Water Quality Monitoring
LPC CDP Consent Application

TABLED AT HEARING
Application: Lyttelton Port Co...
Hearing - CRC172455
Date: 2 May 2017

VISION ENVIRONMENT

Summary Evidence of Leonie Andersen April 2017

Certified System
Quality ISO 9001 SAI GLOBAL
Certified System
Health & Safe AS 4801 SAI GLOBAL
Certified System
Health & Safe OHSAS 18001 SAI GLOBAL
Certified System
Environment ISO 14001 SAI GLOBAL

WEB: www.visionenvironment.com.au

Introduction

- Bachelor of Veterinary Science (1986) & Master Applied Science
- Veterinary Practitioner (10 years)
- Senior Research Fellow CQUniversity marine science (10 years)
- Founding Director at Vision Environment (2008)
- Invited member of a number of technical advisory committees (*TAC*) for dredging projects including LPC TAG
- I authored the report on the methodology and justification for the approach to water quality monitoring:

Lyttelton Port Company Channel Deepening Project Water Quality Environmental Monitoring Methodology (Appendix 21)

About VE

- Specialises in the functional usability of high quality real time water quality data considered 'best practice'
- A company of firsts through in-house design:
  - Telemetered PAR (light) for seagrass management
  - Altimeters to measure sedimentation rates
  - Acoustic (non-cabled) delivery of benthic telemetered physicochemistry data
  - The use of a publicly viewed real time dredge status update dial

Major Projects

- 2009 – 2013 - Western Basin Dredge & Disposal Project and QCLNG Narrows Crossing Dredge project – Gladstone - Australia's second largest dredge project to date (21 M^3)
- 2014 – 2015 Chanel Duplication EIS Gladstone - water/marine ecology
- 2015 – TasPorts Devonport Dredging – 5 months
- 2015 – 2017+ – Abbot Point Baseline and potential dredge (NQBP)
- 2002 to current – Gladstone Ports Corp (GPC) dredge operations – Several programs & last 5 Maintenance dredge campaigns

Ambient Monitoring Design

Key understandings

- Point/diffuse sources
  - Dredge head, spoil ground, natural resuspension, flows
- Sensitive habitats want/need to protect
  - Mahinga kai, marine mammals, birds, fish, invertebrates, rocky reef, mussel farms…
- Hydrodynamics
  - Plume dispersion
- Suitable to ramp up for capital projects if required

Objectives based on historical information, current and future needs

- Select appropriate monitoring
  - Frequency
  - Parameters
  - Sites

Approach

Frequency

- Baseline monitoring to gain understanding of ambient background
- 12 months is considered long term for baseline

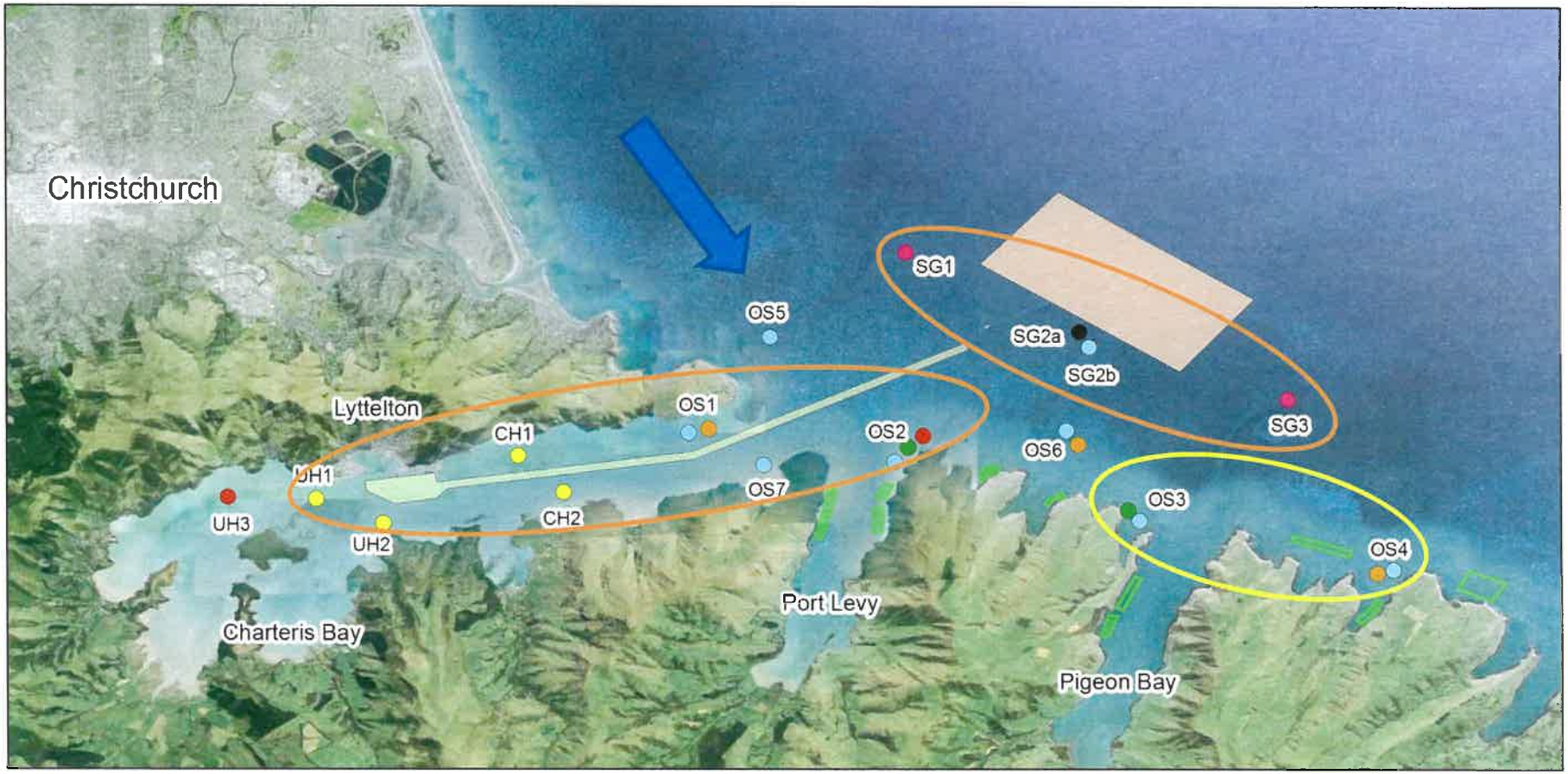
Parameters

- Parameters measured are considered standards for the assessment of various criteria associated with dredge projects, in particular *Water Clarity*
- 15 locations with one to three different types monitoring units
- Telemetered (real time) and continuous
- Validated with monthly physical water sampling

Sites

- **Primary objective of monitoring sites is to manage dredge operations by acting as sentinels for detection of dredge plumes prior to reaching sensitive habitats**
- Impact, Management or Reference sites
- Sites are self-referencing. Compare data from at one site before dredging (baseline) to the same site during dredging

