**Winter Storms 2013-2014**

Please note that this report details changes between scheduled spring interim surveys. Where scheduled surveys took place before or during the storms in early 2014 analysis may not be indicative of post-storm damage.

Survey dates for each location are given in Annex E.

For an analysis of post-storm change and subsequent rates of recovery please see the following reports:

- Review of South West Coast Beach Response to Wave Conditions During the Winter of 2013-2014
- South West Beach Recovery Since Winter 2013-2014

All reports are available from our website www.channelcoast.org/southwest
South West Regional Coastal Monitoring Programme

Annual Survey Report 2014 – Sand Point to Aust

1. Introduction

Analysis presented in this report provides an overview of beach changes and wave and tidal measurements since the extension of the South West Regional Coastal Monitoring Programme. The first beach surveys took place during the spring of 2009 and changes are reported until spring 2014. This provides a short time base over which beach changes have been monitored. Detailed interpretation and decision-making is not advisable on the basis of these short-term changes, since the changes may not be representative of longer-term trends.

Data are presented at several levels:

- Process cell summary of percentage and actual profile change from 2013 to 2014
- Process cell summary of percentage and actual profile change from 2009 to 2014
- Detailed beach profile change from 2013 to 2014
- Detailed beach profile change from 2009 to 2014
- Time series of beach profile graphs (on CD)
- Trend analysis of beach cross-sectional area (on CD)

The process cell summary maps provide an at-a-glance summary of the changes during the past year and over the longer term. It is recommended that the user should use the maps to identify areas of interest and then examine the individual profile plots and trends. Colour-coded lines highlight areas of maximum change and identify profiles which might need closer examination.

It must be noted that the colour coded lines are based on actual change as opposed to percentage change as is the case with similar reports published by the South East Regional Coastal Monitoring Programme. Percentage change is displayed in brackets following the profile name on each line.

Difference models have been produced where there are at least two baseline surveys to compare. In addition, the most recent LiDAR data has been used to extract the level of Mean High Water (MHW) for each survey unit, where possible.

It must be appreciated that the accuracies of each measurement system must be taken into account when drawing conclusions, particularly from the difference models. In the case of topographic difference models from RTK GPS surveys, the accuracy of each data point is ±0.03m and therefore differences of ±0.06m can generally be considered as "real", whilst smaller changes may be an artefact of the measuring system, and are considered to be "No Change". Difference plots show changes >±0.25m, which should be indicative of areas of genuinely measurable change. Smaller changes may also be present but these are filtered from the analysis to provide clarity. This report displays difference models only where detailed analysis suggests that the changes are real but, nevertheless, the user should approach the results as indicative, unless reinforced overtime or with other information.
Where LiDAR has provided the source data sets, the modelling is less precise. Each LiDAR cell value has a plan position representative of a 1m² grid. It is not reasonable to expect to observe changes with positional accuracy of better than 1-2m therefore. Profiles of steep slopes may suggest that the changes “bounce” back and forth. This is an artefact of the accuracy of the source data. LiDAR is particularly ineffective at identifying sharp edges or steep slopes e.g. cliffs, seawalls. Despite these limitations in accuracy the changes shown indicate an overview of profile change, but to a lower precision than the RTK data. The location of the regularly surveyed profiles superimposed on the difference plots indicates how representative these profiles might be of overall changes.

It must be emphasised that this is only the fourth report of a series and that changes identified are indicative only of short-term trends. As the Programme progresses, more detailed and meaningful reporting will be possible and this report should be treated accordingly.

2. **Hydrodynamic Data**
   
a. **Waves**  
   There are no Regional Monitoring Programme wave buoys between Sand Point and Aust.

b. **Tides and Met Stations**  
   A WaveRadar Rex was installed on the Second Severn Crossing in April 2011

   A tide report for the Second Severn Crossing is given at Annex B.

3. **Survey Data – Topographic**

   All profiles continue to show changes of 5% or less between spring surveys.

   Longer term analysis also persists in showing profile changes of 5% or less in four of the five survey units included in the report. Survey unit 7eSU15-1 has continually shown low level gains along two profiles, a trend which is maintained in this year’s baseline to spring survey analysis.

   Dates of surveys are shown in Annex E and the detailed topographic survey report is given at Annex F.

