed		=	15 m/s																							
Mean wind speed		=	4.07 m/s																							

Table B 52 Rhyll – Nov (2000-2012)

Wind Speed and Direction - Percentage occurrence																										
Wind data at Rhyll November 2000-2012																										
Direction (°)		Wind Speed (m/s)																						Total (%)		
		0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+		22.00+	
N	11.25	0.05	0.28	1.01	1.17	0.91	0.52	0.41	0.27	0.3	0.2	0.14	0.1	0.07	0.02	0.01	0.02	0	0	-	-	-	-	-	-	5.48
NN	33.75	0.05	0.17	0.6	0.76	0.56	0.4	0.29	0.21	0.08	0.03	0.01	0.01	0	0	0	0	0	0	-	-	-	-	-	-	3.18
NE	56.25	0.02	0.15	0.39	0.6	0.54	0.72	0.49	0.24	0.18	0.17	0.03	0.01	0.01	0	0.01	0	0	0	0	-	-	-	-	-	3.56
ENE	78.75	0.07	0.26	0.57	0.69	0.62	0.49	0.39	0.3	0.17	0.08	0.03	0.01	0.02	0.01	0	0	0	0	0	-	-	-	-	-	3.71
E	101.25	0.07	0.37	0.76	0.89	0.88	0.83	0.68	0.48	0.52	0.47	0.3	0.13	0.05	0.01	0	0.01	0	0	0	-	-	-	-	-	6.45
ESE	123.75	0.03	0.38	0.66	0.61	0.65	0.68	0.8	0.63	0.6	0.76	0.55	0.2	0.14	0.04	0.02	0.03	0.02	0.01	-	-	-	-	-	-	6.81
SE	146.25	0.04	0.67	1.49	1.19	0.72	0.61	0.64	0.48	0.24	0.11	0.06	0.03	0.01	0	0	0.01	0	0	0	-	-	-	-	-	6.30
SSE	168.75	0.05	0.43	1.2	1.69	1.41	1	0.61	0.42	0.27	0.07	0.02	0.03	0	0	0	0	0	0	0	-	-	-	-	-	7.20
S	191.25	0.06	0.6	1.94	3.88	4.66	2.48	0.9	0.27	0.12	0.1	0.05	0.03	0.01	0	0	0	0	0	0	-	-	-	-	-	15.10
SSW	213.75	0.03	0.24	0.88	1.91	2.2	1.75	0.93	0.48	0.2	0.17	0.07	0.03	0	0	0	0	0	0	0	-	-	-	-	-	8.89
SW	236.25	0.05	0.5	1.63	2.43	1.97	1.86	1.15	0.45	0.24	0.07	0.05	0.01	0.01	0.01	0	0	0	0	0	-	-	-	-	-	10.43
WSW	258.75	0.1	0.59	1.7	1.46	1.32	1.19	0.71	0.38	0.04	0.04	0.01	0	0	0	0	0	0	0	0	-	-	-	-	-	7.54
W	281.25	0.09	0.85	2.03	1.66	1.23	0.84	0.32	0.04	0.02	0.01	0	0	0	0	0	0	0	0	0	-	-	-	-	-	7.09
WNW	303.75	0.11	0.45	0.55	0.64	0.4	0.18	0.02	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	2.35
NW	326.25	0.05	0.33	0.52	0.63	0.42	0.19	0.08	0.02	0	0.01	0	0	0	0	0	0	0	0	0	-	-	-	-	-	2.25
NNW	348.75	0.01	0.21	0.48	0.73	0.48	0.44	0.42	0.33	0.28	0.25	0.09	0.05	0.02	0.01	0	0	0	0	0	-	-	-	-	-	3.80
Bin Totals (%)		0.86	6.48	16.39	20.96	18.95	14.17	8.84	5	3.25	2.53	1.41	0.63	0.33	0.1	0.03	0.05	0.02	0.01	-	-	-	-	-	-	100
Exceedence (%)		100	99.15	92.67	76.28	55.32	36.37	22.20	13.36	8.36	5.11	2.58	1.17	0.54	0.21	0.11	0.08	0.03	0.01	-	-	-	-	-	-	
Number of records in time series:		18446																								
Summary of Statistics																										
Maximum wind speed	=	17.5 m/s																								
Mean wind speed	=	4.52 m/s																								

Table B 53 Stony Pt – Nov (2000-2012)

