MOTT MACDONALD

Tendring District Council

Clacton and Holland-on-Sea Beach Monitoring Report

12 December 2018

Tendring District Council

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Issue and Revision Record

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A	12/12/18	E Smyth	H Taylor	Z Hutchison	Draft Beach Monitoring Report for comment.
B	17/05/18	E Smyth	H Taylor	Z Hutchison	Final issue.

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Contents

Executive summary

A monitoring survey of the beach along the Clacton and Holland-on-Sea coastline, that forms part of the coastal protection scheme constructed in 2014 – 2015, was carried out by representatives of Mott MacDonald on behalf of Tendring District Council between the 28th to 29th August 2018. The previous survey was completed between 25th and 26th July 2017.

The Clacton and Holland-on-Sea frontage is located along the south-eastern coastline of Essex and the scheme's coastal defences comprise of 22 fishtail groynes, 1 terminal groyne and recharged beach material.

The beach monitoring programme of the Clacton and Holland-on-Sea Coastal Protection Scheme is composed of several survey techniques. These consisted of a drone elevation survey, beach profile surveys and fixed aspect photos.

Data collected from the survey has been assessed and indicates that the fishtail groynes are retaining beach material well and are continuing to establish bay formations along the frontage. Furthermore, though the beach has experienced erosion and general lowering, no overall trigger levels for beach levels were reached. Additionally, accretion has mainly occurred on the more northerly groyne in a bay, suggesting the frontage has experienced a typically south westerly wave direction since construction.

The recommended approach is to continue with monitoring the beach annually to observe the future evolution of the frontage.

1 Introduction

1.1 Background Information

As part of The Beach Management Plan (BMP) 2015 for the Clacton and Holland-on-Sea Coast Protection Scheme, a beach monitoring programme of the frontage is to be undertaken annually. The Clacton and Holland-on-Sea Coastal Protection Scheme includes 22 fishtail rock groynes, 1 terminal rock groyne and a sand/shingle mix recharge along the entire frontage.

1.2 Location

The frontage at Clacton and Holland-on-Sea is located on a south-easterly facing section of the Essex coast and is exposed to the North Sea. The beach frontage is a sand/shingle mix material and is backed by London Clay cliffs, which are currently protected from erosion by fishtail groynes, recharged beach material, a seawall, and the promenade.

The beach monitoring programme for the Clacton and Holland-on-Sea frontage covers from the first concrete groyne (Groyne 41) southwest of Clacton Pier to the Gunfleet Boating Club adjacent to the terminal groyne at north-eastern end of the site, presented in Figure 1.

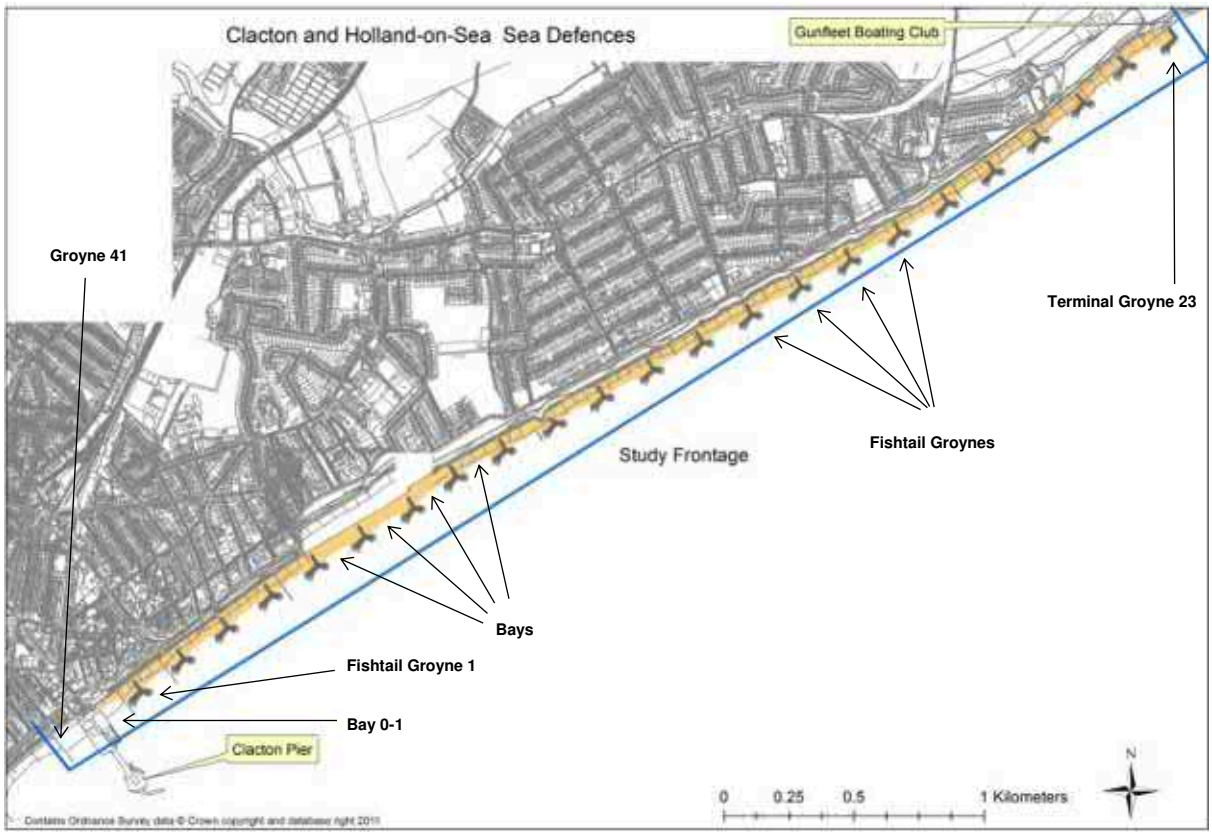


Figure 1 Clacton and Holland-on-Sea frontage covered in the BMP. (Crown Copyright, License Number LA079707 2003)

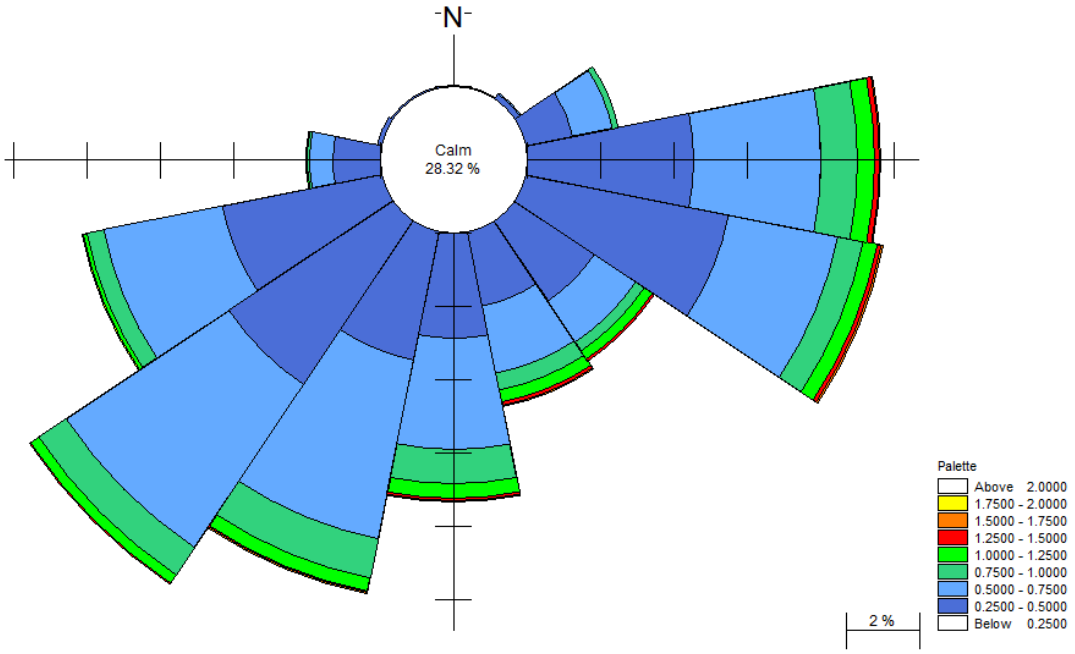
1.3 Weather Conditions

Due to no monitoring stations set up along the frontage or offshore, continuous weather conditions since construction have not been recorded. However, the general weather condition experienced along the Clacton and Holland-on-Sea frontage is discussed in 1.3.1 to 1.3.3 and extreme weather events experienced in the last six months in section 1.3.4.

1.3.1 Wave Conditions

The region generally experiences a southwest and east/east-southeast wave direction, which has been established using Cefas wave buoy located at 51˚ 46.020" N 001˚ 08.840"E in place from October 2006 to October 2009. The wave data was transformed into a 10-year wave data set using the LITPACK model (Mott MacDonald, 2013a), see figure 2. Due to the larger fetch direction across the North Sea higher waves approach the coastline from the east / east-south east direction. The wave direction along the Clacton and Holland-on-Sea frontage varies from the offshore wave conditions. A large proportion of the offshore waves approach from the northeast or south-southwest. The variation between offshore and nearshore wave direction is the result of the large sandbanks which result in the diffraction and breaking of the waves (Mott MacDonald, 2013b).

Figure 2: 10-year wave rose from the Clacton AWAC buoy.



1.3.2 Water Levels

The Clacton and Holland-on-Sea coastline is situated within a macrotidal area and therefore water levels can vary greatly throughout the year. Astronomical tidal levels and surges also affect the water levels. At Clacton and Holland-on-Sea, Chart Datum is equivalent to -2.29m below Ordnance Datum. The tidal range in this area is 2.3m and 4m at neap and spring tides respectively (Mott MacDonald, 2013b).

1.3.3 Wind Conditions

The predominant wind conditions along the frontage are influenced by south westerlies that blow across the Outer Thames Estuary creating the south-westerly wave direction and the east / south easterlies winds that are generated over the North Sea, resulting in the east/east-southeast wave directions (Mott MacDonald, 2015). Due to the sheltering effect of East Anglia north or north-easterlies wind conditions can produce weaker north /north easterly wave conditions (Semedo *et al.*, 2014).

1.3.4 Storm Conditions

On 30th April 2018, the Met Office issued yellow weather warnings for strong winds, heavy rains, and high tides, with the potential to cause minor flooding in low lying coastal areas (ITV News, 2018a). High waters were due to hit Clacton at 1:30am on Tuesday 1st May 2018, at a peak level of 2.70mAODN. This was to be combined with a wind force of Force 6, West North West (ITV News 2018b). However, no damage to the sea defences nor flooding incidents were recorded.

2 Data Analysis

2.1 Introduction

The beach monitoring programme for the Clacton and Holland-on-Sea Coastal Protection Scheme is composed of several survey techniques required to collect data of the evolution of the frontage. These are presented in more detail in the Mott MacDonald Clacton and Holland on Sea Coast Protection Scheme Beach Management Plan, 2015. The techniques undertaken for this report were a drone elevation survey, beach profile surveys and fixed aspect photos.

A drone was flown along the 5km stretch of the Clacton and Holland-on-Sea frontage from Clacton pier to Gunfleet Boating club in the north. This recorded the elevation of the beach from the promenade to the Mean Low Water Mark (MLWM). When undertaking the beach profile surveys, the method of beach levelling was used. Each profile was taken perpendicular from the shoreline as a straight line transect. Within each bay, one profile was taken in the midpoint of the bay between the two groynes structures and others adjacent to both the groyne structure (see Figure 3). Therefore, three beach profiles were taken per bay. Additional profiles were taken between groyne 41 (see Figure 1) and Clacton Pier for comparison between the constructed beach and the beach not within the scheme. In conjunction with the beach profiles fixed aspect photos were taken. These were taken at a fixed position at the same height with one angled perpendicular to the promenade and two at 45˚ either side of the beach profile.

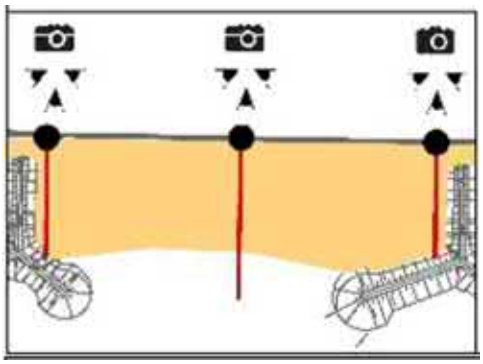


Figure 3: Beach profile locations

The findings from these surveys are discussed in the following sections below, along with the sediment budget processes for the area. The recommendations for future monitoring and maintenance have been concluded from these findings and are outlined in section 3.1.

2.2 Sediment Budget at Clacton and Holland-on-Sea

The Clacton and Holland-on-Sea frontage is exposed to two dominant wave directions from the east-southeast and southwest. Sediment movement along the frontage is complicated by this bi-directional wave environment and the effect of offshore sandbanks on approaching waves. During the last century, there was a significant decrease in the supply of sediment as a result from the cliffs in the region being protected, thus reducing the material produced through cliff erosion (Mott MacDonald, 2013b). In 2014-15 under the Coastal Protection Scheme, a recharge event was undertaken to restore beach levels along the Clacton and Holland-on-Sea frontage.

Prior to the construction of the Clacton and Holland-on-Sea Coast Protection Scheme the longshore sediment movement was identified as very weak along the frontage, although a north-east to south-west movement of sediment was generally seen along this part of the coastline (HR Wallingford, 2002). This is still considered to be the case along the frontage and will continue to be assessed through further beach monitoring reports. Previous specific modelling, undertaken by Mott MacDonald, around the Clacton and Holland-on-Sea frontage has highlighted the variability of longshore sediment transport that exists. The bi-directional wave dominance means that both northerly and southerly transport of sediment occurs around the frontage. Thus, sediment movement is temporally variable; if a year experiences a particularly large amount of

high energy waves approaching from the south west, dominant northerly movement of sediment may occur during that year (Mott MacDonald, 2015).

2.3 Accretion and Erosion Processes

A drone was flow over the frontage from Groyne 41 (Figure 1) in the south to Gunfleet Boating Club in the north to record the elevation of the beach from the promenade to the MLWM. The outputs from the drone survey were compared against the As Built elevation of the frontage, post construction and the survey undertaken in 2017. These comparisons highlight the areas along the frontage which have experienced accretion or erosion since construction. In Table 1 accretion and erosion maps outline the dominant processes for each bay from 2014 – 2015 to 2018 and 2017 to 2018.

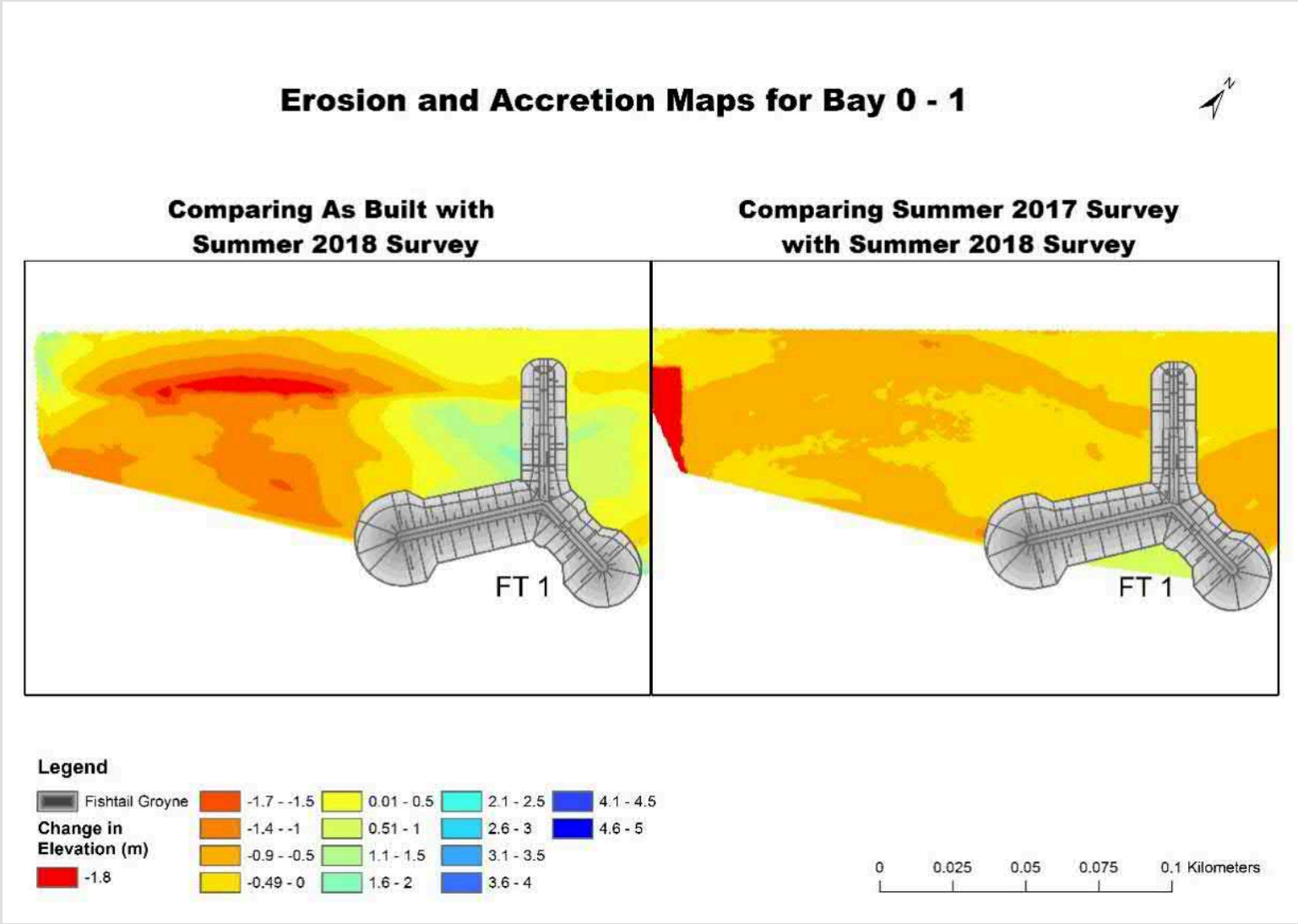
In general, the comparison maps show a similar trend for the As Built maps to 2018, as they did in 2017. Erosion has occurred in the middle of the bay, but in 2018 there has been more erosion along the berm in general. Under the As Built conditions a relatively straight berm was constructed, thus the berm is likely to still be adjusting to an embayment shape caused by wave diffraction. Whereas, accretion of sediment has been trapped in general behind the landward side of the more northly rock groynes' arms and their shore connected spine. This is similar to 2017 and is in line with the pervious assumption that material is being transported along the beach by longshore drift in a northward direction and becoming trapped. It can be assumed that in the last year southerly wave conditions have been prominent

Between 2017 and 2018 the common trend has been erosion in the form of an arc, from the more southern groyne in the bay to the middle of the bay. Then from the middle of the bay, up the upper beach and around to the more northern groyne. Then in front of this area of erosion an area of accretion has occurred. It is likely that the material from the eroded areas is being moved via a backwash wave out towards the sea, hence the accretion of the sand in front of the areas of erosion. This is typical of a sandy beach to move towards a flatter gradient as the small particles of sand means the water takes longer to percolate through than a shingle beach, thus sand is removed with the backwash. This is in line with the general observation that between 2017 and 2018 nearly every bay has experienced lowering of the beach.

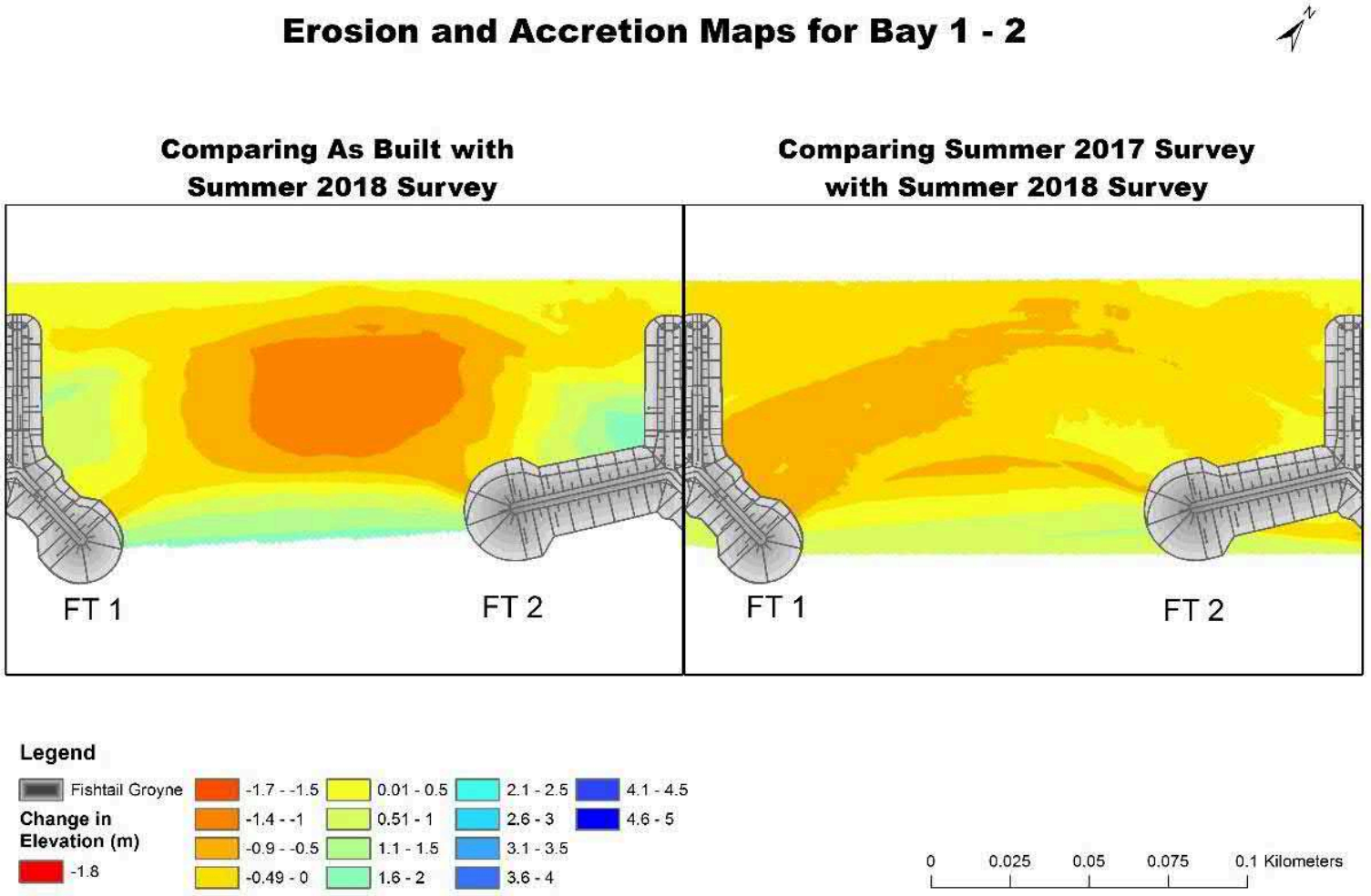
From the accretion and erosion maps within Table 1 it is evident that the berm and middle of the bay have continued to erode to form a bay shape between the fishtail groynes. Accretion has mainly occurred on the more northly groyne in a bay, indicating that waves have approached the frontage from a south westerly direction and resulting in a dominate northerly movement of sediment. However, there has been erosion in an arch shape from the more southerly groyne to the middle of the bay, along the upper beach and behind the northerly groyne, with an area of accretion in front of it. This is like to be material being taken from the upper beach on the backwash wave out of the bay. In general each bay has experienced a lowering of the beach.

There findings show the coastal processes behaving in a way that was predicted, by trapping the sediment behind the groyne, through longshore drift, erosion of the beach to form a bay and the lowering of the beach gradient as the beach material adjusts.

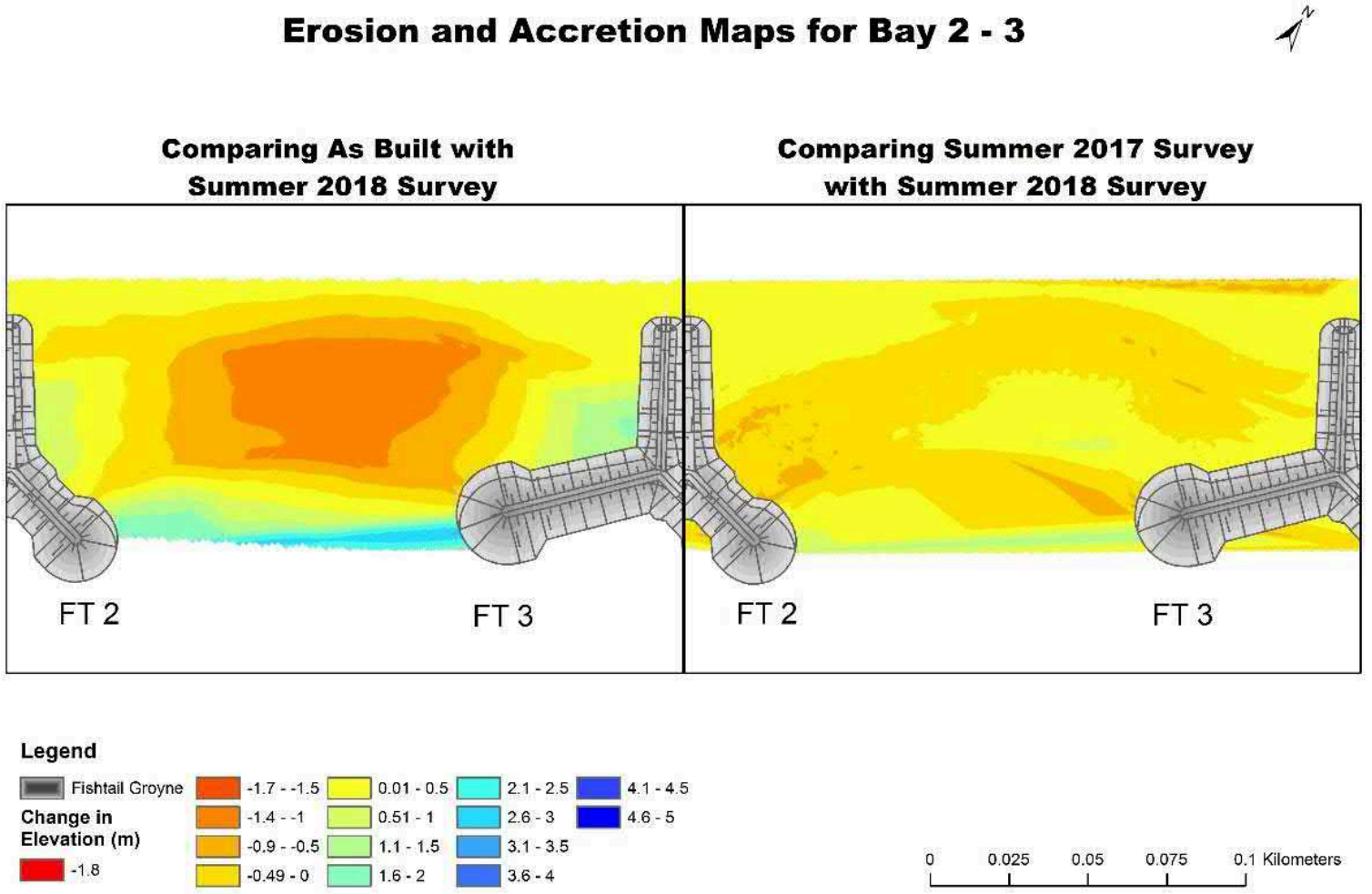
Table 1: Accretion and erosion maps for each bay along the Clacton and Holland-on-Sea frontage.

Bays	Accretion and Erosion Maps	Description of the key changes in the bay
1		- Highest erosion has occurred along the berm, with over 1.8m decrease in beach elevation. This is a continued trend from 2017, see Appendix A. - Accretion has occurred along the spine with a 1.6m-2m increase in elevation, again a similar trend to 2017. - The area of accretion around the spine in 2018 is a smaller area than in 2017, and where there has been erosion in 2018 the area has grown. - Between summer 2017 and summer 2018 there has been a general lowering of the beach. The majority of the lowering has been along the berm and closest to the pier. This is typical of a sandy beach to move towards a flatter gradient as the small particles are evenly distributed and that water takes longer to percolate through the sand than at shingle beaches. Therefore, more sand is removed with the backwash. - As the bay has only one rock groyne, erosion has occurred in the middle and to the south (close to the pier) and thus a typical bay shape has not formed.

Bays	Accretion and Erosion Maps	Description of the key changes in the bay
2		

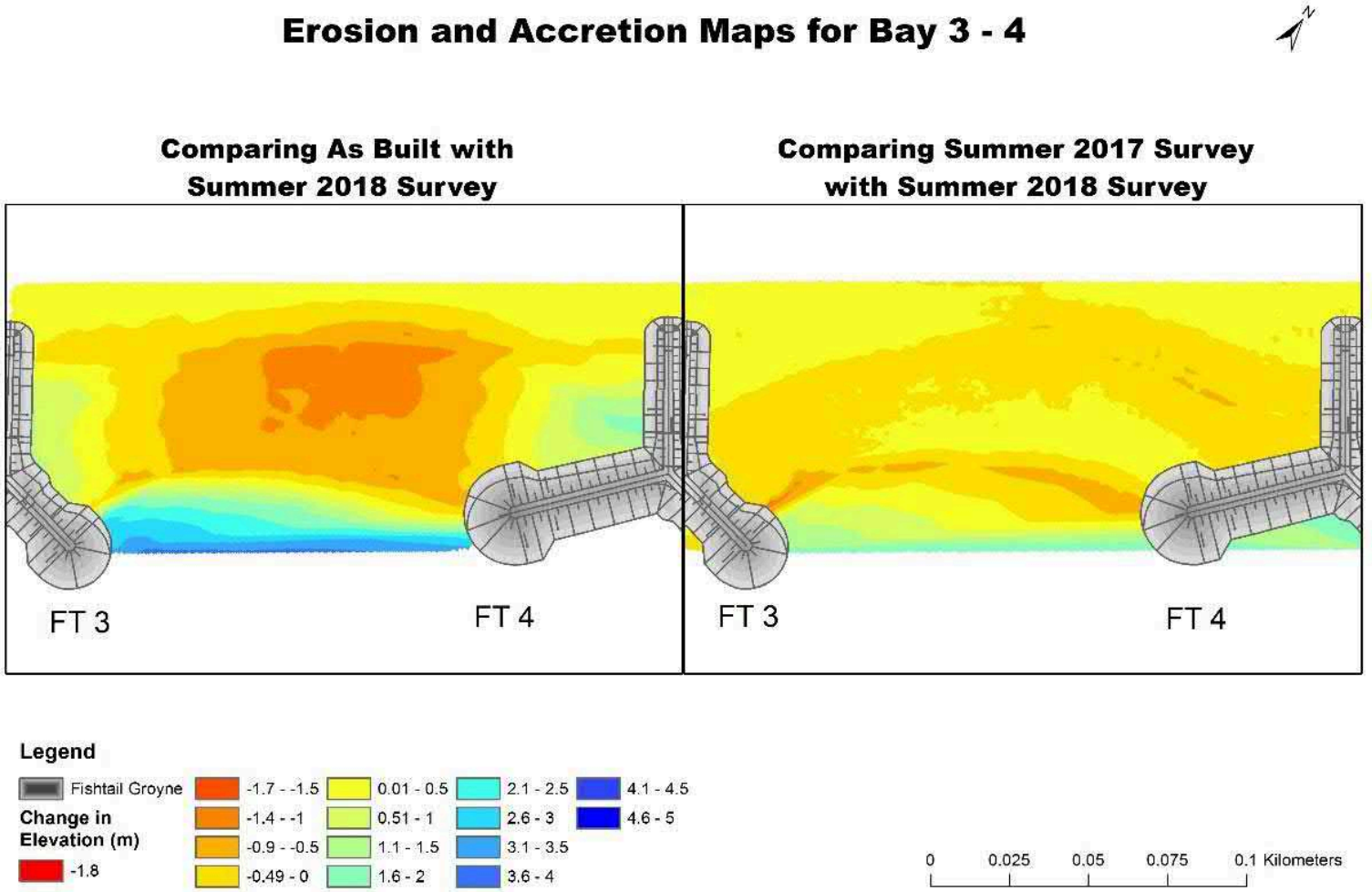


- Highest erosion has occurred along the berm and in the middle of the bay, by -1.4m to -1m decrease in beach elevation.
- Accretion has been highest behind FT2 at 1.6m to 2m increase in beach elevation and is the largest area of accretion in this bay.
- These observations are a continued trend from 2017. Though the berm has been an area of more beach lowering in 2018 than in 2017, See Appendix A
- Additionally, between 2017 and 2018 the beach has experienced the most erosion behind FT1 to the middle of the bay, most likely a result of longshore drift moving northwards along the beach.
- Though generally, the whole bay has experienced an overall lowering of the beach.

Bays	Accretion and Erosion Maps	Description of the key changes in the bay
3		- Highest erosion has occurred along the berm and in the middle of the bay, by -1.4m to -1m decrease in beach elevation. - Accretion has been highest behind FT3 at a high of 1.6m to 2m increase in beach elevation and is the largest area of accretion in this bay. - These observations are a continued trend from 2017. Though the berm has been an area of more beach lowering in 2018 than in 2017, and there has been less intense lowering in the middle of the bay between the two years. - Additionally, between 2017 and 2018 the beach has eroded the most behind FT2 to the middle of the bay, most likely a result of longshore drift moving northwards along the beach. - Though generally, the whole bay has experienced an overall lowering of the beach. This is typical of a sandy beach to move towards a flatter gradient as the small particles are evenly distributed and that water takes longer to percolate through the sand than at shingle beaches. Therefore, more sand is removed with the backwash.