Sites



- Inshore ST Sites
- Benthic SL Sites
- Benthic SL / BPAR Sites
- Offshore ST Sites
- Offshore ST / ADCP Sites
- Altimiter
- Watchkeeper
- Spoil ground
- Dredge area
- Mussel farms

Lyttelton Port of Christchurch

Image Background: Google 2016
Decimal Degrees - WGS 84

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0 2 4 8
Kilometers

Parameters

- Water Clarity
  - Turbidity (NTU in real time)
  - Total Suspended Solids (TSS)
  - Light attenuation (and benthic light)
- Water Chemistry
  - pH (acidity), temperature (°C), conductivity (mS/cm) and dissolved oxygen (mg/L)(real time) = stressors
- Sedimentation Rates
  - Altimeters measure sediment flux and bed level change (mm)
- Water currents (speeds & direction)
  - ADCP
- Meteorological
  - Winds and waves
- Nutrients
- Contaminants
  - Metals and organics

Field Instrumentation

Dual logging units

- Inherent difference between two instruments
- Ensures there is a back-up data – Data validation

- **Surface Telemetry**
  - One weather station with current profiler and wave measurements
  - 12 telemetered subsurface physicochemistry loggers
  - Two telemetered subsurface physicochemistry loggers with current profilers
  - One station on land measuring ambient light.
- **Benthic Continuous**
  - Three benthic continuous loggers measuring seabed physicochemistry
  - Two benthic continuous loggers measuring seabed physicochemistry and seabed PAR
  - Two benthic continuous loggers measuring rates of sedimentation at the seabed

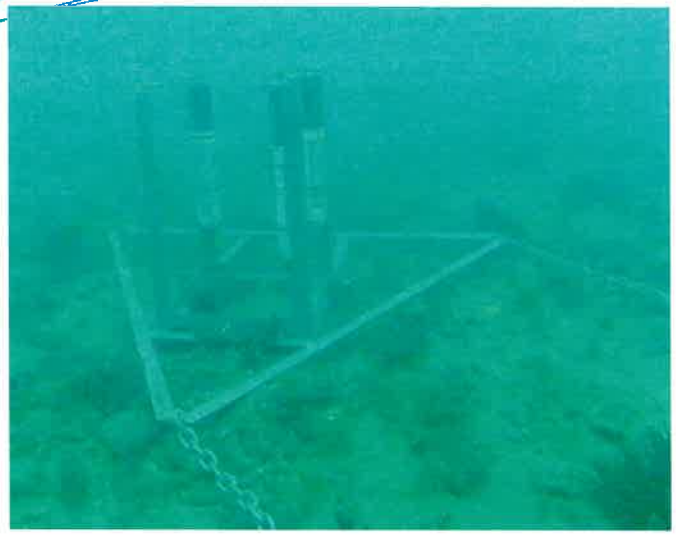
Surface Telemetry

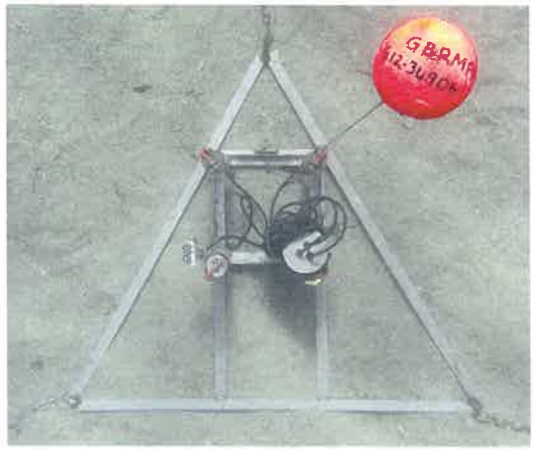
Surface loggers

Surface logger & ADCP

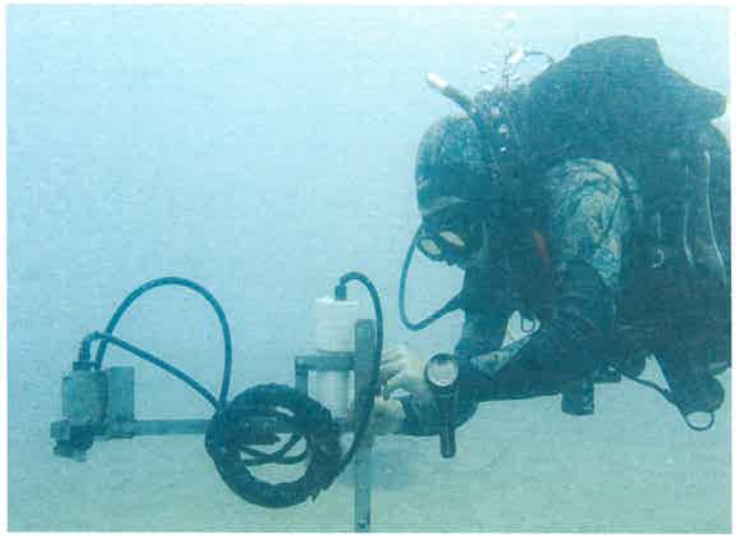
WatchKeeper (ODS)

