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## Staff Management Tools

## Beachboy Software & Systems Review Report

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### Changes Forecast

Change	Description
1.4	No changes – final and complete version

### Issue and Amendment Record

Issue	Date	Comments
0.1	08/09/2023	First draft
0.3	12/09/2023	Updated draft for recommendation timelines (section 4.2)
1.0	20/10/2023	Updated with Review comments and outstanding actions input received w/e 13/10/2023. Recommendations clarified as requested.
1.2	25/10/2023	Fig 2 removed as referenced out of date overflow monitoring requirements quoted in the Good Practice Guide of 2016.
1.3	25/11/2023	Minor corrections from Nick Mills & Luke Hyttner
1.4	29/11/2023	Minor clarifications and reworked Executive Summary

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### Notice

This document and its contents have been prepared and are intended solely as information for Southern Water and use in relation to the Beachbuoy Review.

SMT Ltd assumes no responsibility to any other party in respect of or arising out of or in connection with this document and/or its contents.

This document has 62 pages including the cover.



## Acknowledgements

The author wishes to acknowledge the full and open cooperation of Southern Water in the preparation of this report.

## Caveats

For this Final version the following adjustments have been made prior to finalisation and distribution outside of Southern Water:

- Redaction of individual names if contained in referenced material, screenshots, etc. as per GDPR requirements.
- Links to where reference material is available on a secure Southern Water Sharepoint site are not included

## References

ID	Name	Description	Link to source	Version	Date
1.	Powerpoint – How does Beachbuoy work	Overview powerpoint referencing coastal modelling	Excluded	N/A	03/03/2023
2.	Beachbuoy Phase 2 – Release 3 High Level Design	Design for the first production release (pre Tidal impact) based on Waterfall lifecycle	Excluded	5.00	17/11/2022
3.	BB Working Group Minutes (draft 8 <sup>th</sup> Feb 2023)	Inc 3 page web requirement plus specific outfall issues	Excluded	draft	03/03/2023
4.	BB Working Group (8 <sup>th</sup> Feb 2023) Powerpoint	Powerpoint on BB updates and plans to working group	Excluded	N/A	8/2/2023
5.	BB Working Group Terms of Reference	1 page ToR	Excluded	N/A	26/09/2022
6.	Atkins Report on EDM drift	Reported but not seen	Excluded	Unknown	
7.	SW Report re models	Reported but not seen. Little evidence for EDM sensor drift	Excluded	Unknown	
8.	Jira (link )	Repository for Agile development stories	Excluded	N/A	
9.	Jira export (first 1000 issues)	Covers the tidal impact extension to BB extracted for review	Excluded		
10.	Jira export (last 1000 issues)	Covers the further extensions to BB extracted for review	Excluded		
11.	beachbuoy-how-we-model-impact (pdf)	Paper on the tidal modelling approach	Excluded	N/A	23/09/22
12.	beachbuoy-data-logic (pdf)	Mapping of BWS to outfalls	Excluded		23/09/22
13.	WQ2 Process_v3 (pdf)	Epic BB.WQ2 – Volume & Tide Functionality, High Level Process (swim lane flow chart)	Excluded		20/04/22
14.	Meeting Notes - Atkins Interim Product Owner	Initial background from interim Product Owner	Excluded	0.1	09/08/23
15.	Meeting Notes – Nick Mills	Introductions / scene setting	Excluded	0.1	09/08/23
16.	Meeting Notes – Beachbuoy Lead Developer	BB development	Excluded	0.1	16/08/23
17.	Meeting Notes – SW IT Solution Architect	BB technology architecture	Excluded	0.1	24/08/23
18.	Meeting Notes – Network Insight Manager (Aspire Product Owner and EDM SME)	Spill identification and review	Excluded	0.1	15/08/23
19.	Meeting Notes – Business Analysts	Requirements / User Stories	Excluded	0.1	23/08/23
20.	Meeting Notes – SW IT Solution Architect	Future BB development	Excluded	TBD	29/08/23
21.	Meeting Notes – Network Insight Manager (Aspire Product Owner and EDM SME)	Spill validation detail	Excluded	0.1	TBD
22.	Southern Water EPA Data Report 2019		<a href="https://www.gov.uk/government/publications">https://www.gov.uk/government/publications</a>		



ID	Name	Description	Link to source	Version	Date
			<a href="#">/water-and-sewerage-companies-in-england-environmental-performance-report-2019/southern-water-epa-data-report-2019</a>		
23.	EDM Good Practice Guide, Chartered Institution of Water and Environmental Management, Urban Drainage Group		<a href="https://www.ciwem.org/assets/pdf/Special%20Interest%20Groups/Urban%20Drainage%20Group/EDM-Good-Practice-Guide.pdf">https://www.ciwem.org/assets/pdf/Special%20Interest%20Groups/Urban%20Drainage%20Group/EDM-Good-Practice-Guide.pdf</a>	2.2	Jan 2016
24.	Environment Act - 2021		<a href="https://www.legislation.gov.uk/ukpga/2021/30/contents/enacted">https://www.legislation.gov.uk/ukpga/2021/30/contents/enacted</a>		
25.	Check Factor Limit Implementation Process v7	Flow chart for review automation based on Check Factor Limits	Excluded	V7	March 7 2023
26.	Beachbuoy Schema	Text doc of a script for the BB schema	Excluded		7/9/23
27.	Combined Delivery Stream Road Map as at 040822	Work breakdown (Epics) for BB and Aspire, no timeline	Excluded	?	04/08/2022
28.	Road Map as at 220623-v1.11	High level Plan on a Page showing end of BB and Aspire development at 23/06/2023	Excluded	V1.11	22/06/2023
29.	SW TMMi Test Approach Aspire Beachbuoy_V1.0	Southern Water Test Approach Aspire & Beachbuoy	Excluded	V1.0	09/08/2023
30.	UMP Testing Strategy	Testing Strategy Beach Buoy Release 3	Excluded	V1.0	Approved 30/07/2021
31.	Aspire Beachbuoy_Sprint_11_Test Exit Report_V1.0 Approved_	Test Closure Report Aspire Beachbuoy(ABEW) Sprint 11	Excluded	V1.0	Approved 27/07/2022
32.	Aspire Beachbuoy_Sprint_12_Test Exit Report_V 1.0	Test Closure Report Aspire Beachbuoy(ABEW) Sprint 12	Excluded	V1.0	Approved 02/09/2022
33.	CHG0003941	Change Request Report for BB release approved by Change Approvals Board (CAB)	Excluded	N/A	CAB date 07/09/2022
34.	HLD - Beachbuoy and Inland Water EDM Status - Future State Architecture	Draft High Level Design document for the replacement Beachbuoy app with the extension to Inland Waterway spill reporting	Excluded	1.0	27/07/2023
35.	BB BWQ & Aspire RTM_v3.3b	Requirements Traceability Matrix	Excluded	V3.2 V3.3b	30/06/2022 ?
36.	Beachbuoy Low Level Design Documentation	List of Features and User Stories cross referenced to change documentation. V2.0 Update version with ABEW-Beachbuoy-Release3	Excluded	V1.0 V2.0	07/09/2022 13/07/2023

### Glossary (abbreviations and terms)

Term or Abbreviation	Description
ADSL	<b>Asymmetric digital subscriber line</b>  This is a type of digital subscriber line technology, a data communications technology that enables faster data transmission over copper telephone lines than a conventional voiceband modem can provide.
Agile	Agile is a development methodology based on iterative and incremental approach. A set of principles.
API	<b>Application programming interface</b>
ASPIRE	Spills reporting system



Term or Abbreviation	Description
BB	<b>Beachbuoy</b>
BTS	<b>Business Technology services</b> part of SW IT
BWS	<b>Bathing Water Site</b>
CMS	<b>Content Management System</b>
CSO	<b>Combined Sewage Overflow</b> An outfall from a combined sewer designed to prevent the capacity of the sewer or a sewage treatment works from being exceeded under storm flow conditions by allowing the discharge of excess diluted sewage to another sewer, tank, watercourse or some other disposal point.
DMZ	<b>Demilitarised Zone</b> Subnet bounded by firewalls to segregate internet facing services from the internal core network
DoS	<b>Denial of Service</b> Attempt to disrupt IT services by making a high frequency of malicious requests to a service to impact performance for legitimate users
EDM	<b>Event Duration Monitor</b> The combination of level sensors and logic that monitors and detects overflow spill events and their duration
EMO	<b>Emergency Overflow</b>
EPIC	In Agile, an epic is simply a collection of user stories. These stories are related to one another and combine to form one large story. Epics can work across different teams and projects, but they will be united under a broad banner label, known as a theme. An Epic can be a high-level description of what the client wants, and accordingly, it has some value attached to it.
GDPR	<b>General Data Protection Regulation</b>
JSON	<b>JavaScript Object Notation</b> Open standard interchange format.
LSO	<b>Long Sea Outfall</b>
MS	<b>Microsoft</b>
MSO	<b>Medium Sea Outfall</b>
OSIsoft	Software development company specialising in process monitoring and control. Supplier of the PI suite of applications  In August 2020, it was announced that the UK-based production company AVEVA agreed to buy OSIsoft in a deal worth \$5 billion;[4] the purchase was subsequently completed on 19 March 2021 for a final consideration of £3,831.4 million.
OSIsoft PI	The PI System is a suite of software products that are used for data collection, historicizing, finding, analyzing, delivering, and visualizing. It is marketed as an enterprise infrastructure for management of real-time data and events (a SCADA system). There are two main components in addition to the interfaces: the historian and PI AF (Asset Framework) - allows the definition of consistent representations of organizational assets and/or equipment and uses these representations in analyses that yield critical and actionable information.



Term or Abbreviation	Description
P1	Software classification: P1 - Urgent/Critical priority; affecting several users or the full enterprise; or, negatively affecting the ability to transact time-sensitive business that would have substantial bottom-line impact to the business. (see Gartner <a href="https://www.gartner.com/peer-community/post/definition-priority-1-p1-priority-2-incidents">https://www.gartner.com/peer-community/post/definition-priority-1-p1-priority-2-incidents</a> )
REST	<b>Representational State Transfer</b> A type of API
RPO	<b>Restore Point Objective</b> How much data is permissible to lose on restoring service from a failure – e.g. 1hr, 12 hrs etc
RTO	<b>Restore Time Objective</b> The maximum time allowed to restore a service following a major failure measured in hours
RTU	<b>Remote Telemetry Unit</b>
SAS	<b>Surfers Against Sewage</b> <a href="https://www.sas.org.uk/">https://www.sas.org.uk/</a> A UK marine conservation charity working with communities to protect oceans, waves, beaches and marine life.
SCADA	<b>Supervisory Control and Data Acquisition</b> SCADA is a computer-based system for gathering and analyzing real-time data to monitor and control equipment that deals with critical and time-sensitive materials or events.
Scrum	Scrum is an implementation of agile methodology in which incremental changes are delivered timely.
SDDC	<b>Software Defined Data Centre</b>
SME	<b>Subject Matter Expert</b>
SMTP	<b>Simple Mail Transfer Protocol</b> – protocol for relaying email messages
Sprint	A sprint is a short, time-boxed period when a scrum team works to complete a set amount of work
SSO	<b>Short Sea Outfall</b>
SSO	<b>Settled Storm Overflow</b> An overflow designed to discharge heavily diluted and settled wastewater via an outfall pipe directly to controlled waters, when flows to a wastewater treatment works exceed the pass forward rate capacity for the site and the storm tanks are full, due to rainfall and/or snowmelt.
SuDS	<b>Sustainable Drainage Systems</b> SuDS are drainage solutions that provide an alternative to the direct channelling of surface water through networks of pipes and sewers to nearby watercourses.
SW	<b>Southern Water</b>
User Story	A user story is an informal, general explanation of a software feature written from the perspective of the end user. Its purpose is to articulate how a software feature will provide value to the customer.
WPS	<b>Wastewater Pumping Station</b>



Term or Abbreviation	Description
WTW	Wastewater Treatment Works

## Executive Summary

A holistic review of the Beachbuoy application was conducted on the entire end to end spills identification process and systems. The review was carried out via interviews, examination of documents and project control systems, and examination of the current Beachbuoy public facing functionality.

