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Date	4 April 2016
Attention	Zoe Harrison, RWE
From	Matt Robson, Jacobs UK Ltd
Subject	**Aberthaw pH Variation- Ecological Assessment- preliminary observations note**

1. Introduction

Aberthaw Power Station is a 1500 MW coal-fired plant located on the South Wales coast 9 km west of Barry. It abstracts cooling water (CW) from, and returns it to, the Bristol Channel via two outfalls at low water near Breaksea Point.

The pH of the discharge complies with discharge requirements set by National Resources Wales. Due to possible changes in the station's coal supply, it is anticipated that higher sulphur levels in the coal will result in a discharge with a lower pH. The current permit allows for an instantaneous pH of 5.8, with the proposed permit variation seeking a reduction of this to 5.6. As part of the permit variation process, RWE is undertaking a trial using the new coal supply, allowing an assessment of the likely impacts of the modified discharge on ecological receptors in the adjacent marine environment.

This note provides a summary of the fieldwork conducted to date, which includes the baseline survey (November 2015) and the initial operational trial survey (March 2016). The note details the methods used to assess the status of the intertidal communities, including the *Sabellaria.alveolata* (honey-comb worm) reef and gastropod populations, and outlines the preliminary observations from the two surveys.

2. Methods

2.1 Intertidal benthic communities

Species assemblage surveys were carried out at low, mid and upper shore sites across four transects (LW, EO, LE and HO) within Limpert Bay (Figure 1). A single transect at the reference site (Nash Point) was also assessed. At each shore level, five 0.25 m^2 gridded quadrats were placed on the shore in approximately the same locations as determined during the baseline survey in November 2015.

Within each quadrat the abundance and % cover of biota was assessed and recorded *in situ*. In addition to this, a count of frequency of occurrence for each taxa across the 25 squares of the quadrat was also recorded.

2.2 Gastropod assessments

50 individuals of each target species (*Patella vulgata* and *Littorina littorea*) were collected from the mid shore zone on each of the four transects. Specimens were processed in the Southampton laboratory for biometric information- maximum shell height and length of *P vulgata* and the maximum shell height and width of *L littorea* was recorded to the nearest mm. The body tissue from all specimens was extracted and wet weighed to the nearest 0.0001 g.

2.3 Water Quality

To provide comparative data, 12 *insitu* physico-chemical readings were taken during the March survey at regular intervals along the waters' edge (between sites LE and LW) in Limpert Bay using a handheld YSI 556.

A single reading was taken at Nash Point towards the eastern end of the *S. alveolata* reef area.

2.4 *Sabellaria alveolata* reefs

The extent of the *S. alveolata* reef at Limpert Bay and at Nash Point was mapped by walking the periphery of any reefs and recorded using a handheld GPS, with boundary points logged every 5 seconds. The nature and condition of the reef structures were also recorded and assessed in major areas of the biotope in the form of field notes and photographs.

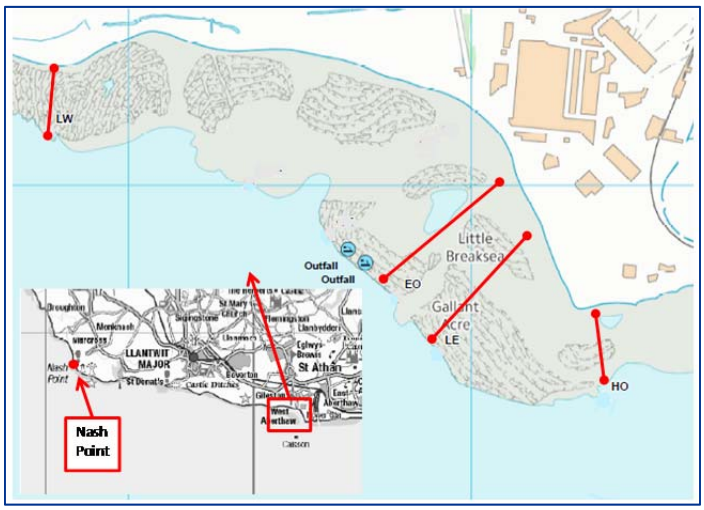


Figure 1 : Map showing the four transects in Limpert Bay, and the location of the Nash Point reference site (inset).