Bays **Accretion and Erosion Maps** **Description of the key changes in the bay**

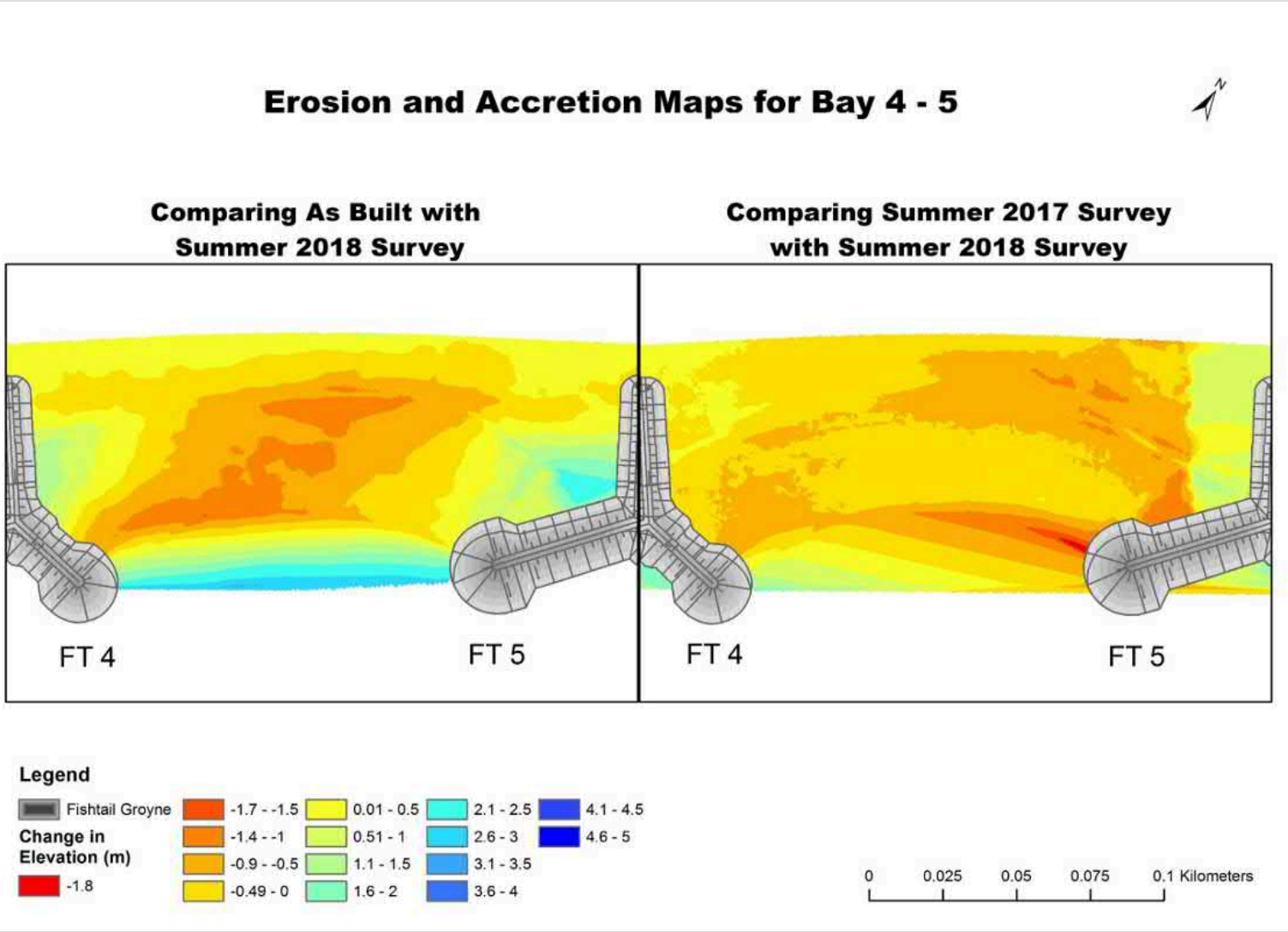
4



- Highest erosion has occurred along the berm and in the middle of the bay, by -1.4m to -1m decrease in beach elevation.
- Accretion has been highest behind FT4 at a high of 1.6m to 2m increase in beach elevation and is the largest area of accretion in this bay.
- These observations are a continued trend from 2017. Though the berm has been an area of more beach lowering in 2018 than in 2017, and there has been less intense lowering in the middle of the bay between the two years.
- Additionally, between the 2017 and 2018 survey the beach has eroded the most behind FT3 in a bay shape to behind FT4. It is likely the material from here is being moved via a backwash wave out towards the sea, hence the accretion of sand in front of the area of erosion.
- Though generally, the whole bay has experienced an overall lowering of the beach. This is typical of a sandy beach to move towards a flatter gradient as the small particles are evenly distributed and that water takes longer to percolate through the sand than at shingle beaches. Therefore, more sand is removed with the backwash.
-

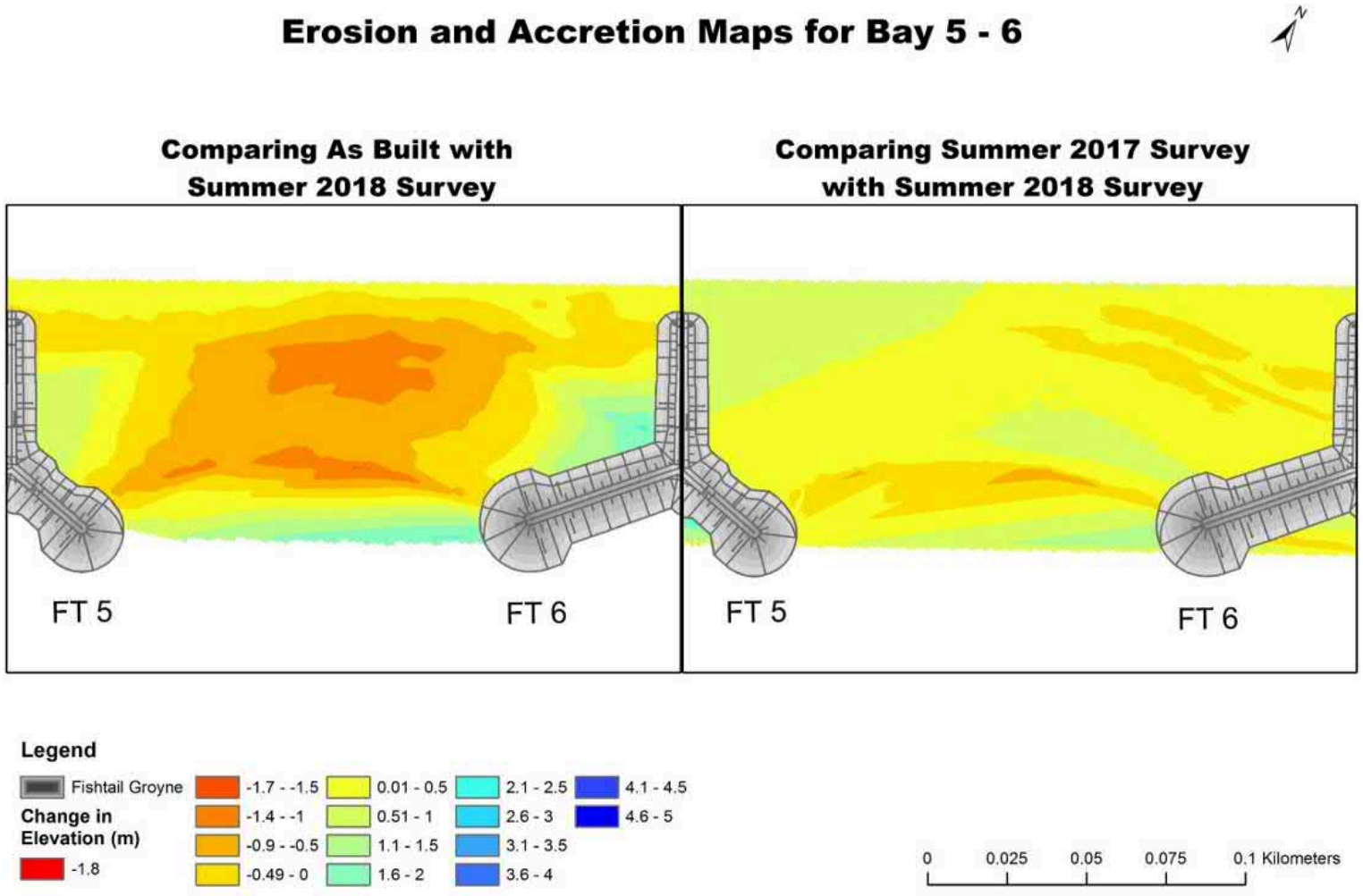
Bays Accretion and Erosion Maps Description of the key changes in the bay

5

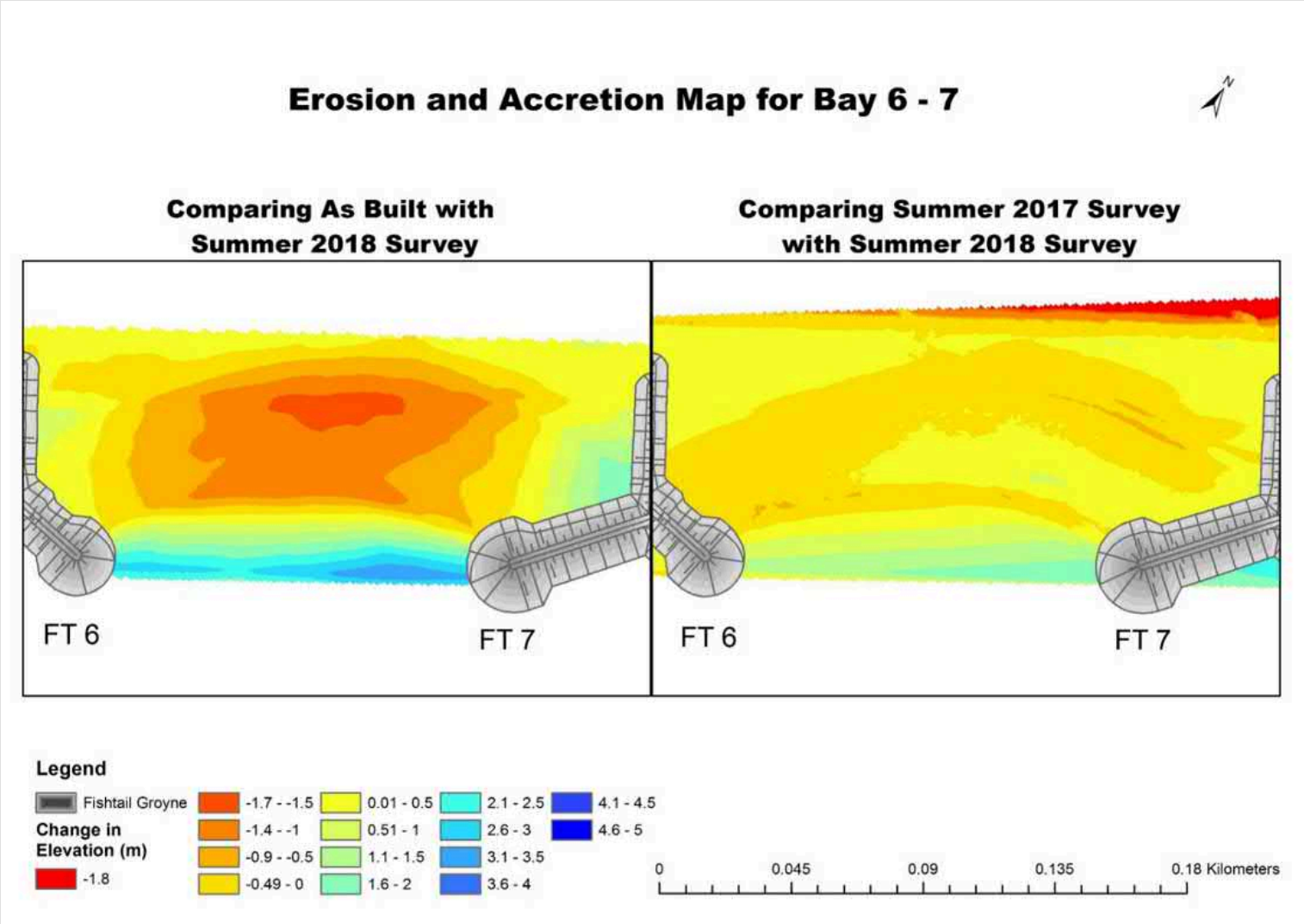


- Highest erosion has occurred along the berm, in the middle of the bay and behind FT4's sea protruding arm, by -1.4m to -1m decrease in beach elevation.
- Erosion close to FT4 is potentially caused by the outfall nearby causing increased scour in this area.
- Accretion has been highest behind FT5 at a high of 2.1.m to 2.5m increase in beach elevation and is the largest area of accretion in this bay.
- These observations are a continued trend from 2017. Though the berm has been an area of more beach lowering in 2018 than in 2017.
- Generally, the whole bay has experienced an overall lowering of the beach. This is typical of a sandy beach to move towards a flatter gradient as the small particles are evenly distributed and that water takes longer to percolate through the sand than at shingle beaches. Therefore, more sand is removed with the backwash.
- Between the summer 2017 and summer 2018 surveys the top of the shore connected arm of FT5 appears to have accreted. However, in 2017 this was an area of unexplained erosion. In 2018 this area experienced an overall lowering of the beach snice the As Built conditions, like other bays. Thus, the decrease in beach elevation in 2017 was most likely due to beach management activities than natural processes.

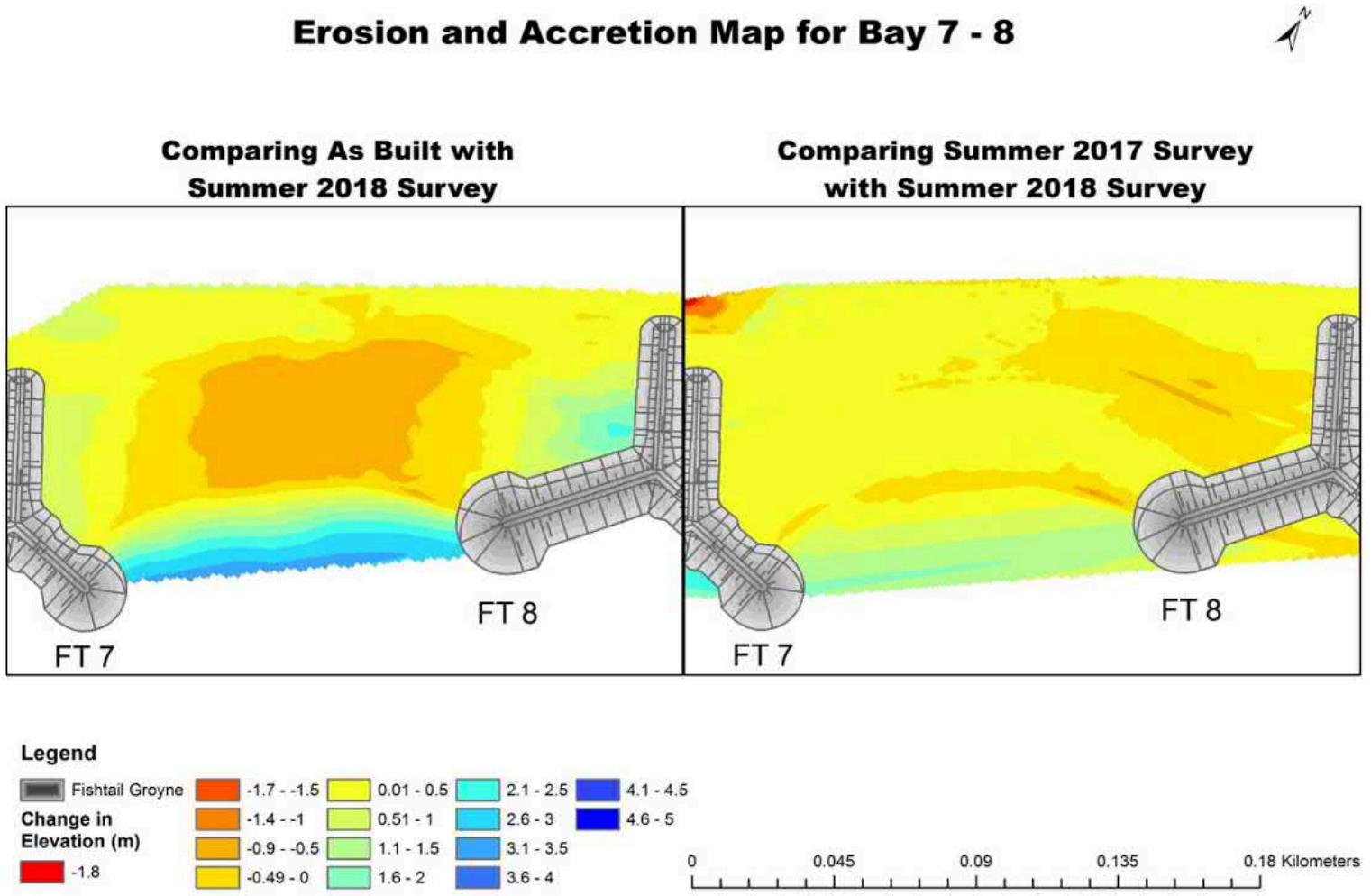
Bays	Accretion and Erosion Maps	Description of the key changes in the bay
6		



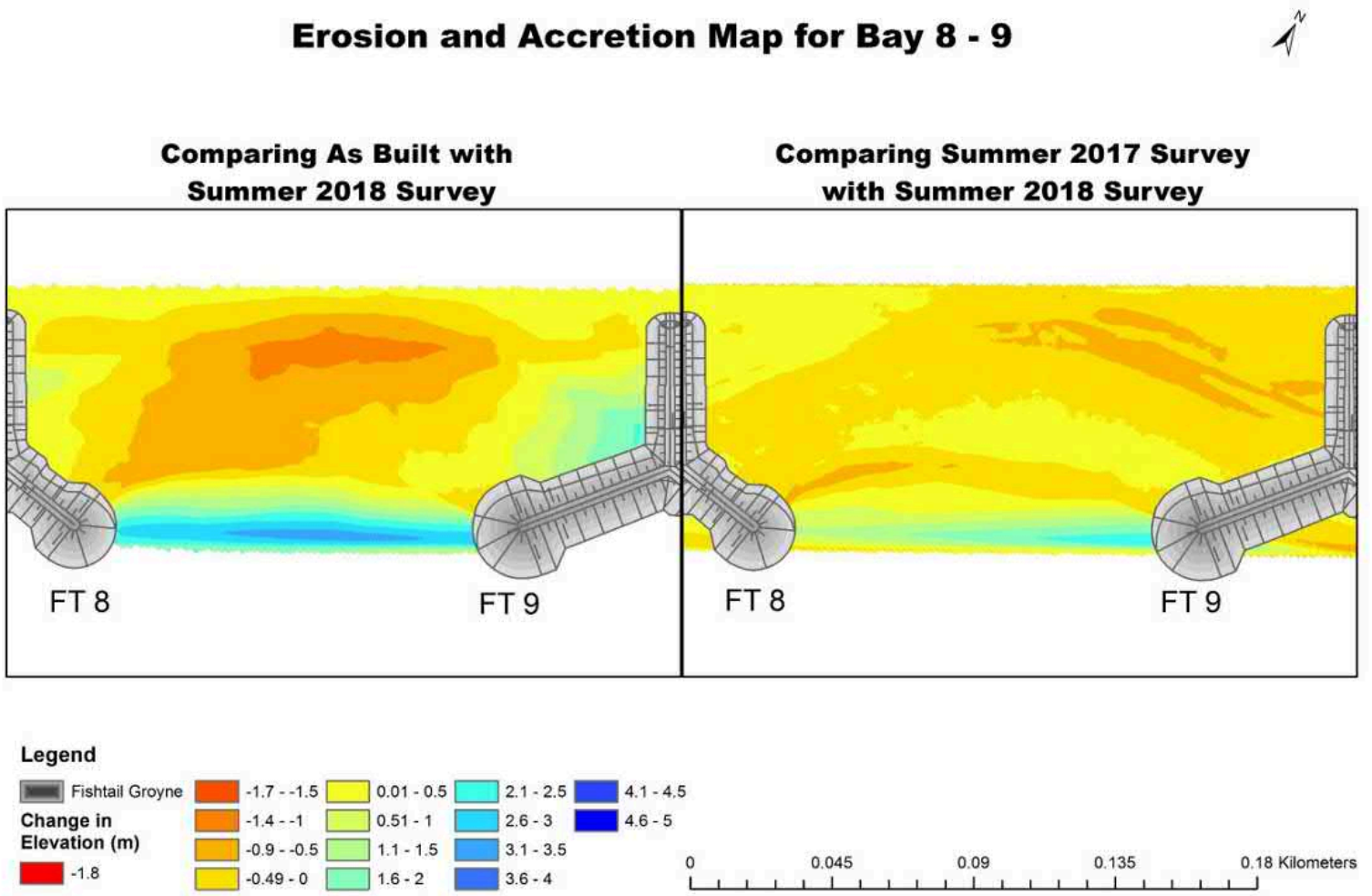
- Highest erosion has occurred along the berm and in the middle of the bay, by -1.4m to -1m decrease in beach elevation. Note that this is less than in 2017, which was a 1.5-1.7m decrease in beach elevation, See Appendix A
- Accretion has been highest behind FT6 at a high of 2.1.m to 2.5m increase in beach elevation and is the largest area of accretion in this bay.
- These observations are similar to 2017. Though the berm has been an area of less beach lowering in 2018 than in 2017.
- The shore connected spine of FT5, between summer 2017 and summer 2018 is an area that appears to have accreted, whereas in 2017 this was an area of unexplained high erosion. Thus, the recent increase in beach elevation around the spine of FT5 is most likely due to beach management activities than natural processes.
- Generally, the whole bay has experienced an overall increase in beach elevation. This is unlike most bays and is probably down to beach management activities around the spine of FT5.

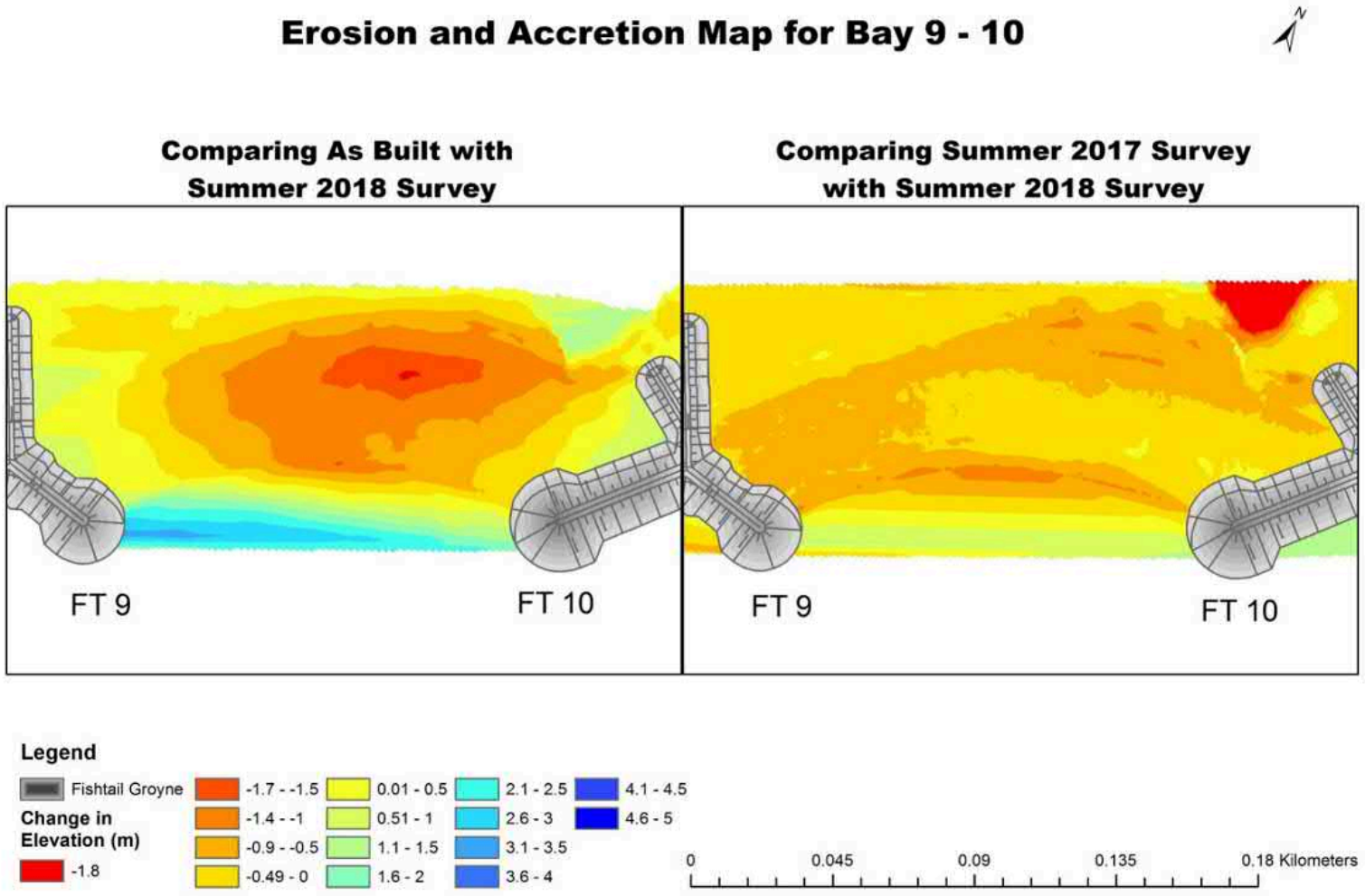
Bays	Accretion and Erosion Maps	Description of the key changes in the bay
7		- Highest erosion has occurred along the berm and in the middle of the bay, with a high of -1.7m to -1.5m decrease in beach elevation along the berm. - Accretion has been highest behind FT7 at a high of 1.6m to 2m increase in beach elevation and is the largest area of accretion in this bay. - These observations are a continued trend from 2017. Though the berm has been an area of more beach lowering in 2018 than in 2017. - There has been less intense lowering in the middle of the bay and between summer 2017 and 2018 the middle of the bay appears to have accreted a little, by 0.01-0.5m. - Additionally, between the 2017 and 2018 survey the beach has eroded the most behind FT6 in a bay shape to behind FT7. It is likely the material from the berm is being moved via a backwash wave out towards the sea, hence the accretion of sand in front of the berm. - Though generally, the bay has experienced lowering of the beach nearest FT6 and a slight increase in elevation closest to FT7, most likely a result of longshore drift moving northwards along the beach.

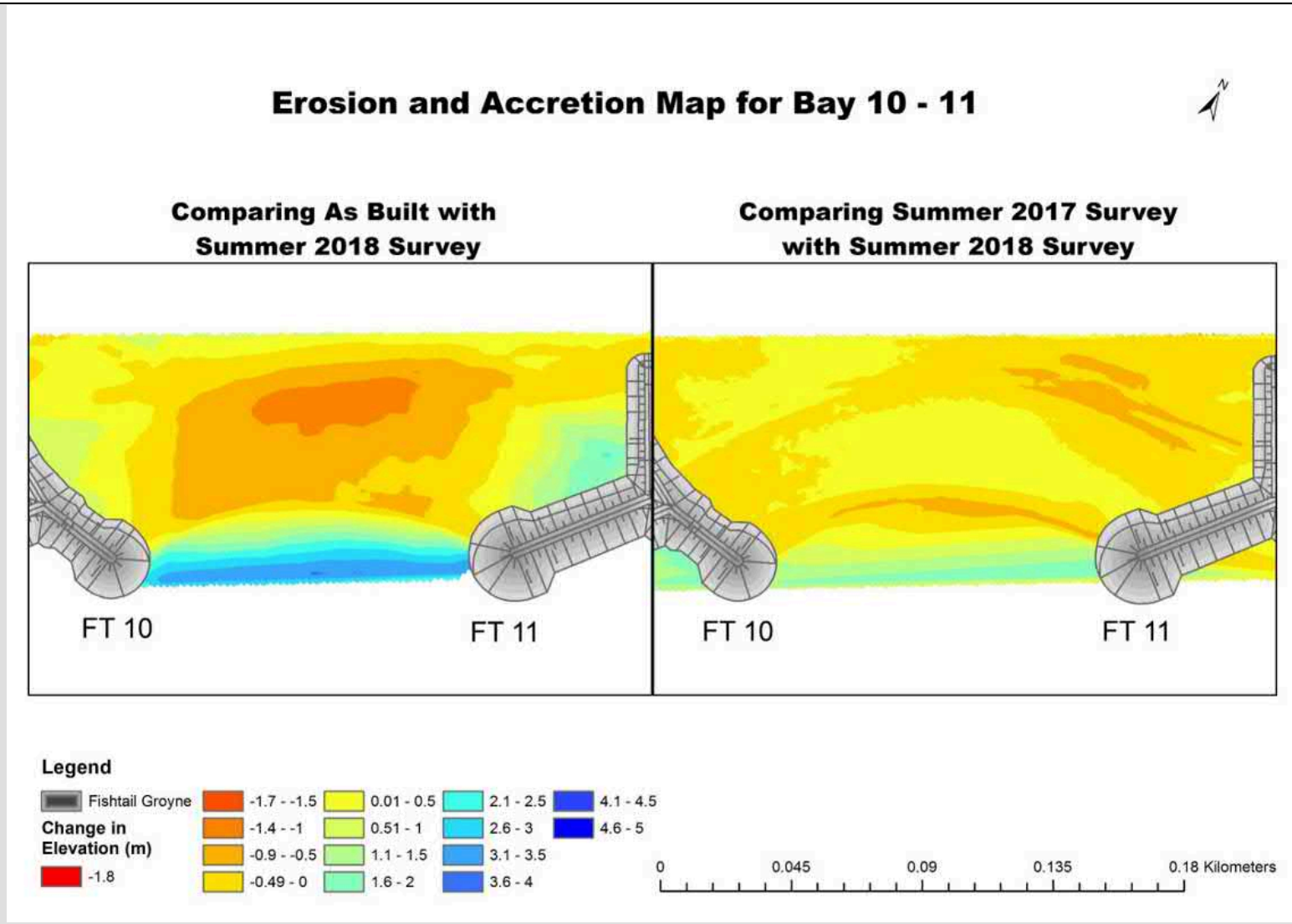
Bays	Accretion and Erosion Maps	Description of the key changes in the bay
8		



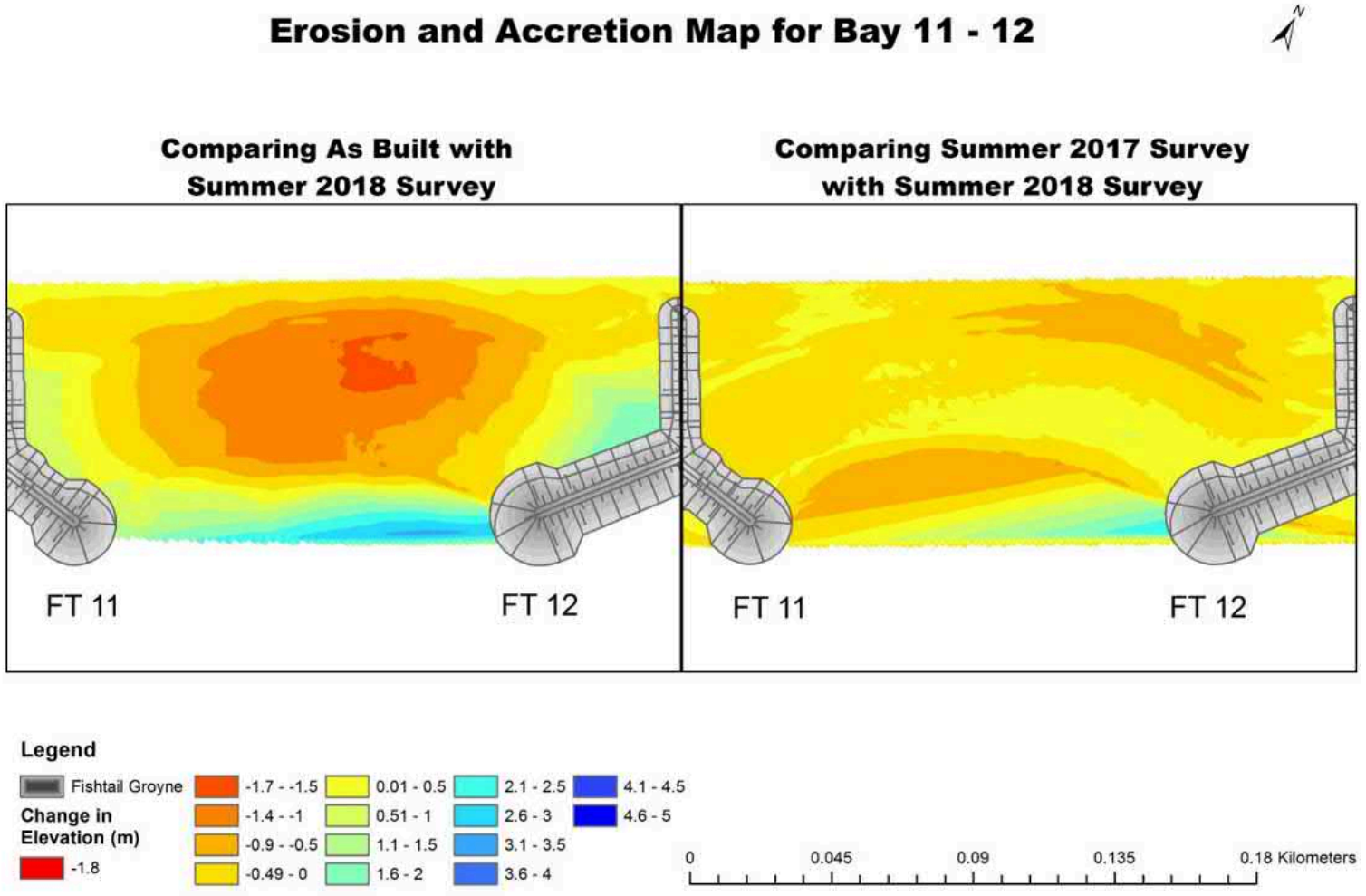
- Highest erosion has occurred along the berm and in the middle of the bay, by -0.9m to -0.5m decrease in beach elevation along the berm.
- Accretion has been highest behind FT8 at a high of 2.1m to 2.5m increase in beach elevation and is the largest area of accretion in this bay.
- These observations are a continued trend from 2017. Though the berm has been an area of more beach lowering in 2018 than in 2017, See Appendix A
- There has been less intense lowering in the middle of the bay and between summer 2017, and 2018 the middle of the bay appears to have accreted a little, by 0.01-0.5m.
- Generally, the bay has experienced lowering of the beach nearest FT8 and a slight increase in elevation closest to FT7 and the middle of the bay. This is unlike the trends found in other bays and could be the influenced by the setback promenade and the beach adjusting to this.