Continuous Benthic





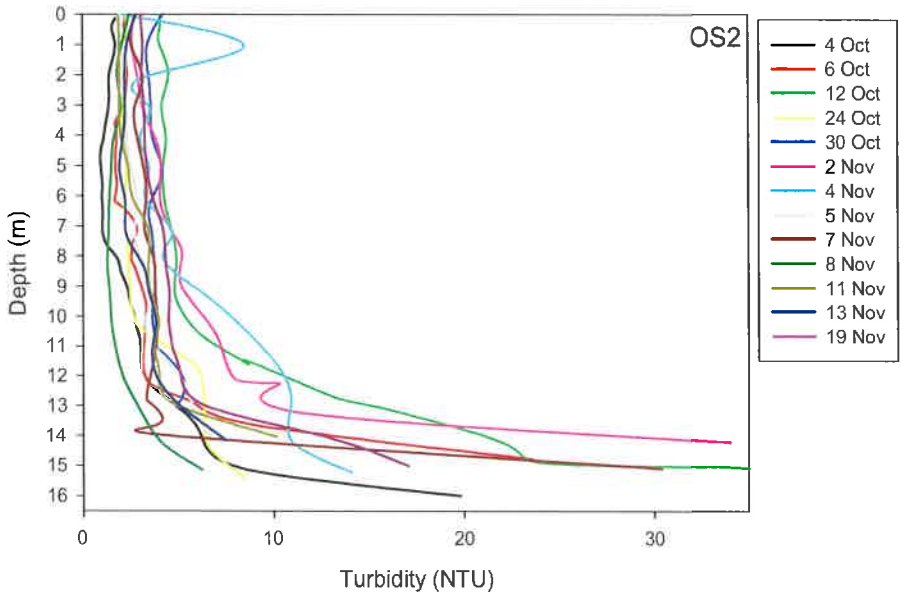
Benthic loggers

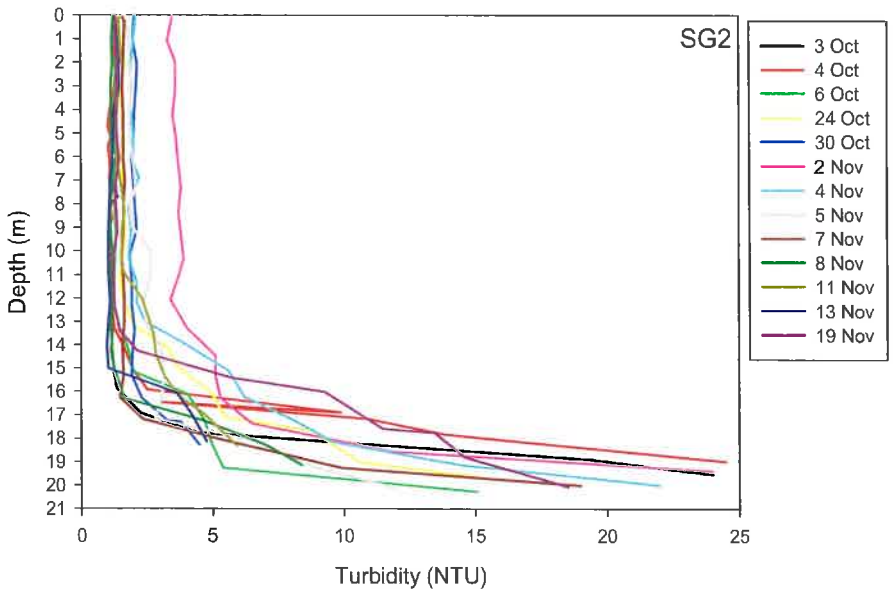


Altimeter

Instrument Justification

- **Telemetered (real time) or not?**
  - Ensures maximum data return
  - Compliance and adaptive management
- **Surface, benthic or both?**
  - Surface standard for majority dredge projects due to reliability, and logistics/safety of maintenance (cabled & acoustic)
  - Benthic is useful only if you have established ecological triggers for sensitive benthic habitats
  - If water column is well mixed no need to measure benthic





LYT Justification

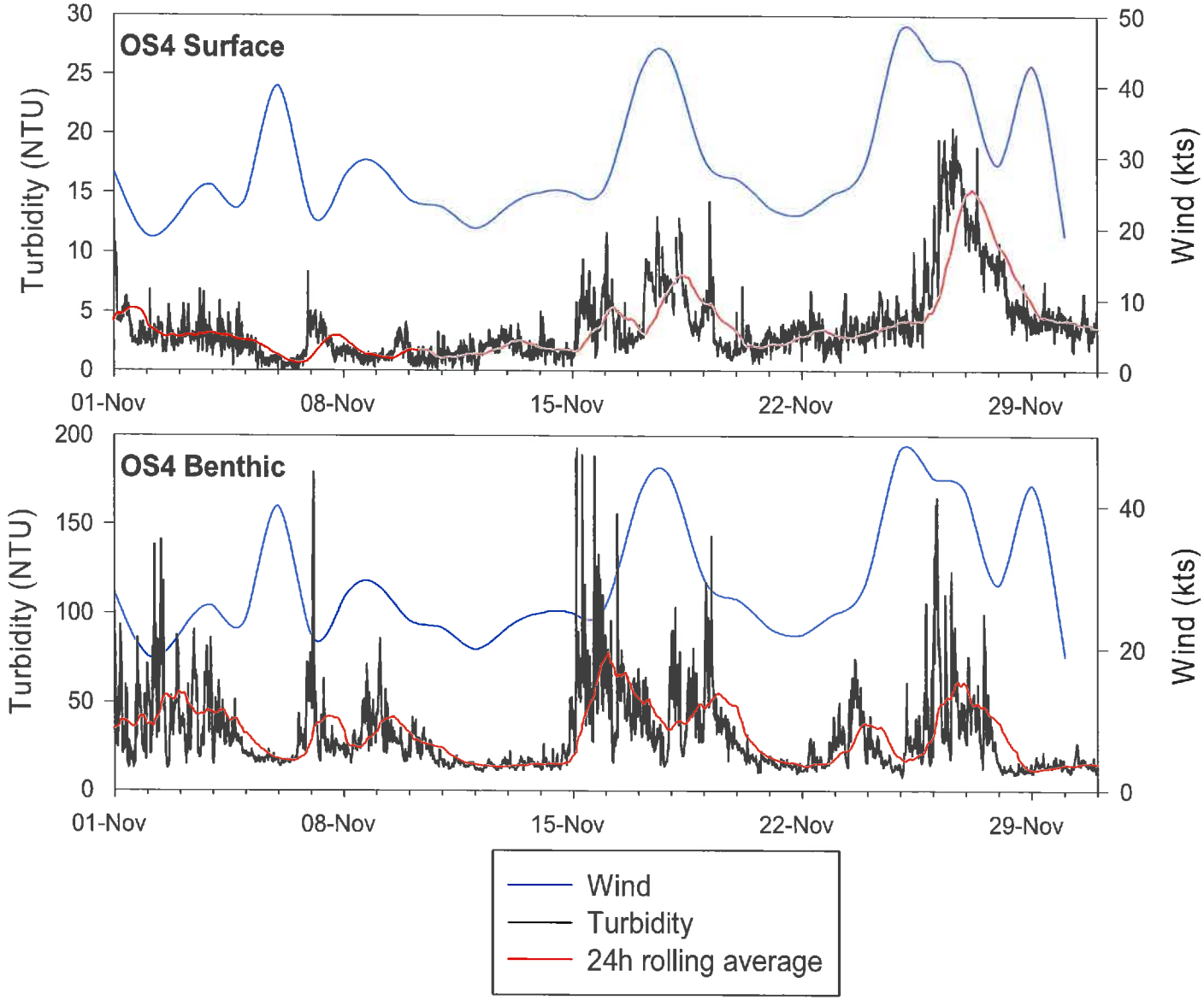
Surface unit of choice

- Volatile sea state with low viz - logistics
- Muddy bottom in LYT resulting in sinking of instruments
- Highly variable benthic data difficult to interpret and decipher