3. Preliminary Observations

3.1 Intertidal benthic communities

Limpert Bay and Nash Point are both exposed tide-swept shores with rocky platforms, interspersed with sediment and boulders. The fauna present across the shore are representative of the habitat and local environmental conditions.

3.1.1 Upper shore

Owing to the exposed nature of the upper shore there is a relatively low species diversity at Limpert Bay. Where areas of sediment were present, populations of *Lanice conchilega* (Sand Mason worm) were observed. The dominant algal species present was *Fucus spiralis* (Spiral wrack).

No discernible temporal variations in the communities recorded were identified between November and March.

The reference site at Nash Point is very exposed, and as such, the upper shore area is characterised by low species richness and reduced algal cover when compared to Limpert Bay. Rock habitat was

predominantly dominated by *Littorina* spp. and *Patella vulgata,* and with a degree of barnacle coverage.

3.1.2 Mid shore

The dominant algae species recorded in Limpert Bay in both the November and March surveys was *Fucus vesiculosus* (Bladder wrack)*. Ascophyllum nodosum* (Egg-wrack) was observed in discrete patches in November, and was also recorded in the quadrats in the March survey.

Gastropods were abundant on the mid-shore, including: *Gibbula* spp. (top shells), *P vulgata,* and *Littorina* spp. (periwinkles). Barnacles were less abundant on the mid shore, with <20% coverage during both the November and March surveys. Corallinaceae crusts of the algae *Lithophyllum* spp. were also present in the mid shore quadrats in November and March.

The mid-shore area at Nash Point did not have a dense coverage of macroalgae as was recorded at Limpert Bay. Gastropods were numerous and *Corallina* spp. present where microhabitats permitted. *Corralina* spp. and *Ulva lactuca* (sea-lettuce) were also observed in the shallow pools and crevices across Limpert Bay.

3.1.3 Lower shore

The lower shore across Limpert Bay was dominated by *Fucus serratus* (toothed wrack)- a shift from *F. vesiculosus* which dominated the mid shore*. S. alveolata* reefs were also present across the lower shore underneath the canopies of *F. serratus,* and were dominant across all transects.

Extensive beds of *S. alveolata* were also identified at Nash Point, but these were not as interspersed with *F. serratus* and supported populations of the smaller, hairy sand weed (*Cladostephus spongiosus*). *C. spongiosus* was also recorded at Limpert Bay in both surveys, but with a lower percentage cover than observed at the reference site.

Nucella lapillus (dogwhelk) was observed across the two lower shores. In Limpert Bay, it was predominately recorded at site HO.

3.2 Gastropod assessments

Gastropods were most populous around the mid shore on all transects, both in November and March. Due to the ease of collection at all five survey sites in both November and March, and the general observations made by survey staff, it is suggested that there was no obvious decrease in the numbers of either species between surveys.

Laboratory and associated data analyses of all specimens collected are pending.

3.3 Water Quality

Physico-chemical water quality data is listed in Table 3.1. With the exception of YSI04, all readings were taken in water directly connected to the tide. YSI04 was taken from a shallow rock pool on the lower shore close to transect EO. Shallow, hard bottomed rock pools are a common feature across Limpert Bay. YSI05 was taken directly west of the outfall and YSI06 in a shallow pool connected to the tide and outfall. The readings taken at both YSI05 and YSI06 were below 7.

Excluding the two sites proximal to the outfall, pH readings across Limpert Bay ranged between 7.29 (YSI07) and 8.52 (YSI10, by site LW).