Bays	Accretion and Erosion Maps	Description of the key changes in the bay
9		- Highest erosion has occurred along the berm, in the middle of the bay and behind FT8, with a high of -1.4m to -1m decrease in beach elevation along the berm. - Accretion has been highest behind FT9 at a high of 2.1m to 2.5m increase in beach elevation and is the largest area of accretion in this bay. - These observations are a continued trend from 2017. Though the berm has been an area of more beach lowering in 2018 than in 2017. - There has been less intense lowering in the middle of the bay and between summer 2017, and 2018 the middle of the bay appears to have accreted a little, by 0.01-0.5m. - Generally, the bay has experienced lowering of the beach nearest FT8 and a slight increase in elevation closest to FT9 and the middle of the bay. This is most likely a result of longshore drift moving northwards along the beach. - Additionally, between the 2017 and 2018 survey the beach has eroded the most behind FT8 in a bay shape to behind FT9. It is likely the material from here is being moved via a backwash wave out towards the sea, hence the accretion of sand in front of the area of erosion.

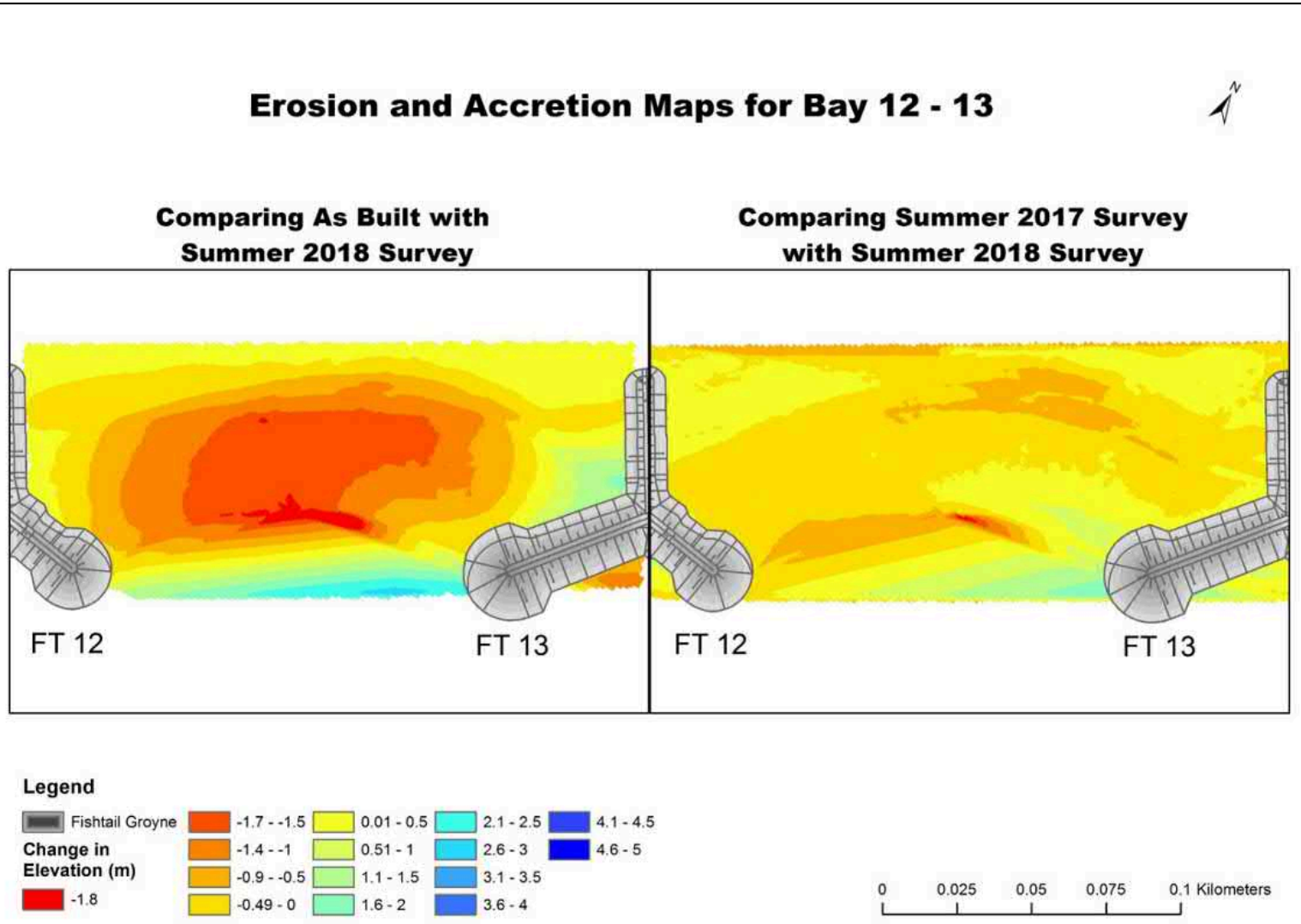
Bays	Accretion and Erosion Maps	Description of the key changes in the bay
10		- Highest erosion has occurred along the berm and in the middle of the bay at a high of over -1.8m decrease in beach elevation along the berm. - Accretion has been highest behind FT9 at 0.51m to 1m increase in beach elevation. It is the largest area of accretion in the bay. - Unlike the majority of bays along the frontage the largest area of accretion is behind the southern groyne FT9. This is likely due to FT10 having a smaller shore connected arm that is at a different orientation to the other groynes along the frontage. Thus, being less effective at trapping sediment - An area of high accretion can be seen near to the top of FT 10, but between the summer surveys this area has decreased by over -1.8m. The area is in front of a manmade headland and thus is more influenced by the projecting headland and beach activities than the natural beach processes. - These observations are a continued trend from 2017. Though the berm and middle of the bay have been areas of more beach lowering in 2018 than 2017. - The whole bay has experienced an overall lowering of the beach. This is typical of a sandy beach to move towards a flatter gradient as the small particles are evenly distributed and that water takes longer to percolate through the sand than at shingle beaches. Therefore, more sand is removed with the backwash.

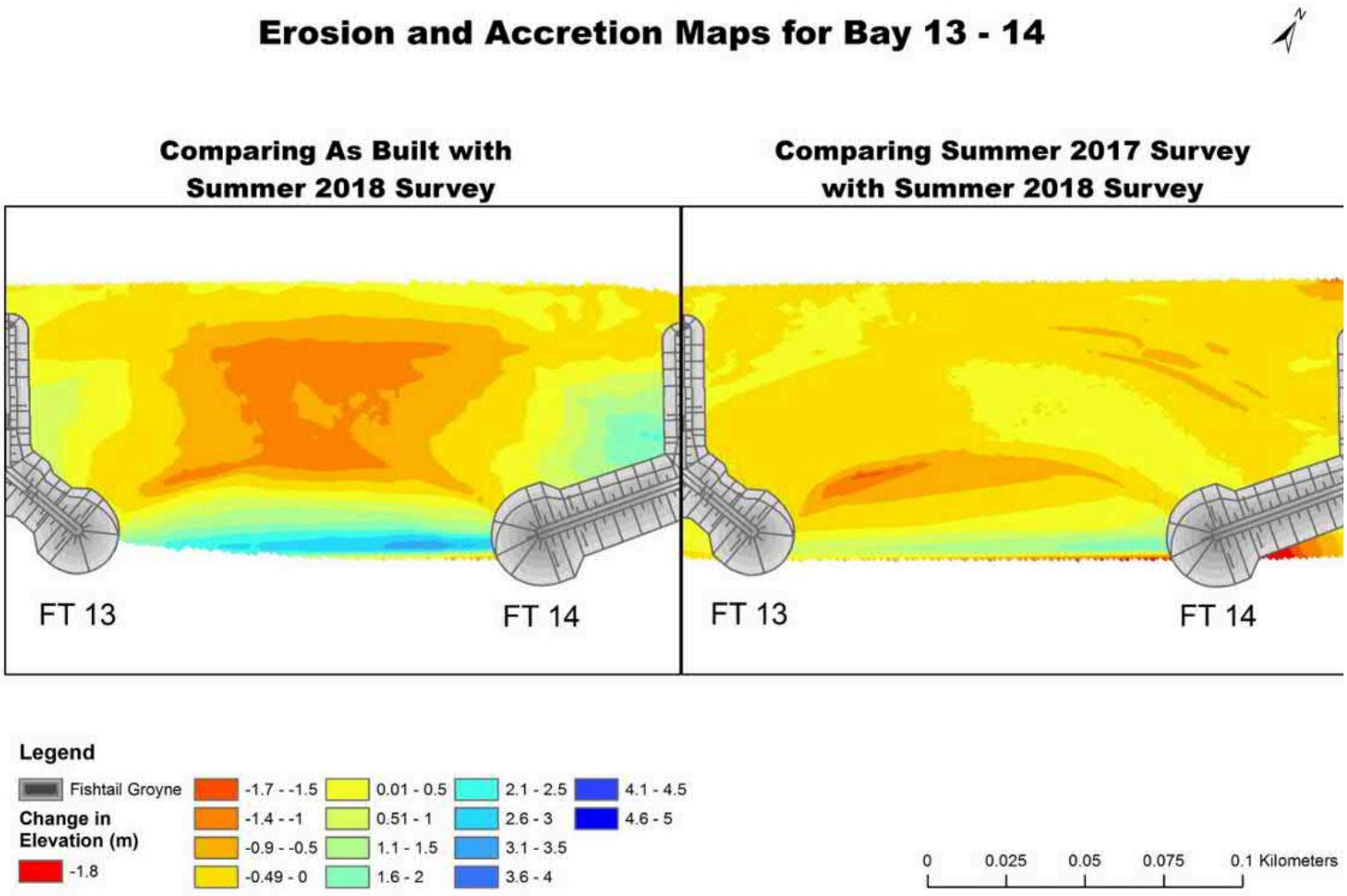
Bays	Accretion and Erosion Maps	Description of the key changes in the bay
11		- Highest erosion has occurred along the berm and in the middle of the bay with a high of over –1.4m to -1m decrease in beach elevation along the berm. - Accretion highest behind FT11 at 2.1m-2.5m increase in elevation, but with a more general high of 1.6m-2m. - These observations are a continued trend from 2017. Though the berm has been an area of more beach lowering in 2018 than in 2017. - In general, between summer 2017 and 2018 surveys the middle of the bay to FT 11 has experienced a small increase by 0.01m to 0.5m. Whereas behind FT 10 and in a bay shape to behind FT11 the beach has generally lower. It is likely the material from the berm is being moved via a backwash wave out towards the sea, hence the accretion of sand in front of the berm.

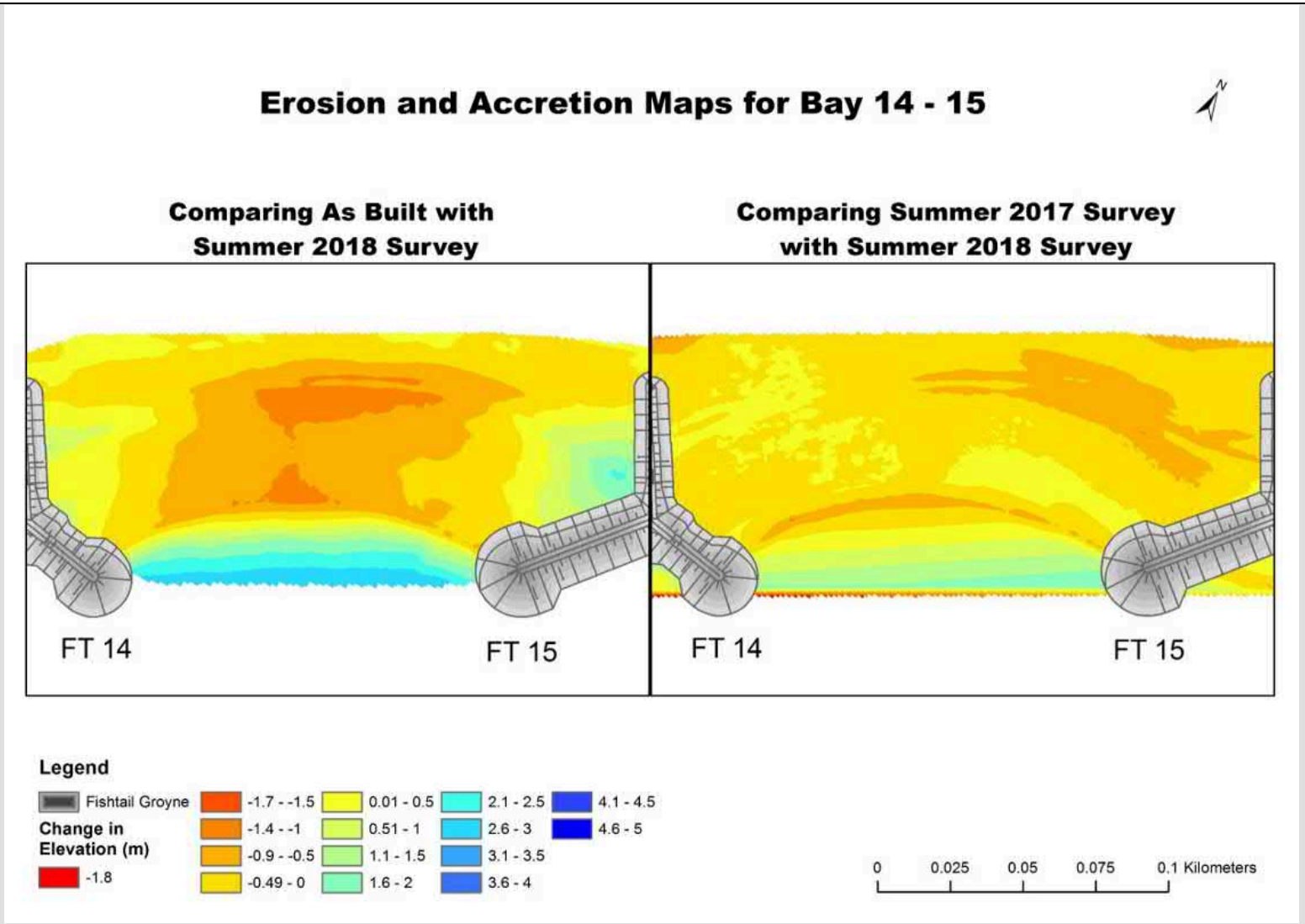
Bays	Accretion and Erosion Maps	Description of the key changes in the bay
12		

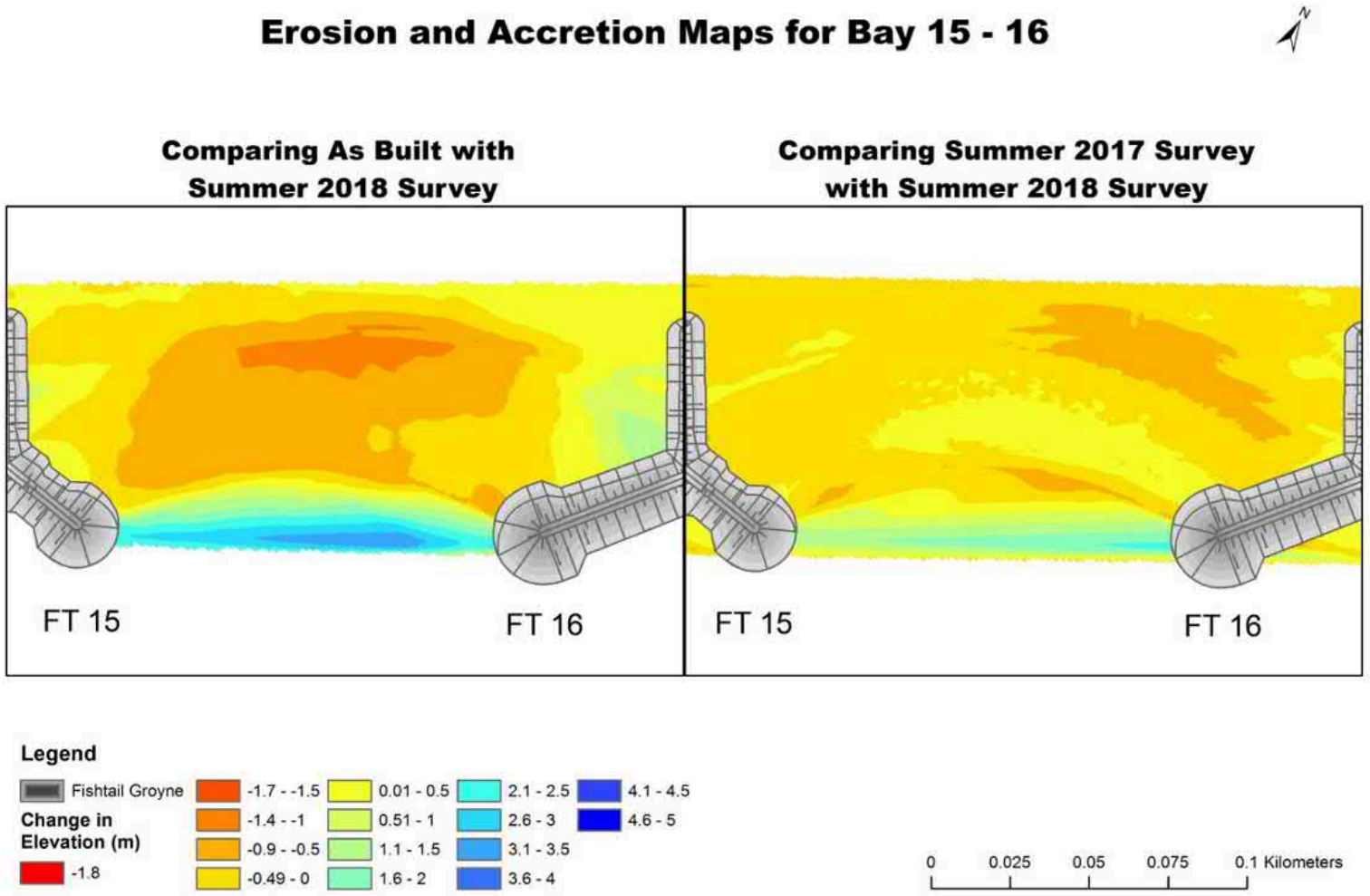


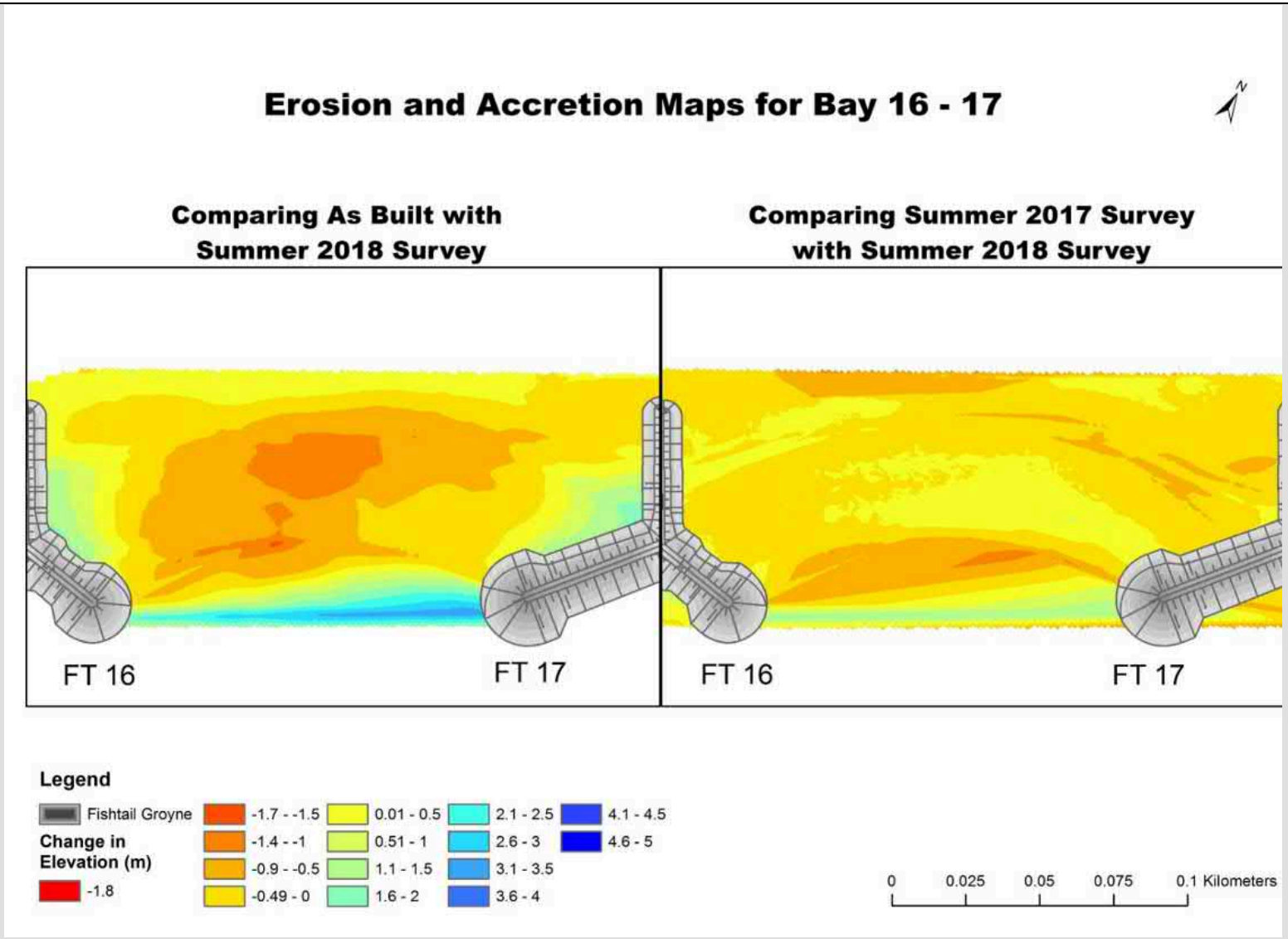
- Highest erosion has occurred along the berm and in the middle of the bay with a high of –1.7m to -1.5m decrease in beach elevation along the berm.
- Accretion highest behind FT12 at 1.6m to 2m increase in elevation.
- These observations are a continued trend from 2017. Though the berm has been an area of more beach lowering in 2018 than in 2017.
- In general, between summer 2017 and 2018 surveys the middle of the bay to FT12 has experienced a small increase by 0.01m to 0.5m. Whereas behind FT 11 and in a bay shape to behind FT12 the beach has generally lower. It is likely the material from the berm is being moved via a backwash wave out towards the sea, hence the accretion of sand in front of the berm.
- Generally, the whole bay has experienced an overall lowering of the beach.

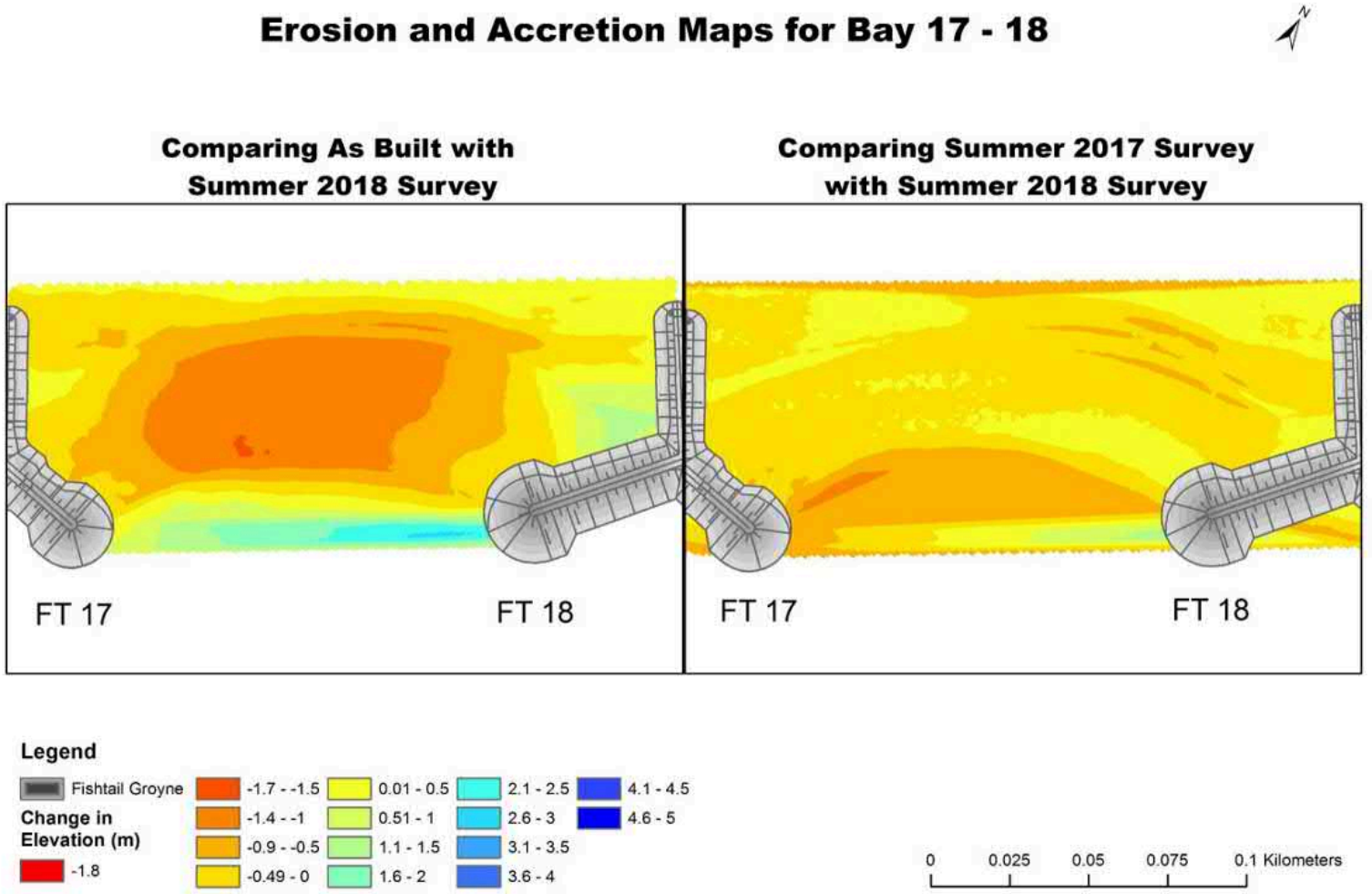
Bays	Accretion and Erosion Maps	Description of the key changes in the bay
13		- The highest level of erosion is experienced right at the centre of the bay, close to the lower water mark with over 1.8m decrease in elevation. Though a more general 1.7-1.5m decrease in elevation has occurred at the centre of bay overall. - Accretion highest behind FT13 at 1.1m-1.5m increase in elevation. - FT13 has a larger area of accretion adjacent to it than FT 12. - These observations are a continued trend from 2017. Though the berm has been an area of more beach lowering in 2018 than in 2017. The area of erosion is larger, and the area of accretion is smaller in 2018. - In general, between summer 2017 and 2018 surveys the middle of the bay to FT13 has experienced a small increase by 0.01m to 0.5m, with a high between 1.1 to 1.5. Whereas behind FT 12 and in a bay shape to behind FT13 the beach has generally lower. It is likely the material from the berm is being moved via a backwash wave out towards the sea, hence the accretion of sand in front of the berm. - Generally, the whole bay has experienced an overall lowering of the beach.

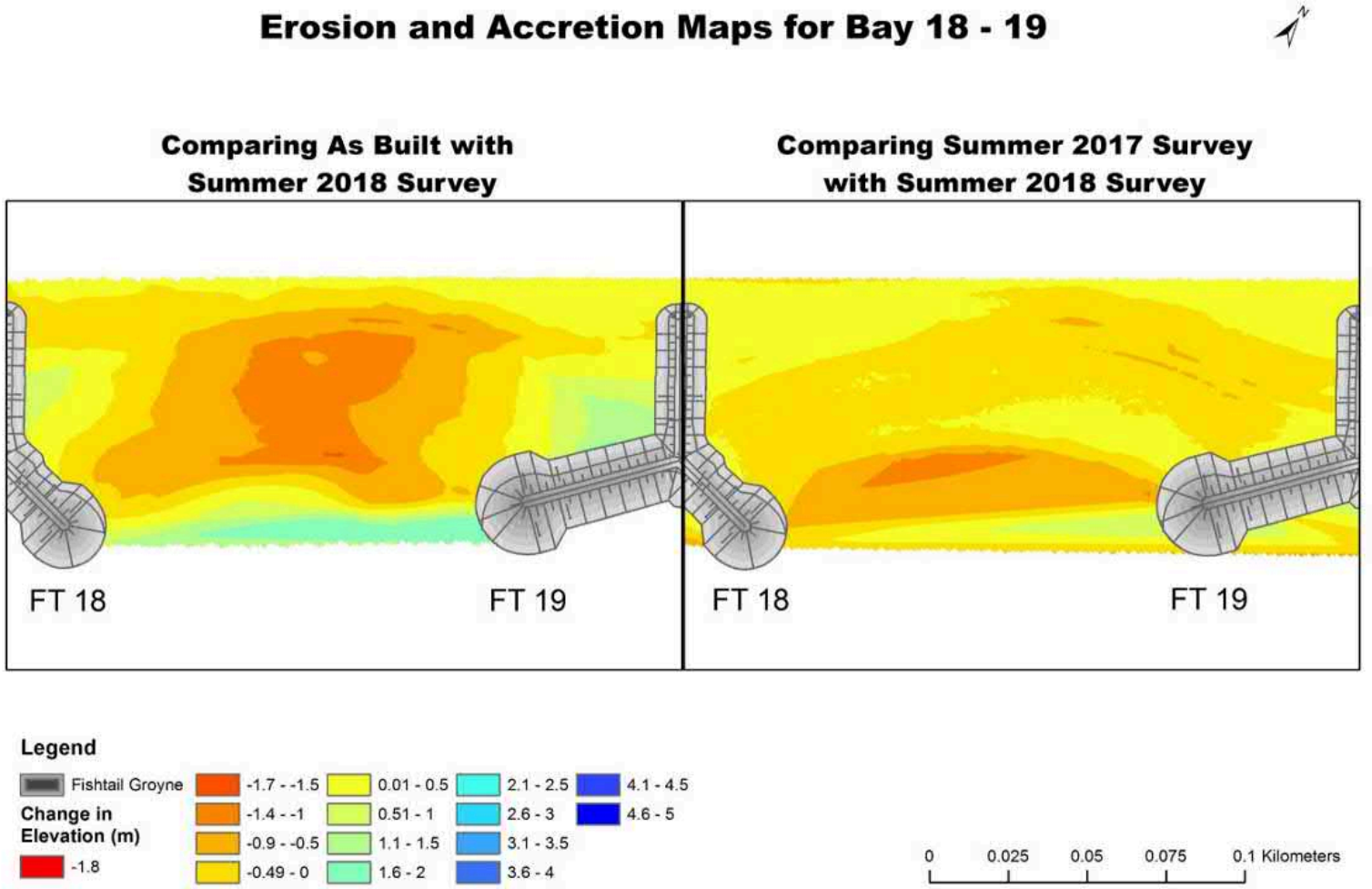
Bays	Accretion and Erosion Maps	Description of the key changes in the bay
14		- Highest erosion has occurred along the berm and in the middle of the bay, with a high of –1.7m to -1.5m decrease in beach elevation. - Accretion highest behind FT14 at a high of 2.1m to 2m.5, but at a more general 1.6 to 2m increase in elevation. - FT14 has a larger area of accretion adjacent to it than FT13. - These observations are a continued trend from 2017. Though the berm and middle of the bay has been an area of more beach lowering in 2018 than in 2017. - In general, between summer 2017 and 2018 surveys the middle of the bay to FT14 has experienced a small increase by 0.01m to 0.5m. Whereas behind FT 13 to the middle of the bay and from the middle of the bay along the upper beach to behind FT14 the beach has generally lowered. It is likely the material from these areas is being moved via a backwash wave out towards the sea, hence the accretion of sand in front of these areas. - Generally, the whole bay has experienced an overall lowering of the beach.