Surface vs Benthic

25 NTU

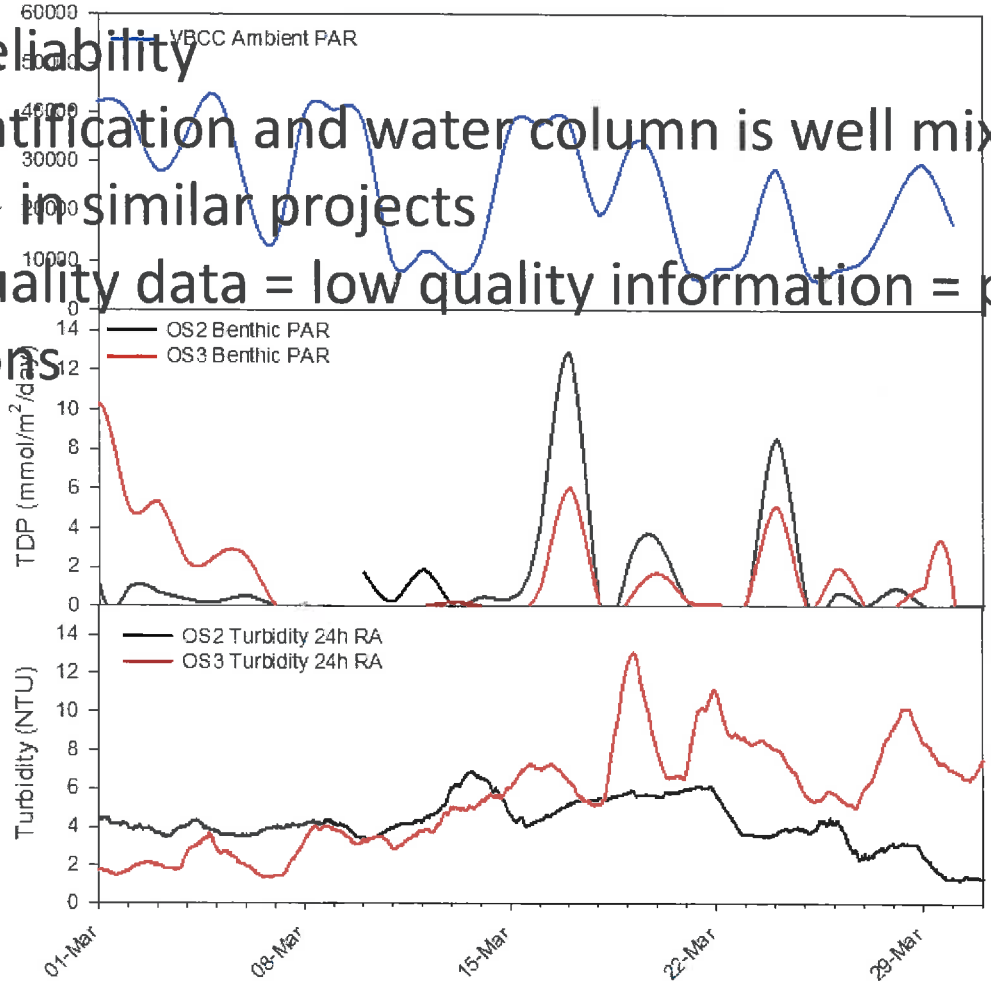
200 NTU



Benthic Light

Surface unit of choice

- Logistics
- Data reliability
- No stratification and water column is well mixed
- Proven in similar projects
- Low quality data = low quality information = poor quality decisions

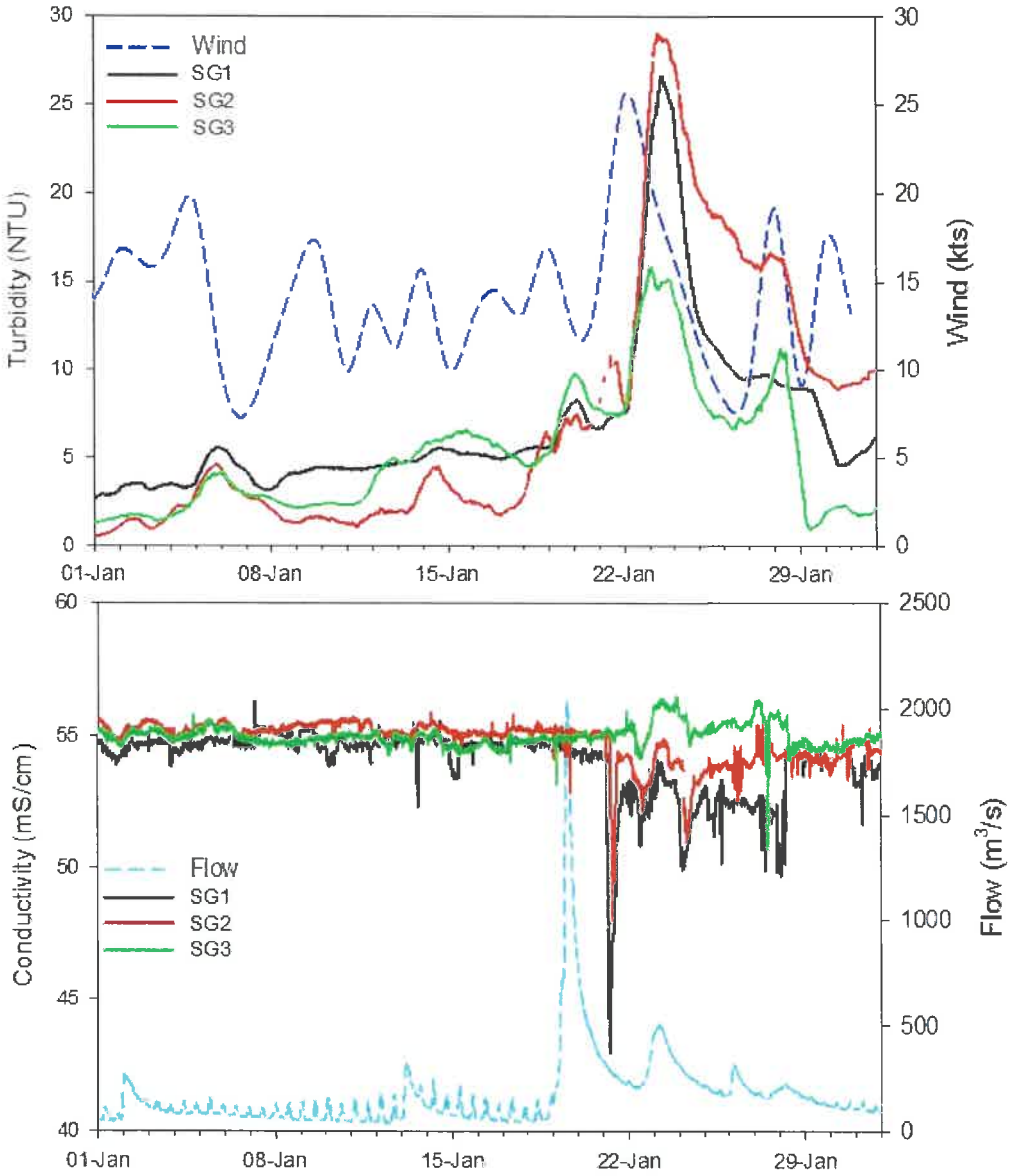


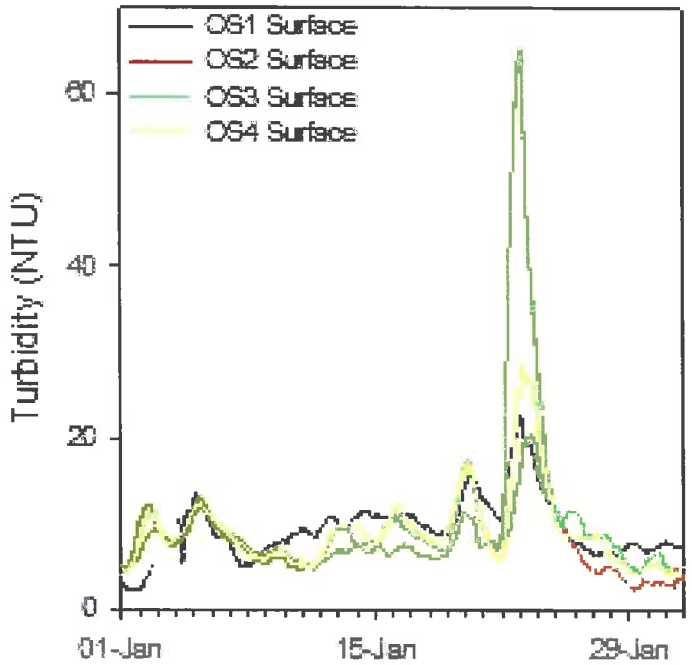
Water Grab Sampling

- Depth profiling physchem and light attenuation (kd)
- TSS (multiple depths for model validation)
- Water chemistry samples
- Compared with ANZECC WQG