There are many positives from the review:

- The event duration monitor (EDM) architecture, information flow and automated data processing is compliant to industry good practice.
- There is the use of well-established and industry strength products.
- Data handling is good with detailed mapping allowing accurate reporting to Ofwat and appropriate data retention.
- Spill reporting - there is an auditable configuration for assigning confidence levels against Check Value Limit values; the conservative and false negative risk averse strategy in spill determination is commendable and SW are addressing the time delays in manual reviews; system log files available for spill reviews.
- Project lifecycle follows good industry practice.
- There is a rigorous IT process for release approval.
- Good technical architecture was implemented and maintained for the original Beachbuoy release.
- There is understanding that the original technical implementation is not scalable for future business needs and has limitations.

There are concerns and potential improvements discussed in the main report and a series of recommendations have been made to address these which can be summarised as:

- Enhanced end user involvement including profiling different persona needs/scenarios and validating requirements through discovery processes and releases through beta testing & early involvement.
- Improve the user interface through utilising usability testing and UX best practice.
- Better provision of informational content to explain how the system works and where the data comes from and the context.
- Incorporate additional data sources and system data including inland overflows and verification decisions.
- Improvements in governance, internal documentation and project management (both over the development process and how the products are configured).
- Backup and disaster recovery improvements which will be delivered by the new data centre.
- Improve system latency through increased polling frequency and resolving telecoms constraints.
- Move to a set of standard products which will reduce maintenance cost & time and allow faster development and resilience to change.

The author understands that the majority of these are now being addressed.

In summary, the main issue identified was that in spite of demonstrable good practice there was no clear joined up clarity and documentation of the end to end spill data flow from overflow sensor detection through verification to EA and BB reporting. This, in the opinion of the author, prevents Southern Water regaining the previously lost trust by members of the public.





## 1. Review methodology

### 1.1. Commission remit:

Dr Robert Kevin Holmes was commissioned by Atkins Ltd on behalf of Southern Water with the following remit:

*Dr Robert Kevin Holmes will undertake a software and systems expert review of Southern Water's Beachbuoy system. This will involve reviewing relevant data and information, and having conversations with people involved in Beachbuoy, and then producing a report addressing the review questions that are within your technical area, as indicated within the Beachbuoy Independent Review Scope March 2023 from Southern Water.*

The Software and Systems Review is one of 4 parallel Reviews into the Beach Buoy application.

In 2019, Southern Water made undertakings under a section 19 notice as part of a "transparency" theme to make Environmental Performance data more available to the public. Changes to the annual report, contribute to this objective, but Beachbuoy was seen as an opportunity to make the spill incident data managed by the ASPIRE system within SW available to the public in near real-time.

Beachbuoy, as currently deployed is an open public facing website that highlights, on a map view, any bathing water sites that may have been affected by recent wastewater release events. Users can drill down at a site level to see historic spill events and subscribe to e-mails informing them about future spill events as they happen.

This original production application development for the base version (~2021) was in 3 releases and in Release 3 an API was added to enable the Surfers Against Sewage SAS organisation to receive release event data directly from SW.

The Beachbuoy web site is a page within the overall Southern water public web site. This is currently hosted externally for SW by hosting provider Ensono <https://www.southernwater.co.uk/water-for-life/our-bathing-waters/beachbuoy>.

The enhancement to add the tidal impact assessment for bathing water sites was developed in 2022 going live on Sept 12<sup>th</sup>. This substantially changed the map view interface. Further minor enhancements have continued to be delivered including splitting the single web page interface into 3 and developing automated spill review algorithms to reduce the time spent in essential manual reviews to determine if a signals indicating a possible spill are genuine or not (false positives). The tidal impact changes were required to reduce the overly pessimistic (risk averse strategy) view of outfall spills affecting bathing water sites by determining the effect of tides and spill duration. This was represented via the changing map pin colours and met with public end user resistance and a lack of trust in the system. The review is to determine, from a software and systems perspective, why the Beachbuoy application behaves in the way it does, to investigate those items which have caused the lack of trust and make recommendations for change if not already in train by Southern Water.

### 1.2. Review methodology

The Software and Systems Review followed the following methodology:

- Discovery via interviews and examination of documents provided by Southern Water. The questions specifically focused by a) industry best practice (app development lifecycle; technology considerations and benefits realisation); and b) the author's experience in how these succeed or fail.
- Review of the discovery from the author's perspective to assess areas of weakness and propose recommendations.
- Specifically address the questions posed in the Review remit based on the discovery and review.
- Summarise findings and recommendations.

Any review has to recognise that:

- a) The overflow Event Duration Monitoring (EDM) system is a complex data recording and reporting system which is part of a wider treatment plant operational processing system that has to meet the



needs of the Environment Agency as set out in Permits for overflow operation and the Regulator (OfWat). Beachbuoy is again a part of the EDM system but geared to meeting the needs of a specific set of (varying) stakeholders in the public domain.

- b) The Southern Water business and organisation primary imperatives in this area are compliance to: i) the Regulatory body (OfWat) regarding the terms of its licence to operate, regulatory and statutory duties, and control period funding; and ii) Safeguarding the environment in accordance with compliance to Environment Agency requirements exercised via Permits (which obviously includes Health and Safety obligations).
- c) As part of its obligations Southern Water has to exercise good Asset Management both in terms of optimal investment in its infrastructure and effective processes according to appropriate Standards such as ISO 55000.
- d) In addition, in terms of risk management, especially mitigation of reputational risk, Southern Water has an obligation to demonstrate good citizenship. This is especially relevant to safeguarding the public from unavoidable potentially hazardous events (both allowable and non-allowable according to the relevant Regulation) through the timely communication of information including warnings. These obligations are included in the Environment Act Of 2021 requiring statutory compliance.

This review takes a wholistic approach based on Systems Engineering principles applied to IT systems and their wider context as articulated in ISO 42010. Fundamentally a 'system' exists which has behaviour and a purpose, it has an 'architecture' (data, process/organisation and technology). There are stakeholders who have 'concerns' which require a specific perspective in order to identify a partial view of the overall system architecture that can be used to identify how these concerns may be met. Which obviously has implications in terms of the changes required to the whole system balanced by not creating concerns for other stakeholders.

The main stakeholders here are Beachbuoy users as members of the public, however, it is apparent there are multiple divisions, ideally represented as a spectrum in the Working Group (see the Beachbuoy Working Group Terms of Reference (ref. [5])). In the opinion of the author these stakeholder divisions are (simplistically and as a minimum):

- Holiday makers, casual recreational bathing water users who use the sea as a leisure resource and who require a non-harmful and aesthetic environment, and who make short term decisions as to whether or not to visit a bathing water site based on these considerations;
- Organised groups of recreational/sporting/concerned bathing water users such as Surfers against Sewage who, because of their sports requirements require not only a non-harmful and aesthetic environment but also one which is more predictable as their activities are of a longer duration and require more planning and organisation. This also applies to boat users, although they can also be a cause of pollution.
- Those who use the sea as a production resource, specifically shell fisheries and fishing in general who, because they cannot change their water usage quickly require not just accurate warnings of potential pollution (by time and location) but reassurance as to longer term mitigation and amelioration of pollution to reduce their risk (this requires investment planning based on the EA assessment of amenity value affected by spillages as included in Permits);
- Environmentalists and lobbyists, taking a wider view as to protecting the environment from damage, both in the short and long term for not just recreational bathing waters but also the wider sea water environment, this also includes Surfers against Sewage. This stakeholder requires detailed analyses of spills (frequency/volume/impact) with insight into the (investment) planning that will ameliorate the spill impact.
- Those who use the sea water users (especially holiday makers) as a commercial resource. This is a wider constituency who are concerned with coastal footfall and hence revenue being impacted.

This review cannot address all of these concerns but in consideration of both Beachbuoy and the wider EDM monitoring system cognizance is taken of these differing needs.



## 2. Context and Discovery

### 2.1. Southern Water

Southern Water is the private utility company responsible for the public wastewater collection and treatment in Hampshire, the Isle of Wight, West Sussex, East Sussex and Kent, and for the public water supply and distribution in approximately half of this area. It was formed in 1989.

It is regulated by OfWat and funded in 5 yearly control periods. Pollution controls are imposed by the Environment Agency via the use of permits that define allowable and reportable discharges.

In 2019 Southern Water had a sudden deterioration in pollution incidents and was fined by OfWat (see <https://www.ofwat.gov.uk/wp-content/uploads/2019/10/Ofwat%E2%80%99s-final-decision-to-impose-a-financial-penalty-on-Southern-Water-S....pdf> ).

Southern Water has been criticised over a series of wastewater releases in recent years and was named among the worst-performing companies by Ofwat in 2022. In 2021, it was fined a record £90m for dumping billions of litres of raw sewage into the sea at 17 sites between 2010 and 2015, with various spillages around the east Kent coast. (see Kent online).

The historic events leading to the reported decline in 2019 (2010-2015) led to a company turnaround in 2017 when a new board and CEO were appointed which created a substantial investment in improving both infrastructure and the means to monitor, identify, and report waste treatment plant overflows into the public domain of rivers and coastal waters (spills) both for regulatory reporting (the Aspire software application) and for public information (the Beachbuoy web based software application detailing the relationship of outfalls to coastal bathing water sites with updates on the state of spills at those overflow sites (see <https://www.southernwater.co.uk/water-for-life/beachbuoy> ). The systems development has gone through a number of iterations and will by March 2024 have gone through a major upgrade of the IT technology.

### 2.2. Waste Water Treatment

Sewage treatment is a type of wastewater treatment which aims to remove contaminants from sewage to produce an effluent that is suitable to discharge to the surrounding environment or an intended reuse application, thereby preventing water pollution from raw sewage discharges.

The overall aim of treating sewage is to produce an effluent that can be discharged to the environment while causing as little water pollution as possible, or to produce an effluent that can be reused in a useful manner.

In many cities, sewage (or municipal wastewater) is carried together with stormwater, in a combined sewer system, to a sewage treatment plant. In some urban areas, sewage is carried separately in sanitary sewers and runoff from streets is carried in storm drains. Access to these systems, for maintenance purposes, is typically through a manhole. During high precipitation periods a sewer system may experience a combined sewer overflow event or a sanitary sewer overflow event, which forces untreated sewage to flow directly to receiving waters. This can pose a serious threat to public health and the surrounding environment. (Wikipedia)

#### 2.2.1. Overflows

(see <https://www.ofwat.gov.uk/about-us/ofwat-and-the-environment/pollution-and-water-quality/storm-overflow-explainer/#:-:text=Storm%20overflows%20are%20designed%20to,a%20short%20space%20of%20time.>)

For the following explanation:

*Storm overflows are designed to act as relief valves when the sewerage system is at risk of being overwhelmed, such as during heavy downpours when a lot of rainwater runs into drains and the sewerage system in a short space of time.*

*If the system does get overwhelmed it can have dreadful impacts for customers, causing flooding or even backing up into people's homes in the worst-case scenario.*



*To prevent that happening water companies sometimes use storm overflows to release extra rainwater and wastewater into rivers or seas.*

*Spills can also come from storm overflows in emergency situations, for example, if there are sewer blockages or equipment failures at wastewater treatment works.*

*The causes and impacts of storm overflow use are not straightforward, so various government bodies (Ofwat, the Environment Agency, Natural Resources Wales, Defra and the Welsh Government) are all playing their part in helping to solve the problem of their overuse. For example, the Environment Agency and Natural Resources Wales regulate the use of storm overflows and can grant permits for them in certain circumstances.*

*Ofwat can set performance targets for wastewater companies related to the management of storm overflows.*

*Furthermore, when we think wastewater companies are not treating sewage in line with their licence conditions, we can open an investigation and, if necessary, issue fines.*

The applicability of this type of overflow scenario for Southern Water can be seen in the following link: <https://www.southernwater.co.uk/our-performance/storm-overflows>, which also describes the role of the Clean Rivers and Seas Taskforce (set up in November 2021) in reducing storm overflow spills.