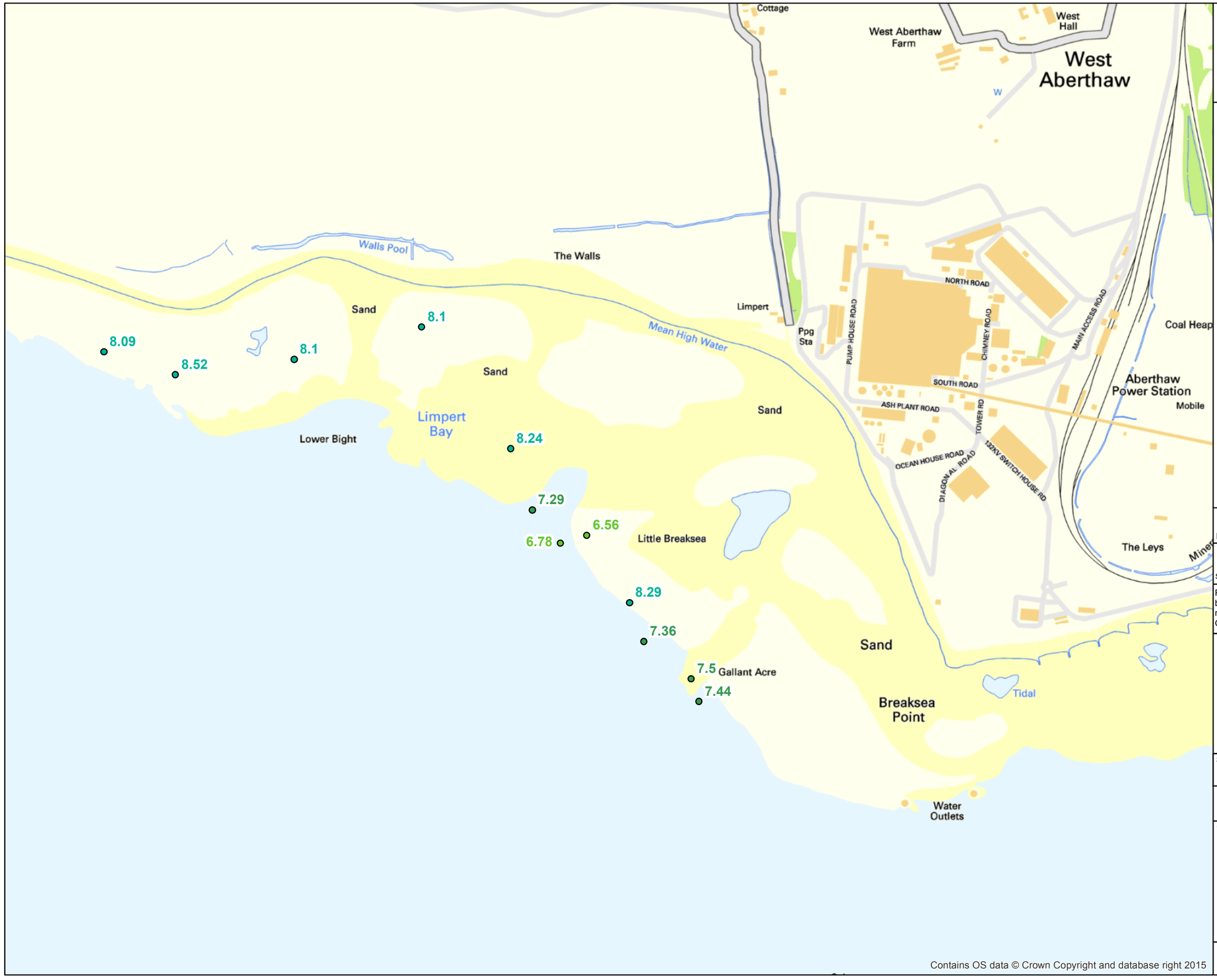
The pH was recorded at Nash Point was 8.08; within the range reported for Limpert Bay.

Water temperatures were recorded above 16°C adjacent to the outfall, with a reading of 15.75°C to the west of the discharge at YSI07. YSI01-YSI03 (east of the outfall) all recorded readings of between 12.39 and 14.25°C.

Table 3.1 : Water quality data and sampling positions along the shore for Limpert Bay (LB, 8th March) and Nash Point (NP, 9th March). All readings (except YSI11 and YSI12) were taken during an ebb tide period.