Results to Date – Spoil ground

Wind speeds, direction, waves and flows

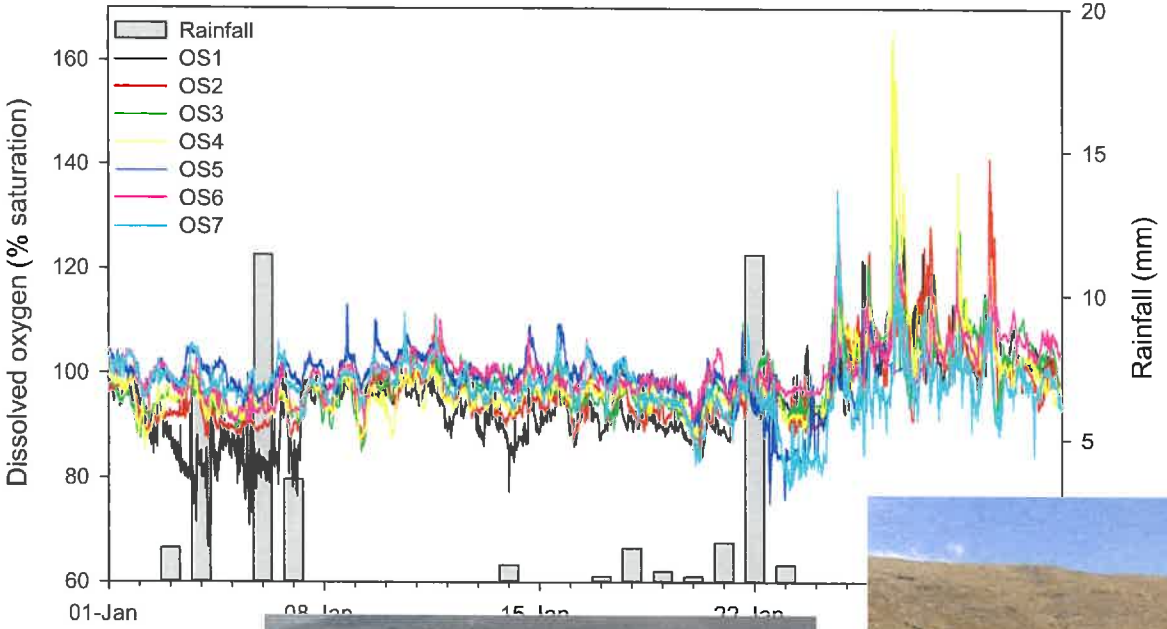




OS3

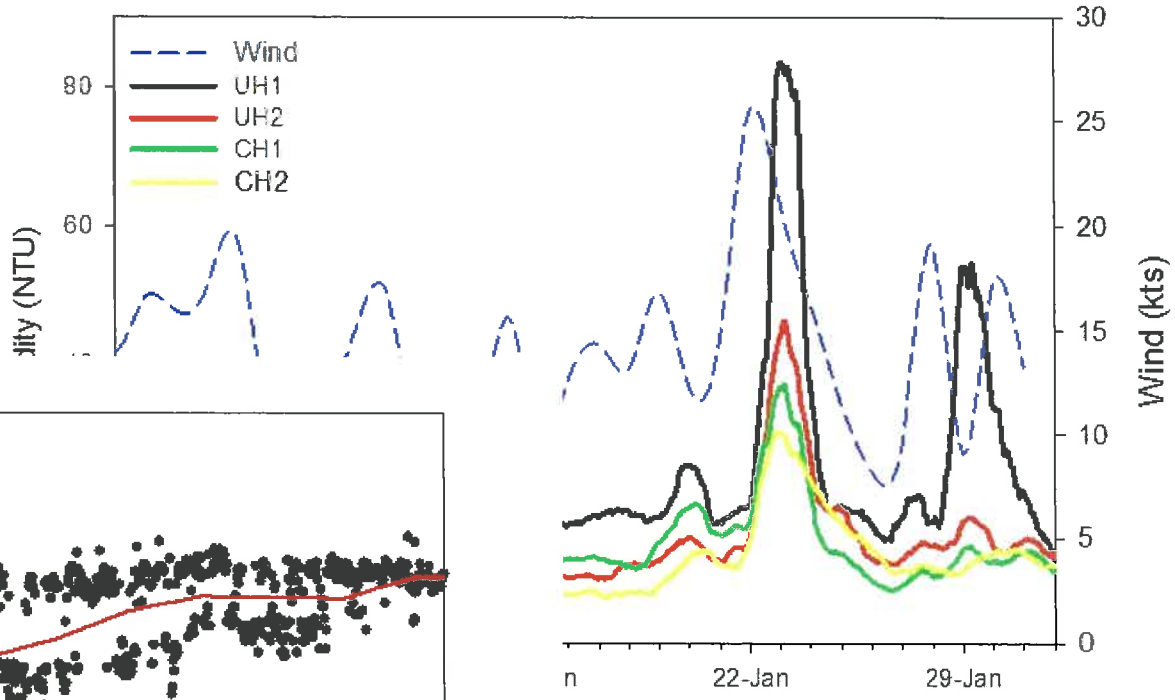
Results to Date – Offshore

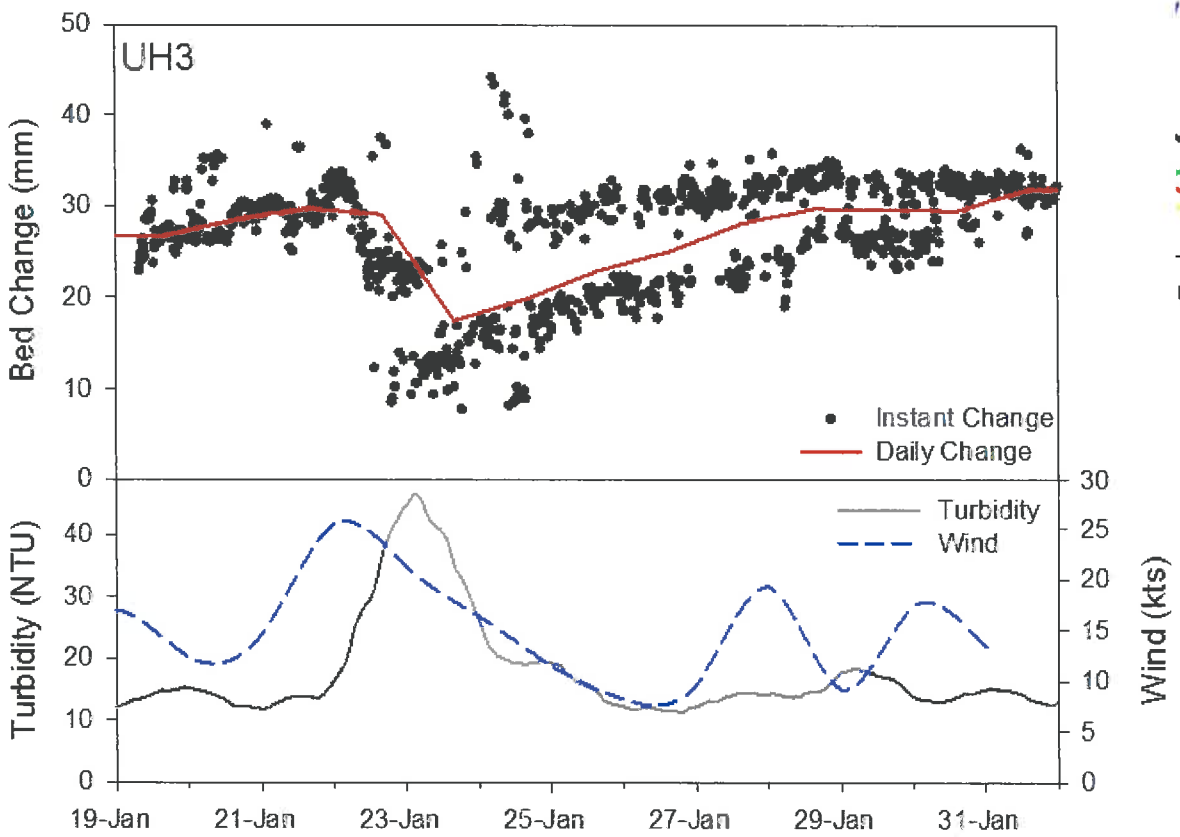
Dissolved oxygen and algal blooms



Results to Date – Inshore

Wind speeds





Sedimentation

Data Processing

- 3000 data points per sonde per month
- Data deconfounding protocols & HSEQ Quality Management System
- Instrument manual deconfounding rules – difference between two sondes – Mean two sondes
- Automatic deconfounding (manual validation)
  - Self-Monitoring Algorithm in Real Time = SMART
- Smoothing techniques
  - 24 and 72 hour rolling averages

Field