### **2.3. Spill detection and Reporting**

#### **2.3.1. Southern Water WTW monitoring Data Flow**

##### **2.3.1.1. Spill detection Overview**

Spill detection is part of the automated monitoring of the Waste Treatment Works. It is one of a number of parameters that are monitored. Parameters can be differentiated between those that indicate the quality of the treatment process via testing such as total dissolved solids (see <https://assets.publishing.service.gov.uk/media/57a08cbce5274a31e00013e6/R8161-ETP.pdf>), and those that indicate the operational state of the plant.

The operational state of the plant parameters may be equipment states and values (pump running, and Alarms (pump failed), power load, temperature, etc.) and physical parameters such as flow rates, liquid levels, etc. Both of these types of operational parameters are typically monitored via a SCADA system, see Wikipedia: "Supervisory control and data acquisition is a control system architecture comprising computers, networked data communications and graphical user interfaces for high-level supervision of machines and processes." At Southern Water PRISM (see <https://www.prismsystems.com/index.php/automation-controls>) is a SCADA system used for WTW operational monitoring.

As spills are mostly weir overflows (with other mechanisms such as release valves, they are generally monitored via level detectors, the sensors typically using ultrasound echo detection, but also float and pressure sensors are used. This class of detection system is known as an Event Duration Monitor (EDM) and records a state change governed by a (level) trigger or threshold value. See <https://www.ciwem.org/assets/pdf/Special%20Interest%20Groups/Urban%20Drainage%20Group/EDM-Good-Practice-Guide.pdf>.

To understand why this EDM process is done see the following extract from the EDM Good Practice Guide (ref. [23]).



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## 2 Rationale for monitoring

The Water Industry is setting out to improve the visibility of the performance of its sewerage networks to third parties including regulators and the public, specifically around Combined Sewer Overflow (CSO) discharges to the environment. To achieve this, Companies are looking to promote more extensive implementation of Event Duration Monitoring (EDM), as part of their five yearly business plans.

For the majority of sites, this would take the form of logging the timing and duration of CSO spills, to enable summarised reports to be consistently produced, generally on an annual basis. Where such monitoring is not already in place, it is intended that further sites would be included on a prioritised basis, focussed on environmental sensitivity.

Where locations are of a particularly sensitive nature, such as designated bathing waters, Companies may seek to notify appropriate parties about spills, as they are happening or soon after. Ideally this would be on a near real-time basis, to allow potential impacts to be pro-actively managed. As examples, there are already several internet and mobile phone systems in operation around the UK by water companies and other third parties that help bathing water users make informed choices. Note that near real-time warnings are not a regulatory requirement placed on Companies.

To provide this capability may require a commensurately higher level of technology and associated support systems than logging alone. Work is being done by water companies in partnership with the shellfish industry to ascertain whether similar systems would be beneficial for shellfish harvesters, so there is potential for real-time warning systems to be used at many more sites.

For recipients to be able to trust this information, it is key that reliable and consistent information is produced.

### 2.3.1.2. EDM Monitoring Good Practice and Southern Water practice

The Chartered Institution of Water and Environmental Management Urban Drainage Group published the Event Duration Monitoring Good Practice Guide V2.2 in Jan 2016 and included the following generic architecture pattern for the full end to end system:

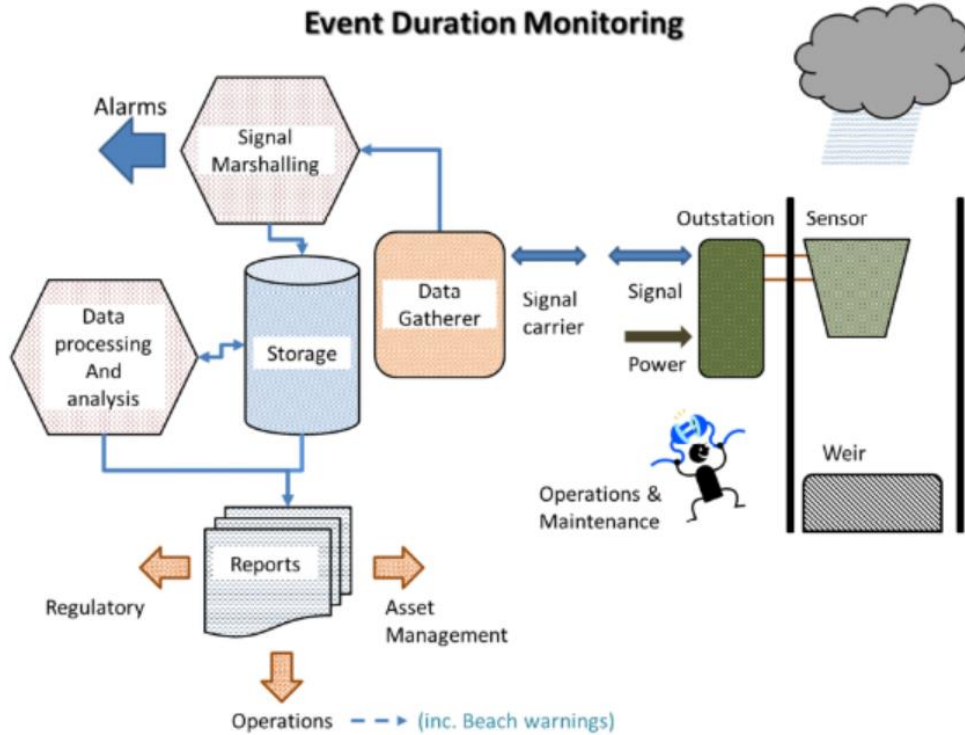


Figure 1 EDM Good Practice Guide Generic EDM Architecture

NOTE Although according to this 2016 Guide not every overflow is required to have EDM monitoring, this has now changed and every overflow must be monitored.

The Southern Water system is compliant to the Good Practice architecture pattern, see the following taken from the Beachbuoy High Level Design Phase 2 Release 3 V5.0 (ref. [2])

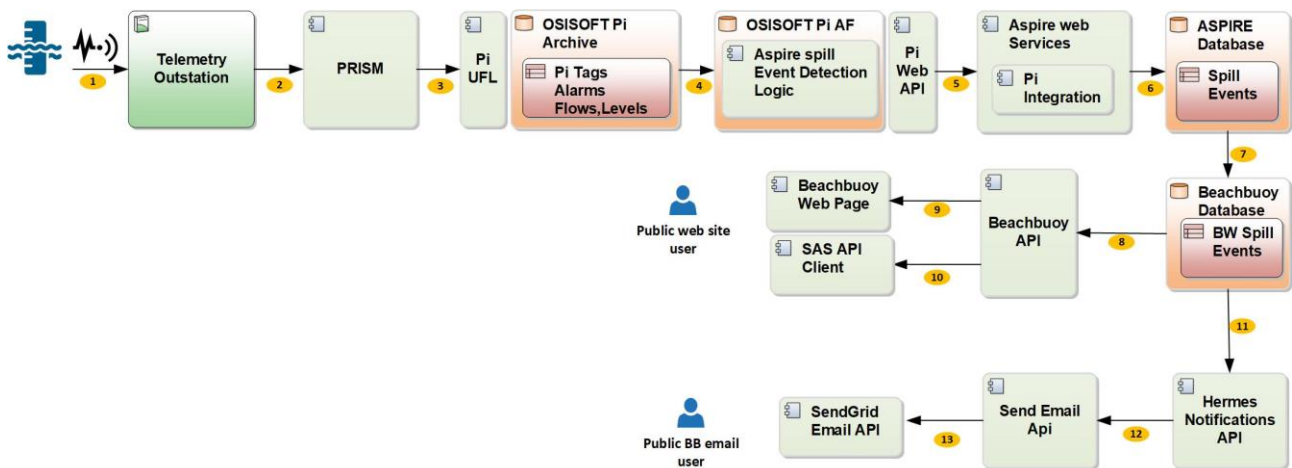


Figure 2 Southern Water EDM Architecture

NOTE: The SendGrid Email API is not used and the Southern Water corporate email system is currently utilised.



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The various steps shown above and the correspondence to the Good Practice pattern is shown in the following table which is an amended version of the table in the Beachbuoy High Level Design document informed by the meeting notes from the Aspire Product Owner and EDM SME (see ref.[18]).:



Table 1 Spill data processing steps and Good Practice compliance

Step	Southern Water EDM Monitoring	Good Practice Architecture Compliance
1	<p>Sensor data monitoring signals from Event duration Monitors, Tank levels are fed to the site RTU outstation for monitoring. NOTE: Overflow EDM sensors are scheduled to be visited a minimum of once per year and the visit should include a calibration.</p> <p>The outstation timestamps sensor data.</p> <p>Realtime signal data is converted to 15 minute averages with 15 min point values as a sample frequency (data volume rationale given PSTN dial up from PRISM data gatherer).</p> <p>Uploads signals and alarms to the PRISM SCADA system (transmission latency is in the order of ~2 minutes)</p>	<p>Sensor to outstation step.</p> <p>Outstation processing, see Good Practice Guide Section 8</p> <p><i>Where there is significant data traffic, then as well as increasing the capacity of signal transmission, managing the timing of device polling and data transfer can balance the loading on both the signal transmission systems, and the associated onward data processing.</i></p>
2	<p>PRISM marshals the signals from the outstations - sites, overflows and EDM are all uniquely identified in the signal data.</p> <p>Note Alarms are routed directly to the control centre for action.</p>	<p>Outstation to Data Gatherer / Signal Marshalling / Storage</p>