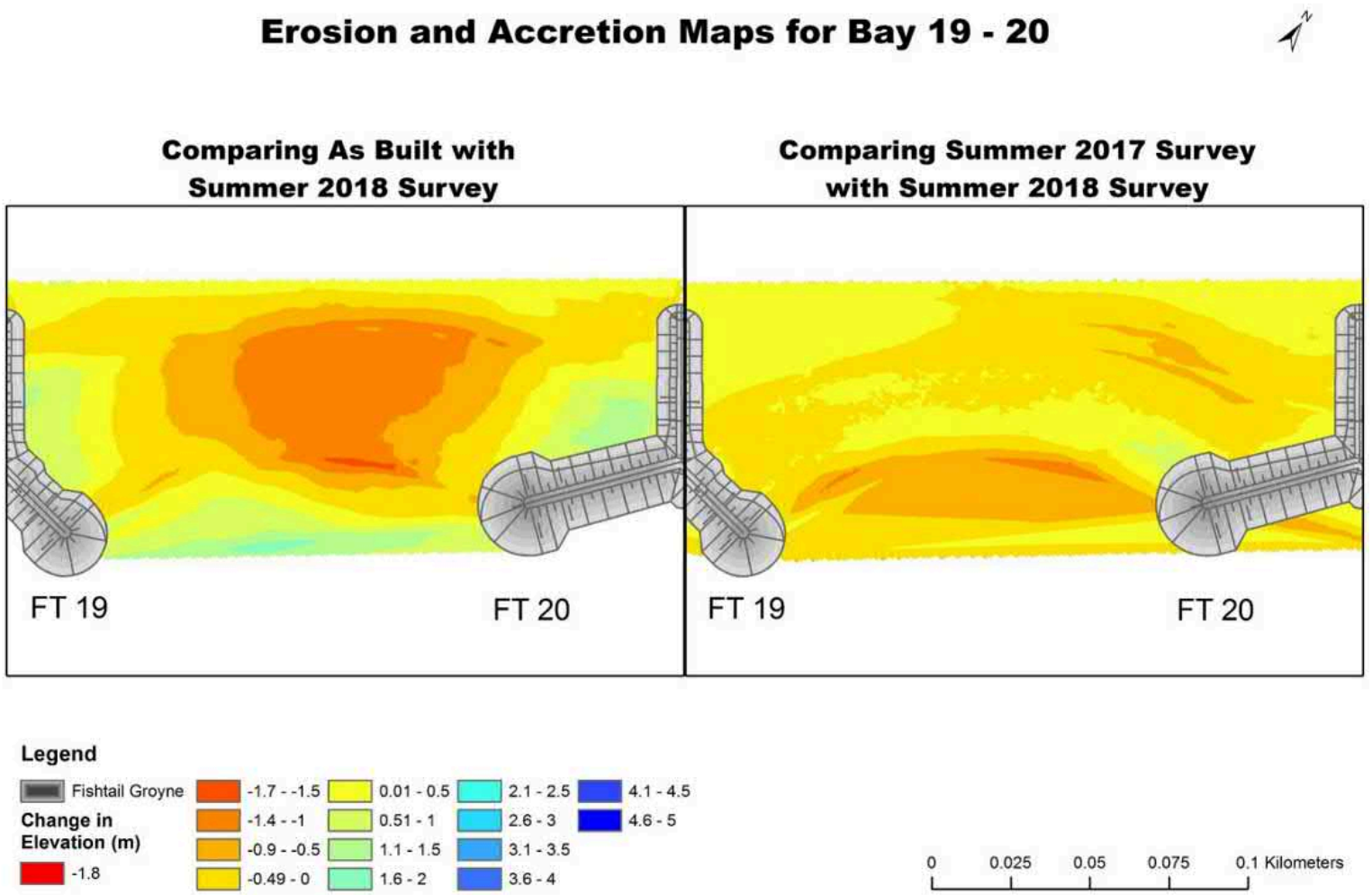
Bays	Accretion and Erosion Maps	Description of the key changes in the bay
15		- Highest erosion has occurred along the berm and in the middle of the bay, with a high of –1.4m to -1m decrease in beach elevation. - Accretion highest behind FT15 at a high of 2.1m to 2m.5, but at a more general high of 1.6 to 2m increase in elevation. - FT15 has a larger area of accretion adjacent to it than FT14. - These observations are a continued trend from 2017. Though the berm and middle of the bay has been an area of more beach lowering in 2018 than in 2017. - In general, between summer 2017 and 2018 surveys the beach closest to FT15 has lowered and there has been patchy accretion behind FT14. This is unlike other bays in the area. However, the beach material behind FT15 is likely being removed from this area by a backwash wave moving it out to sea, hence the area of accumulation from the head of the sea projecting arm into the middle of the bay. The patchy accumulation behind FT14 is likely to be a result of beach activities and not natural process. There is evidence of tyre marks in profile 44 (See photographic section) and there are a number of beach huts running along the promenade here. Thus, it is more likely a human factor that accumulation has occurred here. - Generally, the whole bay has experienced an overall lowering of the beach.

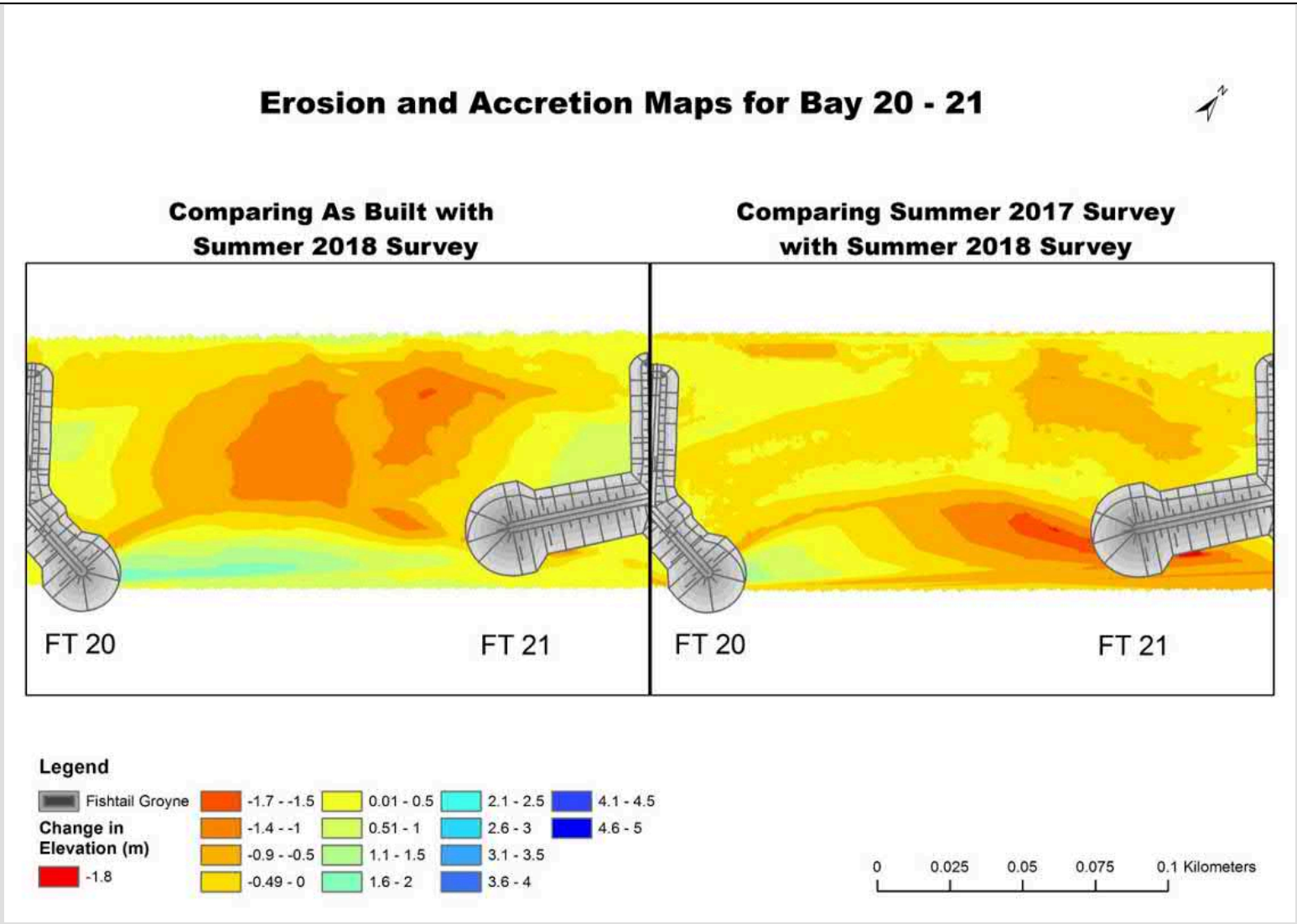
Bays	Accretion and Erosion Maps	Description of the key changes in the bay
16		- Highest erosion has occurred along the berm of the beach, with a high of –1.4m to -1m decrease in beach elevation. - Accretion highest behind FT16 at a high of 1.1.1m to 1.5m. - These observations vary slightly from the 2017 survey, where erosion was occurring mainly in the middle of the bay in 2017. However, erosion was between 1.1m-1.5m increase in elevation behind FT15 in 2017 as well (See Appendix A) - In general, between summer 2017 and 2018 surveys the middle of the bay to FT16 has experienced a small increase by 0.01m to 0.5m. Whereas behind FT15 to the middle of the bay and from the middle of the bay along the upper beach to behind FT16 the beach has generally lowered. It is likely the material from these areas is being moved via a backwash wave out towards the sea, hence the accretion of sand in front of these areas of beach lowering.

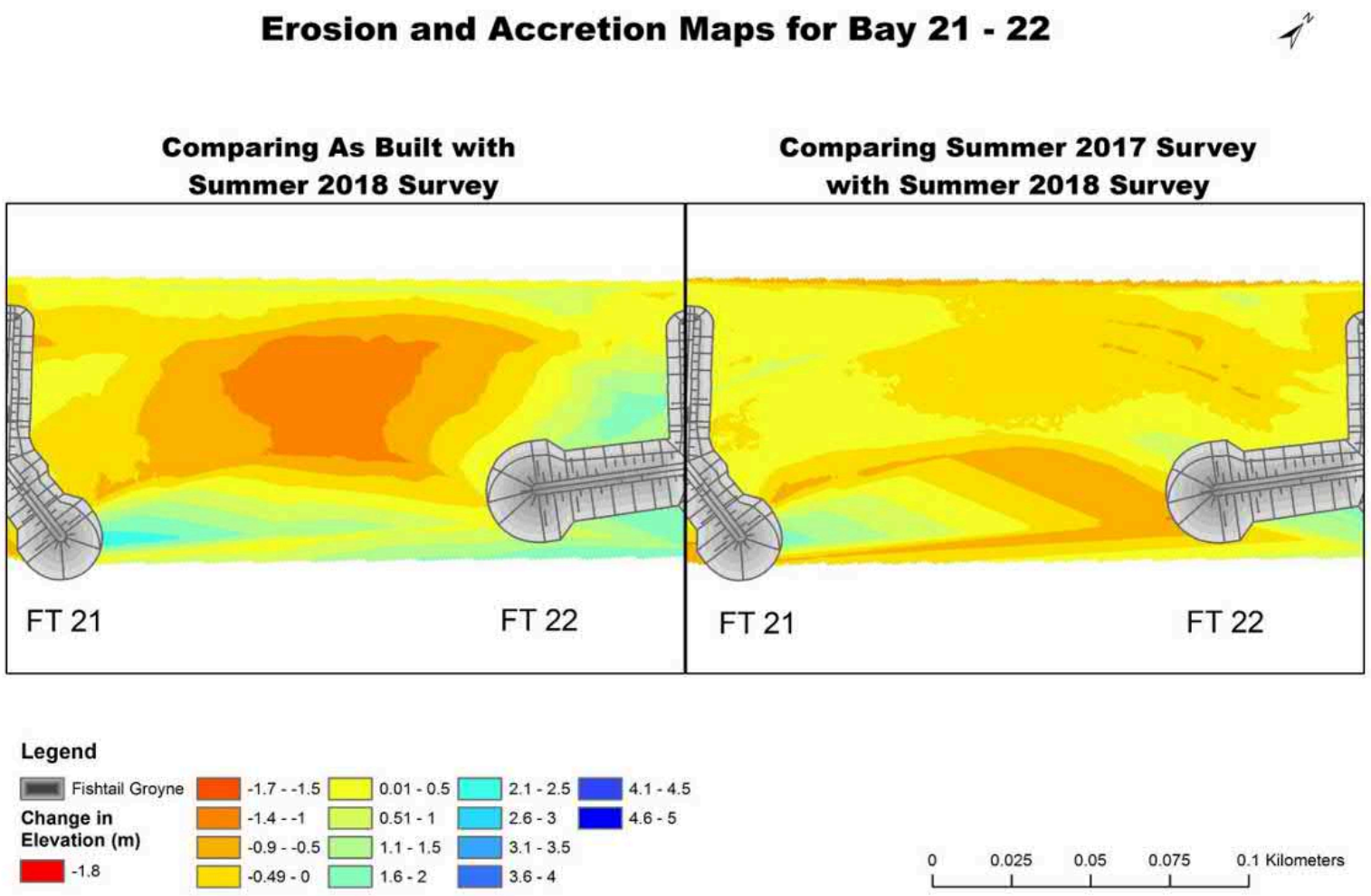
Bays	Accretion and Erosion Maps	Description of the key changes in the bay
17		- Highest erosion has occurred along the berm of the beach and in the middle of the bay with a high of –1.5m to -1.7m decrease, but with a more general high of -1.4m to -1m decrease in beach elevation - Accretion highest behind FT17 at a high of 1.6m to 2m. - These observations vary slightly from the 2017 survey, where erosion was occurring mainly in the middle of the bay in 2017, but in 2018 the berm experienced the largest area of beach elevation decrease at -1.4m to -1m (See Appendix A). - In general, between summer 2017 and 2018 surveys the middle of the bay to FT17 has experienced a small increase by 0.01m to 0.5m. Whereas behind FT16 to the middle of the bay and from the middle of the bay along the upper beach to behind FT17 the beach has generally lowered. It is likely the material from these areas is being moved via a backwash wave out towards the sea, hence the accretion of sand in front of these areas of beach lowering. - Generally, the whole bay has experienced an overall lowering of the beach.

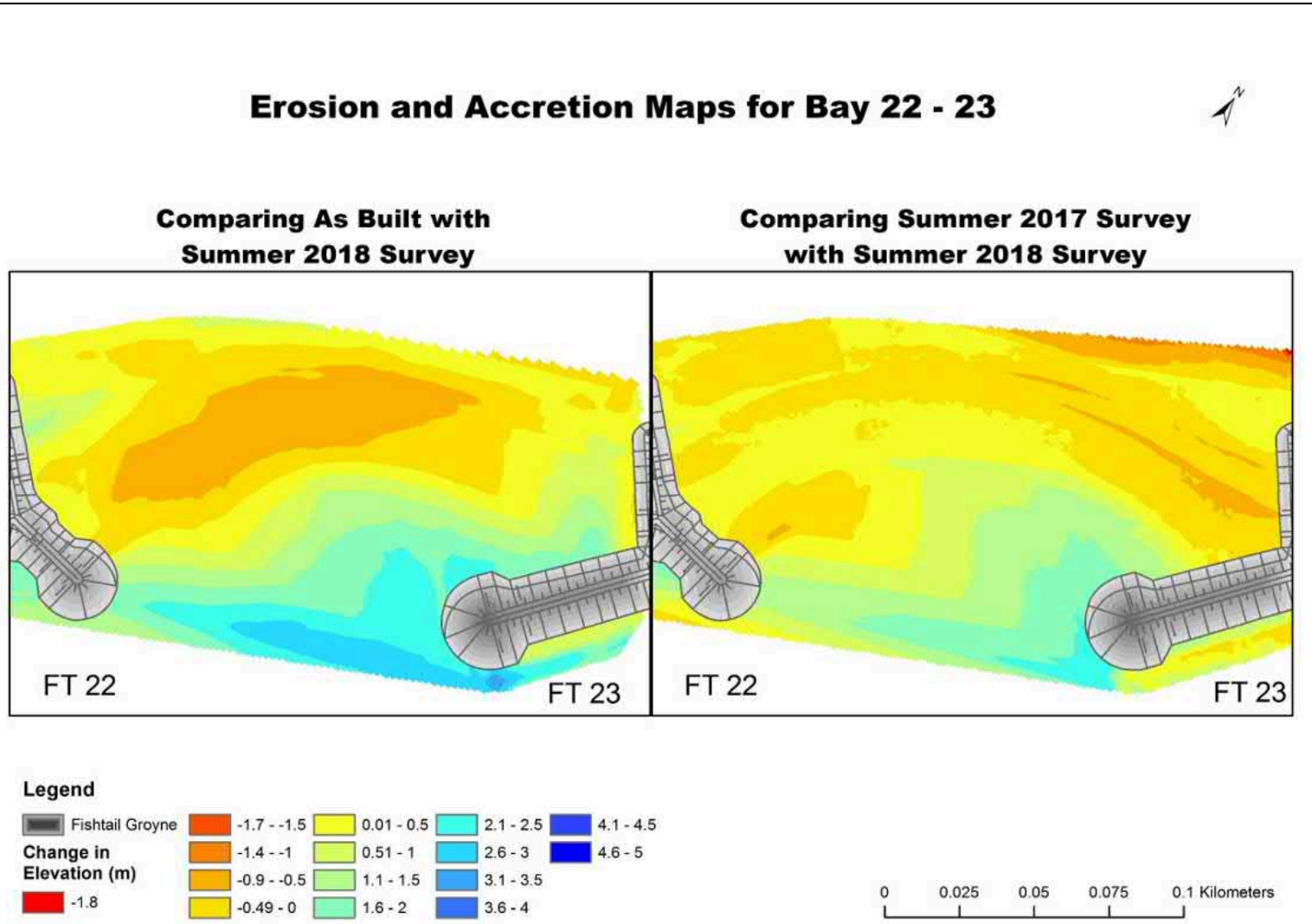
Bays	Accretion and Erosion Maps	Description of the key changes in the bay
18		- Highest erosion has occurred along the berm of the beach and in the middle of the bay with a high of -1.4m to -1m decrease in beach elevation. - Accretion highest behind FT18 at a high of 1.1m to 1.5m. - These observations are a continued trend from 2017. Though the berm and has been an area of more beach lowering in 2018 than in 2017. - In general, between summer 2017 and 2018 surveys the middle of the bay to FT18 has experienced a small increase by 0.01m to 0.5m. Whereas behind FT17 to the middle of the bay and from the middle of the bay along the upper beach to behind FT17 the beach has generally lowered. It is likely the material from these areas is being moved via a backwash wave out towards the sea, hence the accretion of sand in front of these areas of beach lowering. - Generally, the whole bay has experienced an overall lowering of the beach.

Bays	Accretion and Erosion Maps	Description of the key changes in the bay
19		- Highest erosion has occurred along the berm of the beach and in the middle of the bay with a high of -1.4m to -1m decrease in beach elevation. - Accretion highest behind FT18 at a high of 1.1m to 1.5m. - These observations are a continued trend from 2017. Though the berm and middle of the bay has been an area of more beach lowering in 2018 than in 2017. - In general, between summer 2017 and 2018 surveys the middle of the bay to FT19 has experienced a small increase by 0.01m to 0.5m. Whereas behind FT18 to the middle of the bay and from the middle of the bay along the upper beach to behind FT19 the beach has generally lowered. It is likely the material from these areas is being moved via a backwash wave out towards the sea, hence the accretion of sand in front of these areas of beach lowering. - Generally, the whole bay has experienced an overall lowering of the beach.

Bays	Accretion and Erosion Maps	Description of the key changes in the bay
20		- Highest erosion has occurred along the berm of the beach and in the middle of the bay with a high of -1.7m to -1.5m, but a more general high of -1.4m to -1m decrease in beach elevation. - Accretion highest behind FT20 at a high of 1.1m to 1.5m. - These observations are a continued trend from 2017. Though the berm and middle of the bay has been an area of more beach lowering in 2018 than in 2017. - In general, between summer 2017 and 2018 surveys the middle of the bay to FT20 has experienced a small increase by 0.01m to 0.5m in general, with a high of 0.051m to 1m close to the head of the sea protruding arm of FT20. Whereas behind FT19 to the middle of the bay and from the middle of the bay along the upper beach to behind FT20 the beach has generally lowered. It is likely the material from these areas is being moved via a backwash wave out towards the sea, hence the accretion of sand in front of these areas of beach lowering. - Generally, the whole bay has experienced an overall lowering of the beach.

Bays	Accretion and Erosion Maps	Description of the key changes in the bay
21		- Highest erosion has occurred along the berm of the beach and in the middle of the bay with a high of -1.7m to -1.5m, but a more general high of -1.4m to -1m decrease in beach elevation. - Accretion highest behind FT21 at a high of 0.51m to 1m. - These observations are a continued trend from 2017. Though the berm and middle of the bay has been an area of more beach lowering in 2018 than in 2017. There is an area of intense beach lowering from As Built between the middle of the bay and FT 21, this is where a ramp from the promenade comes down onto the beach. Therefore, this area of beach lowering could be a result of human activity rather than wave processes alone. - In general, between summer 2017 and 2018 surveys the middle of the bay to FT21 has experienced a small increase by 0.01m to 0.5m in general, with a high of 0.051m to 1m close to the head of the sea protruding arm of FT20. Whereas behind FT20 to the middle of the bay and from the middle of the bay along the upper beach to behind FT21 the beach has generally lowered. It is likely the material from these areas is being moved via a backwash wave out towards the sea, hence the accretion of sand in front of these areas of beach lowering. - Generally, the whole bay has experienced an overall lowering of the beach.

Bays	Accretion and Erosion Maps	Description of the key changes in the bay
22		- Highest erosion has occurred along the berm of the beach and in the middle of the bay with a high of -1.4m to -1m decrease in beach elevation. - Accretion highest behind FT22 at a high of 1.6m -2m. - These observations are a continued trend from 2017. Though the berm and middle of the bay has been an area of more beach lowering in 2018 than in 2017. Furthermore, the has been more accretion behind FT22 in 2018 than in 2017, which is unlike other bays. This is potentially due to the slight change in orientation at this bay. - In general, between summer 2017 and 2018 surveys the middle of the bay to FT21 has experienced a small increase by 0.01m to 0.5m. Whereas from the middle of the bay, along the upper beach, to behind FT22 the beach has generally lowered. This is unlike any other bay. However, during the profile survey it was noted that this area experiences significant aeolian sand. Potentially this could be the reason for the accumulation near FT21. - There has been some lowering behind FT22 but some accumulation near the head of the protruding arm of FT22 as well. It is likely the material from these areas is being moved via a backwash wave out towards the sea, hence the accretion of sand in front of these areas of beach lowering.

Bays	Accretion and Erosion Maps	Description of the key changes in the bay
23		- Highest erosion is skewed to the south of the bay and along the berm of the beach with a high of -0.9m to -0.5m decrease in beach elevation. - Accretion highest behind FT23 at a high of 1.6m -2m. - These observations are a continued trend from 2017. Though the berm has been an area of more beach lowering in 2018 than in 2017. - In general, between summer 2017 and 2018 surveys the middle of the bay to FT23 has experienced a small increase by 0.01m to 0.5m. Whereas behind FT22 along the upper beach to behind the sea protruding arm of FT23 beach lowering has occurred. It is likely the material from these areas is being moved via a backwash wave out towards the sea, hence the accretion of sand in front of these areas of beach lowering. However, FT23 is the terminal groyne and thus has a longer sea protruding arm, which helps to protect the bay from wave action. This is likely to explain the accumulation seen in the middle of the bay from 2017 to 2018.

Source: <Insert Notes or Source>

2.4 Dip and Crest Trigger Levels

The management of the Clacton and Holland-on-Sea beach is based on two trigger levels from the Beach Management Plan 2015. These levels are related to the berm width and the beach level (crest height) at the seawall, at the fishtail groynes and at the rock burial areas down to the MLWM. Both parameters were obtained during the monitoring of the frontage using the beach profiles. Profiles taken in the middle of the bays extended from the promenade or seawall to the MLWS tide level. Profiles adjacent to the structures were required to be approximately 10m from the structures and extended until the fishtail rock groyne arms were reached. Locations of beach profiles surveyed can be seen in Figure 4. A Larger scale of this map is included in Appendix B.

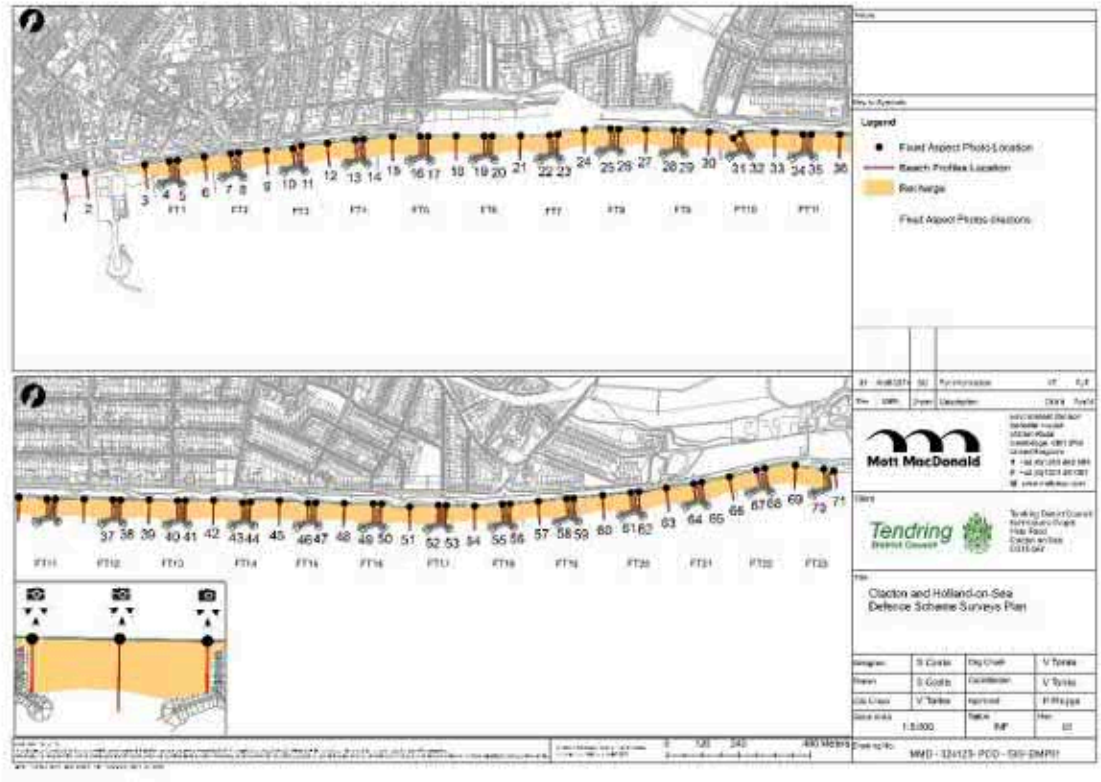


Figure 4 Beach profile survey locations at Clacton-on-Sea

In the Clacton and Holland on Sea Coast Protection Scheme (Mott MacDonald, 2015) it is important to note that it has been assumed the seawall will fail if the beach level drops to **+1mOD** along the frontage. This distance from the promenade to the top of the beach may vary along the frontage depending on the condition and type of seawall; however, in order to simplify the management of the beach, a constant worst-case failure level along the scheme has been assumed. It was assumed that the fishtail groynes and rock revetments will fail if the beach level drops 2.0m from the original recharge level (see Table 2.). The two rock burial areas (Bay 8-9 and Bay 13-14) are merely a store of excess material from the construction works that have no structural or defensive function. Thus a 'failure level' of approximately 0.5m sand coverage over the buried rock is used, to prevent the stored rock from being exposed. This level is approximately a 1.0m drop below the recharge level.

The beach profile survey located in the middle of each bay defines the trigger levels related to the seawall stability. The beach profiles adjacent to the structure indicate the stability of the fishtail groynes. Trigger levels have been graded using a traffic light system. Amber means that beach levels have dropped enough that beach recycling needs to be undertaken. If the trigger levels are red, then recharge of the bay needs to be carried out. Table 2 outlines the trigger values for each type of frontage.

Table 2: Trigger levels for either beach recycling or beach recharge events.

Beach Location	Original Recharge Level in 2014-15	Amber Trigger Level	Red Trigger Level
Seawall in bays without buried rock	**+3.5mOD**	**+2.0mOD**	**+1.0mOD**
Rock Revetments and Fishtail Groynes	**+3.5mOD** (at crest)	**1.0m** below original recharge (**+2.5mOD** at beach crest)	**2.0m** below original recharge (**+1.5mOD** at beach crest)
Bays with buried rock	**+3.5mOD**	**+3.0mOD**	**+2.5mOD**

Source: Mott MacDonald, 2015

Amber trigger levels are also measured using the width of the berm and height of the crest. The berm width along the frontage is recommended to be 18m, however, some retreat is expected in order to reach the equilibrium beach curve. Yet if the berm's retreat is larger than 5m and crest height falls by 1.5m to +2.0mOD at the seawall and/or by 1.0m at the groyne or revetment structures, and/or by 0.5m over the rock burial areas then beach material should be re-profiled.

A Red trigger level is measured if the crest height falls by 2.5m to +1.0mOD at the seawall and/or by 2.0m at the groynes or revetment structures, and/or by 1.0m over the rock burial areas. Under these conditions a recharge scheme in the bay is likely to be required.

In Table 3 the dip and crest measurement recorded from the survey were assessed to determine if the trigger levels, outline previously in this section, have been reached.

Table 3: Comparison of dip and crest measurements from As Built to when surveyed, and whether a trigger level has been reached (Figure 3 for profile locations). Provides comparison from 2017 and 2018 surveys.

Profile (Bay)	Seawall/Prom Level (m)	Survey Dip (m) 2017	Survey Dip (m) 2018	Change in Dip between 2017 to 2018 Survey	Elevation of the Beach (OD) (Prom – 2018)	Trigger for Beach Levels 2018	As Built Crest (m)	Surveyed Crest 2017	Surveyed Crest 2018	Crest Width Change from 2017 to 2018 Survey	Crest Width Change from As Built to 2018	Trigger for Crest Width	Overall Trigger
1 (South of pier)	-	1.02	0.805	-0.215	-	-	-	20.5	26.6	+6.1	-	-	-
2 (South of pier)	-	0.97	1.045	0.075	-	-	-	27	29.75	+2.75	-	-	-
3 (Bay 1)	5.57	1.77	1.2	-0.57	4.37	Not Triggered	19	9.5	8.9	-0.6	-10.1	Amber	Not Triggered
4 (Bay 1)	5.57	1.73	0.72	-1.01	4.85	Not Triggered	22.5	33.5	40.64	+7.14	+18.14	Not Triggered	Not Triggered
5 (Bay 2)	5.57	1.85	0.79	-1.06	4.78	Not Triggered	20	32	35.72	+3.72	+15.72	Not Triggered	Not Triggered
6 (Bay 2)	5.57	1.77	0.645	-1.125	4.925	Not Triggered	22.5	16	18	+2	-4.5	Not Triggered	Not Triggered
7 (Bay 2)	5.57	1.87	0.72	-1.15	4.85	Not Triggered	22.5	34	44.28	+10.28	+21.78	Not Triggered	Not Triggered
8 (Bay 3)	5.57	1.77	0.7	-1.07	4.87	Not Triggered	22.5	31	35.65	+4.65	+13.15	Not Triggered	Not Triggered
9 (Bay 3)	5.57	1.83	0.625	-1.205	4.945	Not Triggered	22.5	16.5	12.4	-4.1	-10.1	Amber	Not Triggered
10 (Bay 3)	5.57	1.75	0.84	-0.91	4.73	Not Triggered	22.5	29	40.8	+11.8	+18.3	Not Triggered	Not Triggered
11 (Bay 4)	5.57	1.61	0.765	-0.845	4.805	Not Triggered	21	28.5	35.47	+6.97	+14.47	Not Triggered	Not Triggered
12 (Bay 4)	5.57	1.73	0.789	-0.941	4.781	Not Triggered	22.5	15	14.59	-0.41	-7.91	Amber	Not Triggered
13 (Bay 4)	5.57	1.8	1.115	-0.685	4.455	Not Triggered	20	36.5	44.24	+7.75	+24.25	Not Triggered	Not Triggered
14 (Bay 5)	5.57	1.81	0.855	-0.955	4.715	Not Triggered	21	33.5	38.23	+4.73	+17.23	Not Triggered	Not Triggered
15 (Bay 5)	5.57	1.75	0.79	-0.96	4.78	Not Triggered	21	18.5	18.51	+0.01	-2.49	Not Triggered	Not Triggered
16 (Bay 5)	5.57	2.02	1.2	-0.82	4.37	Not Triggered	20	34.5	48.82	+14.32	+28.82	Not Triggered	Not Triggered
17 (Bay 6)	5.57	1.85	0.88	-0.97	4.69	Not Triggered	20	32	35.8	+3.8	+15.8	Not Triggered	Not Triggered
18 (Bay 6)	5.57	1.81	0.735	-1.075	4.835	Not Triggered	21	17.5	15.3	-2.2	-5.7	Amber	Not Triggered
19 (Bay 6)	5.57	1.7	0.85	-0.85	4.72	Not Triggered	20.5	33.5	45.6	+12.1	+25.1	Not Triggered	Not Triggered
20 (Bay 7)	5.57	1.79	0.675	-1.115	4.895	Not Triggered	19	29	33.72	+4.72	+14.72	Not Triggered	Not Triggered
21 (Bay 7)	5.57	1.6	0.75	-0.85	4.82	Not Triggered	-	13	13.14	+0.14	-	-	Not Triggered
22 (Bay 7)	5.57	2.3	0.815	-1.485	4.755	Not Triggered	17.5	32	45	+13	+27.5	Not Triggered	Not Triggered
23 (Bay 8)	5.57	1.94	0.705	-1.235	4.865	Not Triggered	18	22.5	26.7	+4.2	+8.7	Not Triggered	Not Triggered