- VE41 Sonde Calibration and Set up
- VE43 Self-Logging Sonde Setup & Download
- VE46 Sonde Exchange
- VE90 Diving Operations Manual

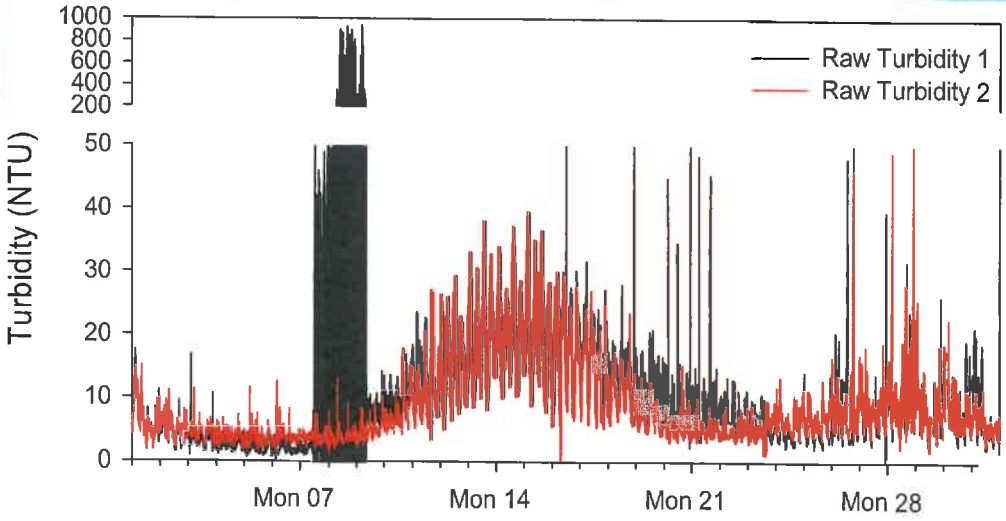
Data

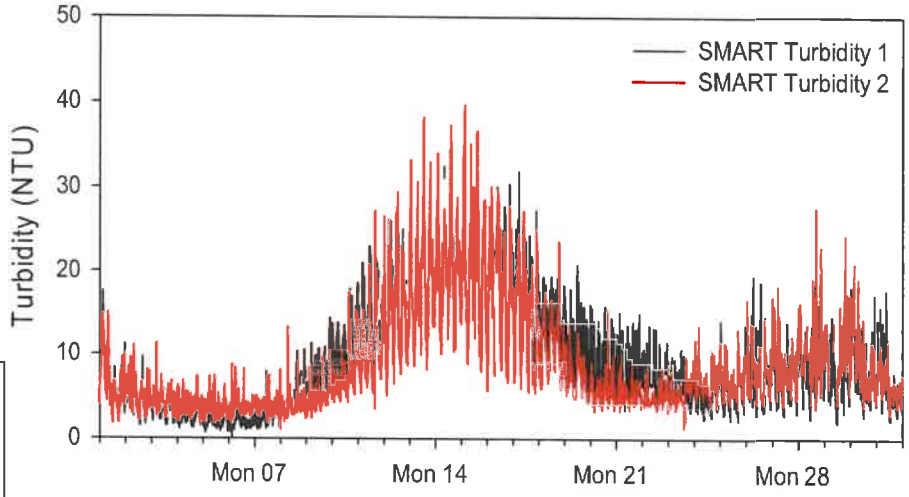
- VE49 Physicochemistry Logger Data Deconfounding
- VE58 Daily Client Logger Data and Checks
- VE81 Control of Records
- VE82 Document Control
- VE115 Telemetry Anomalies and Maintenance

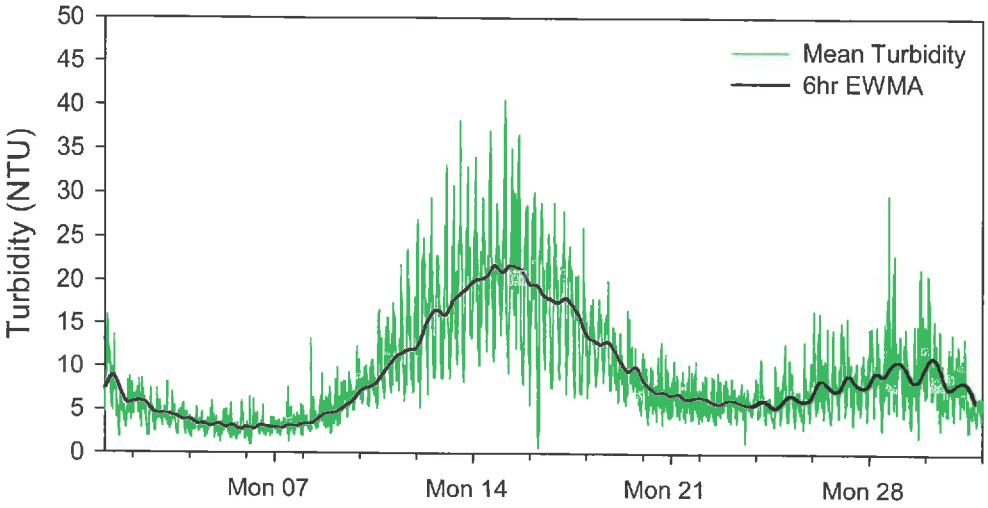
General

- VE01 Vision HSEQ Management System
- VE87 HSEQ Policy
- VE138 Project Management
- VE143 Equipment Management
- VE144 Control of Non-Conforming Product, Corrective a
- VE151 Risk Management and Compliance
- VE166 HSE Incident Management