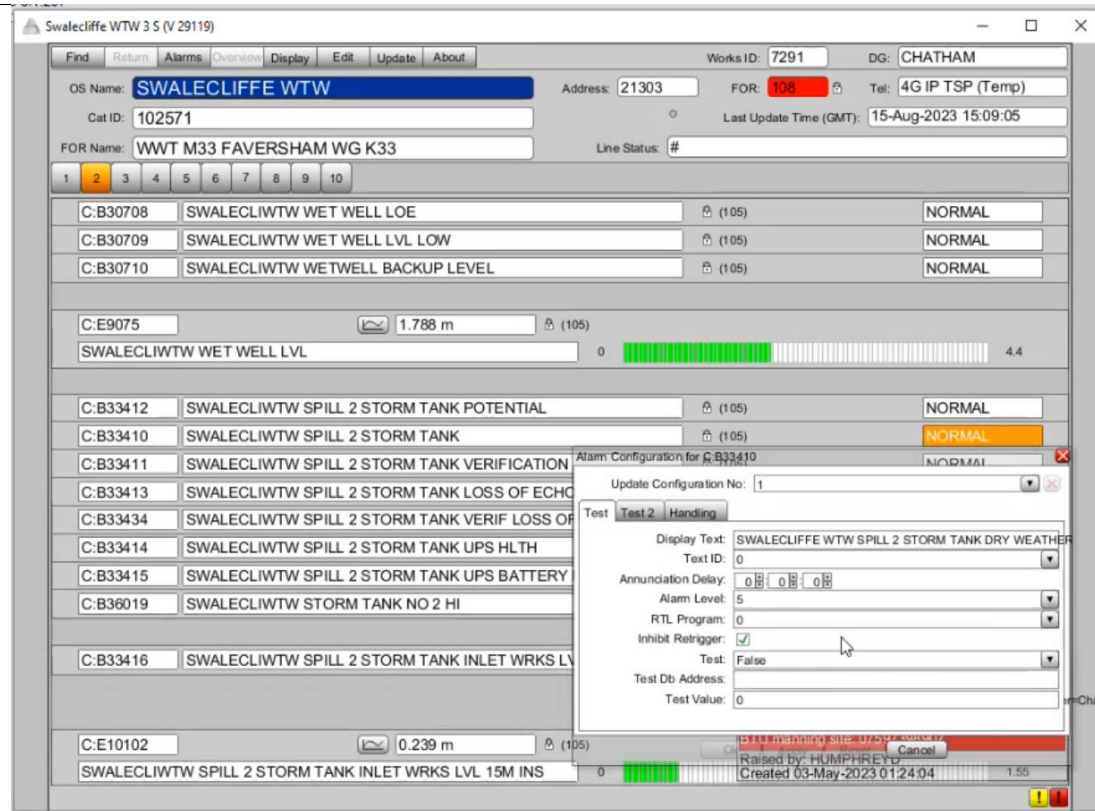


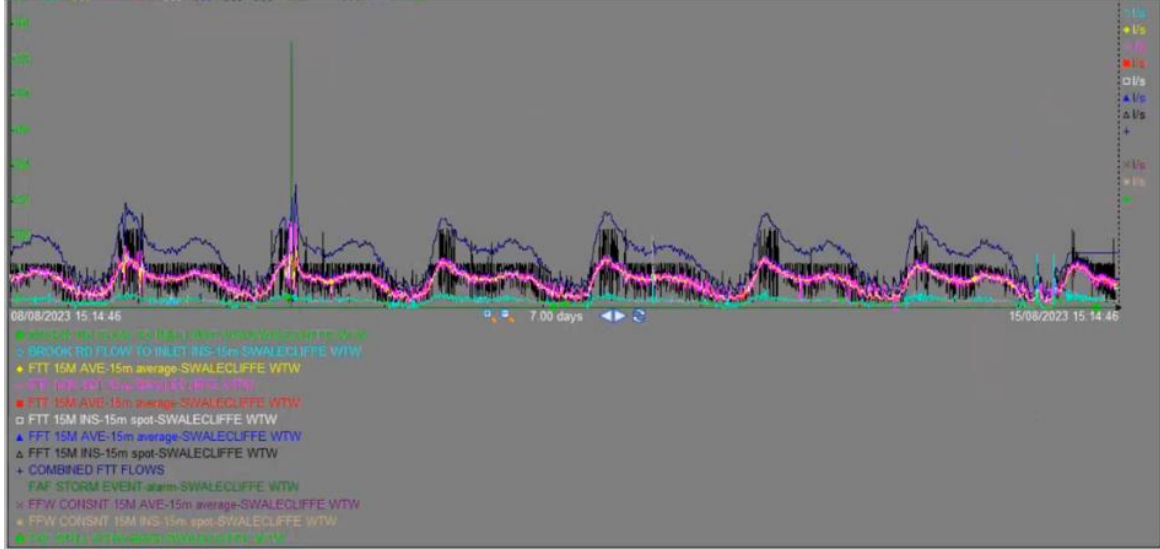
Figure 3 PRISM example monitoring points

PRISM (Scope) is Southern Water’s telemetry handling software produced by Ovarro (new name for Servelec see <https://ovarro.com/en/global/home/> ). It is used as the alarm management tool as well as data archiving into PI. It is used across the industry but each company will tweak it so it’s not exactly in it’s off the shelf format, but the fundamentals are the same.

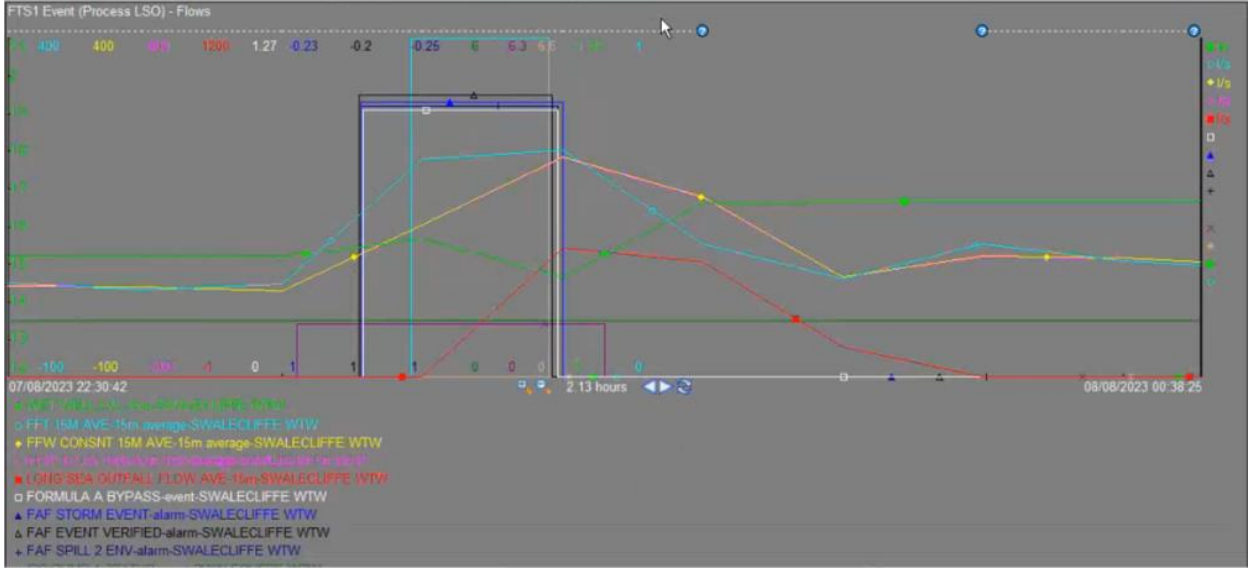


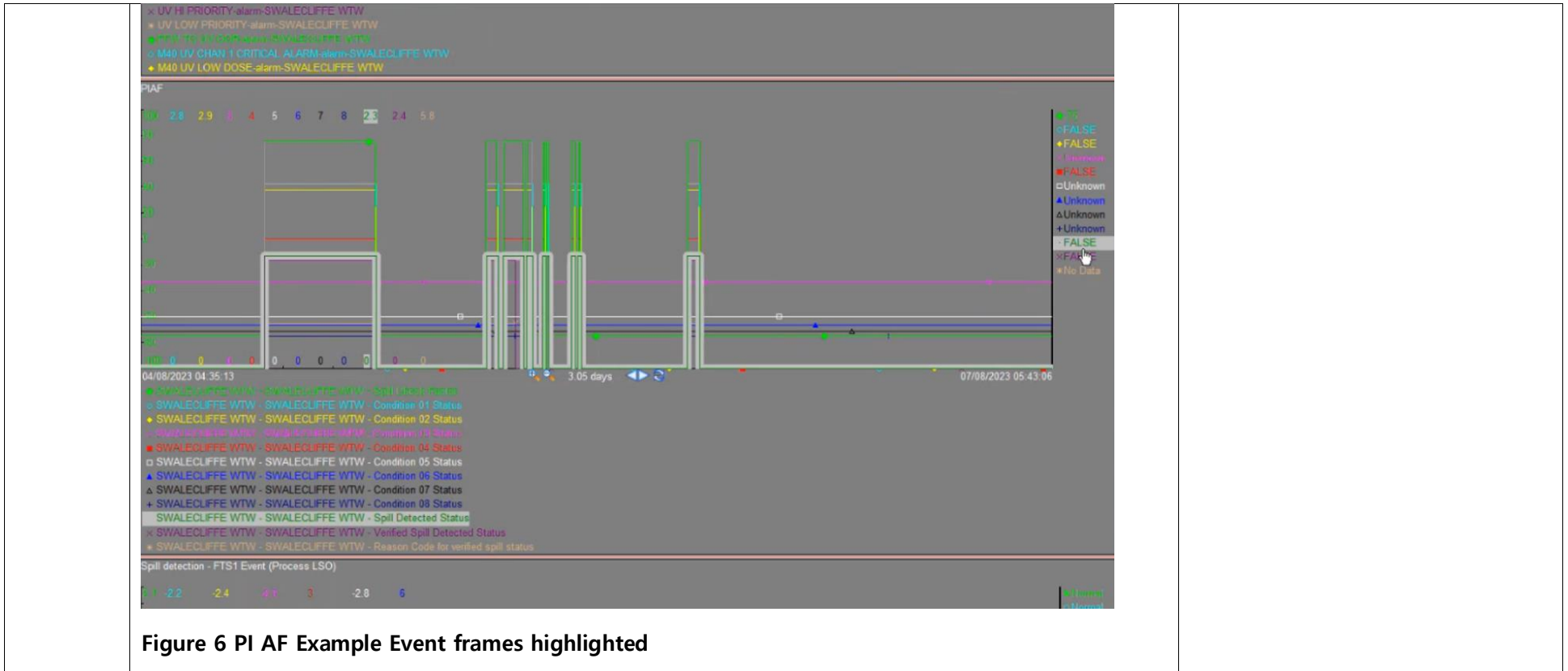
Step	Southern Water EDM Monitoring	Good Practice Architecture Compliance
	<p>The RTUs are set to connect (dial up mostly in Wastewater) on activation of an alarm point and transfer the data archive. The dial up should take less than a minute, the data transfer should be fast, less than 3 minutes. Once the data is on the Prism servers, if all set to archive correctly (needs to be set both ends) then this will transfer to the PI archive within 15 minutes.</p>	
3	<p>EDM data is uploaded to OSIsoft PI historian on a 15 minute cycle. There's circa 200,000 Prism points, across the entire SW estate, so this includes water supply as well as wastewater. Including health alarms etc. most EDM only accounts for a handful of signals per site. The archiving of data from Prism to PI is a continuous cycle but takes approximately 15 minutes to run through all points, so maximum time before data available in PI from Prism should be 15 minutes, so long as the data is in Prism in the first place.</p> <p>The state change data are stored in the PI tier 2 historian as per Data Retention requirements. NOTE: The current retention rule is to never delete anything so some of the archives go back over 20 years since PI was first brought into the company. Permits often quote a requirement minimum 6 years but when you're dealing with a slow 5 year Control Period Asset Management Plan based investment, the principle is the more data the better.</p>	Storage



Step	Southern Water EDM Monitoring	Good Practice Architecture Compliance
	 <p><b>Figure 4 Example data received by PI (Swalecliffe WTW)</b></p>	
4	<p>Once the data is in PI historian it is available for processing within PIAF as it sits on the same server, however SW have built it with a purposeful delay of 30 minutes so that it correctly handles out of sequence data and also late arriving data.</p> <p>OSisoft PI AF event detection logic is executed to detect probable spill events (Frame start times followed by end times) and assign a confidence score and priority. This is done automatically using signals from <b>multiple</b> overflow sensors and state change check factors. False negative (missing real spills) risk minimisation (conservative) logic is applied in the check factor algorithm based on having multiple sensors, i.e. if only one detector out of the set on an overflow triggers this is taken as a possible spill and a frame is started. To end an Event Frame all sensors in the set must be below the trigger threshold.</p>	Data processing and analysis