Date	Temp°C	Sal	DO (%)	pH	Lat and Long	Site
YSI01	12.39	27.83	102.9	7.50	N51 22.836 W3 24.676	Limpert Bay
YSI02	12.34	27.66	105.8	7.44	N51 22.812 W3 24.662	Limpert Bay
YSI03	14.25	26.99	95.1	7.36	N51 22.875 W3 24.758	Limpert Bay
YSI04*	11.19	27.23	109.3	8.29	N51 22.916 W3 24.784	Limpert Bay
YSI05	17.62	26.16	98.7	6.56	N51 22.987 W3 24.859	Limpert Bay
YSI06	16.20	26.38	91.9	6.78	N51 22.978 W3 24.904	Limpert Bay
YSI07	15.75	26.37	99.5	7.29	N51 23.013 W3 24.953	Limpert Bay
YSI08	9.50	27.00	106.0	8.24	N51 23.078 W3 24.992	Limpert Bay
YSI09	8.48	21.43	106.1	8.10	N51 23.169 W3 25.365	Limpert Bay
YSI10	8.81	26.38	110.3	8.52	N51 23.150 W3 25.567	Limpert Bay
YSI11	7.78	26.29	107.3	8.09	N51 23.173 W3 25.690	Limpert Bay
YSI12	8.24	26.40	108.6	8.10	N51 23.206 W3 25.148	Limpert Bay
YSI13	7.38	28.53	105.0	8.08	N51 24.111 W3 33.723	Nash Point

** taken from a shallow rock pool habitat*



N

0 25 50 100 150 200
Metres

KEY:

Sampling point

pH

- 6.56 - 7.0
- 7.0 - 8.0
- 8.0 - 8.52

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RWE

Geospatial Graphics
RWE Generation UK plc
Electron - E12
Windmill Hill Business Park
Swindon
SN5 6PB

T: +44 (0)1793 893618
E: sam.pearshouse@rwe.com

Size of original	Scale of original
A3	1:7,000

Site: ABERTHAW

Title: SAMPLING LOCATIONS - pH VALUES

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Reference: UKP/ATB/1658/AP2

3.4 *Sabellaria alveolata* reefs

A description of the reefs assessed across both sites is provided below. The reefs are discussed in relation to their proximity to the transect sites, outfall structures, and to the YSI water quality positions as listed in Table 3.1. Mapping outputs will be provided in the next update note.

Overall, no changes were observed *in situ* between the November and March survey periods.

3.4.1 Limpert Bay

The limit of *S. alveolota* reef that have been mapped at Limpert Bay is from approximately west of the old outfall structures in the east of the bay, to the west of LW; the most western transect. This area covers the shore approximately 900m east, to over 1 km west of the existing outfall structures. This is representative of the extent of shore mapped historically by CCW (Countryside Council for Wales, now Natural Resource Wales (NRW)) around the outfall, but with a greater area mapped to the east of the outfalls and a smaller area to the west in Penry Bay (lies west of transect LW). The summary descriptions provided below runs from the east at HO, to the west at LW.

East of the old outfall and HO

Although not mapped, it was noted that an large reef extends easterly from the old outfall structures (Figure 2). *S. alveolata* formations were also observed in the openings of the old outfall structures, possibly due to increased sediment deposition in the local sheltered conditions.

Figure 2 : View of *S. alveolata* reef looking eastwards from the old outfall structures (March 2016).

West of old outfall

Discrete patches of *S. alveolata* were noted extending westwards of the old outfall structures.

West of LE

A distinct, continuous thin band of *S. alveolata was* noted on the rock ledge. This was a mix of encrusting type structures, with poor growth of less than 10 cm in height (Figure 3, WQ sample point YSI02). The *S. alveolata* reef then becomes a continuous reef on cobbles, with patches of ball growth (<20cm) in height (Figure 4, WQ sample point YSI03).

Figure 3 : Looking westwards from LE, WQ sample point YSI02 (March 2016).

Figure 4 : *S. alveolata* reef with ball formations on cobbles, looking westwards with outfall in distance (March 2016).

West of EO

West of transect EO *S. alveolata* reef was found encrusting rocks higher on the shore underneath a canopy of *Fucus serratus* (Figure 5, WQ sample point YSI04).

Figure 5 : *S. alveolata* under *Fucus serratus*, looking westwards towards current outfall (March 2016).

Vicinity of current outfall

Low growth of *S. alveolata* was noted adjacent to the current outfall, with growths of < 5cm on the exposed rocky platforms (Figure 6, WQ sample point YSI05).