Profile (Bay)	Seawall/Prom Level (m)		Survey Dip (m) 2017	Survey Dip (m) 2018	Change in Dip between 2017 to 2018 Survey	Elevation of the Beach (OD) (Prom – 2018)	Trigger for Beach Levels 2018	As Built Crest (m)	Surveyed Crest 2017	Surveyed Crest 2018	Crest Width Change from 2017 to 2018 Survey	Crest Width Change from As Built to 2018	Trigger for Crest Width	Overall Trigger
24 (Bay 8)		4.5	0.63	0.29	-0.34	4.21	Not Triggered	17.5	19.5	17.6	-1.9	+0.1	Not Triggered	Not Triggered
25 (Bay 8)		4.5	0.77	0.52	-0.25	3.98	Not Triggered	17.5	35.5	45.06	+9.56	+27.56	Not Triggered	Not Triggered
26 (Bay 9)		4.5	0.71	0.445	-0.265	4.055	Not Triggered	18.5	29	32.18	+3.18	+13.68	Not Triggered	Not Triggered
27 (Bay 9)		4.5	0.77	0.57	-0.2	3.93	Not Triggered	17.5	14	15.1	+1.1	-2.4	Not Triggered	Not Triggered
28 (Bay 9)		4.5	0.77	0.65	-0.12	3.85	Not Triggered	17.5	36.5	41.64	+5.14	+24.14	Not Triggered	Not Triggered
29 (Bay 10)		4.5	0.78	0.49	-0.29	4.01	Not Triggered	19.5	29.5	34.86	+5.36	+15.36	Not Triggered	Not Triggered
30 (Bay 10)		4.5	0.56	0.28	-0.28	4.22	Not Triggered	20	15.5	15.4	-0.1	-4.6	Not Triggered	Not Triggered
31 (Bay 10)		n/a	-	0	-	-	-	20	27	23.1	-3.9	+3.1	Not Triggered	Not Triggered
32 (Bay 11)		n/a	-	0	-	-	-	20	40	46.78	+6.78	+26.78	Not Triggered	Not Triggered
33 (Bay 11)		4.5	0.8	0.52	-0.28	3.98	Not Triggered	18	14	19.2	+5.2	+1.2	Not Triggered	Not Triggered
34 (Bay 11)		4.5	0.8	0.47	-0.33	4.03	Not Triggered	15.5	36	44.52	+8.52	+29.02	Not Triggered	Not Triggered
35 (Bay 12)		4.5	0.8	0.52	-0.28	3.98	Not Triggered	15.5	32	30.88	-1.12	+15.38	Not Triggered	Not Triggered
36 (Bay 12)		5.4	1.27	0.65	-0.62	4.75	Not Triggered	17.5	15	15.7	+0.7	-1.8	Not Triggered	Not Triggered
37 (Bay 12)		5.4	1.47	0.63	-0.84	4.77	Not Triggered	18	36	45.48	+9.48	+27.48	Not Triggered	Not Triggered
38 (Bay 13)		5.4	0.7	0.64	-0.06	4.76	Not Triggered	20	29.5	34.18	+4.68	+14.18	Not Triggered	Not Triggered
39 (Bay 13)		4.5	0.5	0.59	0.09	3.91	Not Triggered	17.5	13.5	14.04	+0.54	-3.46	Not Triggered	Not Triggered
40 (Bay 13)		4.5	0.47	0.42	-0.05	4.08	Not Triggered	18	29.5	49.36	+19.86	+31.36	Not Triggered	Not Triggered
41 (Bay 14)		4.5	0.46	0.495	0.035	4.005	Not Triggered	20	31	35.89	+4.89	+15.89	Not Triggered	Not Triggered
42 (Bay 14)		4.5	0.12	0.09	-0.03	4.41	Not Triggered	20	16.5	17.42	+0.92	-2.58	Not Triggered	Not Triggered
43 (Bay 14)		4.5	0.33	0.35	0.02	4.15	Not Triggered	17.5	32	47.06	+15.06	+29.56	Not Triggered	Not Triggered
44 (Bay 15)		4.5	0.4	0.41	0.01	4.09	Not Triggered	19	28.5	31.32	+2.82	+12.32	Not Triggered	Not Triggered
45 (Bay 15)		4.5	0.38	0.445	0.065	4.055	Not Triggered	20	15.5	17.88	+2.38	-2.12	Not Triggered	Not Triggered
46 (Bay 15)		4.5	0.29	0.305	0.015	4.195	Not Triggered	14.5	32	44.85	+12.85	+30.35	Not Triggered	Not Triggered

Profile (Bay)	Seawall/Prom Level (m)		Survey Dip (m) 2017	Survey Dip (m) 2018	Change in Dip between 2017 to 2018 Survey	Elevation of the Beach (OD) (Prom – 2018)	Trigger for Beach Levels 2018	As Built Crest (m)	Surveyed Crest 2017	Surveyed Crest 2018	Crest Width Change from 2017 to 2018 Survey	Crest Width Change from As Built to 2018	Trigger for Crest Width	Overall Trigger
47 (Bay 16)		4.5	0.26	0.16	-0.1	4.34	Not Triggered	19	29.5	32.04	+2.54	+13.04	Not Triggered	Not Triggered
48 (Bay 16)		4.5	-	0.19	-	4.31	Not Triggered	18	15.5	16.75	+1.25	-1.25	Not Triggered	Not Triggered
49 (Bay 16)		4.5	-	0	-	4.5	Not Triggered	18.5	38.5	45.87	+7.37	+27.37	Not Triggered	Not Triggered
50 (Bay 17)		4.5	-	0	-	4.5	Not Triggered	17.5	33.5	36.96	+3.46	+19.46	Not Triggered	Not Triggered
51 (Bay 17)		4.5	0.78	0.765	-0.015	3.735	Not Triggered	14	10	11	+1	-3	Not Triggered	Not Triggered
52 (Bay 17)		4.5	0.7	0.54	-0.16	3.96	Not Triggered	20	33.5	48.7	+15.2	+28.7	Not Triggered	Not Triggered
53 (Bay 18)		4.5	0.87	0.495	-0.375	4.005	Not Triggered	20	31	33.08	+2.08	+13.08	Not Triggered	Not Triggered
54 (Bay 18)		4.5	0.71	0.435	-0.275	4.065	Not Triggered	15.5	13	14.34	+1.34	-1.16	Not Triggered	Not Triggered
55 (Bay 18)		4.5	0.72	0.41	-0.31	4.09	Not Triggered	17.5	33.5	45.8	+12.3	+28.3	Not Triggered	Not Triggered
56 (Bay 19)		4.5	0.67	0.385	-0.285	4.115	Not Triggered	15.5	25.5	30.7	+5.2	+15.2	Not Triggered	Not Triggered
57 (Bay 19)		4.5	0.38	0.14	-0.24	4.36	Not Triggered	17.5	16.5	16.9	+0.4	-0.6	Not Triggered	Not Triggered
58 (Bay 19)		4.5	0.73	0.295	-0.435	4.205	Not Triggered	18.5	36	47.34	+11.34	+28.84	Not Triggered	Not Triggered
59 (Bay 20)		4.5	0.6	0.23	-0.37	4.27	Not Triggered	18.5	28.5	35.46	+6.96	+16.96	Not Triggered	Not Triggered
60 (Bay 20)		4.5	0.32	0.05	-0.27	4.45	Not Triggered	18.5	16.5	16.7	+0.2	-1.8	Not Triggered	Not Triggered
61 (Bay 20)		4.5	0.6	0.225	-0.375	4.275	Not Triggered	18.5	32	43.17	+11.17	+24.67	Not Triggered	Not Triggered
62 (Bay 21)		4.5	0.63	0.5	-0.13	4	Not Triggered	17.5	16.5	34.18	+17.68	+16.68	Not Triggered	Not Triggered
63 (Bay 21)		4.5	0.65	0.575	-0.075	3.925	Not Triggered	18	15.5	15.84	+0.34	-2.16	Not Triggered	Not Triggered
64 (Bay 21)		4.5	0.66	0.3	-0.36	4.2	Not Triggered	19	32	40.64	+8.64	+21.64	Not Triggered	Not Triggered
65 (Bay 22)		4.5	0.5	0.295	-0.205	4.205	Not Triggered	19	27	32.46	+5.46	+13.46	Not Triggered	Not Triggered
66 (Bay 22)		4.5	0.57	0.785	0.215	3.715	Not Triggered	16	13.5	11.96	-1.54	-4.04	Not Triggered	Not Triggered
67 (Bay 22)		4.5	0.48	0.125	-0.355	4.375	Not Triggered	17.5	33.5	38.07	+4.57	+20.57	Not Triggered	Not Triggered
68 (Bay 23)		4.5	0.42	0.18	-0.24	4.32	Not Triggered	10	25.5	32.12	+6.62	+22.12	Not Triggered	Not Triggered
69 (Bay 23)		4.5	0.08	-0.11	-0.19	4.61	Not Triggered	14.5	16.5	18.54	+2.04	+4.04	Not Triggered	Not Triggered

Profile (Bay)	Seawall/Prom Level (m)	Survey Dip (m) 2017	Survey Dip (m) 2018	Change in Dip between 2017 to 2018 Survey	Elevation of the Beach (OD) (Prom – 2018)	Trigger for Beach Levels 2018	As Built Crest (m)	Surveyed Crest 2017	Surveyed Crest 2018	Crest Width Change from 2017 to 2018 Survey	Crest Width Change from As Built to 2018	Trigger for Crest Width	Overall Trigger
70 (Bay 23)	4.5	-	-	-	-	-	10	36	32.69	-3.31	+22.69	Not Triggered	Not Triggered
71 (north of terminal groyne)	4.5	-	-	-	-	-		-	-			-	-

Source: <Insert Notes or Source><Insert Landscape content here. NOTE: There is a section break on this page AND on the previous portrait page. BOTH SECTION BREAKS MUST NOT BE DELETED MANUALLY. To create another landscape page after this one, use a 'Page Break'.>

From Table 3 it is evident that no overall trigger levels have been reached since As Built conditions. However, a few profiles indicate that an amber trigger level has been reached for crest width. Profile 3 saw a 10.1m decrease in crest width from As Built Conditions. This is similar to the 2017 survey, where the berm had decreased by 9.5m. Profile 3 is located not between two fishtail groynes, but instead it is adjacent to the north side of the pier. Beach material is more easily lost from this location than other bays, as the pier does not act like the fishtail rock groynes, which helps to trap beach material within each bay. Ergo, this bay is more exposed to the erosive action of the waves and thus experiences a loss of material.

Furthermore, the crest width of Profiles 9, 12 and 18 have decreased by 10.1m, 7.91m and 5.7m respectively from As Built conditions. This puts these profiles under the 18m trigger limit for crest width. All profiles are within the middle of the bay and between two fishtail groynes, where erosion is expected. However, profiles 9 and 12 are most likely to be experiencing larger reductions in crest width due to their proximity to the pier. The pier has the potential to affect material being transported via longshore drift, seen in Section 2.3. Profile 18, however, is most likely far enough away from the pier that the pier does not affect it. This profile is at a point where the orientation of the coastline becomes more easterly, and in combination with seasonal variations or beach activities could be the reasons erosion has occurred here.

A key observation to note is that profile 3, 9 and 12 all experienced enough erosion to reach the trigger levels in the 2017 survey and in the 2018 survey. Between the two years the trend was a continued erosion of the beach. Therefore, it is likely these profiles will continue to erode in future surveys. Though the interval between the two years varied from 0.4m to 4.1m suggesting that the erosion maybe slowing down from As Built Conditions.

However, though all these beach profiles have reached an amber trigger level for crest width, the beach levels have not been triggered. Hence these locations have not reached an overall amber trigger level to warrant any beach management activities.

2.5 Photographic Record

Fixed aspects photographs were taken for each beach profile at low tide. These photos included either side of the fishtail rock groynes and the condition of the beach between adjacent groynes. The photographs were taken from a fixed position looking perpendicular to the promenade, and two looking in each direction at an approximate angle of 45˚ (See Figure 4).

From the photographs, the general trend for profiles adjacent to the rock groynes show a very wide beach with a lot of beach material. This indicates that accretion has occurred, and sediment is being trapped behind the rock groyne. The gradient of the beaches along these profiles are generally flat, suggesting the material is relatively stable. In comparison, profiles taken in the middle of the two rock groynes generally have narrower and steeper gradient beaches. From the photographs it is evident that a defined beach scalp is forming at the edge of the berm's crest at most of these middle profiles. Furthermore, an overall trend at these profiles is the formation of a defined curved beach between the two rock groynes, indicating wave diffraction and erosion processes are occurring, forming a bay. These observations are in line with those found in the 2017 survey, indicating the beach has changed little between the surveys and suggests it is relatively stable. However, between 2017 and 2018 the rocks of the fishtail groyne's spine on the middle to upper beach have generally become slightly more exposed. This is most likely due to sand being blown away under windy conditions. Currently this is not affecting the structure but should continue to be observed in future surveys.

Table 4 displays these photos for each of the beach profiles and provides a description of sediment processes that can be observed, if the processes differ from the general trend experienced at this frontage.

Table 4: Profiles from 1 - 71 along the Clacton-on-Sea frontage. Photographs taken at a 45° north, 45° south and perpendicular of the promenade.

Profile	Year	45° north to promenade	Perpendicular to promenade	45° south to promenade	Description
1	2017				The beach is very wide, with the slope from the berm down to the foreshore at low tide being quite level. This is a well-established beach and it is evident that the beach material is stable higher up the beach.
1	2018				Like the 2017 survey the beach is very wide and the gradient of the slope from low tide very level. Beach material covers groyne 41 higher up the beach, suggesting that the upper beach has remained stable snice the 2017 survey. Though faint track lines from a vehicle can be seen in the sand, suggesting that beach management activities have possibly aided in keeping the upper beach stable and level.
2	2017				The beach is very wide, with the slope from the berm down to the foreshore again very level at low tide. From the adjacent images, it is evident that material has been trapped higher up the beach and remaining stable.
2	2018				From the photographs, it is evident that beach material is being held along the upper beach by the pier. The middle picture, then indicates the drop-in beach level down to the sea. The rest of the beach is very wide, with the slope from the berm down to the foreshore very level at low tide. This observation is similar to that seen in 2017, suggesting this area of the beach is relativity stable.

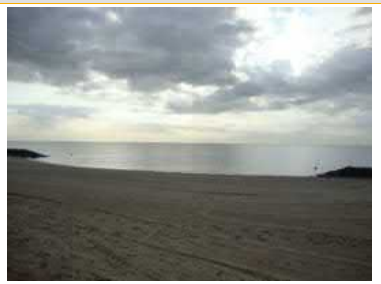
Profile	Year	45˚ north to promenade	Perpendicular to promenade	45˚ south to promenade	Description
3	2017				The beach width varies along this profile, with the beach being wider closer to the rock groyne and narrow towards the pier, indicating this profile has experienced longshore drift in a northward direction. Closer to the pier the gradient from the berm to the foreshore is steeper than at the rock groyne. A more defined berm and beach scalp has formed closer to the rock groyne, indicating that erosive processes for a bay formation has occurred.
3	2018				It is evident the beach width is narrower at the pier and wider closer to the rock groyne. This indicates longshore drift has been experienced in this bay in a northly direction. Further, it suggests the pier does not trap beach material here like the rock groynes and allows this part of the beach to be more exposed to erosive wave action. The observation is in line with obversions from 2017. However, the beach in the 2018 survey nearest the rock groyne appears to be steeper than nearer the pier. This is likely due to the beach levelling out from wave action closer to the pier.
4	2017				
4	2018				Little visual change from 2017, suggesting beach is relatively stable.

Profile	Year	45˚ north to promenade	Perpendicular to promenade	45˚ south to promenade	Description
5	2017				
5	2018				Little visual change from 2017, suggesting beach is relatively stable.
6	2017				
6	2018				The berm and scalp are not as marked in the 2018 photographs compared to the 2017. However, in the 2018 photos it is evident, from the vehicle tracks in the sand, that there have been beach management activities undertaken. These activities are likely to have reduced the definition of the berm and its corresponding scalp.

Profile	Year	45˚ north to promenade	Perpendicular to promenade	45˚ south to promenade	Description
7	2017				
7	2018				Little visual change from 2017, suggesting beach is relatively stable.
8	2017				The end of the groyne (protruding into the sea) has little sediment around it, suggesting erosion due to wave diffraction has occurred.
8	2018				Little visual change from 2017, suggesting beach is relatively stable.

Profile	Year	45˚ north to promenade	Perpendicular to promenade	45˚ south to promenade	Description
9	2017				Noticeably there is more sediment around the end of the rock groyne to the north than the one in the south. This suggest the coastline has experienced longshore drift in a northwards direction here.
9	2018				Similar to 2017, more sediment has gathered around the end of the rock groyne to the north, than the one in the south, suggesting longshore drift has occurred in a northly direction. Further, vehicle tracks can be identified in the sand for both the 2017 and 2018 surveys, indicating beach management activities have been undertaken. The beach management activities are likely to have reduced the definition of the berm and its corresponding scalp.
10	2017				
10	2018				Little visual change from 2017, suggesting beach is relatively stable.

Profile	Year	45˚ north to promenade	Perpendicular to promenade	45˚ south to promenade	Description
11	2017				
11	2018				From the 2018 photos it is clear that a vehicle has driven over the area, likely to be part of beach management activities. Additionally, the spine of the groyne appears to have less sand cover in 2018 than in 2017, where the rocks appeared to be more exposed.
12	2017				Noticeably there is more sediment around the end of the rock groyne to the north than the one in the south. This suggest the coastline has experienced longshore drift in a northwards direction here.
12	2018				Similar to what was observed in 2017, there is more sediment around the end of the rock groyne to the north than the one in the south. This suggests the continued trend of longshore drift in a northerly direction.

Profile	Year	45˚ north to promenade	Perpendicular to promenade	45˚ south to promenade	Description
13	2017				
13	2018				From the 2018 photos it is clear that a vehicle has driven over the area, likely to be part of beach management activities. Additionally, the spine of the groyne appears to have less sand cover in 2018 than in 2017, where the rocks appeared to be more exposed.
14	2017				The end of the groyne (protruding into the sea) has little sediment around it, suggesting erosion due to wave diffraction has occurred.
14	2018				From the 2018 photos it is clear that a vehicle has driven over the area, likely to be part of beach management activities. Additionally, the spine of the groyne appears to have less sand cover in 2018 than in 2017, where the rocks appeared to be more exposed.

Profile	Year	45˚ north to promenade	Perpendicular to promenade	45˚ south to promenade	Description
15	2017				Noticeably there is more sediment around the end of the rock groyne to the north than the one in the south. This suggest the coastline has experienced longshore drift in a northwards direction here.
15	2018				Similar to what was observed in 2017, there is more sediment around the end of the rock groyne to the north than the one in the south. This suggests the continued trend of longshore drift in a northerly direction.
16	2017				
16	2018				Little visual change from 2017, suggesting beach is relatively stable.

Profile	Year	45˚ north to promenade	Perpendicular to promenade	45˚ south to promenade	Description
17	2017				The end of the groyne (protruding into the sea) has little sediment around it, suggesting erosion due to wave diffraction has occurred.
17	2018				The spine of the groyne appears to have less sand cover in 2018 than in 2017, where the rocks appeared to be more exposed.
18	2017				Noticeably there is more sediment around the end of the rock groyne to the north than the one in the south. This suggest the coastline has experienced longshore drift in a northwards direction here.
18	2018				Similar to what was observed in 2017, there is more sediment around the end of the rock groyne to the north than the one in the south. This suggests the continued trend of longshore drift in a northerly direction.

Profile	Year	45˚ north to promenade	Perpendicular to promenade	45˚ south to promenade	Description
19	2017				
19	2018				Little visual change from 2017, suggesting beach is relatively stable.
20	2017				The end of the groyne (protruding into the sea) has little sediment around it, suggesting erosion due to wave diffraction has occurred.
20	2018				Little visual change from 2017, suggesting beach is relatively stable.

Profile	Year	45˚ north to promenade	Perpendicular to promenade	45˚ south to promenade	Description
21	2017				
21	2018				Little visual change from 2017, suggesting beach is relatively stable.
22	2017				
22	2018				Little visual change from 2017, suggesting beach is relatively stable.

Profile	Year	45˚ north to promenade	Perpendicular to promenade	45˚ south to promenade	Description
23	2017				The end of the groyne (protruding into the sea) has little sediment around it, suggesting erosion due to wave diffraction has occurred.
23	2018				Little visual change to the beach snice 2017, indicating the beach is relatively stable. Furthermore, the end of the rock groyne still has little sediment around it, suggesting a similar wave environment has persisted.
24	2017				Noticeably there is more sediment around the end of the rock groyne to the north than the one in the south. This suggest the coastline has experienced longshore drift in a northwards direction here.
24	2018				Similar to what was observed in 2017, there is more sediment around the end of the rock groyne to the north than the one in the south. This suggests the continued trend of longshore drift in a northerly direction. Note, that the profile was taking slightly to the north of the photos due to the protruding ramp (bottom of picture) in the middle of the bay.

Profile	Year	45˚ north to promenade	Perpendicular to promenade	45˚ south to promenade	Description
25	2017				
25	2018				The spine of the groyne appears to have less sand cover in 2018 than in 2017, where the rocks appeared to be more exposed. Rest of the beach shows little visual change from 2017, suggesting the beach is relatively stable.
26	2017				The end of the groyne (protruding into the sea) has little sediment around it, suggesting erosion due to wave diffraction has occurred.
26	2018				The spine of the groyne appears to have less sand cover in 2018 than in 2017, where the rocks appeared to be more exposed.

Profile	Year	45˚ north to promenade	Perpendicular to promenade	45˚ south to promenade	Description
27	2017				Noticeably there is more sediment around the end of the rock groyne to the north than the one in the south. This suggest the coastline has experienced longshore drift in a northwards direction here.
27	2018				Similar to what was observed in 2017, there is more sediment around the end of the rock groyne to the north than the one in the south. This suggests the continued trend of longshore drift in a northerly direction.
28	2017				
28	2018				Little visual change from 2017, suggesting beach is relatively stable.

Profile	Year	45˚ north to promenade	Perpendicular to promenade	45˚ south to promenade	Description
29	2017				
29	2018				Little visual change from 2017, suggesting beach is relatively stable.
30	2017				Noticeably there is more sediment around the end of the rock groyne to the north than the one in the south. This suggest the coastline has experienced longshore drift in a northwards direction here.
30	2018				Unlike in 2017, the more southern rock groyne has more material around the arm projecting into the sea. In the 2018 picture, it appears as fine sediment has gathered around it, with more boulder/stone like material scatted close by. This is likely to have been caused by activities on the beach or a storm event.

Profile	Year	45˚ north to promenade	Perpendicular to promenade	45˚ south to promenade	Description
31	2017				
31	2018				Compared to 2017, the 2018 survey indicates there has been significant expose of rock at the top of the fishtail's spine. This fishtail groyne here is in front of sheet piles that protrudes out from the seawall, thus the spine is shorter and at a different angle than the other fishtail groynes along the frontage. Note the profile was taken slightly to the south of the photos, so the profile could be taken from the seawall and not the sheet piles.
32	2017				
32	2018				Note, 2018 photos were taken to the north of the fishtail groyne to be in line with the rest of the photos in the survey.

Profile	Year	45˚ north to promenade	Perpendicular to promenade	45˚ south to promenade	Description
33	2017				
33	2018				Little visual change from 2017, suggesting beach is relatively stable.
34	2017				
34	2018				Little visual change from 2017, suggesting beach is relatively stable.

Profile	Year	45˚ north to promenade	Perpendicular to promenade	45˚ south to promenade	Description
35	2017				The end of the groyne (protruding into the sea) has little sediment around it, suggesting erosion due to wave diffraction has occurred.
35	2018				The spine of the groyne appears to have less sand cover in 2018 than in 2017, where the rocks appeared to be more exposed.
36	2017				Noticeably there is more sediment around the end of the rock groyne to the north than the one in the south. This suggest the coastline has experienced longshore drift in a northwards direction here.
36	2018				Unlike in 2017, the more southern rock groyne has more material around the arm projecting into the sea. In the 2018 picture, it appears as fine sediment has gathered around it, with more boulder/stone like material scatted close by. This is likely to have been caused by activities on the beach or a storm event.

Profile	Year	45˚ north to promenade	Perpendicular to promenade	45˚ south to promenade	Description
37	2017				
37	2018				Little visual change from 2017, suggesting beach is relatively stable.
38	2017				The end of the groyne (protruding into the sea) has little sediment around it, suggesting erosion due to wave diffraction has occurred.
38	2018				The spine of the groyne appears to have less sand cover in 2018 than in 2017, where the rocks appeared to be more exposed.

Profile	Year	45˚ north to promenade	Perpendicular to promenade	45˚ south to promenade	Description
39	2017				
39	2018				Unlike in 2017, the more southern rock groyne has more material around the arm projecting into the sea. In the 2018 picture, it appears as fine sediment has gathered around it, with more boulder/stone like material scatted close by. This is likely to have been caused by activities on the beach or a storm event.
40	2017				
40	2018				Little visual change from 2017, suggesting beach is relatively stable.

Profile	Year	45˚ north to promenade	Perpendicular to promenade	45˚ south to promenade	Description
41	2017				
41	2018				The spine of the groyne appears to have less sand cover in 2018 than in 2017, where the rocks appeared to be more exposed.
42	2017				
42	2018				Little visual change from 2017, suggesting beach is relatively stable.

Profile	Year	45˚ north to promenade	Perpendicular to promenade	45˚ south to promenade	Description
43	2017				
43	2018				The spine of the groyne appears to have less sand cover in 2018 than in 2017, where the rocks appeared to be more exposed.
44	2017				The end of the groyne (protruding into the sea) has little sediment around it, suggesting erosion due to wave diffraction has occurred.
44	2018				Little visual change from 2017, suggesting beach is relatively stable.

Profile	Year	45˚ north to promenade	Perpendicular to promenade	45˚ south to promenade	Description
45	2017				
45	2018				Little visual change from 2017, suggesting beach is relatively stable.
46	2017				
46	2018				The spine of the groyne appears to have less sand cover in 2018 than in 2017, where the rocks appeared to be more exposed.

Profile	Year	45˚ north to promenade	Perpendicular to promenade	45˚ south to promenade	Description
47	2017				The end of the groyne (protruding into the sea) has little sediment around it, suggesting erosion due to wave diffraction has occurred.
47	2018				Little visual change from 2017, suggesting beach is relatively stable.
48	2017				
48	2018				Little visual change from 2017, suggesting beach is relatively stable.

Profile	Year	45˚ north to promenade	Perpendicular to promenade	45˚ south to promenade	Description
49	2017				
49	2018				The spine of the groyne appears to have less sand cover in 2018 than in 2017, where the rocks appeared to be more exposed.
50	2017				
50	2018				Little visual change from 2017, suggesting beach is relatively stable.

Profile	Year	45˚ north to promenade	Perpendicular to promenade	45˚ south to promenade	Description
51	2017				
51	2018				Little visual change from 2017, suggesting beach is relatively stable.
52	2017				
52	2018				Little visual change from 2017, suggesting beach is relatively stable.

Profile	Year	45˚ north to promenade	Perpendicular to promenade	45˚ south to promenade	Description
53	2017				The end of the groyne (protruding into the sea) has little sediment around it, suggesting erosion due to wave diffraction has occurred.
53	2018				Little visual change from 2017, suggesting beach is relatively stable.
54	2017				Noticeably there is more sediment around the end of the rock groyne to the north than the one in the south. This suggest the coastline has experienced longshore drift in a northwards direction here.
54	2018				Similar to what was observed in 2017, there is more sediment around the end of the rock groyne to the north than the one in the south. This suggests the continued trend of longshore drift in a northerly direction.

Profile	Year	45˚ north to promenade	Perpendicular to promenade	45˚ south to promenade	Description
55	2017				
55	2018				Little visual change from 2017, suggesting beach is relatively stable.
56	2017				The end of the groyne (protruding into the sea) has little sediment around it, suggesting erosion due to wave diffraction has occurred.
56	2018				Little visual change from 2017, suggesting beach is relatively stable.

Profile	Year	45˚ north to promenade	Perpendicular to promenade	45˚ south to promenade	Description
57	2017				
57	2018				Similar to what was observed in 2017, there is more sediment around the end of the rock groyne to the north than the one in the south. This suggests the continued trend of longshore drift in a northerly direction.
58	2017				
58	2018				Little visual change from 2017, suggesting beach is relatively stable.

Profile	Year	45˚ north to promenade	Perpendicular to promenade	45˚ south to promenade	Description
59	2017				The end of the groyne (protruding into the sea) has little sediment around it, suggesting erosion due to wave diffraction has occurred.
59	2018				Little visual change from 2017, suggesting beach is relatively stable.
60	2017				Noticeably there is more sediment around the end of the rock groyne to the north than the one in the south. This suggest the coastline has experienced longshore drift in a northwards direction here.
60	2018				Little visual change from 2017, suggesting beach is relatively stable.

Profile	Year	45˚ north to promenade	Perpendicular to promenade	45˚ south to promenade	Description
61	2017				
61	2018				Little visual change from 2017, suggesting beach is relatively stable.
62	2017				The end of the groyne (protruding into the sea) has little sediment around it, suggesting erosion due to wave diffraction has occurred.
62	2018				Little visual change from 2017, suggesting beach is relatively stable.

Profile	Year	45˚ north to promenade	Perpendicular to promenade	45˚ south to promenade	Description
63	2017				Noticeably there is more sediment around the end of the rock groyne to the north than the one in the south. This suggest the coastline has experienced longshore drift in a northwards direction here.
63	2018				Similar to what was observed in 2017, there is more sediment around the end of the rock groyne to the north than the one in the south. This suggests the continued trend of longshore drift in a northerly direction.
64	2017				
64	2018				Little visual change from 2017, suggesting beach is relatively stable.

Profile	Year	45˚ north to promenade	Perpendicular to promenade	45˚ south to promenade	Description
65	2017				The end of the groyne (protruding into the sea) has little sediment around it, suggesting erosion due to wave diffraction has occurred.
65	2018				The spine of the groyne appears to have less sand cover in 2018 than in 2017, where the rocks appeared to be more exposed.
66	2017				Noticeably there is more sediment around the end of the rock groyne to the north than the one in the south. This suggest the coastline has experienced longshore drift in a northwards direction here.
66	2018				Little visual change from 2017, suggesting beach is relatively stable.

Profile	Year	45˚ north to promenade	Perpendicular to promenade	45˚ south to promenade	Description
67	2017				
67	2018				Little visual change from 2017, suggesting beach is relatively stable.
68	2017				The end of the groyne (protruding into the sea) has little sediment around it, suggesting erosion due to wave diffraction has occurred.
68	2018				The spine of the rock groyne is covered by more sand than in 2017. This is likely to be due to aeolian sand being trapped here, which is has been observed in other parts of the bay here.

Profile	Year	45˚ north to promenade	Perpendicular to promenade	45˚ south to promenade	Description
69	2017				Unlike other bays, there is a significant amount of erosion at either end of the rock groynes. This is likely due to the slight change in orientation at this point along the frontage and the extended arm of the rock groyne affecting wave diffraction.
69	2018				Little visual change from 2017, suggesting beach is relatively stable.
70	2017				The beach is very wide with a good amount of beach material. However, unlike other profiles taken on the south side of the groyne, there is very little sediment around the end of the groyne (protruding out to sea). This is likely due to the slight change in orientation at this point along the frontage and the extended arm of the rock groyne affecting wave diffraction.
70	2018				Little visual change from 2017, suggesting beach is relatively stable.

Profile	Year	45˚ north to promenade	Perpendicular to promenade	45˚ south to promenade	Description
71	2017				The beach is very wide, with the slope from the berm down to the foreshore at low tide being quite level. The beach appears to be relatively stable, though no accretion processes appear to have occurred here.
71	2018				Little visual change from 2017, suggesting beach is relatively stable.

Source: Mott MacDonald, 2017

3 Summary

3.1 Recommendations

The site surveys that have been carried out as part of the Clacton and Holland-on-Sea Coast Protection Scheme beach monitoring programme clearly indicate that the fishtail groynes are retaining beach material well and are establishing the predicted bay formations for the frontage.

The beach profiles that were undertaken show that no overall trigger level have been reached. However, a few profiles indicate that an amber trigger level has been reached for crest width. Three out of the four profiles that reached an amber warming for crest width also reached an amber trigger level in 2017 for crest width as well. It is therefore likely that these profiles will continue to erode in the future and thus should be continued to be monitored. However, beach levels for these profiles were not triggered.

Further the accretion and erosion maps highlight that bay formation have continued to form since As Built conditions, and that in a continued trend from 2017 a dominant south westerly wave direction has occurred. This has resulted in a northerly movement of sediment in the form of longshore drift. Additionally, between 2017 and 2018 there has been a general lowering of the beach overall and is likely due to the beach material still adjusting. However, the beach changed has continued in a predicted way.

Overall, from these findings the recommended approach is to continue with annual surveys of dip and crest measurements and drone surveys, to continue monitoring the future evolution of the frontage.