Step	Southern Water EDM Monitoring	Good Practice Architecture Compliance
	<p>Note spill frame records are held in PI AF for 30 minutes from spill start time to enable updates from late arriving data from upstream.</p> <p>Note: PI contains the tide data so it can be correctly assigned at the start of an eventframe.</p> <p>Note: Events are also reviewed to ensure that the check factor process isn't failing due to EDM health issues. The analysts can raise investigative jobs by exception so don't need to wait for the next scheduled / planned visit to check EDM sensors.</p>  <p><b>Figure 5 Example PI AF Event Frame detection</b></p>	





Elements		SWALECLIFFE CSO - V3.0	
		General Child Elements Attributes Ports Analyses Notification Rules Version	
		Filter	
		Name	Value
	STAPLEFIELD WTW	Check Level Lookup	-75
	STAPLEHURST WTW	Check Level Lookup Key	Spills Detection - Overflow - Profile 1 - V1.0
	STATION HILL MOORDEN WPS	Condition 01 Status	FALSE
	STATION ROAD FOREST ROW CSC	Condition 02 Status	FALSE
	STATION ROAD HALSHAM CSO	Condition 03 Status	Unknown
	STATION ROAD LISS CSO	Condition 04 Status	FALSE
	STATION ROAD RAINHAM CSO	Condition 05 Status	UNKNOWN
	STATION ROAD ROBERTSBRIDGE I	Condition 06 Status	UNKNOWN
	STATION ROAD RUSTINGTON CSO	Condition 07 Status	UNKNOWN
	STATION ROAD WHITSTABLE WPS	Condition 08 Status	UNKNOWN
	STATION STREET LYMINGTON NO	Condition 09 Status	UNKNOWN
	STEEP HILL COVE WPS	Condition 10 Status	UNKNOWN
	STEYNING WTW	Condition Trigger Tag	0.35003
	STOCKBRIDGE WTW	Discharge Name	
	STOCKERS HILL BOUGHTON STREE	Display URL Root	<a href="https://division.southernwater.co.uk/P/View/#/Displays/145/SPILL_VERIFICATION_PROFILE_0">https://division.southernwater.co.uk/P/View/#/Displays/145/SPILL_VERIFICATION_PROFILE_0</a>
	STOCKLAND GREEN WPS	Exceptional Overflow	False
	STONE GREEN STONE IN OWNEY W	Instrument Tag Available %	100 %
	STONE HILL ROAD EGERTON WTW	Instrument Tag Bad %	20 %
	STONEBRIDGE BLACKBOYS WPS	Overflow Enabled	True
	STONEBRIDGE ROAD BROOK K WP	Overflow ID	115444
	STORRINGTON WTW	Overflow Name	SWALECLIFFE CSO
	STRAWLANDS PLUMPTON GREEN V	Overflow Tag Mnemonic	115444
	STREET END LANE BROAD OAK WP	Overflow Tag Mnemonic	115444
	STUBBS LANE BREDE WTW	Pass Forward Flow	78.555
	STURLA ROAD CHATHAM CSO	Pass Forward Rate	0
	SUMMER LAKE PAGHAM WTW	Primary Spill Monitor Device Digital	Normal
	SUNNYFIELD ROAD BARTON ON SE	Profile Name	Spills Detection - Overflow - Profile 1 - V1.0
	SUTTON VALENCE WTW	Secondary Spill Monitor Device Digital	Normal
	SWALECLIFFE WTW	Site Name	SWALECLIFFE WTW
	Site Calculations	Site Tag Prefix	SWALECLI-CSO-
	SWALECLIFFE CSO - V1.0	Spill Check Level	-75
	SWALECLIFFE CSO - V1.1	Spill Origin Level Analogue	-6.3842E-08
	SWALECLIFFE CSO - V2.0	Spill Origin Level Digital	Normal
	SWALECLIFFE CSO - V3.0		
	SWALECLIFFE SSO - V1.0		
	SWALECLIFFE SSO - V1.1		
	TANGMERE WTW		
	TANKERTON CIRCUS CSO		
	Site Calculations		
	TANKERTON CIRCUS CSO - V1		
	TANKERTON CIRCUS CSO - V2		
	TANYARD LANE SOUTHBOROUGH C		
	TATES COPSE HYTHE H WPS		
	TAIT YALDING WPS		
	TAYLOR STREET SOUTHBOROUGH		
	TAYLORS LANE BOSHAM WPS		
	TEMPLARS WAY CHANDLERS FORC		



Step	Southern Water EDM Monitoring	Good Practice Architecture Compliance
	<p><b>Figure 7 Example Overflow profile (attributes) showing Check Factor condition values and spill check value</b></p> <p>Example of current status of Swalecliffe CSO (there is also a SSO) showing the attributes in the CSO profile. There are 4 sensors with condition values (Condition 01 Status = FALSE, etc. with Condition 03 = Unknown. If one condition = TRUE it would set an eventframe start (possible spill). The overall confidence factor is the spill check level value = -75 (because 1 Condition status is unknown).</p>	
. 5	<p>The ASPIRE application polls for new events from PI.</p> <p>ASPIRE obtains data from PI via the PI Web API (a RESTful Web Service)</p> <p>The PI AF service is polled for Eventframes from Aspire and Eventframe acknowledgement from PIAF to Aspire can take up to 15 minutes. Eventframe' data are collated set of data points (site, 'check value', tidal state, etc.) related to a single spill event. Event Frames can either be 'Closed' or 'Open' in relation to a spill event that is either completed or ongoing.</p> <p>Completed or 'Closed' events are acknowledged in PI so that they are not repeatedly returned in the poll (which polls for unacknowledged event frames). Ongoing or open events are not acknowledged and continuously returned (to allow things like the check value to change over time) until they complete and are acknowledged (email from the IT Solution Architect 30/8/2023).</p> <p>Once an event has completed and been acknowledged the link between the eventframe and Aspire is severed. However, there is work ongoing with IT at present to try to extend that link 24 hours after event closure to handle a scenario where late arriving data may change the checkfactor of the event</p>	Interface for reporting
6	<p>The spill events are stored in the ASPIRE database awaiting review by the spills team using the ASPIRE web application. These are prioritised by a) permit requirements and b) Bathing Water Sites (always the highest priority). Note tidal impact is also assessed.</p> <p>NOTE: wrt verification:</p> <p>Unverified spills are always treated as potentially genuine for reporting.</p>	<p>Processing for reporting. Note this includes validation, see Good Practice Guide Section 11:</p> <p><i>"In deciding upon the degree of checking that data is subject to, there is a balance to be struck, particularly when information is used for warning purposes. Even in these circumstances, depending on the number of sites and the degree of checking employed, checking times can vary from minutes to</i></p>



Step	Southern Water EDM Monitoring	Good Practice Architecture Compliance
	<p>Start time of potential (unverified) spill (from PI AF frame, from original date/time stamp) to first possible validation review start will have a system latency of at least 30 to 45 mins (~2+max 15+30).</p> <p>The manual validation process start time is recorded.</p> <p>A verification can be paused and restarted. The validation in progress but paused status should be relayed to Beachbuoy.</p> <p>A spill can be confirmed as genuine by verification prior to the spill end time being recorded. A genuine/non-genuine decision terminates the verification process.</p> <p>A genuine spill with no end time is always flagged as occurring in the last 24 hours (red) for beach warning.</p> <p>The 24 hour and 72 hour status change limits start from the spill end time.</p> <p>Every spill triggered as possible even if the check factor value is &lt; prioritisation / minimum confidence limit (+50%) is still verified.</p> <p>The Check Factor Limit is a numerical value from -100 to 100 that assists in the validation of ascertaining if any given spill event is more, or, less likely to be a genuine spill event. If the spill event Check Factor is <math>\geq</math> than the CFL the spill is more likely to be genuine and if the spill event Check Factor is &lt; the CFL, the spill event is more likely to be defective.</p>	<p><i>hours. It is also important to note that many of these checks are carried out manually by companies, so are resource intensive. Note that where warnings are provided, checking is not generally carried out until after the warnings have been issued. Depending on the numbers of warnings being generated, this validation stage can take from minutes to hours, and can involve the need to send people to site.</i></p> <p><i>Checks carried out on data used for warning purposes include detection of sudden rise and fall of level (square wave), as opposed to a ramping up of flows before spillage, and whether the levels tie in with the time that an overflow is recorded as a change of state.</i></p> <p><i>More sophisticated analyses, such as cusums are more likely to be carried out manually, and are unlikely to be used in the context of generating warnings.</i></p> <p><i>It should also be borne in mind that no system is likely to have 100% reliability in spill recording, when viewed over the long term. No criteria have been defined to date for recording reliability, or time to recover once a recording system is known to be inoperable. It is recommended that through use, the reliability of recording for individual overflows is established, so that ultimately reliability criteria can be defined.</i></p>
	<p>Addendum to the SW EDM process:</p> <p>Reference data refreshes PI, Aspire and BB. This is:</p> <p>a) Configuration (source / overflow(s) / outfall / bathing water site(s) from the CATalogue application.</p>	





Step	Southern Water EDM Monitoring	Good Practice Architecture Compliance
	b) EA Permit reporting requirements from CALMS (Consent and Licence Management Systems) application;	
		The subsequent Beachbuoy steps are not detailed in the Good Practice Guide other than 'Beach Warnings'
7	<p>A periodic (1 hours) extract of spills impacting BW is extracted and stored in the BB database. Beachbuoy only polls every hour currently, so most events should be on BB within the hour, but if not, the second hour.</p> <p>Note: All events, whether 'ongoing' or 'complete' are picked up by Aspire and therefore Beachbuoy. An event doesn't have to be reviewed in order to appear on BB, it just has to have a high check factor meaning it has to 'appear' genuine at least, according to corroboration of the telemetry data.</p> <p>Note: In Aspire Check Factor Limits are used to initially determine if a spill is potentially genuine or not based on the Check Factor value recorded for an overflow. These are different for the Aspire workflow filtering for reporting to the EA and for passing the event to Beachbuoy. The Aspire SME (ref. [18]) stated that if a value is greater than the Aspire CFL but less than the BB CFL then it is only passed to BB after manual verification.</p>	
8	The BB API queries the BB database in response to a user loading/refreshing the BB web page	Note: if the web page is left open the page automatically refreshes after 30 minutes
9	Current spills and spills over the last 72 hours are extracted via the API and returned to the BB web page script to be rendered as map markers and tabular data	Note: 72 hours from the time the spill terminates is the time for bacteria to decompose in sea water.
10	The current BB event and status data is published to the SAS API subscriber API – this is synchronised with the new data being made available to the BB website.	
11	The BB scheduled task to refresh spills and generate notification events for subscribers	
12	BB generates and relays emails to subscribers for the BWs impacted by new events via Southern Water corporate email system (Microsoft Exchange), not SendGrid	



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Step	Southern Water EDM Monitoring	Good Practice Architecture Compliance
13	Email is delivered to the subscriber by the Southern Water corporate email system (Microsoft Exchange) not SendGrid.	