4. **Survey Data – Bathymetric**

   The first baseline bathymetric survey of the Severn Estuary was undertaken in May and June 2009. No further analysis will be carried out until after the next baseline survey.
<table>
<thead>
<tr>
<th>Annex</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>N/A</td>
</tr>
<tr>
<td>B</td>
<td>Second Severn Crossing Tide Report</td>
</tr>
<tr>
<td>C</td>
<td>N/A</td>
</tr>
<tr>
<td>D</td>
<td>N/A</td>
</tr>
<tr>
<td>E</td>
<td>High Level Report – field data collection (SECG)</td>
</tr>
<tr>
<td>F</td>
<td>Topographic Survey Report for Sand Point to Aust</td>
</tr>
<tr>
<td>G</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Explanatory Notes
South West Regional Coastal Monitoring Programme  
Field Data Collection – SECG  
Topographic Data

<table>
<thead>
<tr>
<th>Subcell</th>
<th>Survey Unit</th>
<th>Autumn Interim 2013</th>
<th>Post-storm</th>
<th>Spring Interim 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Target</td>
<td>Completion</td>
<td>Target</td>
</tr>
<tr>
<td>7e</td>
<td>SU17-5</td>
<td>31/03/2014</td>
<td>27/02/2014</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SU17-2</td>
<td>31/03/2014</td>
<td>25/02/2014</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SU15-2</td>
<td>31/03/2014</td>
<td>26/02/2014</td>
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</tr>
<tr>
<td></td>
<td>SU15-1</td>
<td>31/03/2014</td>
<td>26/02/2014</td>
<td></td>
</tr>
</tbody>
</table>

Key
- Green: Completed on time and accepted
- Red: Completed late
- Orange: Surveyed but not submitted / Accepted
- Gray: Will not be surveyed

For the most recent survey schedules for each survey unit please see [http://www.channelcoast.org/southwest/survey_programme_schedule/](http://www.channelcoast.org/southwest/survey_programme_schedule/)
Annex F – Topographic Survey Report for Sand Point to Aust

1. Introduction

Profile Data

Analysis has been conducted for those sites where a minimum of three surveys have been recorded. In general, changes are measured relative to the Mean Low Water Springs (MLWS) level. In the case of surveys conducted in the Severn Estuary, none reach MLWS due to muddy conditions and therefore MLWS has been substituted by Mean Low Water Neaps (MLWN) or Mean Low Water (MLW) as appropriate. In cases where none of these levels can be reached the master profile is placed at the lowest level achieved in the survey unit.

Master profile levels for each survey unit are given in Table 1.

Table 1: Master Profile levels for each survey unit

<table>
<thead>
<tr>
<th>Survey Unit</th>
<th>Survey Level (mOD)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>7eSU17-5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clevedon</td>
<td>-2.03</td>
<td>Lowest level reached by profiles 7e00477 to 7e00488</td>
</tr>
<tr>
<td></td>
<td>-1.40</td>
<td>Lowest level reached by profile 7e00491</td>
</tr>
<tr>
<td>7eSU17-2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Portishead</td>
<td>4.10</td>
<td>Lowest level reached by all profiles</td>
</tr>
<tr>
<td>7eSU15-2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avonmouth</td>
<td>3.80</td>
<td>Lowest level reached by profiles 7e00830 to 7e00849</td>
</tr>
<tr>
<td></td>
<td>5.04</td>
<td>Lowest level reached by remaining profiles</td>
</tr>
<tr>
<td>7eSU15-1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severn Beach</td>
<td>5.18</td>
<td>Lowest level reached by all profiles</td>
</tr>
</tbody>
</table>

A full time series of plotted beach profiles are shown superimposed and relative to a Master Profile for each profile location (on the CD accompanying printed copies). The Master Profile provides the basis for calculation of beach cross-section area changes. Where possible, identical depth boundaries have been used for all profiles within a survey unit. However, even where this has not been possible, direct comparisons can be made for the beach cross-sectional area at one profile over time, since the master profile is constant for each profile (Figure 1). In some instances, raising the lower depth of the Master Profile may reduce the overall cross-sectional area of the profile. This may cause small changes in the beach profile to have a large impact on the percentage change. This effect has been taken into account in the analysis of change to beach profiles. The trend in cross-sectional area (CSA) is presented as a graph for each profile (Figure 2).
Figure 1: Example Master Profile with CSA calculated from the surveyed GPS Profile

Figure 2: Example of Beach Profile Trend Analysis
1. Beach Cross-Sectional Area (CSA)
2. Replenishment Activities
3. Mathematically Derived Trend line
Baseline Data

As part of the Monitoring Programme specification, each survey unit receives a full topographic baseline survey once every 5 years. In addition, repeat baseline sites receive an annual baseline survey. Baseline surveys include a full profile survey at 50m intervals and continuous spot height data collected at approximately 1m intervals across the whole beach to the level of MLWS. This continuous data also includes a feature code for each spot height data point recorded.