Wind Speed and Direction - Percentage occurrence																									
Wind data at Stony Pt November 2000-2012																									
Direction (°)	Wind Speed (m/s)																							Total (%)	
	0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+	22.00+		
N	11.25	0.35	0.63	1.04	1.27	0.75	0.3	0.28	0.16	0.08	0.09	0.03	0	0.01	0	0	0.01	0	0	-	-	-	-	-	5.00
NNE	33.75	0.35	0.5	0.94	1	0.69	0.53	0.48	0.16	0.04	0.03	0	0.01	0	0	0	0.01	0	0	-	-	-	-	-	4.74
NE	56.25	0.41	0.75	0.8	0.83	0.59	0.18	0.26	0.15	0.06	0.01	0	0.03	0.01	0	0.01	0	0	0	-	-	-	-	-	4.09
ENE	78.75	0.19	0.33	0.39	0.28	0.29	0.08	0.15	0.06	0.09	0.03	0.01	0.01	0.01	0	0	0	0	0	-	-	-	-	-	1.92
E	101.25	0.25	0.28	0.26	0.43	0.31	0.21	0.26	0.14	0.06	0.05	0	0	0	0	0	0	0	0	-	-	-	-	-	2.25
ESE	123.75	0.2	0.69	0.74	0.74	0.71	0.78	1.04	0.6	0.45	0.1	0.01	0.01	0	0	0	0	0	0	-	-	-	-	-	6.07
SE	146.25	0.18	0.43	0.95	1.13	1.32	0.76	0.55	0.73	0.61	0.59	0.35	0.15	0.01	0.03	0.03	0	0	0	-	-	-	-	-	7.82
SSE	168.75	0.2	0.31	0.88	1.44	1.78	1.74	1.06	0.43	0.24	0.21	0.1	0.01	0.04	0.01	0	0	0	0	-	-	-	-	-	8.45
S	191.25	0.18	0.44	0.88	1.68	2.38	1.79	0.9	0.69	0.53	0.45	0.21	0.04	0.05	0.01	0	0.01	0	0	-	-	-	-	-	10.24
SSW	213.75	0.3	0.79	1.57	1.67	2.76	2.38	1.42	0.96	0.59	0.28	0.1	0.13	0.09	0.05	0	0	0	0	-	-	-	-	-	13.09
SW	236.25	0.36	1.01	1.24	1.42	2.28	2.1	1.37	0.73	0.19	0.1	0.01	0.04	0	0	0	0	0	0	-	-	-	-	-	10.85
WSW	258.75	0.28	0.86	1.21	1.21	1.34	1.05	0.73	0.25	0.14	0.05	0	0.01	0	0	0	0	0	0	-	-	-	-	-	7.13
W	281.25	0.4	1.01	1.44	0.86	0.79	0.76	0.45	0.35	0.1	0.03	0.04	0.01	0	0	0	0	0	0	-	-	-	-	-	6.24
WNW	303.75	0.31	0.91	1.09	0.65	0.85	0.34	0.45	0.25	0.1	0.05	0.03	0.03	0	0	0	0	0	0	-	-	-	-	-	5.06
NW	326.25	0.3	0.45	0.55	0.48	0.43	0.4	0.2	0.23	0.15	0.1	0	0	0	0.01	0	0	0	0	-	-	-	-	-	3.30
NNW	348.75	0.13	0.39	0.64	0.63	0.41	0.36	0.34	0.31	0.25	0.18	0.09	0.04	0	0.01	0.01	0	0.01	0.01	-	-	-	-	-	3.81
Bin Totals (%)		4.38	9.78	14.62	15.69	17.67	13.77	9.93	6.2	3.67	2.33	0.98	0.51	0.23	0.13	0.05	0.04	0.01	0.01	-	-	-	-	-	100
Exceedance (%)		100	95.62	85.84	71.22	55.53	37.86	24.09	14.16	7.96	4.29	1.96	0.98	0.47	0.23	0.11	0.06	0.02	0.01	-	-	-	-	-	
Number of records in time series:				7984																					
Summary of Statistics																									
Maximum wind speed	=	17.5 m/s																							
Mean wind speed	=	4.45 m/s																							

Table B 54 Cerberus – Dec (2000-2012)