Figure 6 : *S. alveolata* encrusting rocks in the vicinity of current outfall (March 2016).

West of current outfall

On the rocky platforms just to the west of the current outfall, the aggregations of reefs become denser with ball morphologies of up to 20cm in height (Figure 7). Lower down on the shore there is a very extensive area of reef, again with dense aggregations, but with smaller ball structures of up to 15cm (WQ sample point YSI06). A similar bed was noted adjacent to WQ sample point YSI07, but was interspersed with cobbles and *Fucus* spp.

West of WQ sample point YSI08 there is a larger area of *S. alveolata* reef that is very patchy and encrusting. Moving westwards there is a continuous reef, interspersed with boulders, rockpools and dome-shaped growths 10-15cm in height, notably in the upper shore area. The lower shore areas had encrustations with a high proportion of relic tubes.

West of the sandy inlet adjacent to WQ sample point YSI09, a small area of 'termite mound' shaped *S. alveolata* structures was identified within a larger area of reef. However, the majority of this reef was low-lying encrusting and interspersed with occasional ball-like features, with abraded tubes characterising the south-west corner of the reef.

Figure 7 : *S. alveolata* west of outfall higher up from low waters mark (March 2016).

West of LW

This area of the shore is noted as having an appreciable amount of abundant reef, interspersed with areas of low encrusting growths on predominantly rocky platforms underneath dense fucoid canopies (Figure 8). The reef on the wave swept rocky platforms become relatively dense, with colonies up to 10cm in height. To the very west of LW, the reefs were similar but more abraded reef being noted, and with a moderate cover of fucoids (WQ sample point YSI11).

Figure 8 : Reef underneath fucoid canopies, looking west of LW (March 2016).

3.4.2 Nash Point

The limit of *S. alveolata* reef that was mapped at Nash Point was between the freshwater runoff on to the shore, to over 360 m west of this point (Figure 9). NRW have previously mapped a larger area at Nash Point (~ 1 km east of the freshwater input), but for the purpose of this investigation it is not required to assess such a large area of shore.

The Nash Point shore is very exposed and the reefs present exhibited two distinct zones. The beds of the lower western area were abraded, with sparse low crusts on the rocks. In comparison, the reefs in the eastern mid shore area where continuous with distinct ball formations 20 – 30 cm in height. Appreciable areas of bedrock were also noted as being interspersed with the reef.

Figure 9 : NW corner of the *S. alveolata* reef at Nash Point (March 2016). Note the erect dome structures.

4. Preliminary conclusions

The intertidal benthic communities recorded across Limpert Bay are representative of the habitat and environmental conditions of the shore.

Based on *in situ* observations and initial interpretation of the quadrat assessments, there does not appear to be any spatial differences in the assemblages in relation to the position of the discharge. Natural difference in the substrata (e.g. rock to sand) result in different community composition, and in areas of increased tidal exposure, assemblages follow classic intertidal zonation patterns.