4 Refences

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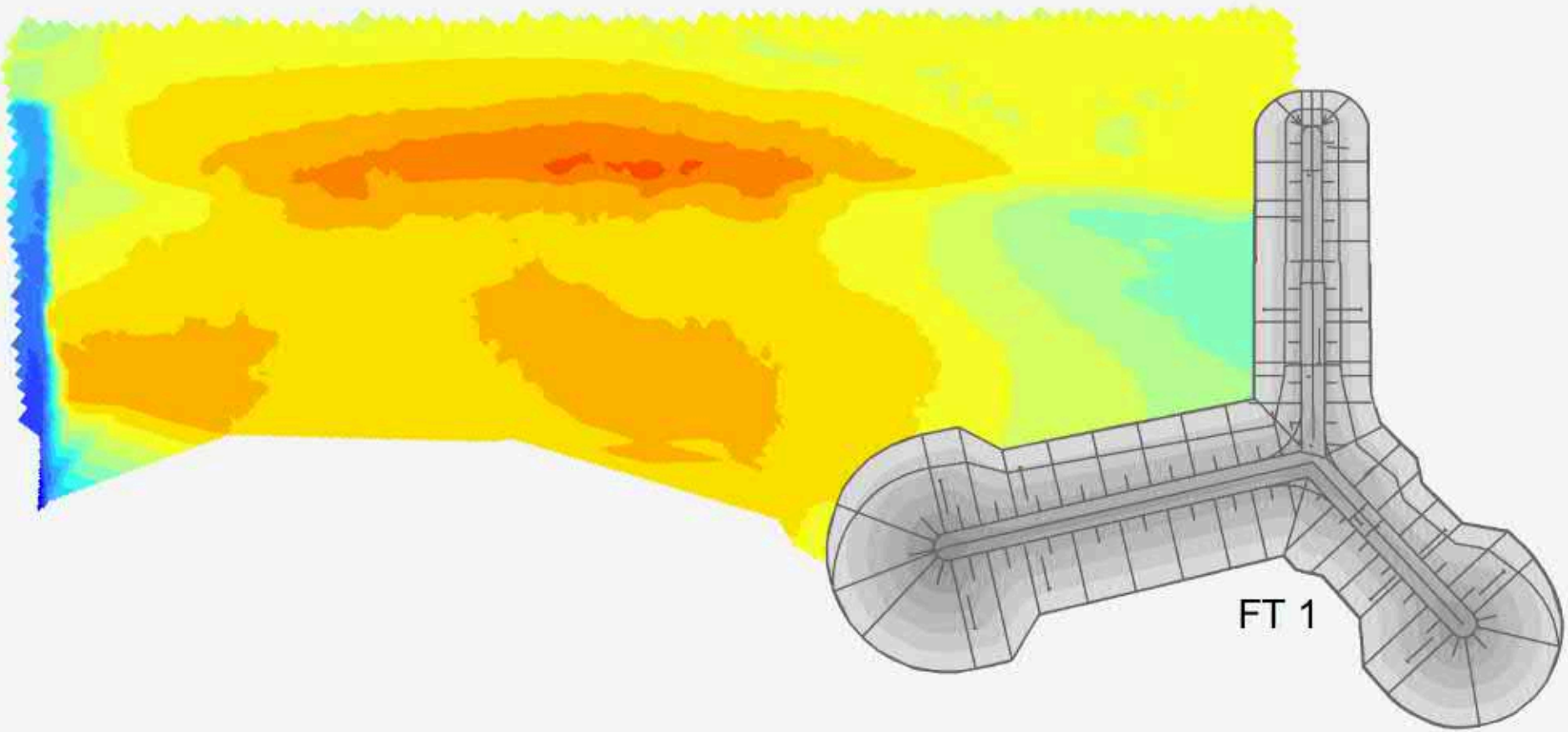
Appendices

A. Erosion and Accretion Maps - 2017

Erosion and Accretion Map for Bay 0 - 1
Comparing As Built with Summer 2017 Survey



Legend

Fishtail Groyne

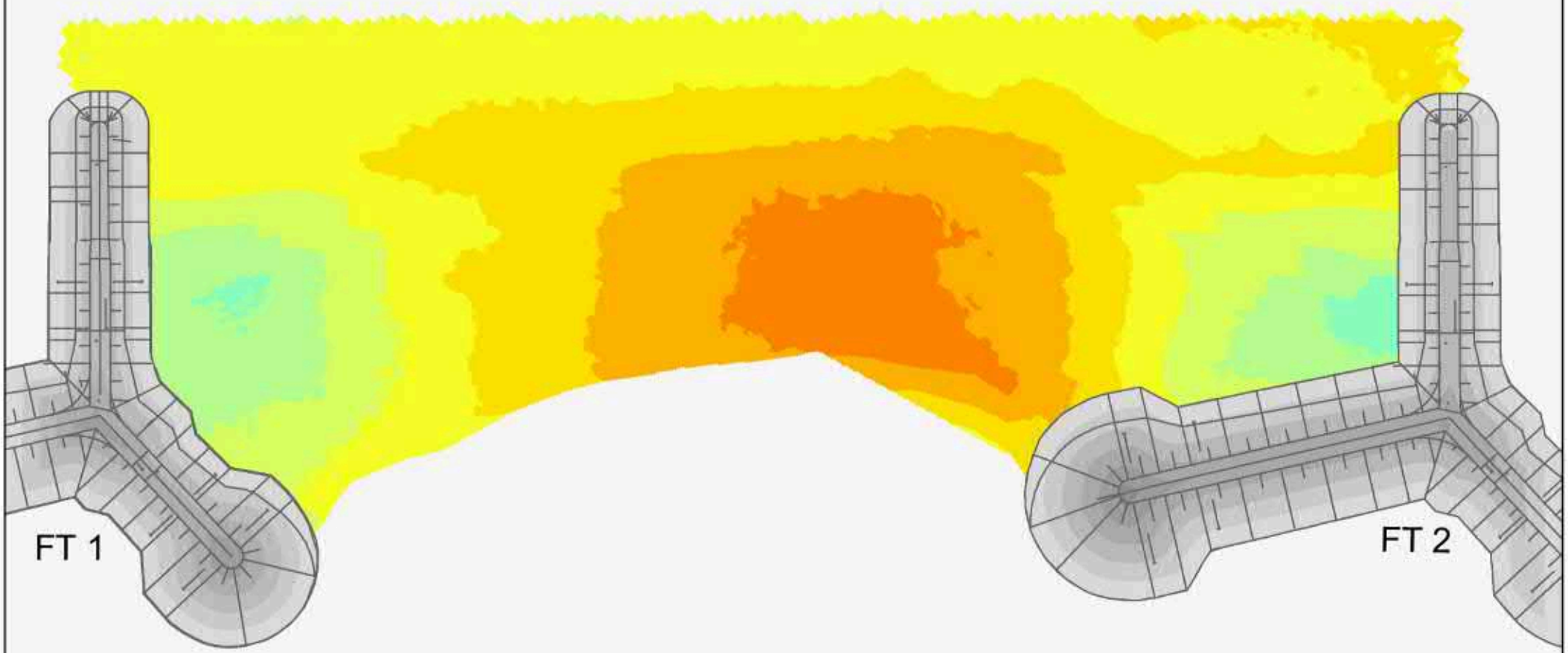
Change in Elevation (m)

-1.8

-1.7 - -1.5
-1.4 - -1
-0.9 - -0.5
-0.49 - 0
0.01 - 0.5
0.51 - 1
1.1 - 1.5
1.6 - 2
2.1 - 2.5
2.6 - 3
3.1 - 3.5
3.6 - 4
4.1 - 4.5
4.6 - 5

0 0.025 0.05 0.075 0.1 Kilometers

Erosion and Accretion Map for Bay 1 - 2
Comparing As Built with Summer 2017 Survey



Legend

Fishtail Groyne

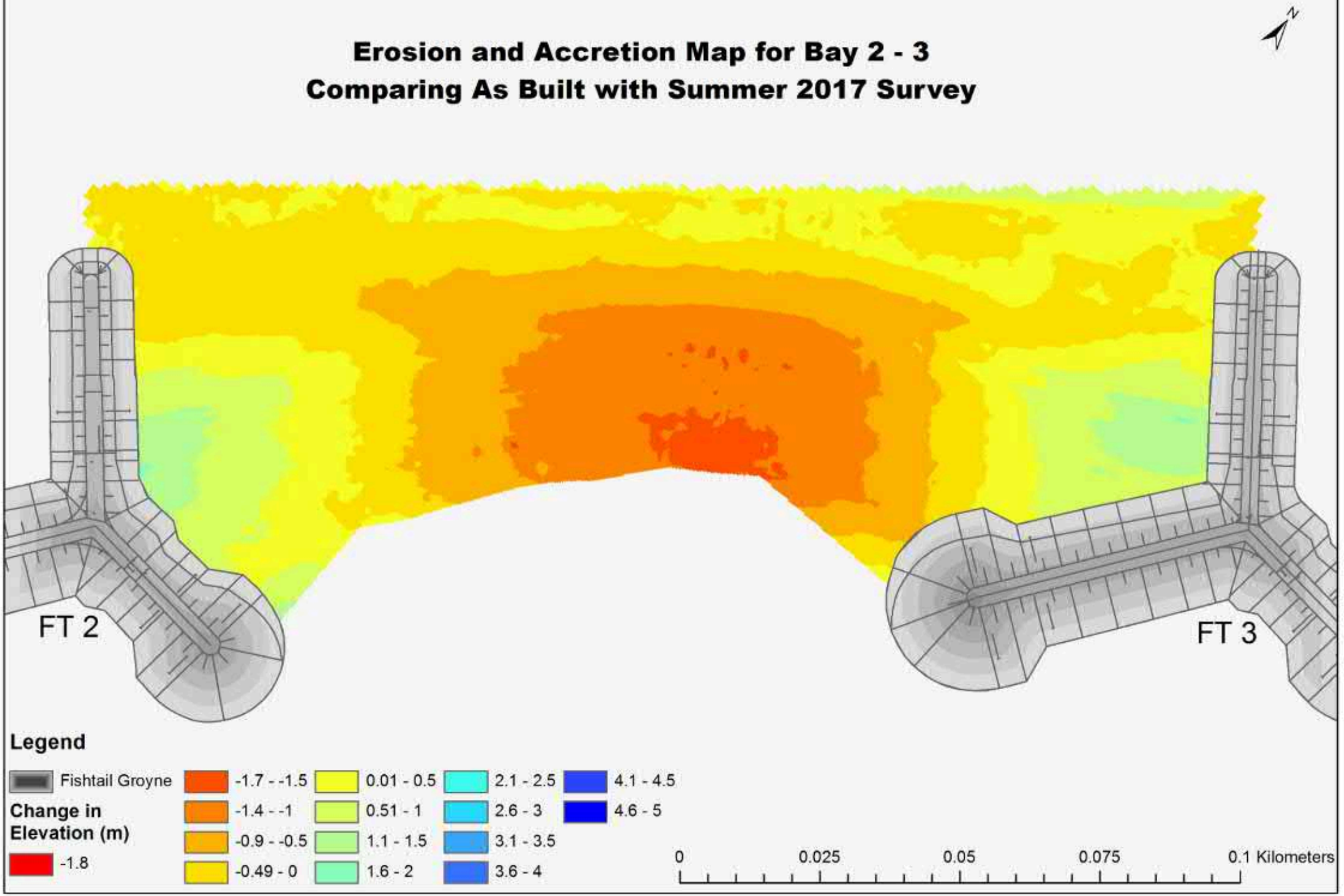
Change in Elevation (m)

-1.8

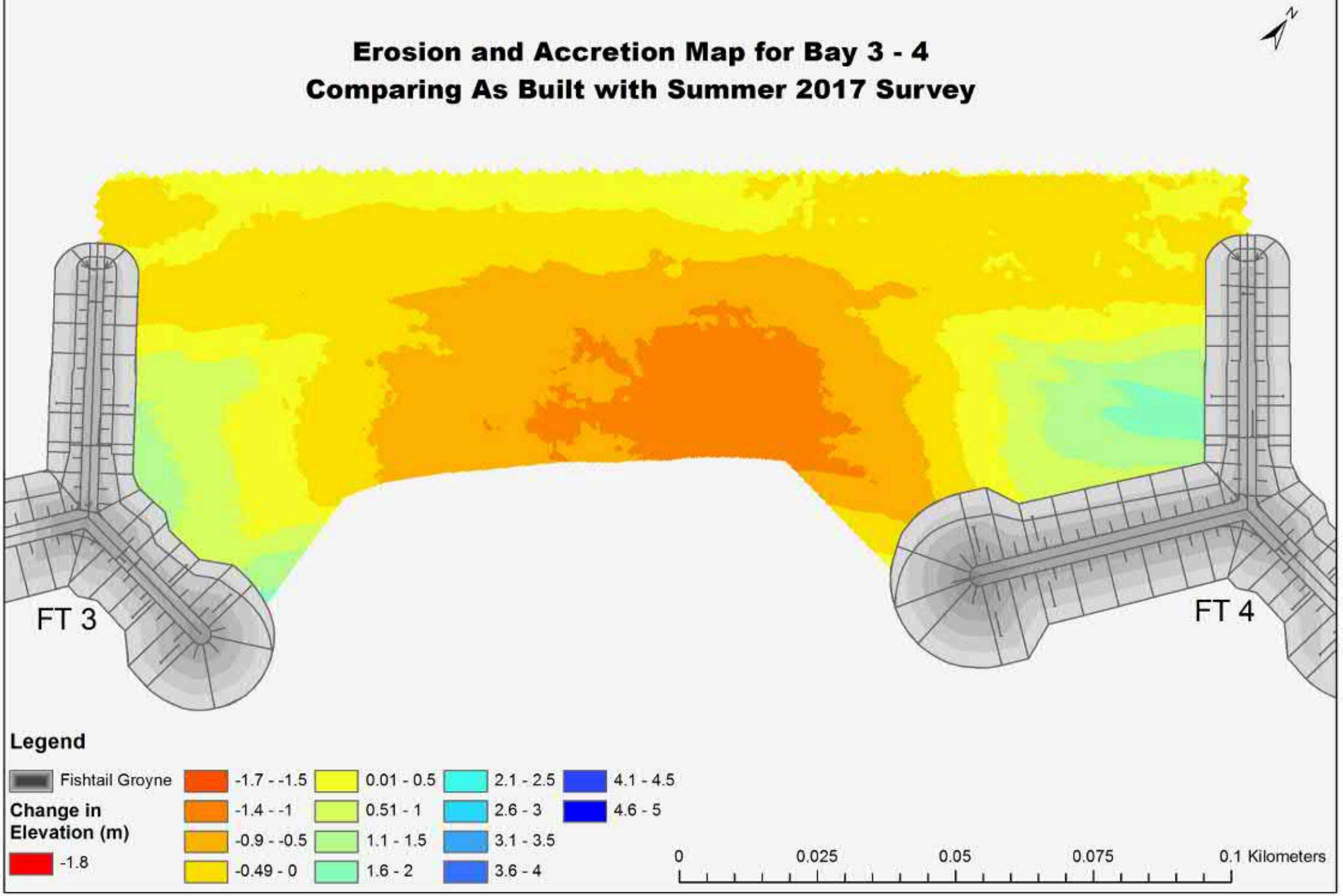
-1.7 - -1.5	0.01 - 0.5	2.1 - 2.5	4.1 - 4.5
-1.4 - -1	0.51 - 1	2.6 - 3	4.6 - 5
-0.9 - -0.5	1.1 - 1.5	3.1 - 3.5	
-0.49 - 0	1.6 - 2	3.6 - 4	

0 0.025 0.05 0.075 0.1 Kilometers

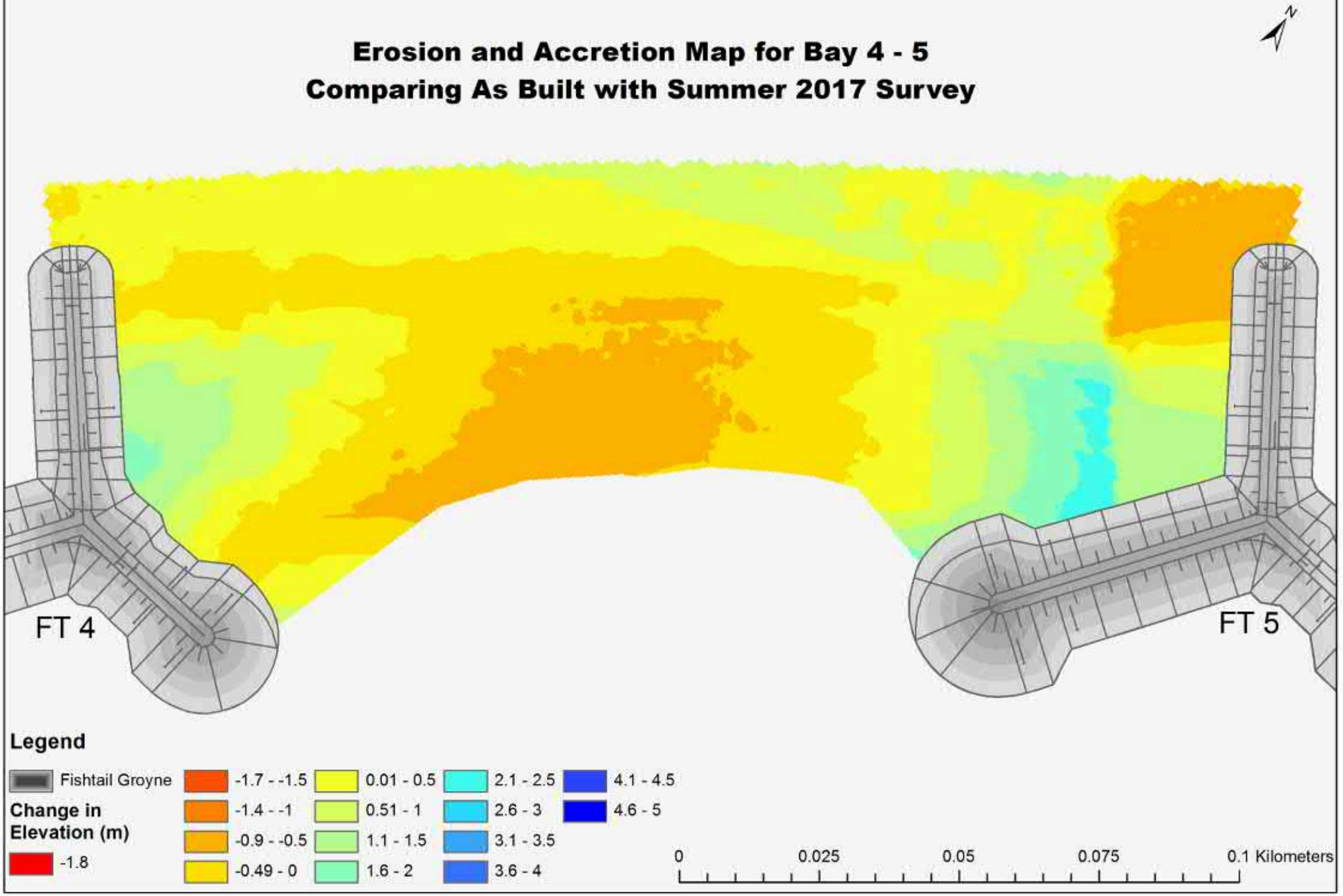
Erosion and Accretion Map for Bay 2 - 3
Comparing As Built with Summer 2017 Survey



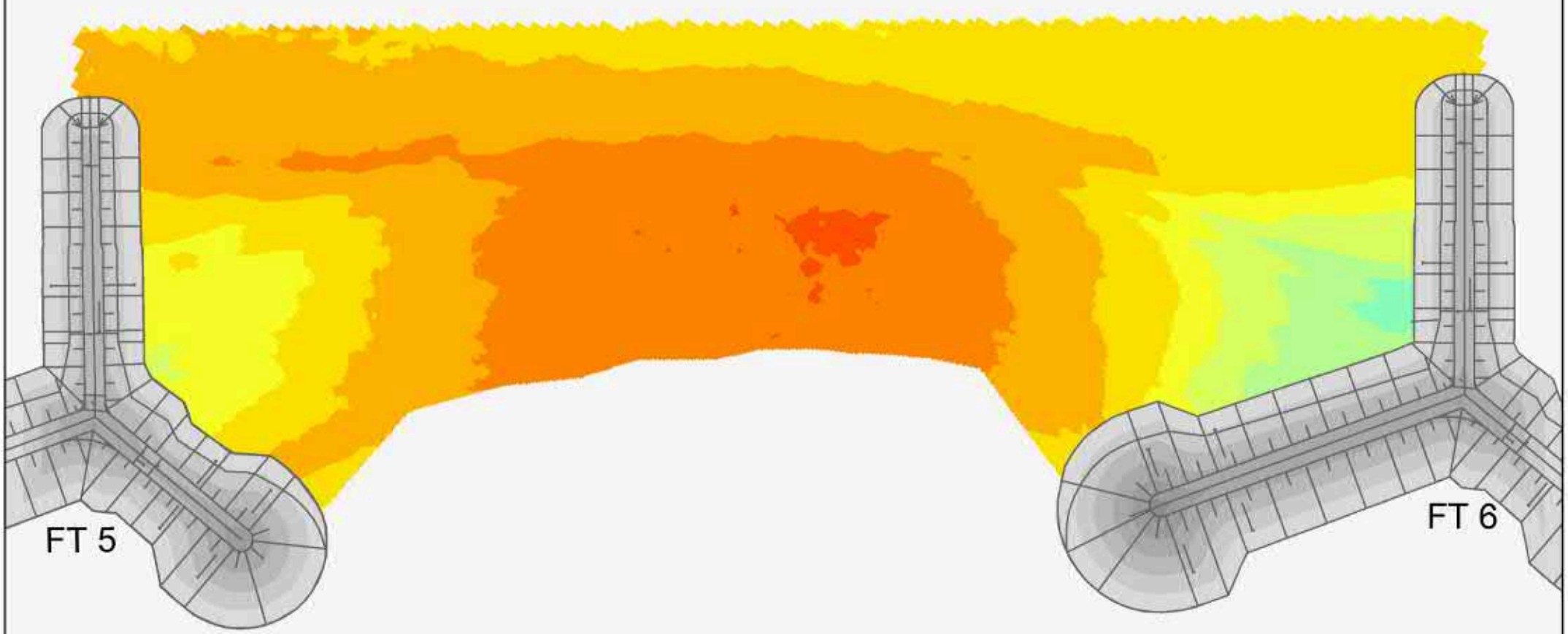
Erosion and Accretion Map for Bay 3 - 4
Comparing As Built with Summer 2017 Survey



Erosion and Accretion Map for Bay 4 - 5
Comparing As Built with Summer 2017 Survey



Erosion and Accretion Map for Bay 5 - 6
Comparing As Built with Summer 2017 Survey



Legend

Fishtail Groyne

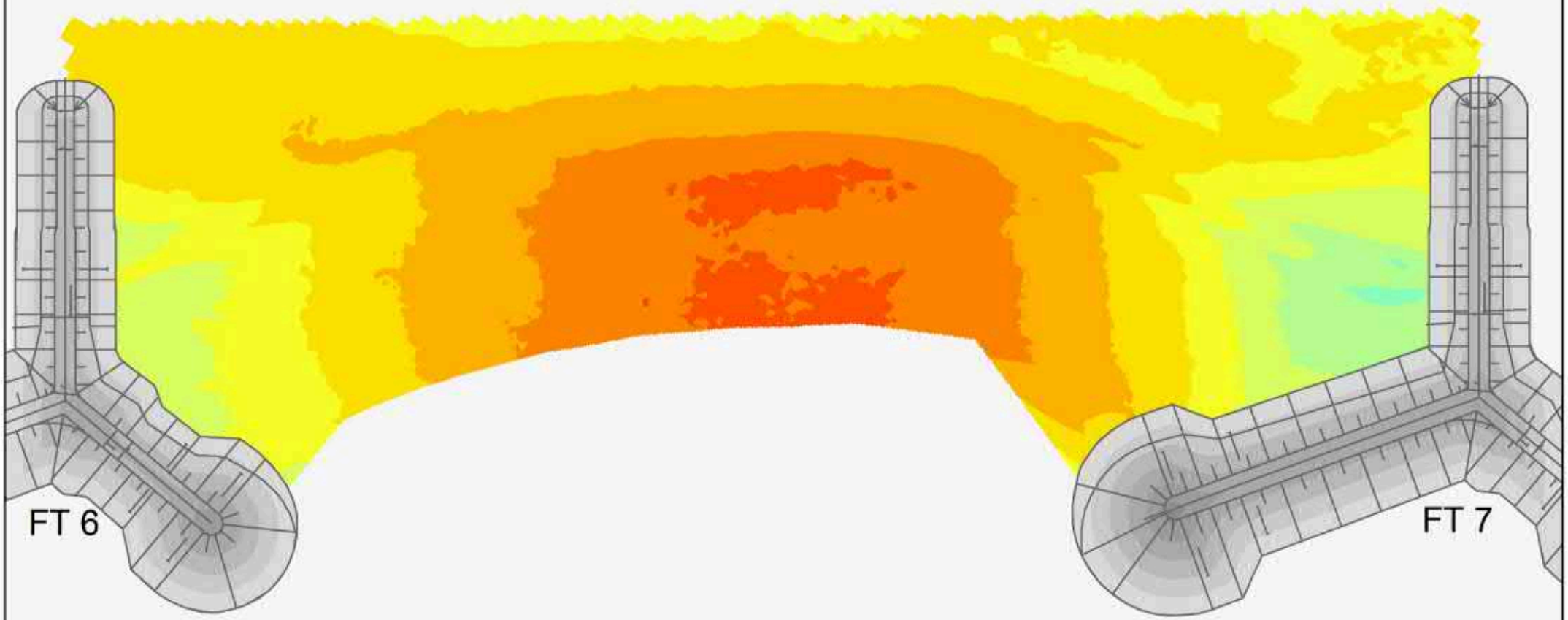
Change in Elevation (m)

-1.8

-1.7 - -1.5
-1.4 - -1
-0.9 - -0.5
-0.49 - 0
0.01 - 0.5
0.51 - 1
1.1 - 1.5
1.6 - 2
2.1 - 2.5
2.6 - 3
3.1 - 3.5
3.6 - 4
4.1 - 4.5
4.6 - 5

0 0.025 0.05 0.075 0.1 Kilometers

Erosion and Accretion Map for Bay 6 - 7
Comparing As Built with Summer 2017 Survey



Legend

Fishtail Groyne

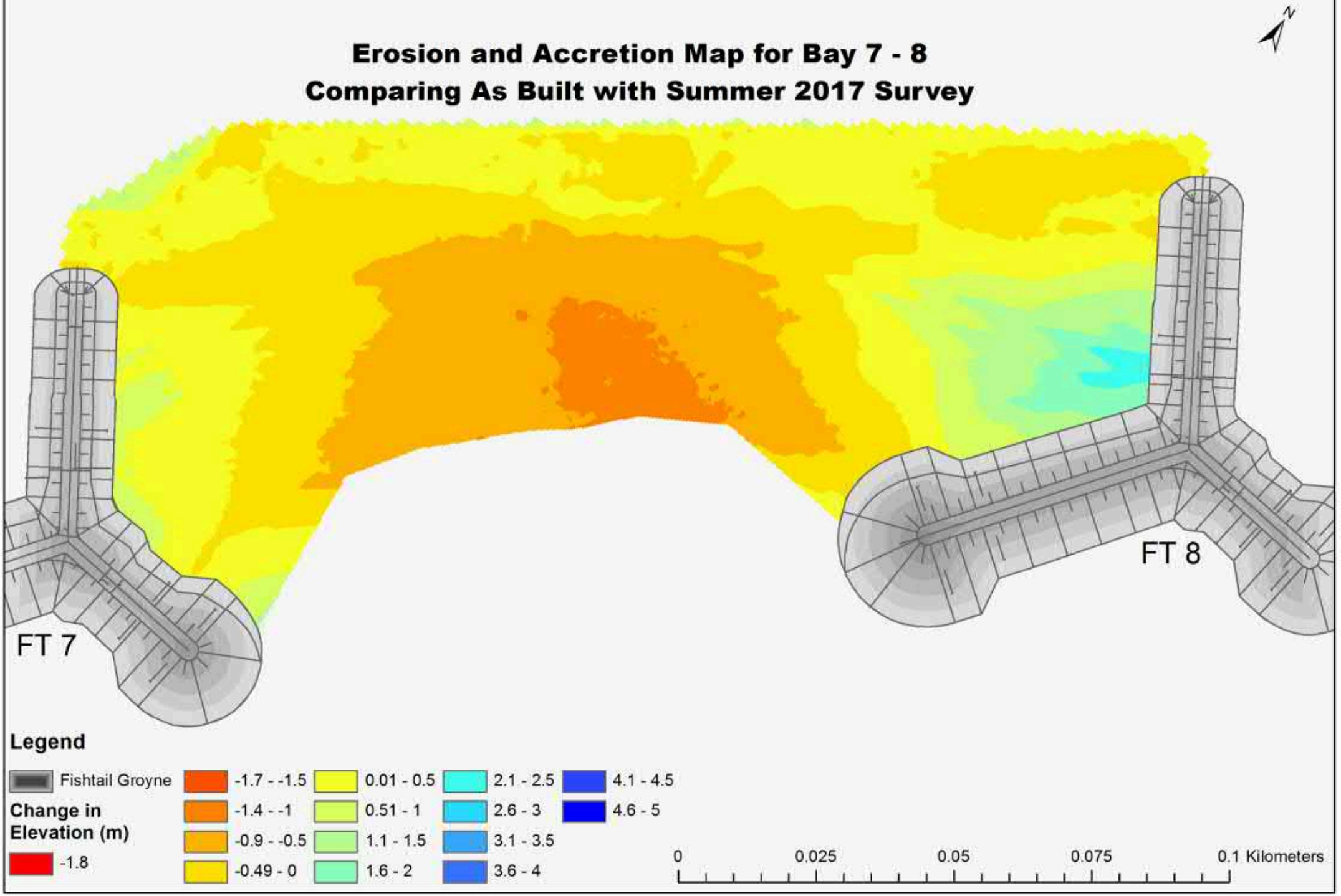
Change in Elevation (m)

-1.8

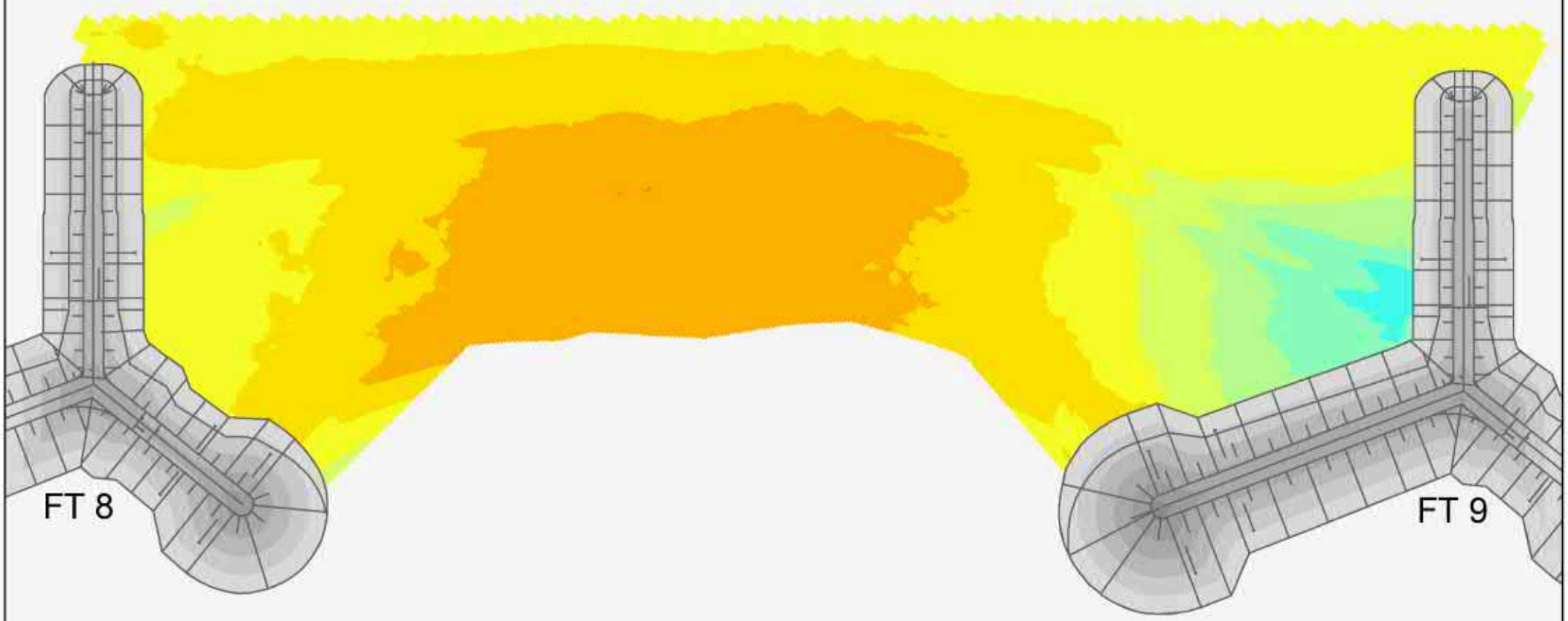
-1.7 - -1.5
-1.4 - -1
-0.9 - -0.5
-0.49 - 0
0.01 - 0.5
0.51 - 1
1.1 - 1.5
1.6 - 2
2.1 - 2.5
2.6 - 3
3.1 - 3.5
3.6 - 4
4.1 - 4.5
4.6 - 5

0 0.025 0.05 0.075 0.1 Kilometers

Erosion and Accretion Map for Bay 7 - 8
Comparing As Built with Summer 2017 Survey



Erosion and Accretion Map for Bay 8 - 9
Comparing As Built with Summer 2017 Survey



Legend

Fishtail Groyne

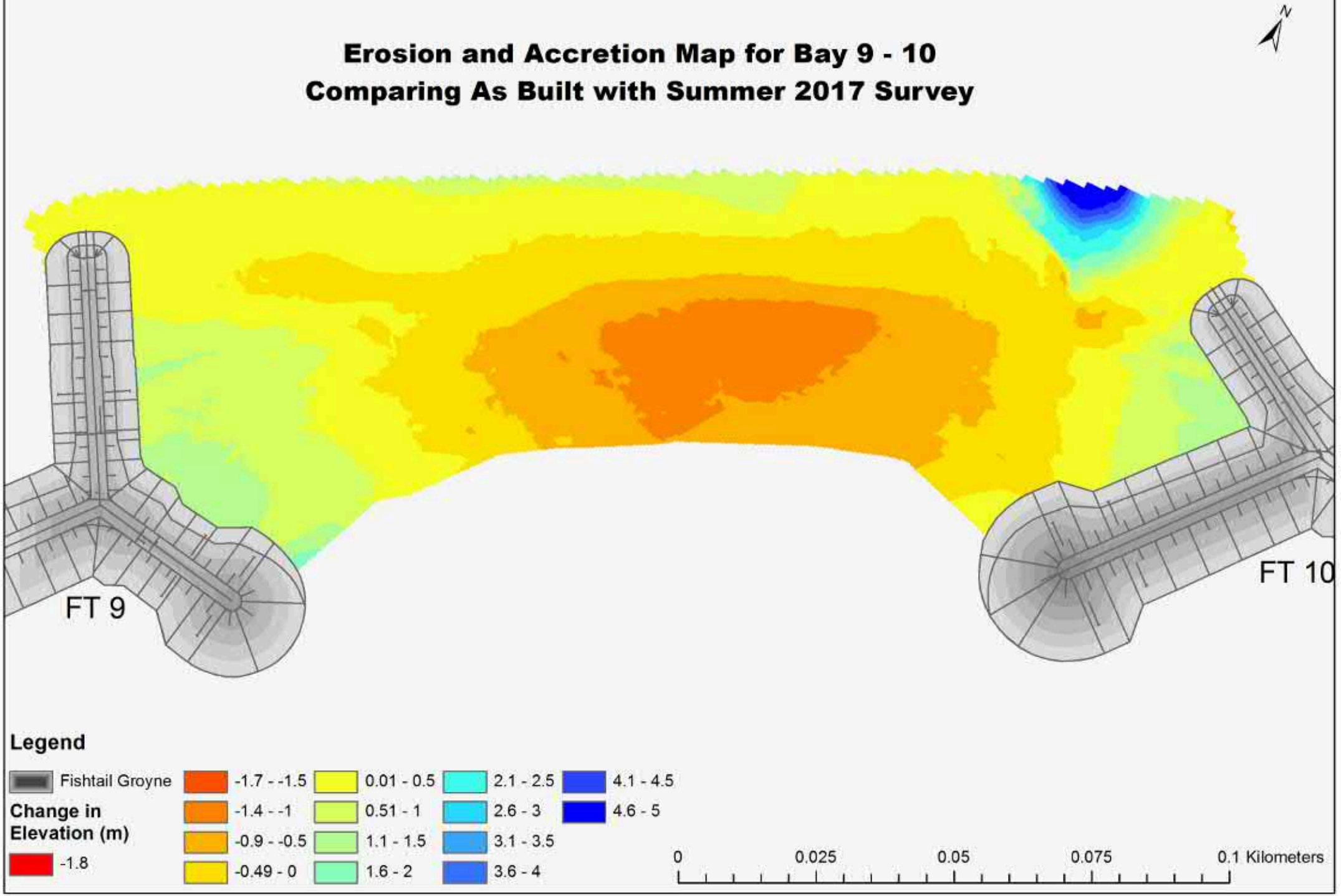
Change in Elevation (m)