Wind Speed and Direction - Percentage occurrence																									
Wind data at Cerberus December 2000-2012																									
Direction (°)		Wind Speed (m/s)																						Total (%)	
		0.00+	1.00+	2.00+	3.00+	4.00+	5.00+	6.00+	7.00+	8.00+	9.00+	10.00+	11.00+	12.00+	13.00+	14.00+	15.00+	16.00+	17.00+	18.00+	19.00+	20.00+	21.00+		22.00+
N	11.25	0.16	0.94	1.57	0.8	0.59	0.63	0.54	0.29	0.13	0.09	0.02	0	0	0	-	-	-	-	-	-	-	-	-	5.76
NNE	33.75	0.07	0.5	1.1	1.05	0.65	0.14	0.03	0.01	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	3.55
NE	56.25	0.1	0.37	1.1	1.53	1.08	0.49	0.1	0.01	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	4.78
ENE	78.75	0.1	0.42	0.76	0.9	0.77	0.49	0.3	0.07	0.02	0	0	0	0	0	-	-	-	-	-	-	-	-	-	3.83
E	101.25	0.1	0.38	0.84	0.98	0.8	0.29	0.07	0.01	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	3.47
ESE	123.75	0.04	0.27	0.76	1.05	1.16	0.58	0.23	0.02	0.01	0	0	0	0	0	-	-	-	-	-	-	-	-	-	4.12
SE	146.25	0.1	0.34	0.61	1	0.56	0.48	0.55	0.26	0.18	0.04	0	0	0	0	-	-	-	-	-	-	-	-	-	4.12
SSE	168.75	0.15	0.73	1.49	0.93	0.52	0.37	0.17	0.06	0.01	0.01	0	0	0	0	-	-	-	-	-	-	-	-	-	4.44
S	191.25	0.2	1	1.95	2.26	2.44	2.25	1.17	0.39	0.04	0.01	0	0	0	0	-	-	-	-	-	-	-	-	-	11.71
SSW	213.75	0.15	0.55	0.97	1.78	3	3.95	3.55	1.68	0.52	0.17	0.06	0.02	0.02	0	-	-	-	-	-	-	-	-	-	16.42
SW	236.25	0.17	0.42	0.92	1.22	1.59	1.91	1.93	1.5	1.08	0.5	0.17	0.1	0.02	0.01	-	-	-	-	-	-	-	-	-	11.54
WSW	258.75	0.2	0.58	0.96	0.89	0.78	0.88	0.69	0.46	0.35	0.17	0.02	0.02	0.01	0	-	-	-	-	-	-	-	-	-	6.01
W	281.25	0.21	1.04	1.71	1.5	1.16	0.9	0.64	0.41	0.19	0.1	0.02	0.01	0	0	-	-	-	-	-	-	-	-	-	7.89
WNW	303.75	0.07	0.54	0.85	0.78	0.96	1	0.79	0.51	0.25	0.18	0.08	0.02	0.01	0.01	-	-	-	-	-	-	-	-	-	6.05
NW	326.25	0.04	0.36	0.57	0.48	0.43	0.41	0.36	0.2	0.12	0.08	0.04	0	0.01	0	-	-	-	-	-	-	-	-	-	3.10
NNW	348.75	0.1	0.42	0.72	0.34	0.25	0.39	0.4	0.33	0.17	0.08	0.04	0	0	0	-	-	-	-	-	-	-	-	-	3.24
Bin Totals (%)		1.97	8.88	16.88	17.47	16.75	15.16	11.51	6.21	3.07	1.43	0.44	0.17	0.06	0.01	-	-	-	-	-	-	-	-	-	100
Exceedence (%)		100	98.04	89.16	72.28	54.81	38.06	22.90	11.39	5.18	2.11	0.68	0.24	0.07	0.01	-	-	-	-	-	-	-	-	-	
Number of records in time series:		18162																							
Summary of Statistics																									
Maximum wind speed	=	13.89 m/s																							
Mean wind speed	=	4.33 m/s																							

Table B 55 Rhyll – Dec (2000-2012)

[illegible]

Table B 56 Stony Pt – Dec (2000-2012)

[illegible]

Port of Hastings
Development Project
Preliminary Base Case
Phase

APPENDIX C
WATER QUALITY
DATA (EPA, 2011)



Parameters available

Arsenic
Carotenoids
Cadmium
Chlorophyll a
Chlorophyll a - functional
Chlorophyll b
Chlorophyll c
Copper
Dissolved oxygen
Percent saturated dissolved ox
Fluoride
Iron
Mercury
Ammonia
Ammonia filtered (dissolved)
Nitrite
Nitrite filtered (dissolved)
Nitrate
Nitrate filtered (dissolved)
Oxidised nitrogen
oxidised nitrogen - filtered
(dissolved)
Organic Nitrogen filtered (dissolved)
Total Kjeldahl nitrogen
Total nitrogen
Nitrogen - total particulate
Suspended solids
Nickel
Phosphorus - organic
Organic phosphorus filtered
(dissolved)
Orthophosphate
Orthosphosphate filtered (dissolved)
Total phosphorus
Total phosphorus particulate
Lead
pH
Phaeophytin
Salinity
Secchi depth
Silicate
Silica Filterable
Temperature - Water
Zinc