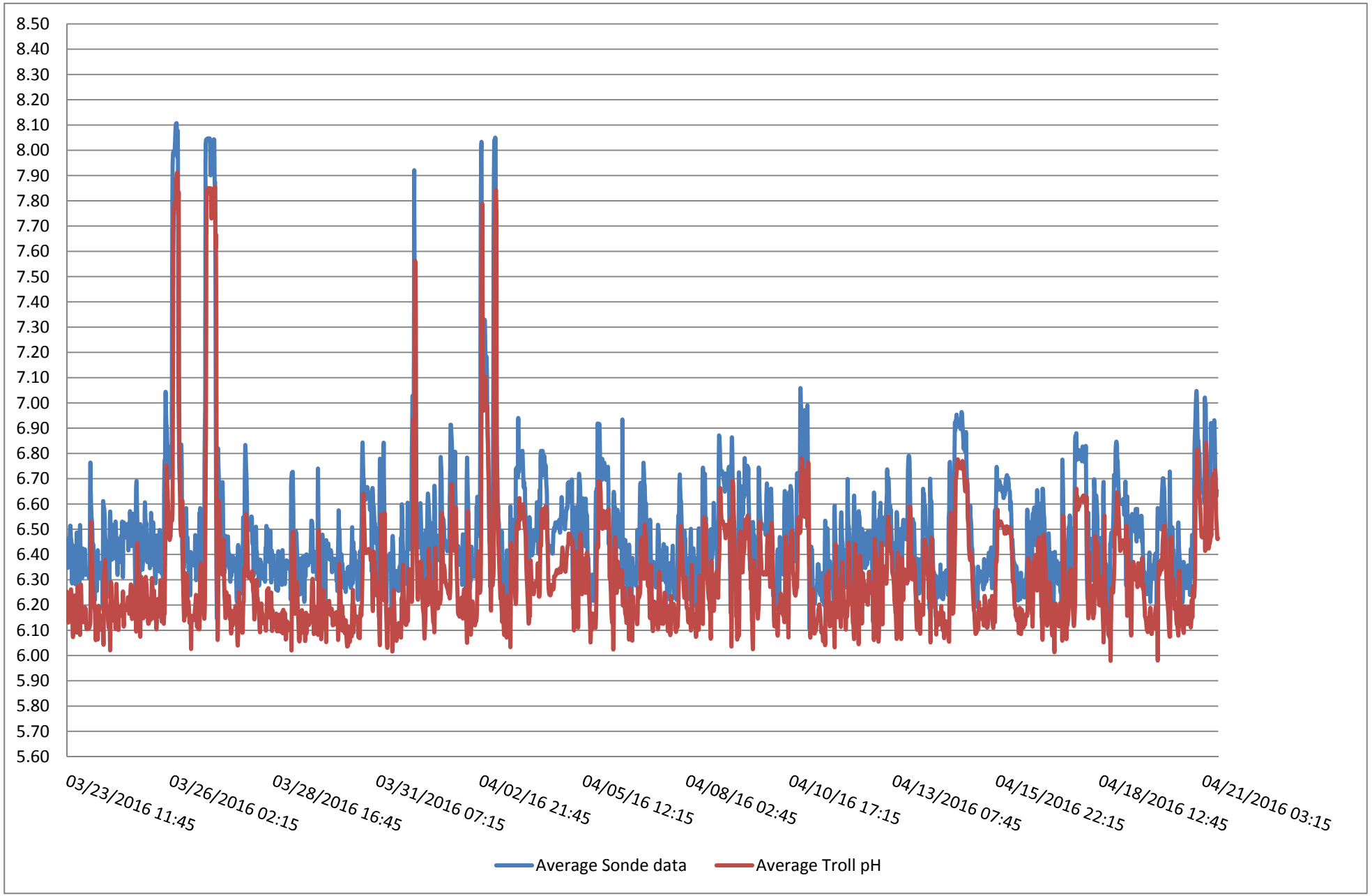
In situ physico-chemical water quality measurements indicated a reduced pH (<7) and elevated water temperatures (>16°C) local to the outfall (March 2016). The pH levels recorded in March were in line with those reported from RWE realtime measurements, and were indicative of those anticipated during the trial period. It is considered that any effects related to the discharge will be localised, the greatest potential for discharge-biota interaction being during the low water windows due to the reduced dilution factor.

Preliminary observations suggest little discernible difference in the marine community between November 2015 and March 2016. Differences between the sites were within that expected taking account of level on the shore, exposure, and substrata type. Gastropods were noted as being abundant during both surveys. Although not available at this time, it is anticipated that there will be no difference in the biometric data from the gastropods collected between the two surveys. The operational trial only commenced in February 2016, and hence it is unlikely that any potential effects of a reduced pH would translate into a difference in shell size etc in such a short time frame.

Preliminary data suggest no notable changes in the extent or health of the *S. alveolata* reefs between the two survey periods in Limpert Bay. Areas of abraded and relic tubes were observed in the far western area (remote from the outfall) during both periods. In the vicinity of the outfall low encrusting reefs were observed, although a short distance west from this point the reefs become extensive, with ball formations visible up to 20cm height. Areas of relict *S. alveolata* reef were commonly recorded at the margins of mature reefs.

The reef structures at Nash Point can clearly be correlated with wave exposure, with taller features visible higher up on the shore compared with crusts and abraded areas across the lower shore. No differences were recorded between the November 2015 and March 2016 surveys.