2. Condition of process sub-cell

The Beach Change Summary maps contain an at-a-glance condition of the whole area between Sand Point and Aust, with the lines representing the average accretion, no change or erosion for each survey unit where there is topographic data.

3. Condition of individual survey units

Changes within each survey unit are summarised on three maps: Beach change map (Spring to Spring), beach change map (Baseline to Spring) and mean high water line maps. Beach Change maps show the location of each beach profile, superimposed on an aerial photograph (note that the line may be extended for clarity). Where possible, the annual change in cross-sectional area has been calculated from spring 2013 to spring 2014 and from baseline 2009 to spring 2014.

7eMU17-5: Wains Hill to Ladye Point

Spring 2013 to Spring 2014
Consistent with previous spring to spring analysis the profiles have all remained stable, with none showing a change of more than 5m².

Baseline 2009 to Spring 2014
Longer term analysis has previously consistently shown the unit to be stable with no changes above 5m² seen along any of the profiles. The results of the current baseline to spring analysis differs from this, as profile 7e00478 has gained 5m² of material and profile 7e00491 has lost just over 5m² of material. These changes do not, however, amount to a change of greater than 3% in the profiles cross-sectional area.

7eMU17-2: Woodhill Bay

Spring 2013 to Spring 2014
Over the past year the most southerly profile has gained just under 9m² of material, an increase of 4%. The remaining profiles show no change.

Baseline 2009 to Spring 2014
The longer term analysis shows a similar trend to the spring to spring analysis. Profile 7e00654 has shown a small increase in cross-sectional area, whilst the remaining profiles have shown a change of less than 5m² overall.
7eMU15-2: Mitchell’s Pill to Severnside Works

Spring 2013 to Spring 2014
None of the profiles in this survey unit show a change of greater than 2% over the past year. The overall trend is, however, for very low level erosion.

Baseline 2009 to Spring 2014
As with the previous baseline to spring analysis, none of the profiles in the survey unit show an overall change of greater than 5% since 2009. The overall trend is for erosion, with profile 7e00845 having experienced the greatest decrease in cross-sectional area, losing 21m² (-4%) of material.

7eMU15-1: Severn Beach

Spring 2013 to Spring 2014
Consistent with previous spring to spring analysis, there has been no change in the survey unit over the past year. Profiles show a net change of less than 5m² overall.

Baseline 2009 to Spring 2014
Consistent with previous baseline to spring analysis, the two most southerly profiles in the unit have gained material. Both profiles have shown deposition of between 5m² and 15m², amounting to increases of between 10% and 7% in their cross-sectional area. The remaining profile has lost material, which is also consistent with previous analysis, although the change shown (-5%), is slightly higher than in previous reports.
EXPLANATORY NOTES

Change in Cross-sectional Area (CSA)

The annual change in cross-sectional area is calculated as the difference in CSA between two surveys, expressed as a percentage change compared to the earlier CSA.

\[
\frac{CSA_1 - CSA_2}{CSA_2} \times 100 \quad \text{eqn}(1)
\]

Where CSA₁ = most recent springtime survey and CSA₂ = spring survey previous year. Therefore an annual change of –14% represents erosion during the last year of 14% of the area of last year’s survey.

Net Sediment Calculation

The value derived from this calculation represents the volume change in m³ across each individual management unit over time. The initial volumes are derived from the Digital Terrain Models made for consecutive baseline topographic surveys. Both models are clipped to cover the same area, then a volume above the MLWS plane is calculated for each DTM. The net sediment change is calculated as

\[
Vol_1 - Vol_2 \quad \text{eqn}(2)
\]

Where Vol₁ = most recent DTM model volume and Vol₂ = earlier DTM model volume. Therefore a net change of –19730 m³ represents erosion since the earlier survey.
Change in Cross-sectional Area (Spring 2013 to Spring 2014)

- > 30%
- 15 - 30%
- 5 - 15%
- Less than 5%
- No Change

- Actual Annual Change in Cross-sectional Area (m^2)