Raw vs SMART NTU Data







Real Time Data Publication

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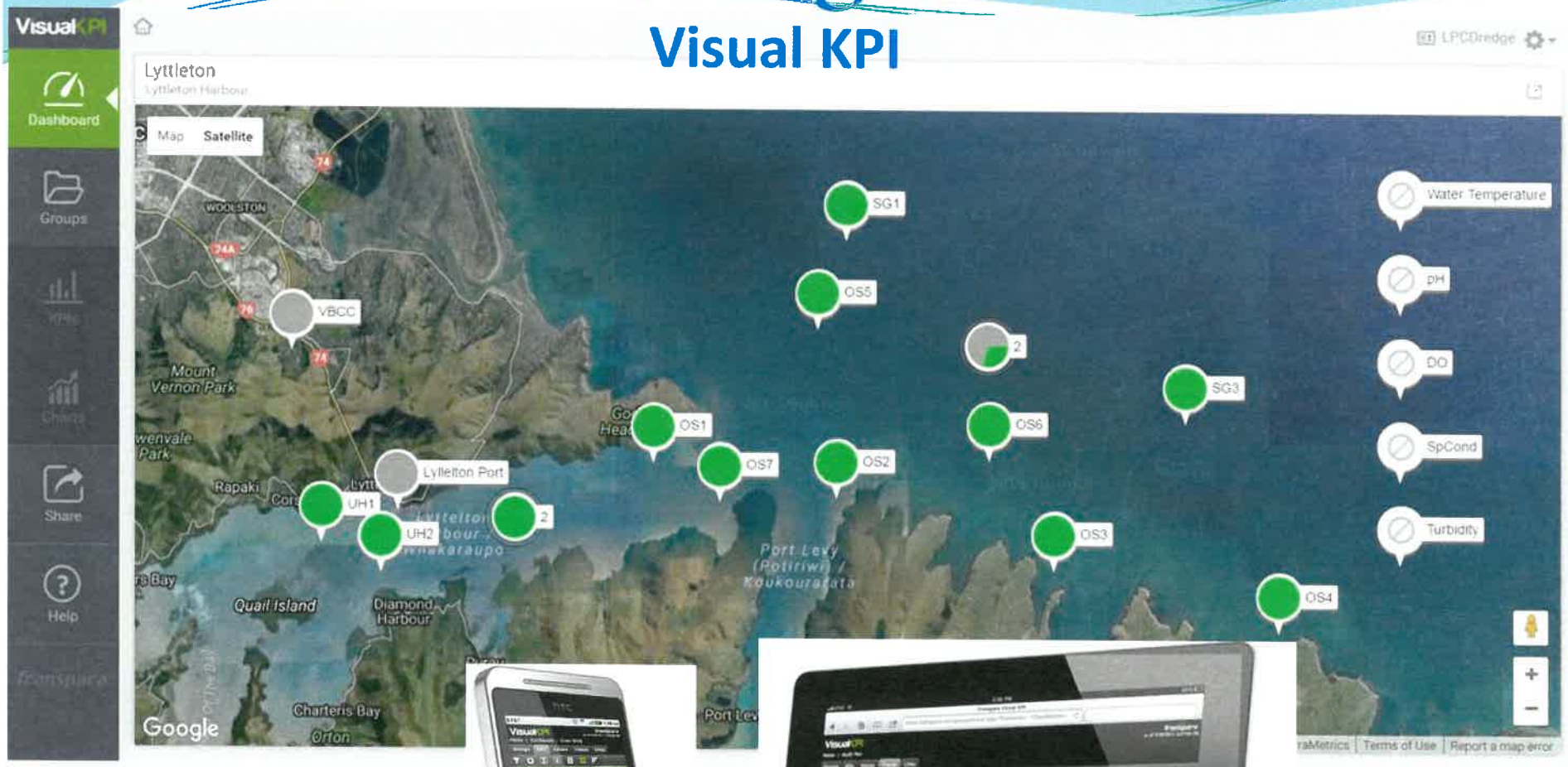
METSERVICE

VECloud:
-Data Import & Processing
-Data QC/QA (SMART)
-Data Report Generation
-Web Page Publication