Overall, preliminary observations and data suggest that operation of the pH variation trial at the Aberthaw station has had no discernible effects on the intertidal benthic communities in the vicinity of the outfalls.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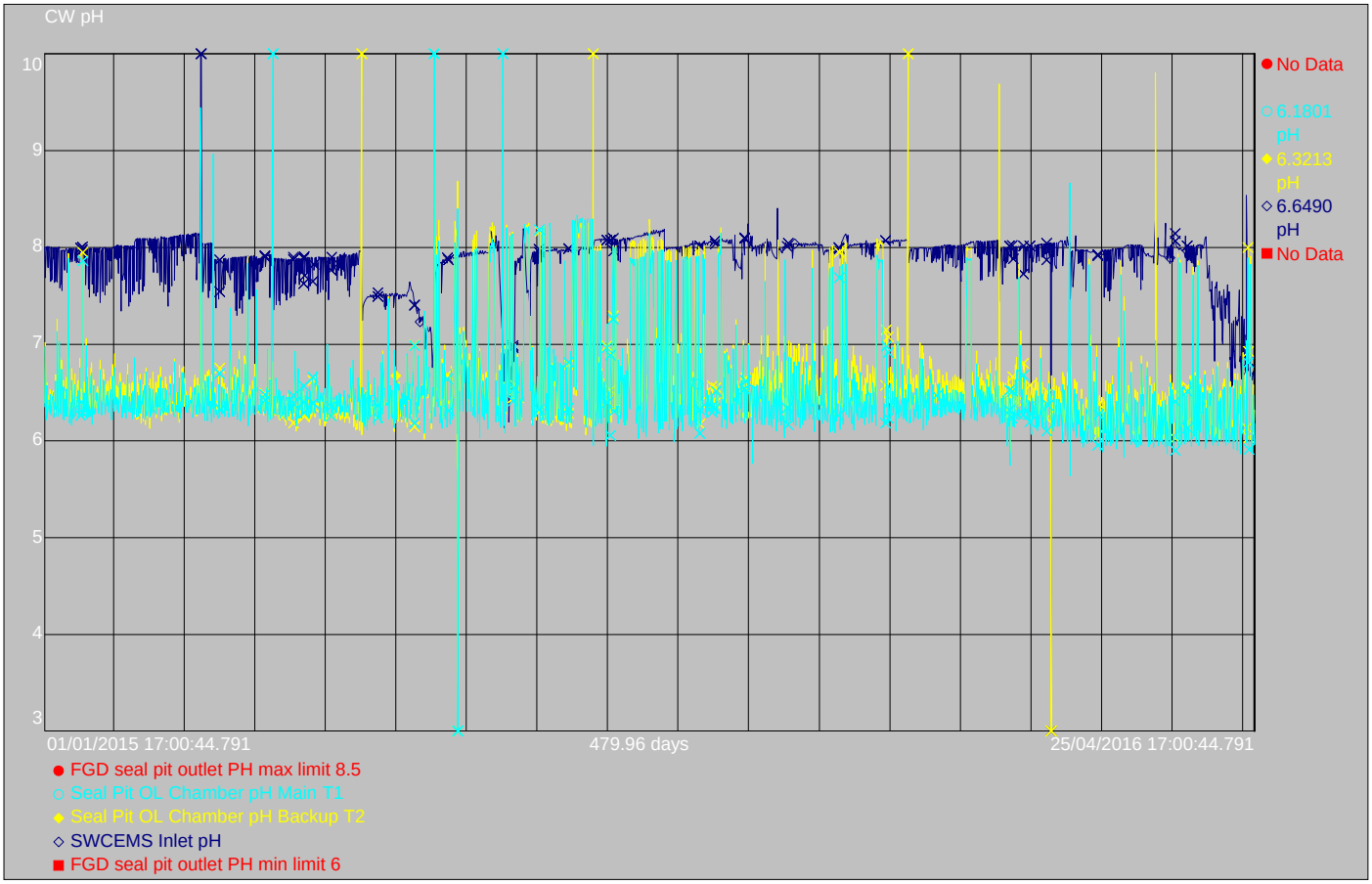
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