-1.8

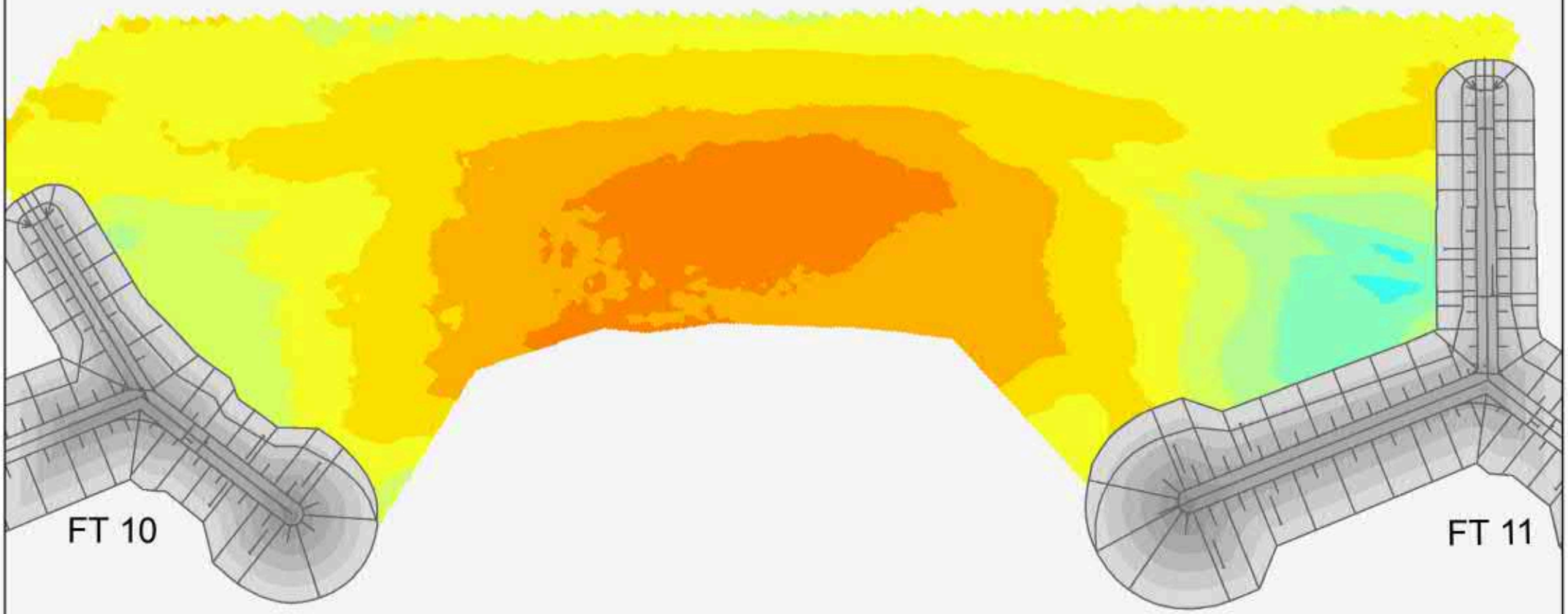
-1.7 - -1.5	0.01 - 0.5	2.1 - 2.5	4.1 - 4.5
-1.4 - -1	0.51 - 1	2.6 - 3	4.6 - 5
-0.9 - -0.5	1.1 - 1.5	3.1 - 3.5	
-0.49 - 0	1.6 - 2	3.6 - 4	

0 0.025 0.05 0.075 0.1 Kilometers

Erosion and Accretion Map for Bay 9 - 10
Comparing As Built with Summer 2017 Survey



Erosion and Accretion Map for Bay 10 - 11
Comparing As Built with Summer 2017 Survey



Legend

Fishtail Groyne

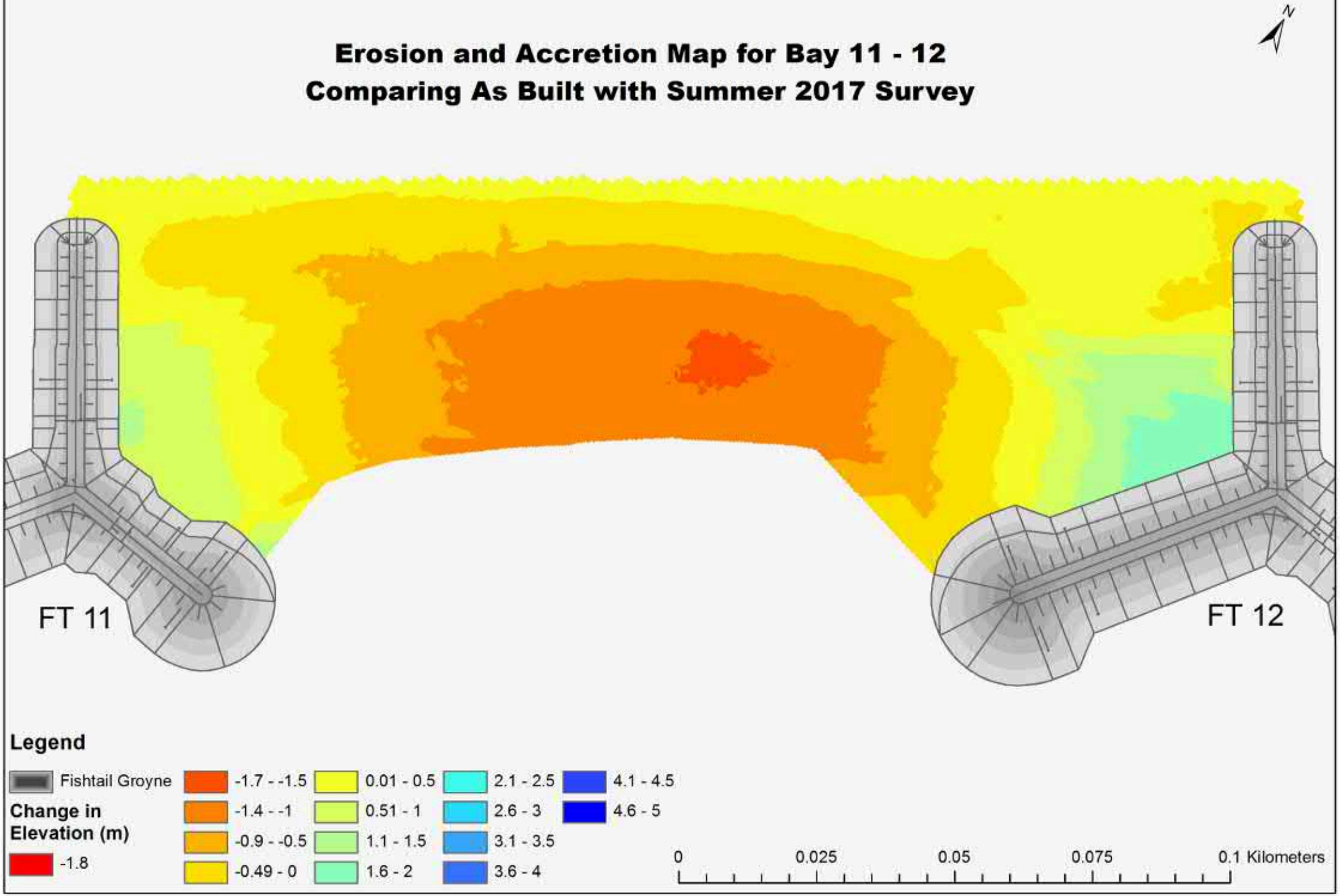
Change in Elevation (m)

-1.8

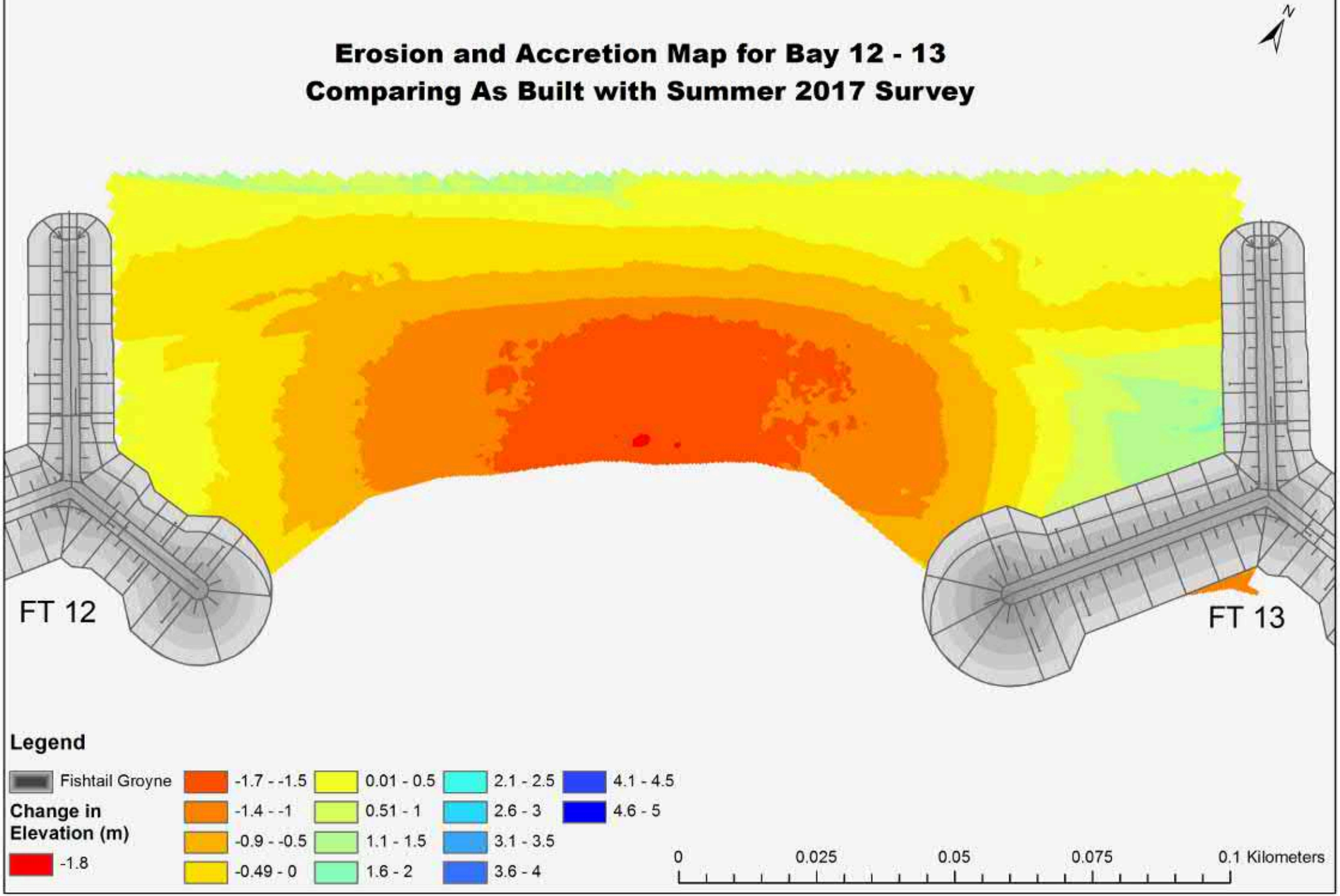
-1.7 - -1.5
-1.4 - -1
-0.9 - -0.5
-0.49 - 0
0.01 - 0.5
0.51 - 1
1.1 - 1.5
1.6 - 2
2.1 - 2.5
2.6 - 3
3.1 - 3.5
3.6 - 4
4.1 - 4.5
4.6 - 5

0 0.025 0.05 0.075 0.1 Kilometers

Erosion and Accretion Map for Bay 11 - 12
Comparing As Built with Summer 2017 Survey



Erosion and Accretion Map for Bay 12 - 13
Comparing As Built with Summer 2017 Survey



Erosion and Accretion Map for Bay 13 - 14
Comparing As Built with Summer 2017 Survey

Legend

Fishtail Groyne

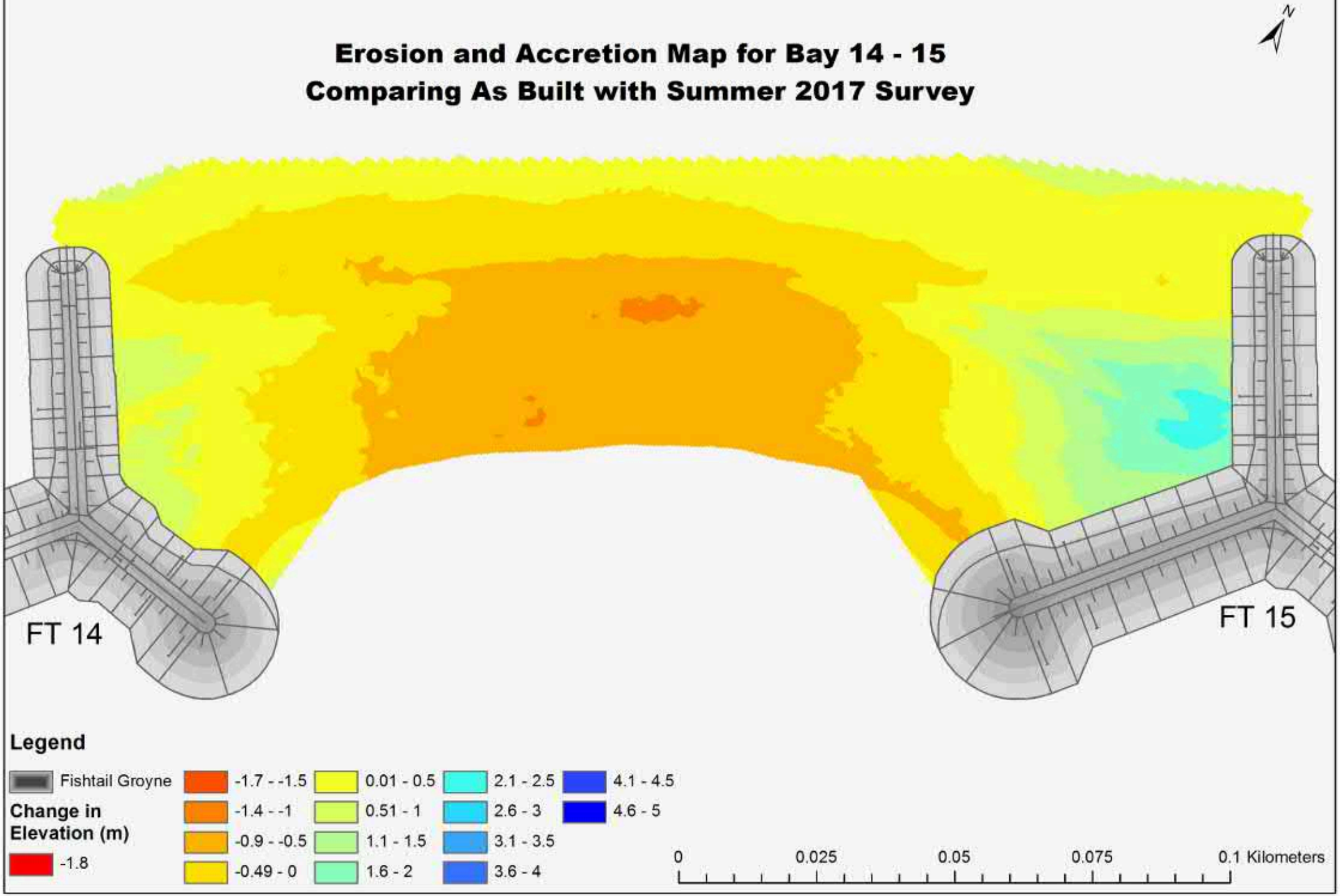
Change in Elevation (m)

-1.8

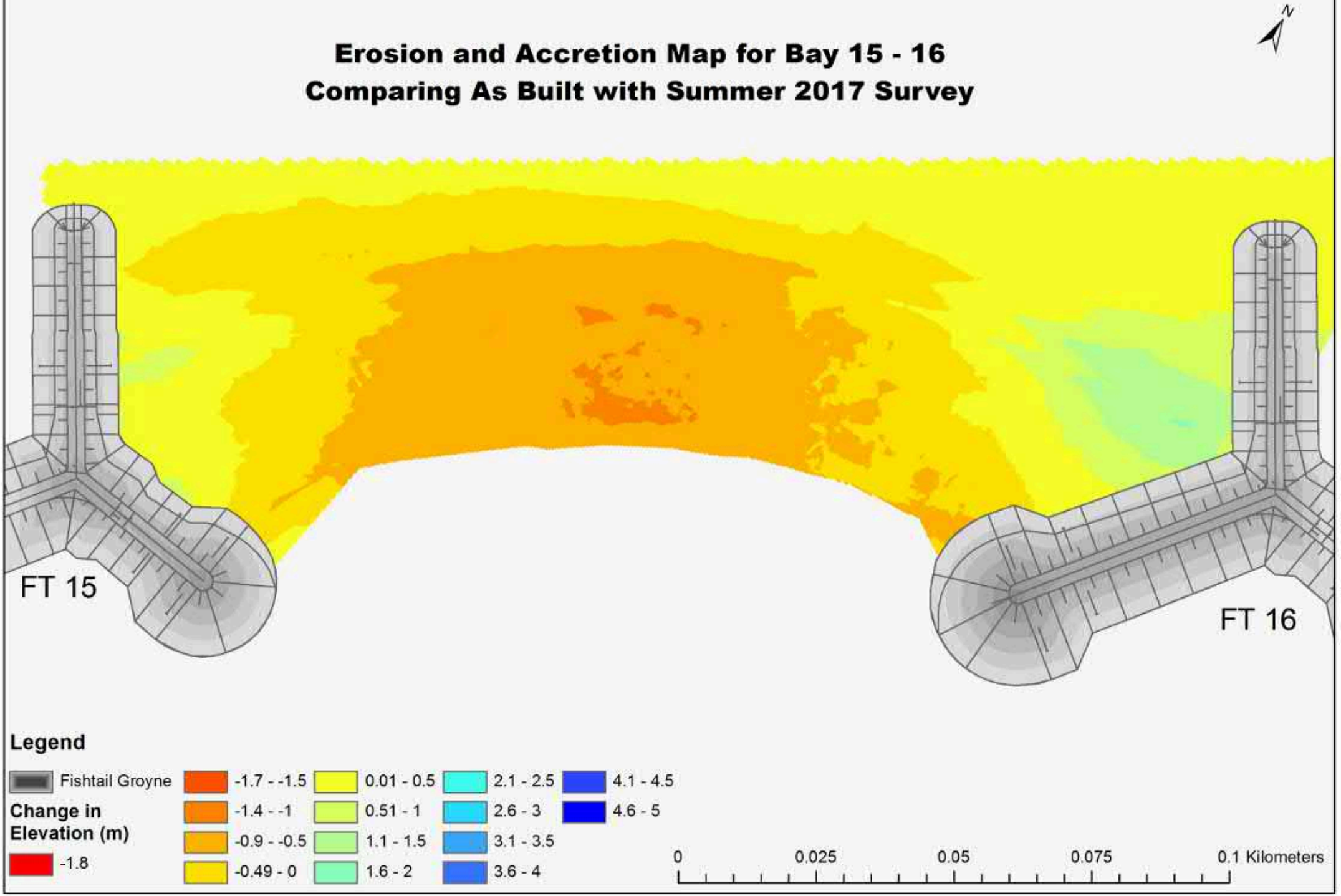
-1.7 - -1.5
-1.4 - -1
-0.9 - -0.5
-0.49 - 0
0.01 - 0.5
0.51 - 1
1.1 - 1.5
1.6 - 2
2.1 - 2.5
2.6 - 3
3.1 - 3.5
3.6 - 4
4.1 - 4.5
4.6 - 5

0 0.025 0.05 0.075 0.1 Kilometers

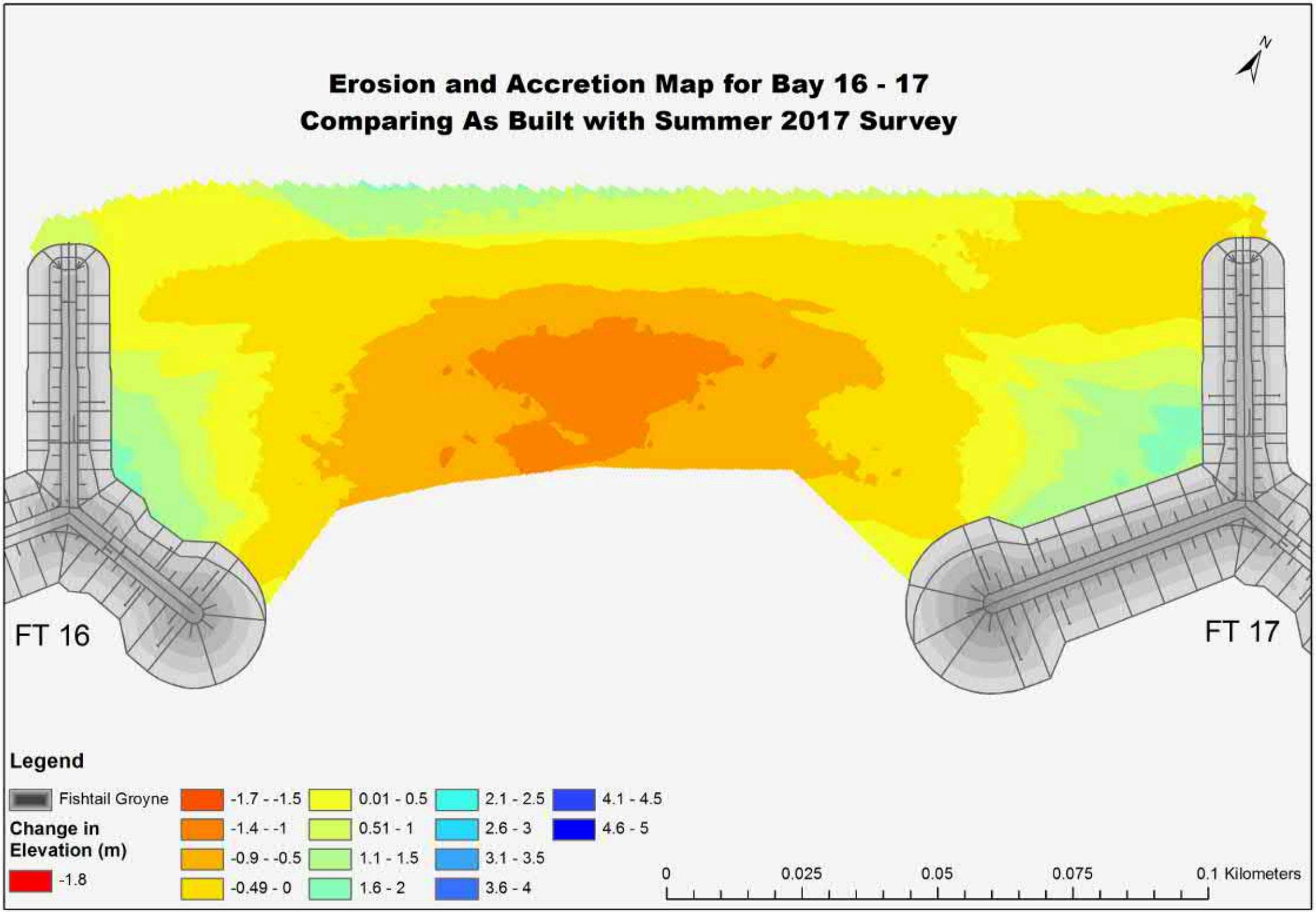
Erosion and Accretion Map for Bay 14 - 15
Comparing As Built with Summer 2017 Survey



Erosion and Accretion Map for Bay 15 - 16
Comparing As Built with Summer 2017 Survey



Erosion and Accretion Map for Bay 16 - 17
Comparing As Built with Summer 2017 Survey



Erosion and Accretion Map for Bay 17 - 18
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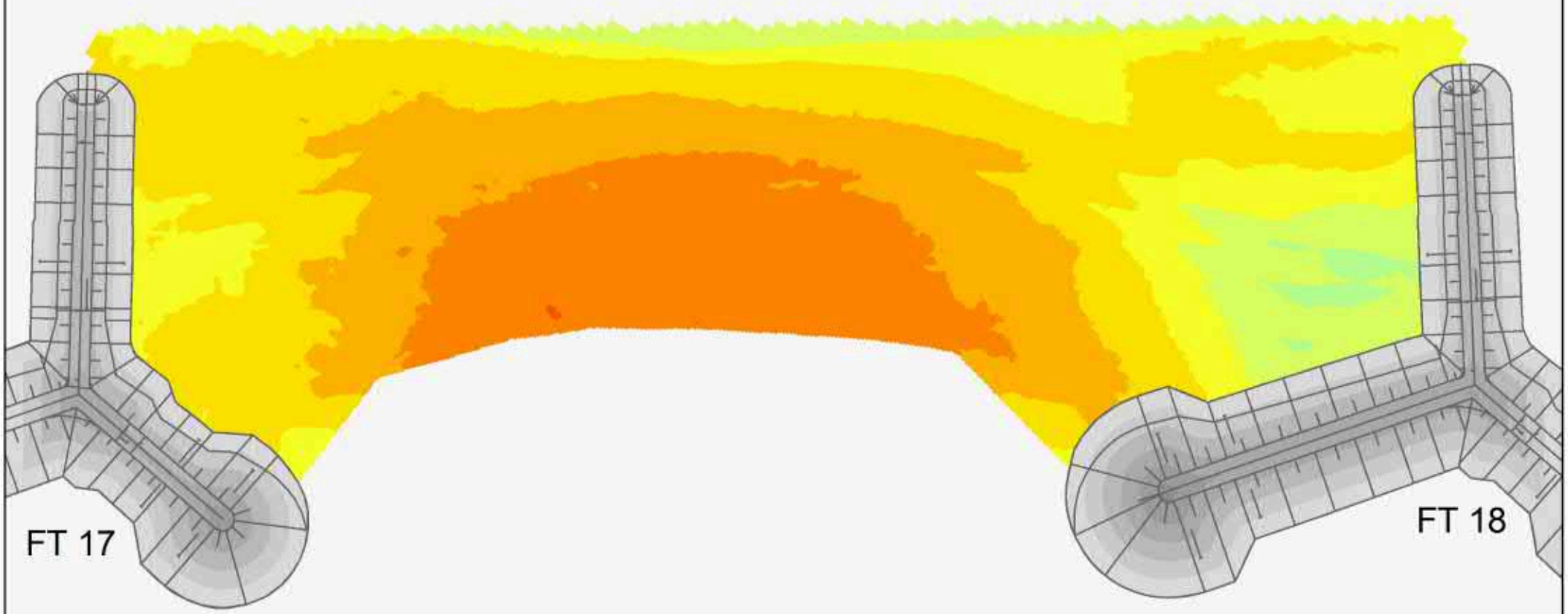


Legend

Fishtail Groyne

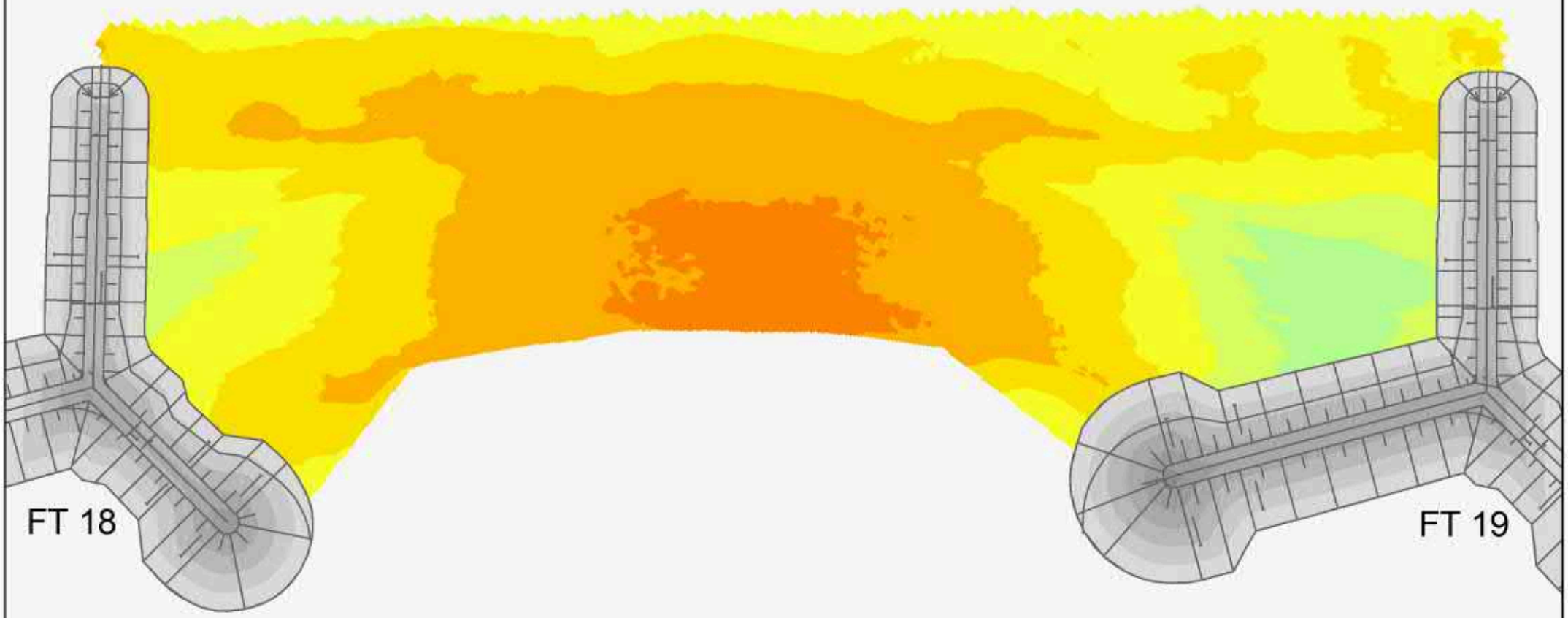
Change in Elevation (m)

-1.8

-1.7 - -1.5
-1.4 - -1
-0.9 - -0.5
-0.49 - 0
0.01 - 0.5
0.51 - 1
1.1 - 1.5
1.6 - 2
2.1 - 2.5
2.6 - 3
3.1 - 3.5
3.6 - 4
4.1 - 4.5
4.6 - 5

0 0.025 0.05 0.075 0.1 Kilometers

Erosion and Accretion Map for Bay 18 - 19
Comparing As Built with Summer 2017 Survey



Legend

Fishtail Groyne

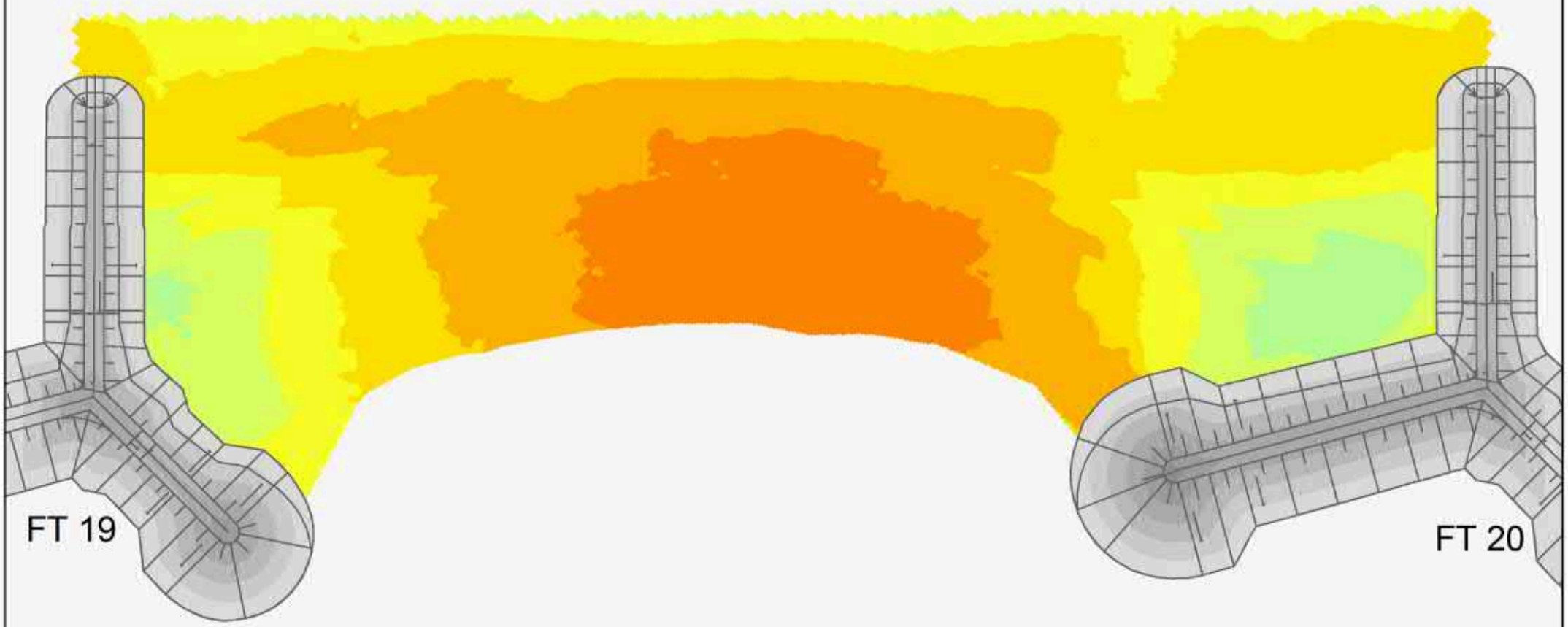
Change in Elevation (m)