### 2.3.2. Specific Concerns

#### 2.3.2.1. Latency (processing delays)

It is important to put the SW EDM monitoring and reporting into the context of the 2021 Environment Act which states:

*Reporting on discharges from storm overflows*

*In Chapter 4 of Part 4 of the Water Industry Act 1991 (as inserted by section 80 above), after section 141D insert—*

*“141DA Reporting on discharges from storm overflows*

*(1) Where there is a discharge from a storm overflow of a sewerage undertaker whose area is wholly or mainly in England, the undertaker must publish the following information—*

*(a) that there has been a discharge from the storm overflow;*

*(b) the location of the storm overflow;*

*(c) when the discharge began;*

*(d) when the discharge ended.*

*(2) The information referred to in subsection (1)(a) to (c) must be published within an hour of the discharge beginning; and that referred to in subsection (1)(d) within an hour of it ending.*

*(3) The information must—*

*(a) be in a form which allows the public readily to understand it, and*

*(b) be published in a way which makes it readily accessible to the public.*

The latency in the data flow up to and including Aspire is, in the main, a normal consequence of the technology being used and compliant with the Good Practice Guide (ref. [23]). However, there are three items which require further confirmation and elucidation.

- The telemetry outstation sampling frequency of 15 minutes (for the mean sensor reading over the 15 minutes and point value at the 15 minute mark). Ideally this should be 2 minutes for a High amenity class and >1 spill per annum. It is thought shellfish fisheries for sea discharge would fall into this classification but this requires confirmation.
- The event frame update from PI AF to Aspire delay of 30 minutes to accommodate late data arrivals from the outstations via PRISM.
- The manual validation time. This is **not** a delay in notification per se as unverified spills polled by Aspire from PI AF are available to be published immediately (to the EA as per Permit requirements and Beachbuoy as per the BB Aspire interface delay), and it should be noted SW has put in place actions to further automate the spill validation (see ref. [25]) even though the Good Practice Guide accepts manual validation may have to be necessary in some instances. Also, even though a spill may be unverified it is still treated as ‘genuine’ for the purposes of assessing the tidal impact.

The delay between Aspire and Beachbuoy of 1 hour is treated in the Beachbuoy architecture section.

The following example illustrates the technology imposed delays:

- EDM to telemetry outstation (minimal with timestamp)
- Telemetry outstation to PRISM: comms delay ~ several minutes
- PRISM to PI (Historian): ~15 mins (200,000 data point cycle time)
- PI AF Spill frame start availability delay to Aspire: 30 mins to give time for data late arrival from PRISM
- Aspire to Beachbuoy: polling on the hour from BB to Aspire.



Example #1 for a spill start event:

- Recorded at 1505
- Prism to PI at 1520
- Prism AF to Aspire at 1550
- BB polling at 1600 therefore available in Web app as an unverified spill start time from 1600 (total unverified spill start indication latency 55 mins).

Example #2,

- if spill start event recorded at 1516,
- it would be available in Aspire at 1601,
- but would not be available in BB web app until 1700, next time BB polls Aspire (total unverified spill start indication latency 104 mins - maximum).

NOTE a spill can be verified based on the start event in Aspire, thus for Example #1 if verification took place between 1550 and 1600 the spill would be flagged in BB on polling at 1600 as genuine or non-genuine (but of potentially unknown duration), or if not but verified between 1600 and 1700 the BB flag would change from unverified to genuine (red or yellow) at 1700 on polling (non genuine spills are not displayed).

Hence some of the end user confusion about the way the web app flags change from unverified to a genuine (red/yellow) or back to blue are due to the fact BB polls Aspire on a strict one hour cycle (on the hour), and not necessarily due to the time taken to verify.

### 2.3.2.2. Data Transformation

All the systems in the flow of data have audit logs that record data changes and interventions (state changes) which could be analysed in the event of an incident.

The only 'manual' processing for a state change is in Aspire for validation to class the spill as genuine or non-genuine and these actions are recorded in the Aspire log files with user identification (log on id). The manual review process also includes a view of compliance, i.e. were the permit conditions met to have been a 'lawful' spill, however this information is not shared externally.

The various systems in the chain process the data according to configured rules. The main processing is in the use of check factors. The signals from the EDM monitoring are determined to be positive (i.e. a configured and calibrated threshold level has been exceeded indicating an overflow), or negative (below the threshold) . To reduce the risk of a missed spill a single positive value in a set of multiple overflow monitoring points is taken to be a potential spill. The checkfactor is a measure of signal corroboration; the more signals that indicate a spill the more positive the checkfactor, the more that indicate no spill, the more negative the check factor. As automation depends on this, the health of the EDM sensors becomes critical, as it would be possible for genuine events to have negative check factors if sensors have ceased to work correctly. A review process exists to look for this scenario and feed into the maintenance schedule of the sensors.

The only other change is the review qualification of the spill as genuine or non genuine based on other criteria, which again are recorded and are auditable. This review process in Aspire is both manual and partly automated. Currently KPIs are being implemented for reporting review state changes (start / end / paused / rereview) and type (automated/manual) with reporting (by overflow, by time to review e.g. >5 days, etc.). These reports are designed for performance assessment and process improvement. Other KPIs are being implemented with automated dashboard reporting for BB Event Accuracy i.e. percentages of false positives, false negatives, etc.

If an EDM monitoring system is under maintenance and no signal is available this can reduce the check factor trigger level for the other on line EDM signals, however, usual practice is to flag an overflow as under maintenance in BB in the BB Admin portal (with start and end times) which suppresses any EDM event frames as the field testing and calibration of the sensor will return a false signal.



### 2.3.2.3. Data Storage

Spill data storage:

- Raw EDM signal data (as received from PRISM to OSISoft PI) is archived in the PI historian for 6 years as per Data Retention rules specified in the EA Permits..
- PI AF spill event frames are not deleted but stored for analysis and Control Period investment planning (over 20 years of spill data is currently stored).
- Aspire spill event data received from PI AF since Aspire entered production is retained with end times updated as it changes in PI AF. NOTE in addition when a user edits a spill record in Aspire, e.g. to change a state to 'genuine' or 'non-genuine', this is logged in Aspire and these logs are also retained (for audit purposes).
- Beachbuoy spill event data as imported into the Beachbuoy schema tables. According to the High Level Design (ref.[2]) this maintains a cache of the current events that is refreshed every hour. It also maintains subscriber details and audit records. The BB Admin portal functionality is used for Maintenance events and also reference data such as the tidal impact tables. As this is highly sensitive in how spills are displayed usage is restricted and all changes are audit logged.

Re Backup and Disaster Recovery the BB High Level Design Section 6.12 stated:

*"The solution has high availability provision but will not have disaster recovery support until it is migrated to the SDDC....."*

Software Defined Data Centre – SDDC.

The SDDC itself is already operational now, it is believed it came on line around March of this year (2023), and there is an on-going programme of work in the process of migrating services to it currently. The systems that make up the rest of the SPILLS stack are due for migration by the end of Feb. 2024. For Beach Buoy itself SW IT are targeting to get it fully stood up in the SDDC by the end of March 2024, at which point full Disaster Recovery and failover capability will be in place.

## 2.4. Beachbuoy Architecture

### 2.4.1. BB Architecture As Is Description

The Beachbuoy technical architecture is detailed in the Release 2 High Level Design for the pre Tidal impact enhancement (see ref.[2] Beachbuoy Phase 2 – Release 3 High Level Design), and this was unchanged for the tidal impact enhancement (Sept 2022).

NOTE there is an in flight project to change this technical architecture with delivery by March 2024. (See ref. [34] HLD - Beachbuoy and Inland Water EDM Status - Future State Architecture)

#### 2.4.1.1. BB As Is Technical Architecture

See the Release 2 Phase 3 V5.0 High Level Design (ref. [2]).

The enabling technical architecture has not changed from Release 2 Phase 3 as built to support the subsequent enhancements including the tidal impact assessment. What did change was the level of detail expressed by the icon colours representing bathing water sites and outfalls, i.e. the interface functionality.

It is important to note that the design, in terms of the aspects covered, is complete and comprehensive.

The following is taken from the HLD for the basic (pre tidal impact) Phase 2 Release 3 As Built version:

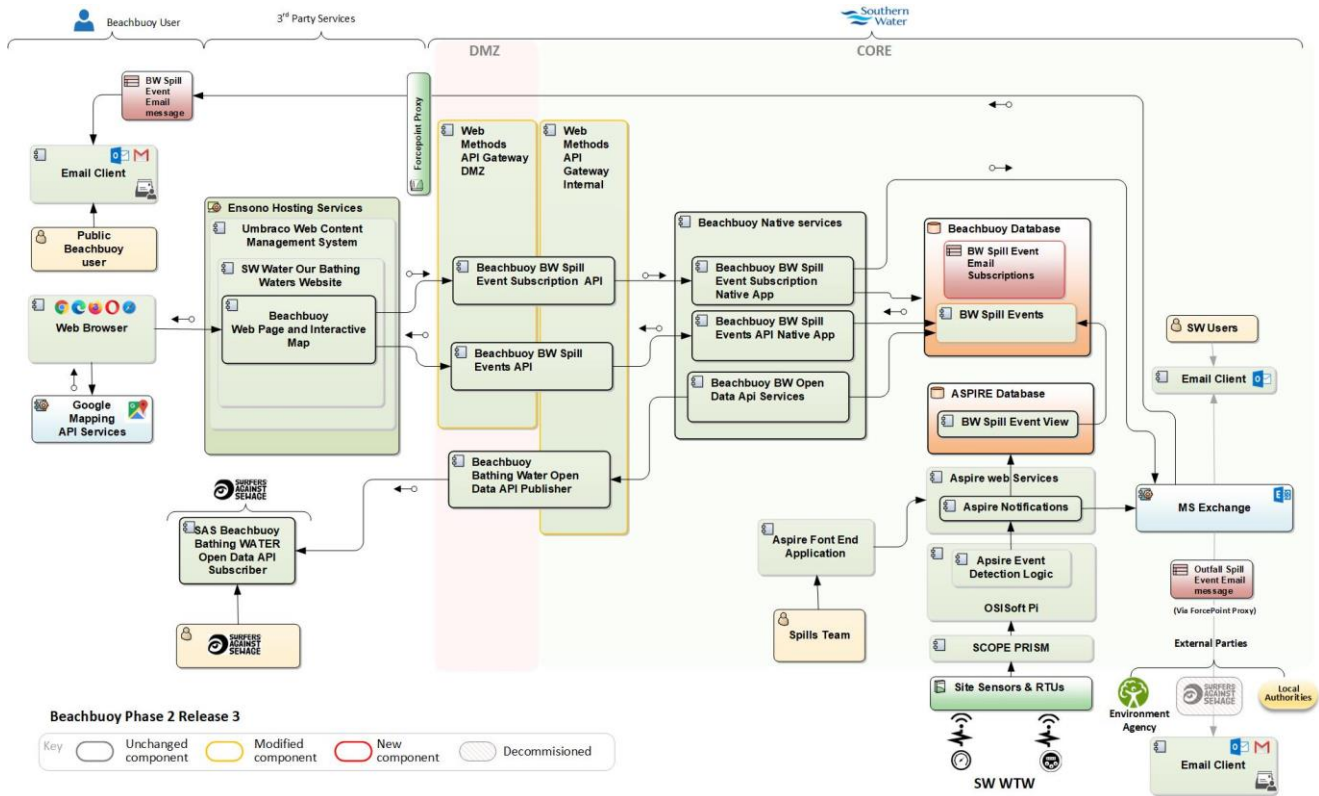


Figure 8 Beachbuoy technical architecture Phase 2 Release 3 V5.0

Although comprehensive this diagram is specifically for BB design and as a consequence omits:

- The PI Historian raw data archive;
- The reference data in CALMS and CATalogue as these feed Aspire only.