- Accretion
- Erosion

% Change in Cross-Sectional Area
Change in Cross-sectional Area (Baseline 2009 to Spring 2014)

- **Accretion**
  - > 30 m²
  - 15 - 30 m²
  - 5 - 15 m²
- **No Change**
  - Less than 5 m²
  - 5 - 15 m²
  - 15 - 30 m²
- **Erosion**
  - > 30 m²

Actual Annual Change in Cross-sectional Area (m²)

SU boundary

7d01323 (3)

Actual Change in Cross-Sectional Area

Beach Change Summary - Baseline 2009 to Spring 2014

SECG - Severn Estuary
Change in Cross-sectional Area (Baseline 2009 to Spring 2014)

- **Accretion**
  - > 30 %
  - 15 - 30 %
  - 5 - 15 %
  - Less than 5 %
  - 5 - 15 %
  - 15 - 30 %

- **Erosion**
  - > 30 %
  - Less than 5 %
  - 15 - 30 %
  - 5 - 15 %

**SU boundary**

Actual Annual Change in Cross-sectional Area (m²)

% Change in Cross-Sectional Area

Beach Change Summary - Baseline 2009 to Spring 2014

SECG - Severn Estuary

Annual Survey Report 2014

South West Regional Coastal Monitoring Programme
Actual Change in Cross-sectional Area (Spring 2013 to Spring 2014)

- **Accretion**
  - > 30 m²
  - 15 - 30 m²
  - 5 - 15 m²

- **Erosion**
  - 5 - 15 m²
  - 15 - 30 m²
  - > 30 m²

- **No Change**
  - Less than 5 m²
Contours

MHW Elevation: 4.70D
MLW Elevation: -4.00D

- MHW 2014 - 04
- MHW 2012 - 06
- MHW 2009 - 02
- MHW 2007 - 09
- MLW 2014 - 04
South West Regional Coastal Monitoring Programme

Annual Survey Report 2014

Actual Change in Cross-sectional Area (Spring 2013 to Spring 2014)

- **Acreation**
  - > 30 m²
  - 15 - 30 m²
  - 5 - 15 m²
  - Less than 5 m²

- **Erosion**
  - 5 - 15 m²
  - 15 - 30 m²
  - > 30 m²

No Change
- Less than 5 m²
- 5 - 15 m²
- 15 - 30 m²
- > 30 m²

Aerial Photography from 2014

Annual Change in Cross-sectional Area (%)

- 7e00666 (-1%)
- 7e00666 (-1%)
- 7d01323 (3%)
- 7e00659 (0%)
- 7e00659 (0%)
- 7e00654 (-1%)

SECG - Severn Estuary

7eMU17-2: Woodhill Bay - Beach Change
Actual Change in Cross-sectional Area (Baseline 2009 to Spring 2014)

- **Accretion**
  - > 30 m²
  - 15 - 30 m²
  - ≤ 5 m²
  - 5 - 15 m²

- **Erosion**
  - > 30 m²
  - 15 - 30 m²
  - ≤ 5 m²

- **No Change**
  - Less than 5 m²

**SU boundary**

Annual Change in Cross-sectional Area (%)

Aerial Photography from 2014

0 50 100 m

＞30 m²
15 - 30 m²
≤ 5 m²
5 - 15 m²
＞30 m²

7e00668 (2%)
7e00666 (1%)
7d01323 (3%)
7e00659 (1%)
7e00651 (5%)
7e00650 (5%)

7eMU17-2: Woodhill Bay - Beach Change

SECG - Severn Estuary

South West Regional Coastal Monitoring Programme

Annual Survey Report 2014
Aerial Photography from 2014

Contours
MHW Elevation: 4.70OD
MLW Elevation: -4.00OD

MHW 2014 - 04
MHW 2012 - 04
MHW 2007 - 09
MLW 2014 - 04
Actual Change in Cross-sectional Area (Spring 2013 to Spring 2014)

Accretion

- > 30 m²
- 15 - 30 m²
- 5 - 15 m²

Erosion

- Less than 5 m²
- 5 - 15 m²
- 15 - 30 m²
- > 30 m²

No Change

Annual Change in Cross-sectional Area (%)

SU boundary

Aerial Photography from 2014
Actual Change in Cross-sectional Area (Baseline 2009 to Spring 2014)