-1.8

-1.7 - -1.5
-1.4 - -1
-0.9 - -0.5
-0.49 - 0
0.01 - 0.5
0.51 - 1
1.1 - 1.5
1.6 - 2
2.1 - 2.5
2.6 - 3
3.1 - 3.5
3.6 - 4
4.1 - 4.5
4.6 - 5

0 0.025 0.05 0.075 0.1 Kilometers

Erosion and Accretion Map for Bay 19 - 20
Comparing As Built with Summer 2017 Survey



Legend

Fishtail Groyne

Change in Elevation (m)

-1.8

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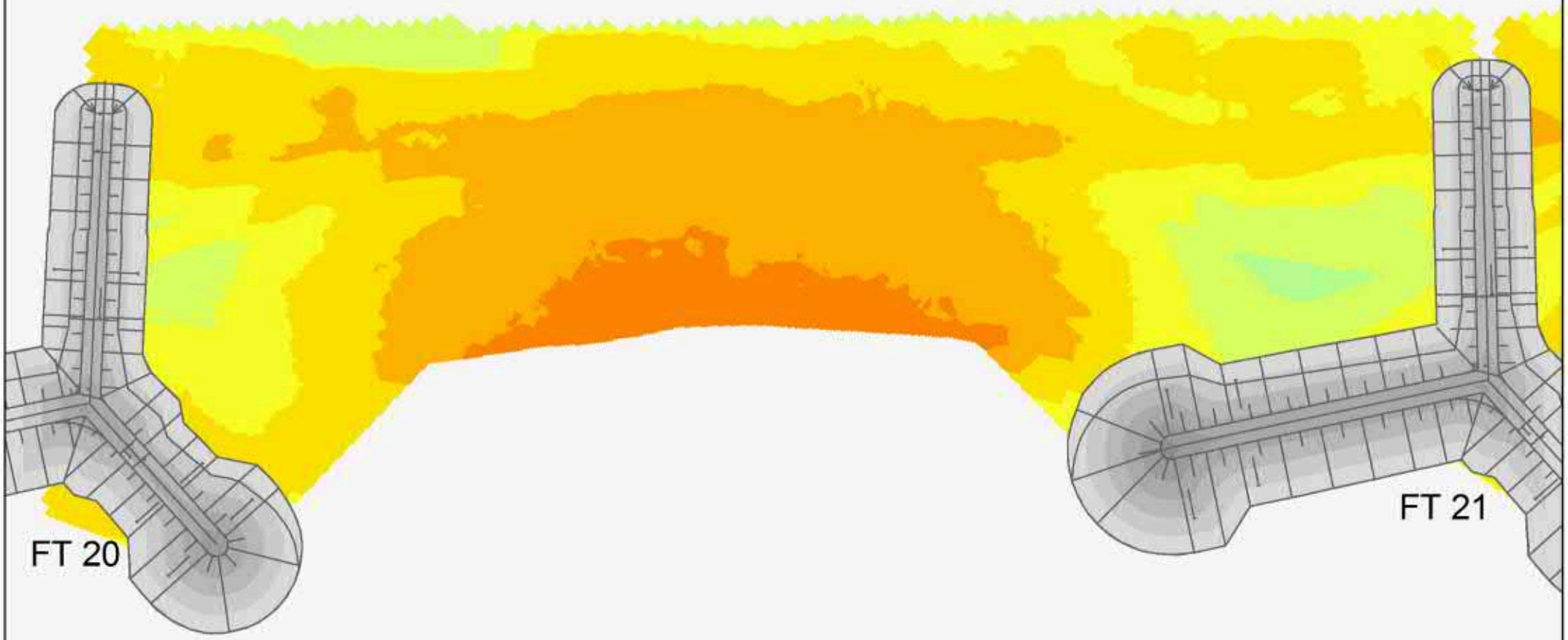
-1.4 - -1	0.51 - 1	2.6 - 3	4.6 - 5
-0.9 - -0.5	1.1 - 1.5	3.1 - 3.5	
-0.49 - 0	1.6 - 2	3.6 - 4	

0 0.025 0.05 0.075 0.1 Kilometers

Erosion and Accretion Map for Bay 20 - 21
Comparing As Built with Summer 2017 Survey



Legend

Fishtail Groyne

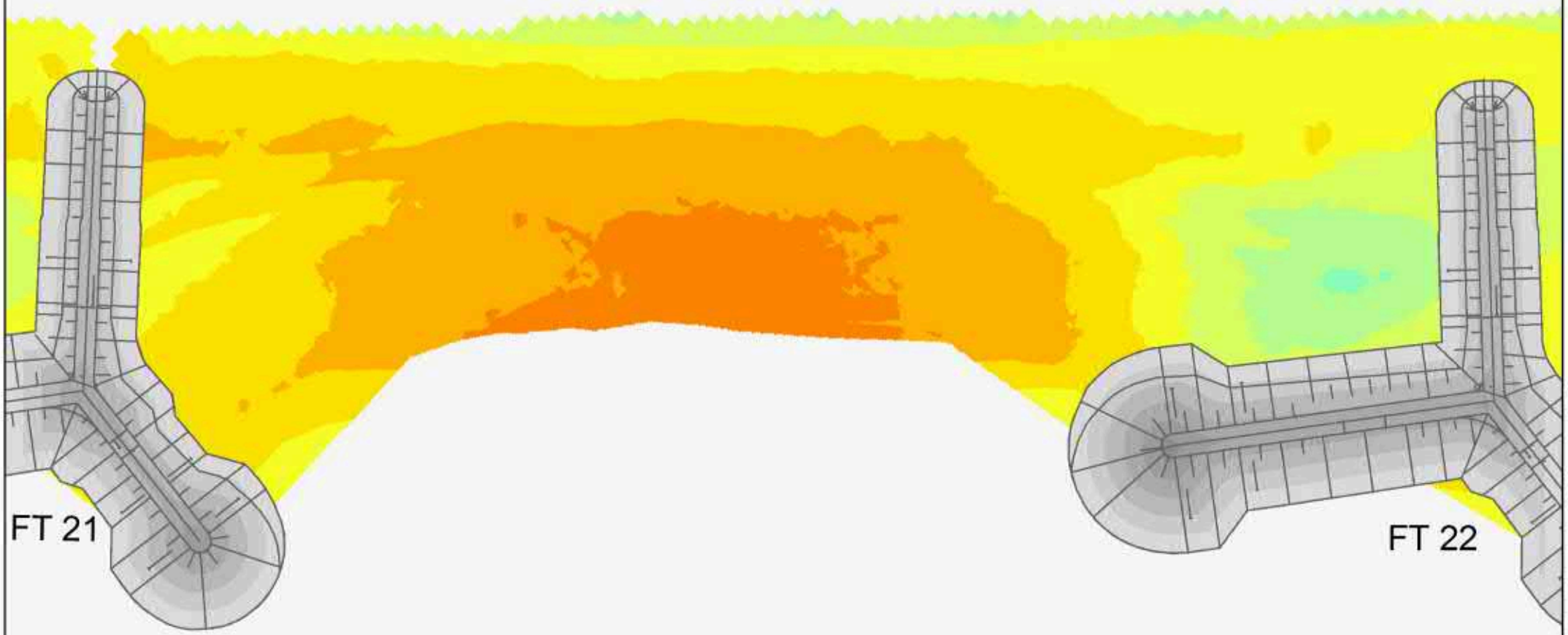
Change in Elevation (m)

-1.8

-1.7 - -1.5
-1.4 - -1
-0.9 - -0.5
-0.49 - 0
0.01 - 0.5
0.51 - 1
1.1 - 1.5
1.6 - 2
2.1 - 2.5
2.6 - 3
3.1 - 3.5
3.6 - 4
4.1 - 4.5
4.6 - 5

0 0.025 0.05 0.075 0.1 Kilometers

Erosion and Accretion Map for Bay 21 - 22
Comparing As Built with Summer 2017 Survey



Legend

Fishtail Groyne

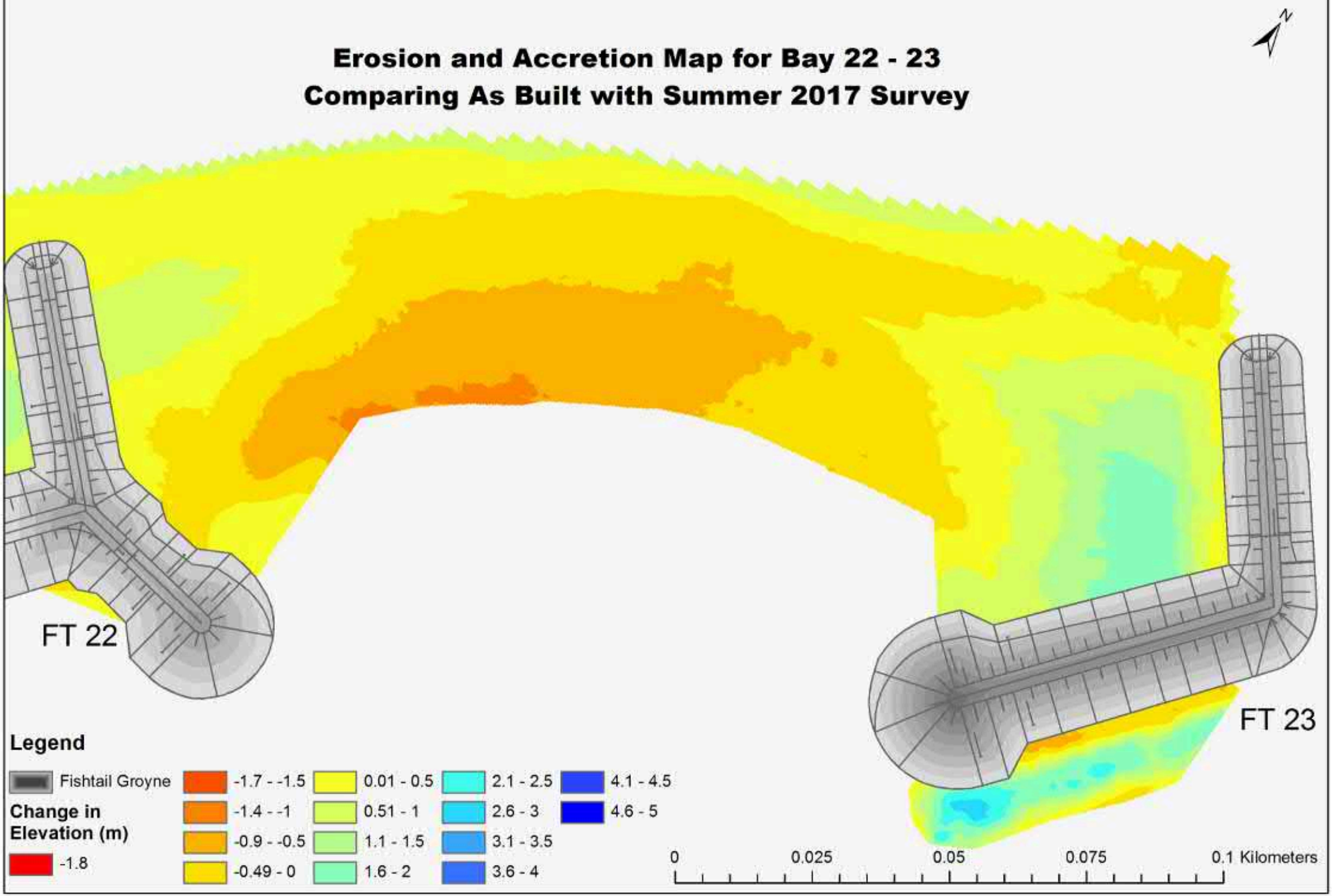
Change in Elevation (m)

-1.8

-1.7 - -1.5	0.01 - 0.5	2.1 - 2.5	4.1 - 4.5
-1.4 - -1	0.51 - 1	2.6 - 3	4.6 - 5
-0.9 - -0.5	1.1 - 1.5	3.1 - 3.5	
-0.49 - 0	1.6 - 2	3.6 - 4	

0 0.025 0.05 0.075 0.1 Kilometers

Erosion and Accretion Map for Bay 22 - 23
Comparing As Built with Summer 2017 Survey



B. Bay Layout Plan

Legend

Fishtail Groyne

Reference Drawings - N/A

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	20/07/2018	ES	Fishtail Groynes 1 to 5	HT	ZH

Mott MacDonald House
8-10 Sydenham Road
Croydon, CR0 2EE
United Kingdom

T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W mottmac.com

Client

Tendring District Council,
Town Hall,
Station Road,
Clacton-on-Sea,
Essex

Title

Clacton-on-Sea Beach Management Plan

Plan layout 1 of 5.

Designed	E Smyth		Eng Check	H Taylor	
Drawn	E Smyth		Coordination	H Taylor	
GIS Check	V Deakin		Approved	Z Hutchison	

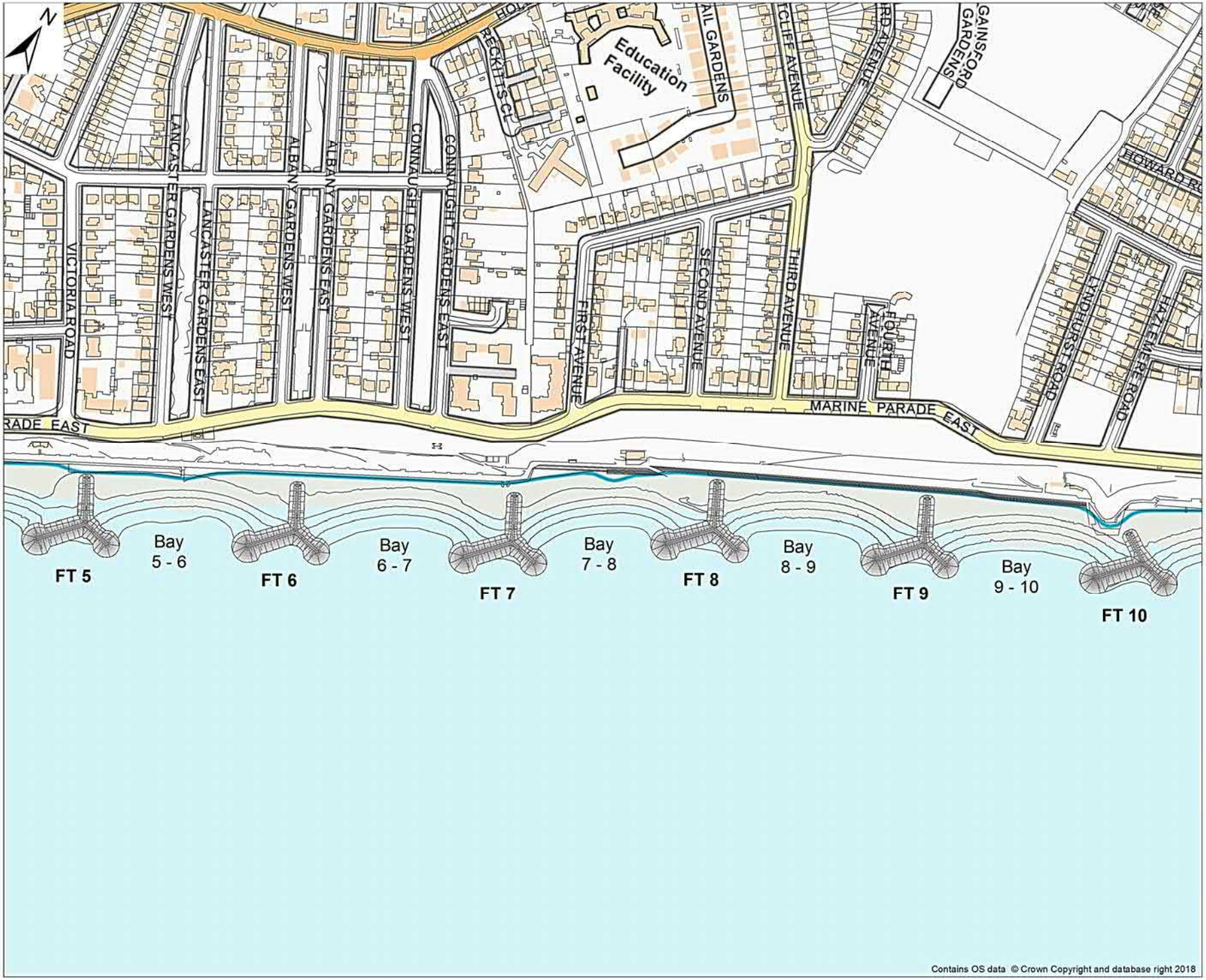
Scale at A1	Status	Rev	Security
1:1,800	INF	1.0	STD

Drawing Number

384750-MMD-BMP-001-GIS-2018

0 0.25 0.5 0.75 1

Kilometers



Legend

Fishtail Groyne

Reference Drawings - N/A

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	20/07/2018	ES	Fishtail Groynes 1 to 5	HT	ZH

Mott MacDonald House
8-10 Sydenham Road
Croydon, CR0 2EE
United Kingdom

T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W mottmac.com

Client

Tendring District Council,
Town Hall,
Station Road,
Clacton-on-Sea,
Essex

Title

Clacton-on-Sea Beach Management Plan

Plan layout 2 of 5.

Designed	E Smyth		Eng Check	H Taylor	
Drawn	E Smyth		Coordination	H Taylor	
GIS Check	V Deakin		Approved	Z Hutchison	

Scale at A1	Status	Rev	Security
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Drawing Number

384750-MMD-BMP-002-GIS-2018

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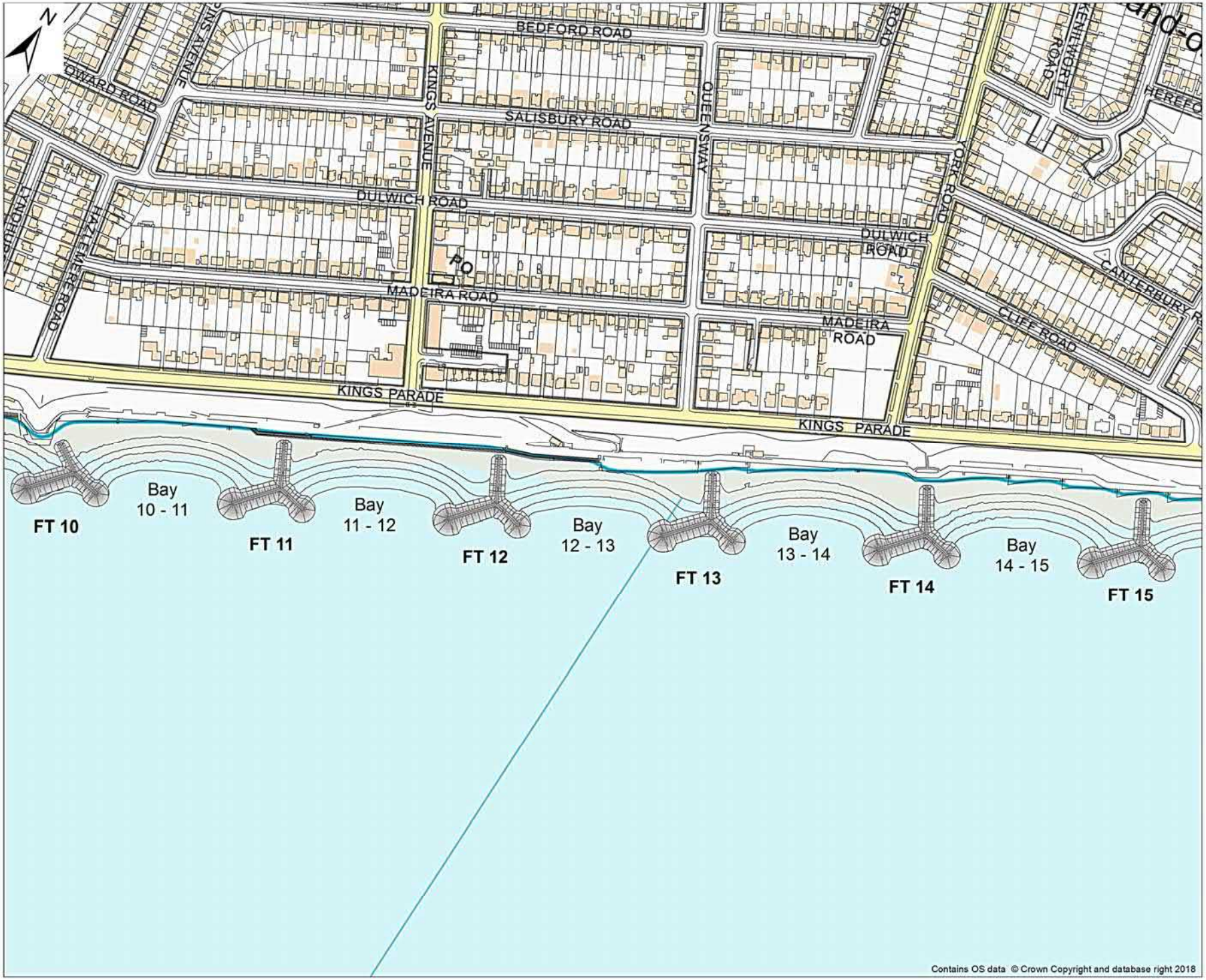
Kilometers



Legend

Fishtail Groyne

Reference Drawings - N/A

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	20/07/2018	ES	Fishtail Groynes 1 to 5	HT	ZH

Mott MacDonald House
8-10 Sydenham Road
Croydon, CR0 2EE
United Kingdom

T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W mottmac.com

Client

Tendring District Council,
Town Hall,
Station Road,
Clacton-on-Sea,
Essex

Title

Clacton-on-Sea Beach Management Plan

Plan layout 3 of 5.

Designed	E Smyth		Eng Check	H Taylor	
Drawn	E Smyth		Coordination	H Taylor	
GIS Check	V Deakin		Approved	Z Hutchison	

Scale at A1	Status	Rev	Security
1:1,800	INF	1.0	STD

Drawing Number

384750-MMD-BMP-003-GIS-2018

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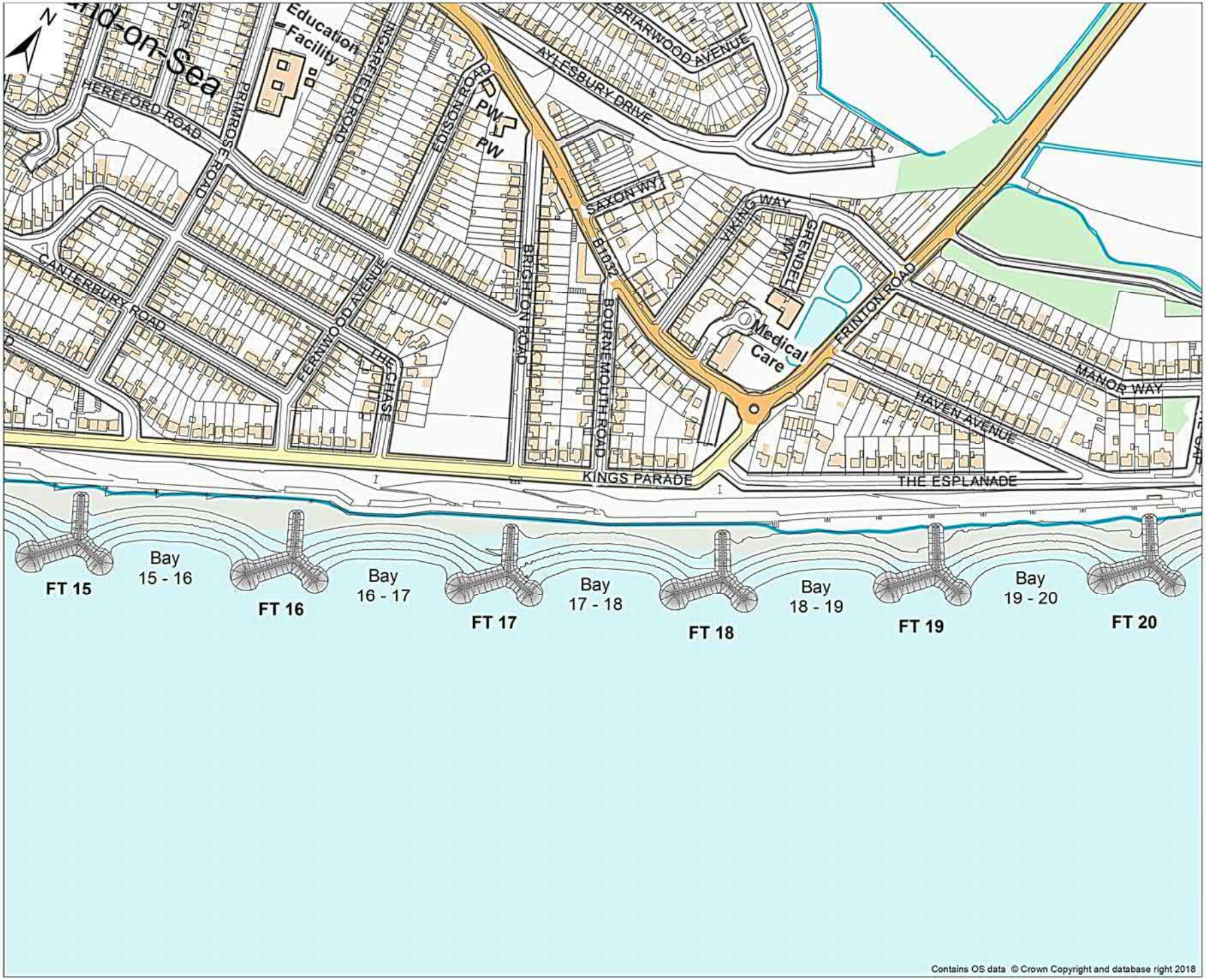
Kilometers



Legend

Fishtail Groyne

Reference Drawings - N/A

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	20/07/2018	ES	Fishtail Groynes 1 to 5	HT	ZH

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Client

Tendring District Council,
Town Hall,
Station Road,
Clacton-on-Sea,
Essex

Title

Clacton-on-Sea Beach Management Plan

Plan layout 4 of 5.

Designed	E Smyth		Eng Check	H Taylor	
Drawn	E Smyth		Coordination	H Taylor	
GIS Check	V Deakin		Approved	Z Hutchison	

Scale at A1	Status	Rev	Security
1:1,800	INF	1.0	STD

Drawing Number

384750-MMD-BMP-004-GIS-2018

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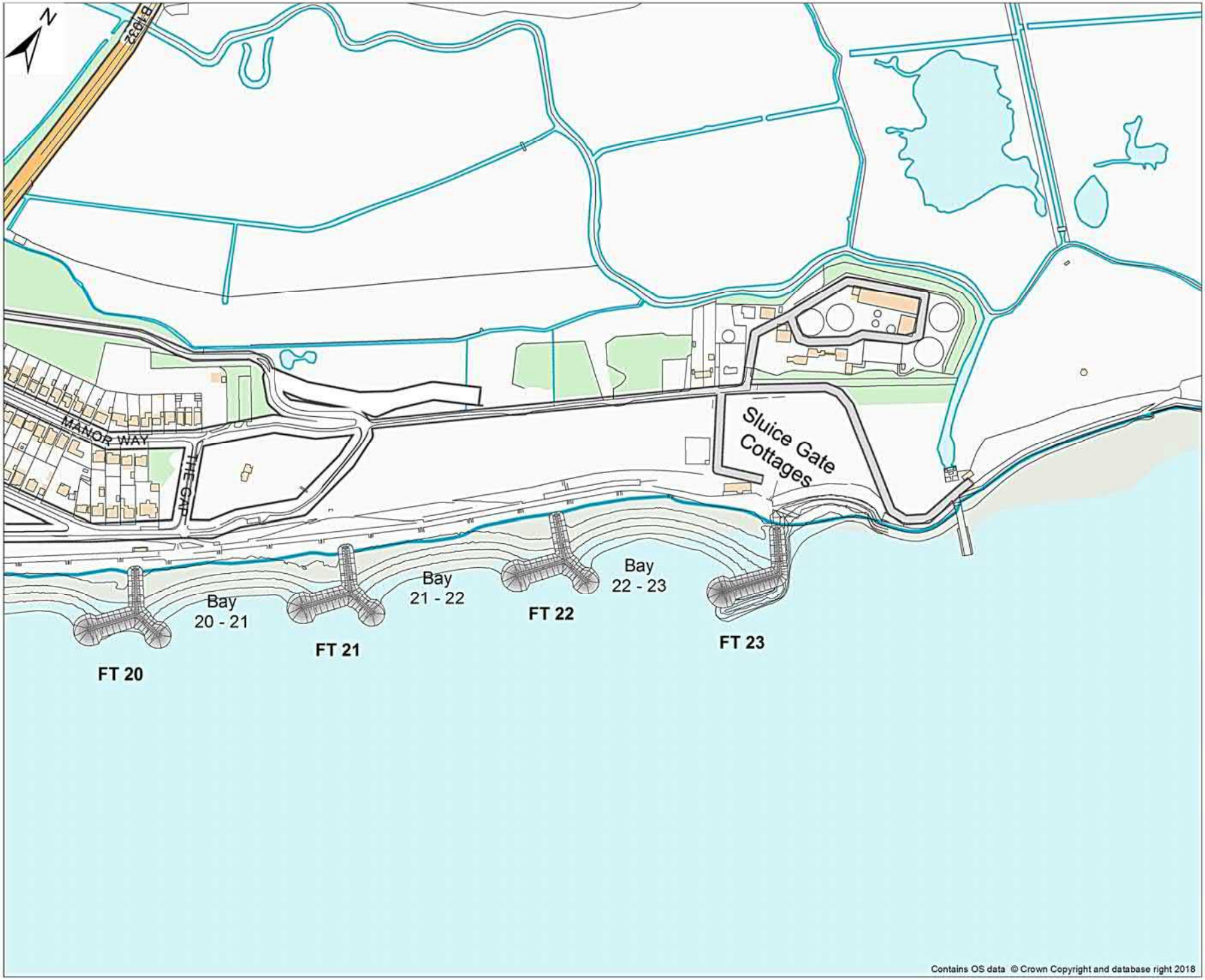
Kilometers



Legend

Fishtail Groyne

Reference Drawings - N/A

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	20/07/2018	ES	Fishtail Groynes 1 to 5	HT	ZH

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Title

Clacton-on-Sea Beach Management Plan

Plan layout 5 of 5.

Designed	E Smyth		Eng Check	H Taylor	
Drawn	E Smyth		Coordination	H Taylor	
GIS Check	V Deakin		Approved	Z Hutchison	

Scale at A1	Status	Rev	Security
1:1,800	INF	1.0	STD

Drawing Number

384750-MMD-BMP-005-GIS-2018

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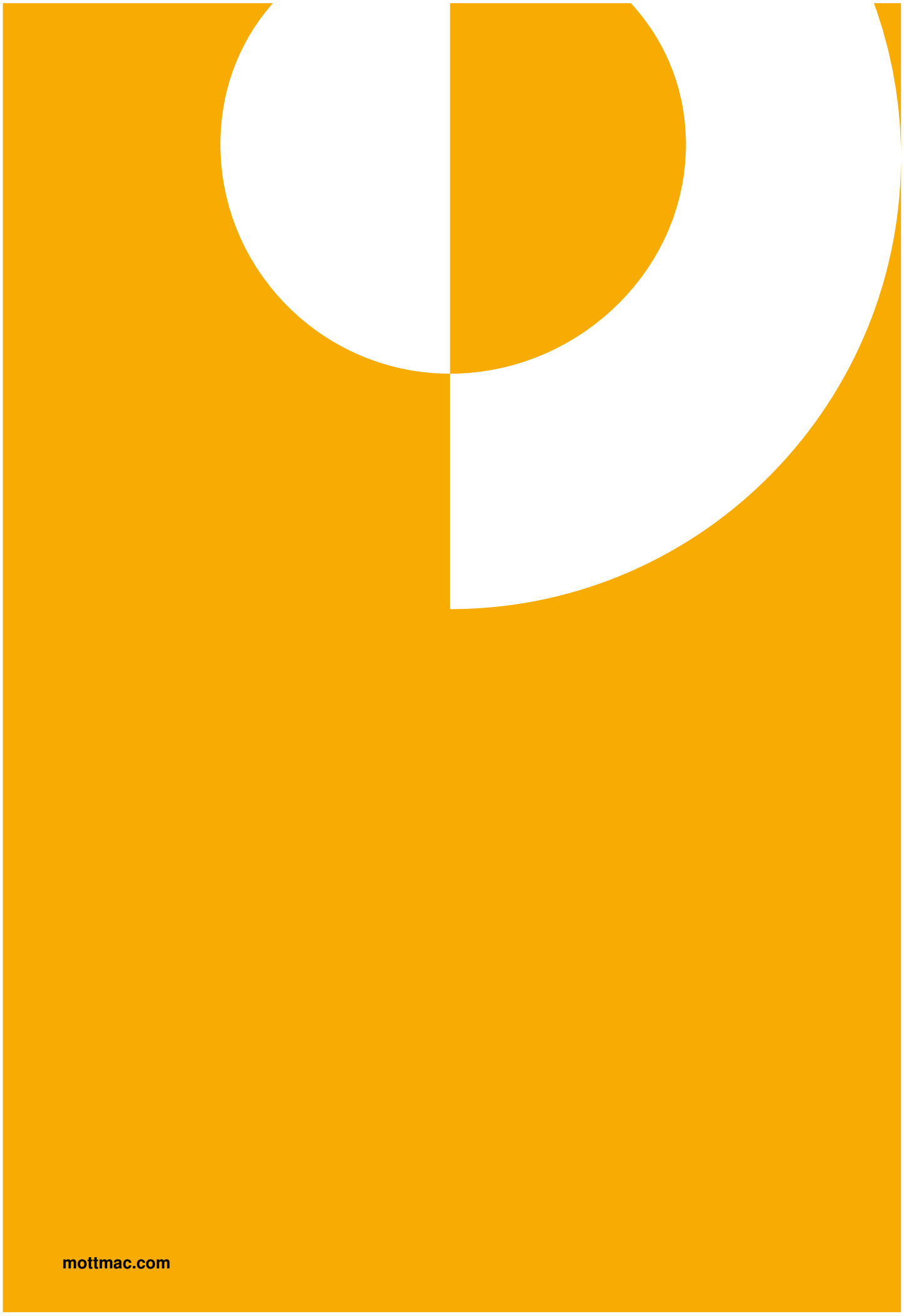
Kilometers



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