NOTE: this technology architecture does not include any mobile app, access was always via the hosted web page so usage via a mobile device (tablet, smart phone etc.) would need to rely on access via a browser. It is unclear if this was communicated effectively to the user community via the Working Group.

As this predates the tidal modelling it should, as a design artefact, have been updated to include the changes in PI AF, Aspire and BB for the inclusion of the tidal modelling tables as part of the enhancement Epics.

The key components in the Phase 2 base Beachbuoy technology architecture are as follows:

Table 2 Beachbuoy technology components

Component	New / Modified / Unchanged	Phase 2 Release	Description
ASPIRE Database	Modified	R1	Modified to include a view to obtain all Spill Events related to Bathing Water sites.
Beachbuoy Database	New	R1	Database to hold Spill Events, this acts as a cache for Bathing Water related events to ensure that high demand - hosted in the ASPIRE database instance
Task Scheduler	New	R1	Part of the Beachbuoy Application using Quartz Scheduler process used to execute service tasks to refresh the bathing water spill database and send notification events.



Component	New / Modified / Unchanged	Phase 2 Release	Description
Hermes	Modified - Decommission	R3	Functionality to handle e-mail subscriptions and triggers sending e-mails to subscribers via the SendGrid external bulk email service is relocated to Beachbuoy application. <b>NOTE BB 1 still uses the SW corporate email (Microsoft Exchange).</b>
Send Email API	New	<b>Post Phase 2</b>	Façade to the SendGrid send restful API used to send emails to BB subscribers. <b>Currently for BB 1 still uses the SW corporate email (Microsoft Exchange).</b>
Beachbuoy BW Release event query API	New	R1	Façade Web Service API deployed to the web services Gateway for accessing spill event data from the BB web client application.
Beachbuoy BW Release event subscription API	New	R2	Façade Web Service API deployed to the web services Gateway for accessing the Hermes services to subscribe to release event notifications. <b>Currently for BB 1 still uses the SW corporate email (Microsoft Exchange).</b>
Beachbuoy Application Services	New	R1	The native services for querying spill events and for managing subscriptions – called from the web services Gateway Beachbuoy API Facade
Web services Gateway	Modified	R1	Enterprise integration platform for deploying and managing API services internally and externally. Handles the separation of internal SW applications from anonymous external access and protects against external cyber-attacks such as DoS.
Beachbuoy Web content	New	R1	Web client composed of static content and java script client using the Google Maps API to present a maps-based user interface showing Bathing Water locations and spill statuses.
SW Corporate Web Site	Modified	R1	Modified to include new Beachbuoy web pages. Stored within the SW public Web Site within the Umbraco CMS hosted by Ensono.
Bulk Email Send API	New	<b>Post Phase 2</b>	Façade to the SendGrid Send API to deliver notification emails to BB subscribers independently of SW domain email services
SendGrid Bulk Email Delivery	Modified	<b>Post Phase 2</b>	Commercial service for the delivery of bulk email – for BB notification emails are delivered to subscribers of a bathing water impacted by a release event. This is relatively low volume. < 10,000s emails per month
SendGrid Send API	New	<b>Post Phase 2</b>	Restful API used in single sender mode to deliver no reply emails to BB subscribers. <a href="https://docs.sendgrid.com/for-developers/sending-email/api-getting-started">https://docs.sendgrid.com/for-developers/sending-email/api-getting-started</a>
Beachbuoy BW open data API Publisher	New	R3	Web service façade used to deliver BW Status and events to SAS and potentially other subscribers in the future. This will be called from the task scheduler within BB to deliver updates to the SAS system via a restful web service call.



Component	New / Modified / Unchanged	Phase 2 Release	Description
Beachbuoy BW open data API Subscriber	New	R3	Web services endpoint exposed by SAS as the target for the SW publisher process.
Email verification service	NEW	R3	An email verification services is added as part of verifying subscriber emails

The following shows the sequence of processing steps for the execution of one use case/Epic for the base Phase 2 Release 3 application:

**“As a Beachbuoy website user, I want to see the current spills that may be impacting bathing water quality”**

1. A user clicks on the SW web site to load the Beachbuoy web page at URL (A), the site content is retrieved from the CMS hosted by Ensono.
2. The Beachbuoy map and JavaScript code behind is loaded and started in the browser.
3. The map JavaScript invokes the /API/spill’s web service to retrieve current and historic spills via a reverse proxy server hosted by Ensono
4. The API/spills API service call is rewritten by the reverse proxy to URL (C) to call the SW hosted API on the WebMethods web service gateway.
5. The WebMethods API gateway has components in the DMZ and core network to implement a secure threat prevention architecture.
6. The WebMethods API gateway in the core network invokes the native spills web service hosted in IIS. This is a SW built .net service.
7. The .net spills service invokes a stored procedure in the Beachbuoy data base to retrieve the current spills.
8. This SP queries the BB database cache of spill events for all bathing waters.

NOTE with the inclusion of the tidal spills data does not affect this processing sequence as these are spill site values held as spill attributes and this technology view does not include code or SQL script specifications.

**This technology architecture has not changed for the tidal Impact release on Sept 12<sup>th</sup> 2022 or subsequently. It follows good IT application design principles including strong cyber security protection through the DMZ and encryption. However, elements of the design:**

- **Constrain functionality in terms of spill data timeliness and accessibility because of the use of the Quartz scheduler and stored procedure limiting the Aspire to BB spill data update to once per hour on the hour whereas upstream spill state changes are not sequenced to a clock.**
- **Impose a high maintenance overhead in the use of a mix of bespoke code (C Sharp) and third party utilities (Quartz, Google map services, etc.)**

#### 2.4.1.2. BB As Is Data Architecture

The Data Architecture as described in the original Phase 2 Release 3 High Level Design is very light and lacking in detail as to the physical schema design (which is included in the Aspire database instance). However, the spill data table is the main driver in terms of the user accessibility of spill information timely or not, both in terms of current state and history.





The BB database physical design is not documented as a data dictionary and the only information was obtained in the form of an uncontrolled script (see ref. [26]) part of which is shown in the following extract for two tables which lists the table columns (attributes) with data types e.g. for the HistoricSpills table it has SiteUnitNumber with a data type of integer and outfallName with a datatype of varchar. It is possible to infer some may be foreign keys, however, there is no obvious non code based schema design to check for referential integrity nor separately identify enumerations (lists of values for dropdowns). This is probably a consequence of the Agile code based approach to the development.

```
/****** Object: Table [Beachbuoy].[HistoricSpills] Script Date: 07/09/2023 10:00:47 *****/
SET ANSI_NULLS ON
GO
SET QUOTED_IDENTIFIER ON
GO
CREATE TABLE [Beachbuoy].[HistoricSpills](
    [Id] [int] IDENTITY(1,1) NOT NULL,
    [EventId] [int] NOT NULL,
    [SiteUnitNumber] [int] NOT NULL,
    [OutfallName] [varchar](255) NOT NULL,
    [EventStart] [datetime] NOT NULL,
    [EventStop] [datetime] NOT NULL,
    [Duration] [int] NOT NULL,
    [Status] [varchar](200) NOT NULL,
    [AssociatedSiteId] [int] NOT NULL,
    [BathingSite] [varchar](255) NOT NULL,
    [IsImpacting] [bit] NOT NULL,
    CONSTRAINT [Unique_spillEvent] UNIQUE NONCLUSTERED
(
    [EventId] ASC,
    [SiteUnitNumber] ASC,
    [AssociatedSiteId] ASC
)WITH (PAD_INDEX = OFF, STATISTICS_NORECOMPUTE = OFF, IGNORE_DUP_KEY = OFF, ALLOW_ROW_LOCKS = ON, ALLOW_PAGE_LOCKS = ON) ON [PRIMARY]
) ON [PRIMARY]
GO
/****** Object: Table [Beachbuoy].[ImpactOfReleaseInDays] Script Date: 07/09/2023 10:00:47 *****/
SET ANSI_NULLS ON
GO
SET QUOTED_IDENTIFIER ON
GO
CREATE TABLE [Beachbuoy].[ImpactOfReleaseInDays](
    [Id] [int] IDENTITY(1,1) NOT NULL,
    [TideCaseID] [int] NOT NULL,
    [SiteID] [int] NOT NULL,
    [AssociatedAreaID] [int] NOT NULL,
    [ImpactInDays] [int] NOT NULL
) ON [PRIMARY]
GO
```

Figure 9 Example BB database table script

### 2.4.1.3. BB As Is Functionality

There are a number of different aspects of the BB functionality:

- Direct access via the web interface:
  - Map visualisation of the derived state of bathing water sites and outfalls, bearing in mind this is not real time and subject to varying and essentially unpredictable delays from when an event is detected;
  - History reports of spills both ongoing and ended.
- Notifications:
  - By direct API subscription e.g. for the Surfers against Sewage web site
  - By email notification (note this is a separate email notification channel from the email notifications to the Environment Agency as required by the Permits).

Other functionality relates to what is displayed/notified as opposed to the 'how'. This is based on business rules – filters. It is apparent that filters are in place, both explicit and by inference, for deciding what is actually available for publication in BB and these filters are in both Aspire and BB, how some of these rules operate is set via configuration, for example the tables of BWS/tide/date time/spill duration that determine if a spill will



impact a BWS or the filter to select only impacting spills to determine the BB map pin colour. Also, the use of check factor limits to determine the likelihood a spill is genuine prior to manual review. The configuration of these filters, and the ability to do such configuration, are fundamental operational decisions (not necessarily “design” decisions which usually relate to the app technology and look and feel, e.g. the choice of Google Map services was a design decision. NOTE there are other user selected report filters that are necessary as flexible search mechanisms for the Aspire SW users workflow and BB Admin users. It is, however, unclear how these are both centrally documented and operationally controlled given that with the adoption of the Agile/Scrum lifecycle in (January) 2022 for the Aspire/Beachbuoy Enhancement work these are cast as individual User Stories for both functionality to configure a rule and the rule itself, see two examples below taken from Jira (see ref.[8]):

The screenshot shows a Jira issue page for a user story. At the top, there are navigation links for 'Projects / Aspire-beachbuoy enhancement work', 'Issues', 'Share', 'Export issues', and 'Go to all issues'. Below this is a search bar containing 'ABEW-67' and a filter dropdown for 'Project: Aspire-Beachbuoy Enhancement ...'. The main content area shows the issue title 'BBWQ1&3 - Removal of LSOs' with associated icons for 'Attach', 'Create subtask', and 'Zephyr Scale'. The description reads: 'BB WQ 1 - Removal of LSOs: As product owner I want Beach Buoy to ignore spills from the attached list of Long Sea Outfalls (LSOs) because they will not impact bathing water in any circumstance.' Under 'Questions:', there is one question: '1. Where is the current list of LSO's?'. The 'Activity' section shows 'Show: All Comments History Work log' and 'Newest first'. On the right, there is a 'To Do' and 'Actions' sidebar with 'Details', 'Priority', 'Assignee', 'Reporter', and 'Automation' sections. The 'Automation' section shows 'Rule execution' and 'Created 11 February 2022 at 16:26 Updated 20 July 2022 at 13:54'.