- **Accretion**
  - > 30 m²
  - 15 - 30 m²
  - 5 - 15 m²

- **Erosion**
  - Less than 5 m²
  - 5 - 15 m²
  - 15 - 30 m²
  - > 30 m²

**SU boundary**

Annual Change in Cross-sectional Area (%)

- 7d01323 (3%)
- 7e00870 (0%)
- 7e00880 (-1%)
- 7e00854 (-2%)
- 7e00849 (-2%)
- 7e00845 (-4%)
- 7e00839 (-3%)
- 7e00833 (-4%)

Aerial Photography from 2014

0 125 250 m

**SU boundary**

Daily Change in Cross-sectional Area (%)

- Accretion
- Erosion
- No Change

Annual Change in Cross-sectional Area (%)

- > 30 m²
- 15 - 30 m²
- 5 - 15 m²
- Less than 5 m²

**SU boundary**

Aerial Photography from 2014

0 125 250 m
Aerial Photography from 2014

Contours

MHW Elevation: 5.00OD
MLW Elevation: -4.10OD
Aerial Photography from 2014

Actual Change in Cross-sectional Area (Spring 2013 to Spring 2014)

- **Accretion**
  - > 30 m²
  - 15 - 30 m²
  - 5 - 15 m²

- **Erosion**
  - Less than 5 m²
  - 5 - 15 m²
  - 15 - 30 m²
  - > 30 m²

**SU boundary**

- **7d01323 (3%)**

**Annual Change in Cross-sectional Area (%)**

- > 30 m²
- 15 - 30 m²
- 5 - 15 m²
- Less than 5 m²

**7e00902 (-2%)**

**7e00900 (0%)**

**7e00898 (0%)**
Contours

MHW Elevation: 5.00OD
MLW Elevation: -4.10OD

- MHW 2014 - 06
- MHW 2012 - 06
- MHW 2007 - 04
- MLW 2014 - 04
Cross Sectional Area above MP Trend for Location: 7e00477 and Reference Profile Set

Area Above MP Trend: Eroding at -0.242 m²/Year
Cross Sectional Area above MP Trend for Location: 7e00478 and Reference Profile Set

Area Above MP Trend Accreting at 0.933 m²/Year
Cross Sectional Area above MP Trend for Location: 7e00488 and Reference Profile Set

Area Above MP Trend: Eroding at -0.089 m²/Year
Cross Sectional Area above MP Trend for Location: 7e00491 and Reference Profile Set

Area Above MP Trend: Eroding at -0.685 m²/Year
Cross Sectional Area above MP Trend for Location: 7e00654 and Reference Profile Set

Area Above MP Trend: Accreting at 1.807 m2/Year

Survey Date


Beach Area (m2)

228 228.5 229 229.5 230 230.5 231 231.5 232 232.5 233 233.5 234 234.5 235 235.5 236 236.5 237 237.5 238 238.5 239

Survey Unit 7eSU17-2
Cross-Sectional Area Charts
Cross Sectional Area above MP Trend for Location: 7e00666 and Reference Profile Set

Area Above MP Trend: Eroding at -0.104 m²/Year
Cross Sectional Area above MP Trend for Location: 7e00668 and Reference Profile Set

Area Above MP Trend: Eroding at -0.159 m²/Year
Cross Sectional Area above MP Trend for Location: 7e00333 and Reference Profile Set

Area Above MP Trend: Eroding at -0.409 m²/Year

Survey Unit 7eSU15-2
Cross-Sectional Area Charts
Cross Sectional Area above MP Trend for Location: 7e00849 and Reference Profile Set

Area Above MP Trend: Eroding at -2.484 m²/Year
Cross Sectional Area above MP Trend for Location: 7e00870 and Reference Profile Set

Area Above MP Trend: Accreting at 1.099 m²/year

Survey Date:

Recycling Event
Area Above MP
Area Trend
Area Between MP & DP
Cross Sectional Area above MP Trend for Location: 7e00898 and Reference Profile Set

Area Above MP Trend: Accreting at 2.062 m²/Year

Survey Date: 24/09/2009 to 01/01/2014

Graph showing trends in cross-sectional area with specific dates and values.
Cross Sectional Area above MP Trend for Location: 7e00902 and Reference Profile Set

Area Above MP Trend: Eroding at -1.356 m²/Year

Survey Date

Beach Area (m²)

Survey Unit 7eSU15-1
Cross-Sectional Area Charts