CloudGeoTech
Virtual Geoscience Support

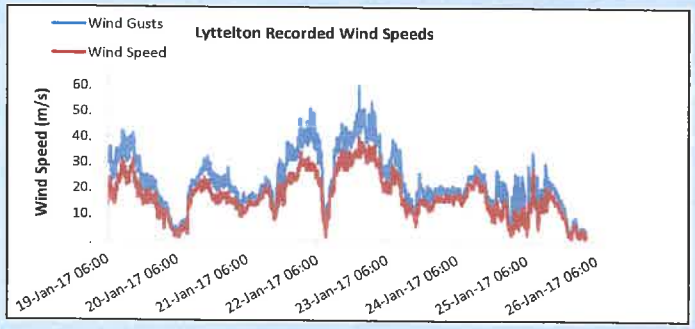
LPC Viewing Platform

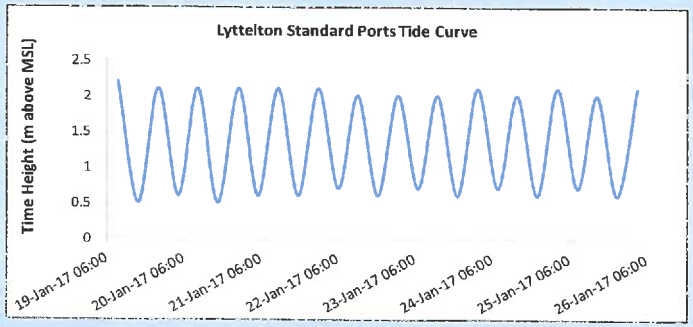
Visual KPI

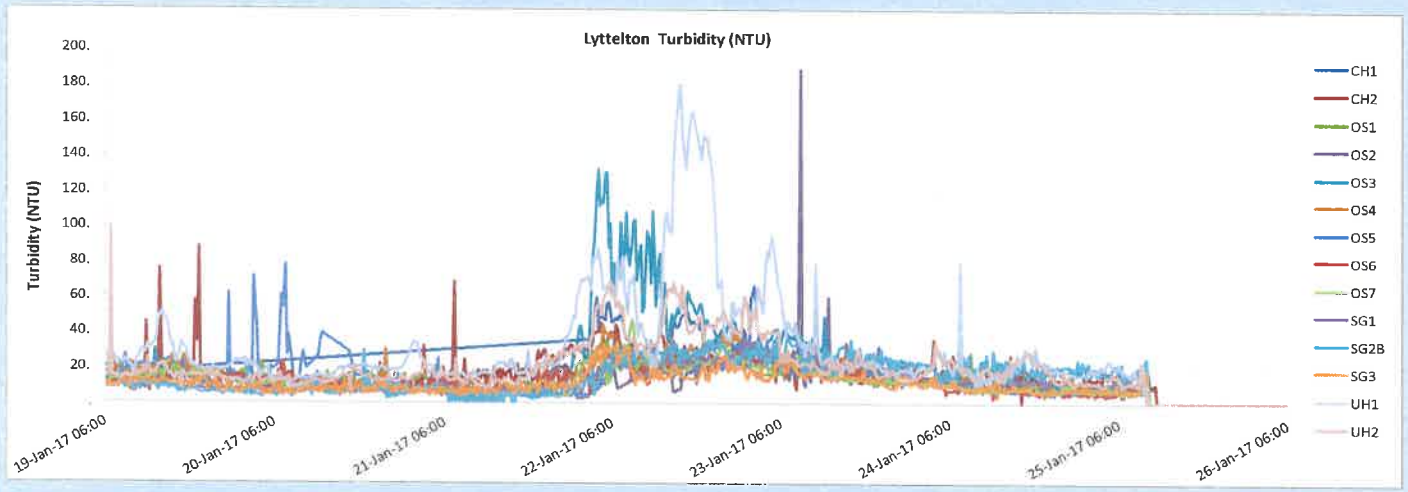


https://visionenvironmentqld.com.au/VisualKPI

LPC Daily Email







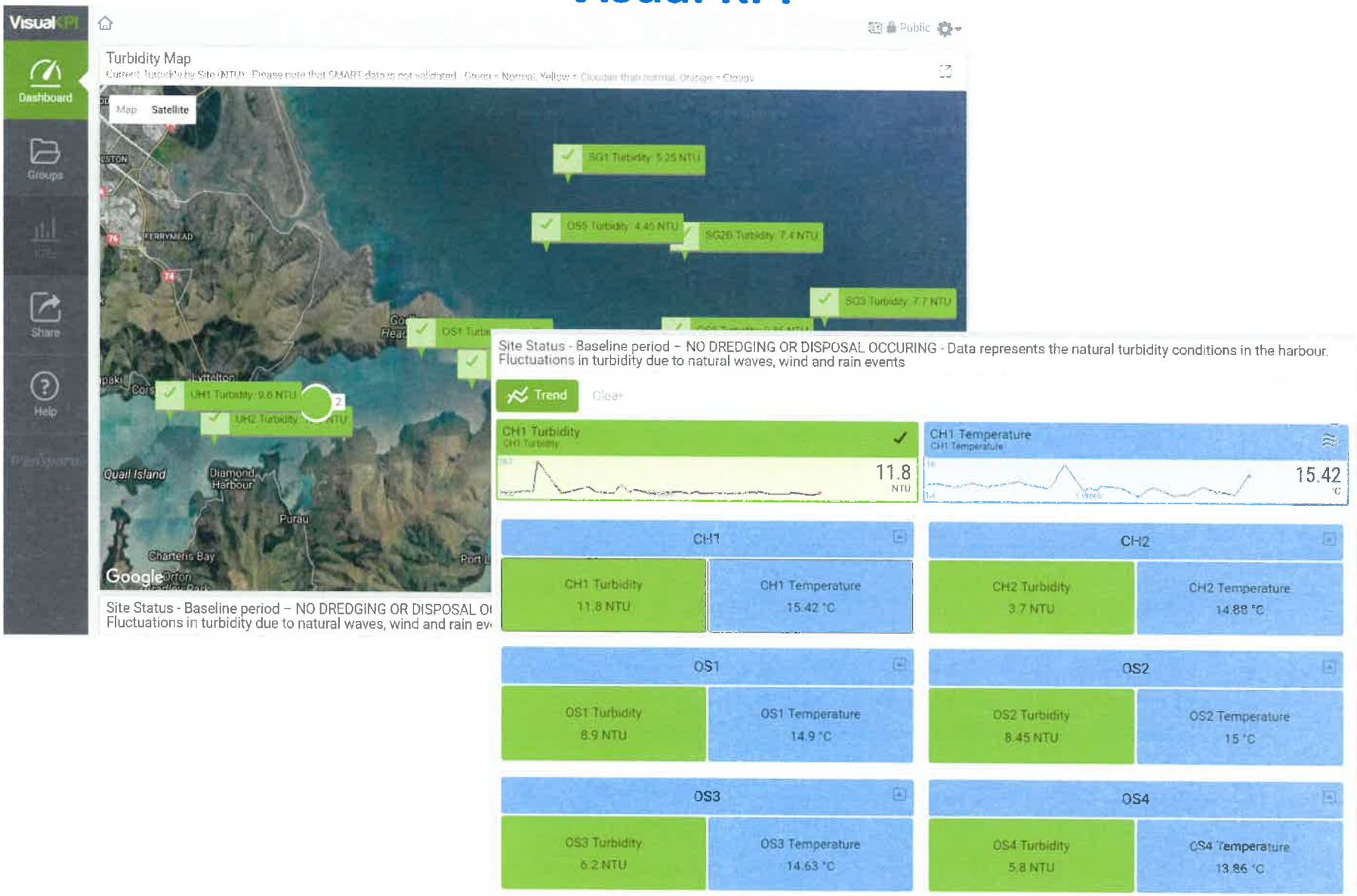
Turbidity (NTU)		
Dates: 19-Jan-2017 06:00 - 26-Jan-2017 06:00		
Site	Minimum	Maximum
CH1	6	67
CH2	0	1099
OS1	1	100
OS2	0	100
OS3	6	198
OS4	4	1175
OS5	3	1927
OS6	3	888
OS7	4	100
SG1	3	36
SG2B	0	789
SG3	4	39
UH1	6	180
UH2	0	100

Tide Times		
19-Jan-17 10:00	2.2	High
19-Jan-17 16:15	0.5	Low
19-Jan-17 22:30	2.1	High
20-Jan-17 04:45	0.6	Low
20-Jan-17 10:45	2.1	High
20-Jan-17 17:00	0.5	Low
20-Jan-17 23:30	2.1	High
21-Jan-17 05:30	0.6	Low
21-Jan-17 11:45	2.1	High
21-Jan-17 18:00	0.6	Low
22-Jan-17 00:15	2.1	High
22-Jan-17 06:30	0.7	Low
22-Jan-17 12:30	2.0	High
22-Jan-17 18:45	0.6	Low
23-Jan-17 01:00	2.0	High
23-Jan-17 07:15	0.7	Low

- Custom recipient list
- Includes attached data in Excel
- Traffic light system for exceedances

Public Viewing Platform

Visual KPI



Thankyou