Figure 10 Example Jira User Story specifying a business rule requirement for LSOs



Projects / Aspire-Beachbuoy Enhancement Work

Issues Share Exp

ABEW-407 x **Project: Aspire-Beachbuoy Enhancement ...** Type Status Assignee More + Reset Save filter

Created 17 12

- Beachbuoy Tidal Impact - Release History to only show impacted bathing sites ABEW-407
- Beachbuoy Tidal Impact - Test SAS API following introduction of Tidal Impact Functionality ABEW-347

**ABEW-382 / ABEW-407**

**Beachbuoy Tidal Impact - Release History to only show impacted bathing sites**

Attach Create subtask Zephyr Scale ...

Description

As a user of Beachbuoy

I want the release history to only show bathing sites that have been impacted by releases so that I can make an informed decision on water quality

This User story is created in Reference form the Testing Task of USER story - [ABEW-347: Beachbuoy Tidal Impact - Test SAS API following introduction of Tidal Impact Functionality](#) DONE

Acceptance Criteria:

**Given that** the release history table is populated with release data

**it should** only show release history information for releases that have impacted bathing sites.

If a bathing site is not impacted by a release from an outfall due to tidal states, then this should not show as an entry in the release history table.

For example:

Outfall "Portobello Road No2" is associated to "Saltdean" and "Seaford" bathing sites.

If "Portobello Road No2" has a release and only impacts "Saltdean" then we would only want to see a single entry in the release history table for this event.

Currently, we would get all (both in this example) associated bathing waters.

Event ID	Site Number	Bathing Site	Outfall	Last Activation Start	Last Activation End	Duration (hrs)	Activity
532398	12582	SEAFORD	PORTOBELLO BRIGHTON NO2	09/07/2022 07:00 AM	09/07/2022 08:45 AM	1.75	Genuine
532398	12583	SALTDEAN	PORTOBELLO BRIGHTON NO2	09/07/2022 07:00 AM	09/07/2022 08:45 AM	1.75	Genuine

**Done** Done

Details

Priority ↑

Disposition Reac

Assignee RB

Sprint Non

Fix versions ABE

Story point estimate 8

Reporter RB

Automation Rule execution

Created 11 July 2022 at 12:55  
 Updated 16 September 2022 at 14:13  
 Resolved 31 August 2022 at 14:12

**Figure 11 Example Jira User Story specifying a business rule for Spill history report**

In addition there is a document, the Requirements Traceability Matrix (ref. [35]), which details the functional requirements for setting configurable filters, primarily in Aspire to support review workflow, dashboards, and reporting Reviewer performance and Regulatory compliance. This includes the filters on event Check Factor values compared to Check Factor Limits.

**2.4.2. Specific Concerns**

There are the following concerns with the existing As Is Beachbuoy architecture and functionality:

**2.4.2.1. Delays/latency**

Inherent technical delay in publishing updated spill data from Aspire to the Beachbuoy schema tables to be available to the web front end. See the following component description.

Task Scheduler	New	R1	Part of the Beachbuoy Application using Quartz Scheduler process used to execute service tasks to refresh the bathing water spill database and send notification events.
----------------	-----	----	--

The service task is a stored procedure.

This is executed every hour on the hour. The aspiration is a 15 minute cycle time, the original implementation was two hours that was reduced to 1 hour which is apparently the limit. This is unchanged in the new in flight redevelopment. The consequence of a fixed cyclic refresh can be considerable in terms of user perception, especially when the spill history table shows the actual spill start time as being considerably earlier than the point at which an icon changed from blue to say white or indeed red when validated as genuine.

**2.4.2.2. The use of Google Map services:**

The use of Google map services means the app is constrained in a number of ways:



- Use of bespoke .css code for map overlay of BB icons
- No ability to hide standard Google map items when zooming
- No search facility.
- Limited use of popups

These concerns are addressed in the BB redevelopment project via the use of ESRI ArcGIS mapping functionality that permits app native multi layering with filtering, incorporation of Ordnance Survey base maps, third part data, search capabilities and display of popup and attribute data for the map elements, all of which are configurable.

#### 2.4.2.3. Business rule configuration control and accountability

This concern is more related to how functionality that may affect what and how spills are published in BB to the public stakeholders is configured, and how that configuration is approved and subsequently controlled.

The fragmented User Story development is more concerned with building the point functionality to support configuration and this does not support a wholistic view of all such functionality.

In terms of the configuration itself and its control, this is a governance process issue determined by the reporting requirements. One specific area is Check Factor Limit values for determining the likelihood an event is a genuine spill. These seem to be under the control of the Southern Water Network Insight Manager and have appropriate governance (senior management approval). See an extract from an update to the Aspire limits below:

	A	B
1	SUN	CFL
143	108846	25
144	115801	50
145	115400	50
146	108595	25
147	115924	50
148	108462	-7
149	108062	25
150	108200	50
151	108596	25
152	108713	0
153	108802	0
154	115781	0

Figure 12 Extract from a CFL update table

However, transparency with regard to the rationale for the values is needed at least in SW in the case of challenge with regard to false negatives.

A Concept of Operations document would help identify these rules and their use and management. A Concept of Operations (CONOPS) is a document that describes a proposed system concept and how that concept would be operated in an intended environment. The user community develops the CONOPS to communicate the vision for the operational system to the acquisition and developer community.

#### 2.4.2.4. Design Documentation

The available documentation reflects the nature of the changes in the development lifecycle and a focus on technology (including the Agile code based approach). After the initial waterfall development and the move to Agile/Scrum the typical design documents such as Requirements Specification, Requirements Traceability Matrix, Outline and Detailed Solution Design apparently either ceased or took on a different type of content.



## 2.5. Beachbuoy Development History

The full BB development history is very unclear, the following is derived from various documents in the absence of an overarching project plan (or PoaP) or roadmap for the past development (there is now (June 2023) a 'roadmap' for future work.

1. An original beta Beachbuoy website which was implemented as a beta trial by digital design agency BoxHarry in 2018.
2. It is assumed the "Phase 2" BB (delivered in 3 releases) was a response to the Section 19 notice undertakings served on SW at the end of 2019, Southern Water committed to be more transparent with the public about their environmental performance. The HLD (ref.[2]) supplied is draft version 5 dated 17/11/2022, however, the first draft V0.1 was 16/3/2021 with V3.0 19/7/2021. It details 3 Releases with Release 3 for an API to enable the Surfers Against Sewage (SAS) organisation to receive release event data directly from SW.
3. Given this timeline and the start of Jira User Stories it is assumed that the tidal modelling extension development work was post the phase 2 initial release. It would seem the project was a combined Aspire/Beachbuoy Enhancement Project and the first Story in Jira (for Aspire) is January 2022). This delivered the Tidal impact release on Sept 12<sup>th</sup> that caused the pushback (a Phase 3?), this chimes with the fact that the Phase 2 Release 3 HLD map icons differ from the current live version.

However, Aspire/ Beachbuoy enhancements did not stop in Sept 2022 but are still ongoing.

4. From the conversation with the Lead Developer (ref[16]) issues were raised in the Feb 2023 working group (ref.[3]) that led to the June release moving the client web interface from a single to three web pages (also with minor cosmetic changes such as icon sizing) the Lead Developer seemed to imply there was no formal release versioning and that releases, having gone through the Sprint governance process, were deployed after the sprints into production (subject to CAB approval).
5. The Aspire BB TMMi Test Approach (ref.[5]) is dated 9/8/2023 and lists a number of User Stories (Issues) grouped into BB and Aspire Epics and references Project Management as "Jira Project - Aspire-Beachbuoy Enhancement Work". This implies a new (in flight) enhancement project.

## 2.6. Beachbuoy (and other) Development Process and Governance

### 2.6.1. Project Lifecycle

#### 2.6.1.1. Types of lifecycle

Software development in terms of delivering a product via a project lifecycle follows one of two main types (there are variants and hybrids). These may be preceded by a Proof of Concept (thrown away), and a Prototype and the initial product tends to be known as the Minimal Viable Product (MVP) which is then enhanced. There are precursors to the formal project kick off involving identification of need, cost estimation (high level), business case (benefits), budget approval, investment board approval for funds release, setting up the project team and governance (Project Board). Typically there will be a Project Sponsor (who holds the budget) and a Product Owner (business representative who owns the system in terms of functionality). In an IT project there will be specific departmental governance through a Project Management Office (PMO for accounting, progress reporting, etc. with a requirement for a Project Plan, normally a Gantt but sometimes just a Plan on a Page PoaP)). Also a departmental Design Authority (to approve designs given the MVP will have to align strategically (platforms, etc.) and integrate into the corporate IT ecosystem physically through interfaces, production environments, etc. which especially focus on cyber security (user authentication, firewalls, etc.). IT governance also requires a release control body that authorises an application to go live in a production environment and assures it will not have a negative impact on other systems, controlling risk via backout strategies. The development team will also need development resources, typically development and testing environments. Typically the preferred project lifecycle will mandate a stage or quality gate set of hurdles the project has to satisfy to move forward. These gates require a set of artefacts which are normally templated such as a High Level Design, Security Policy, Data Migration strategy and plan, Test plans (with test scripts). Deployment into production (business as usual) requires a formal handover for ongoing maintenance and support (the 3 level Help Desk).



The two types of project lifecycle are as follows, each has advantages and disadvantages dependent on the nature of the application desired:

- Waterfall - The waterfall model is a breakdown of project activities into linear sequential phases, meaning they are passed down onto each other, where each phase depends on the deliverables of the previous one and corresponds to a specialization of tasks. The approach is typical for certain areas of engineering design. In software development, it tends to be among the less iterative and flexible approaches, as progress flows in largely one direction ("downwards" like a waterfall) through the phases of conception, initiation, analysis, design, construction, testing, deployment and maintenance (Wikipedia). Ben Aston from The Digital Project Manager explains, "Waterfall is generally regarded with some disdain as an inefficient and passé traditional project management approach. But Waterfall can be a useful and predictable approach if requirements are fixed, well documented, and clear, if the technology is understood and mature, if the project is short, and if there's no additional value gained from 'going Agile.' A Waterfall approach can actually provide more predictable end result for budget, timeline, and scope."

This was the approach taken for the first implementation of the Beachbuoy application, which is especially relevant given the urgency in 2019 and 2020 to respond to the concerns expressed by OfWat, the Environment Agency and the public. It also, because of the required project delivery timeline influenced the technology choices and design even though these introduced technical debt ("In software development, or any other IT field technical debt is the implied cost of future reworking required when choosing an easy but limited solution instead of a better approach that could take more time." Wikipedia).

- Agile – a set of principles for rapid application development delivery via a SCRUM framework. One description is "*Agile means "incremental", allowing teams to develop projects in small increments. Scrum is one of the many types of agile methodology, known for breaking projects down into sizable chunks called "sprints." Agile scrum methodology is good for businesses that need to finish specific projects quickly*". (see <https://www.atlassian.com/agile/scrum>). The tidal impact enhancement to the original development chose to use Agile as described in the following. In fact the 'project' scope was wider than just Beachbuoy from a systems perspective and included changes to both Aspire and PI AF and the name chosen was more open ended 'Aspire Beachbuoy Enhancement Work' (the ABEW prefix for the User Stories in Jira).

### 2.6.1.2. Beachbuoy Agile development

Agile was chosen as the development lifecycle for the Beachbuoy Tidal impact development post the initial release. This has been documented in detail using the industry standard Jira tool from Atlassian <https://www.atlassian.com/> (see ref. [8], [9] and [10]). An overview was provided by the BB Business Analysts (see Meeting Notes with the Business Analysts (ref. [19]) and Lead Developer ref. [16]), this was enhanced from conversations with the BB Product Owner:

Although SW has a formal process for initiating projects business need will arise from multiple sources such as increased efficiency, response to external and Regulatory demands, etc.

The standard project inception process at SW for new projects applied to BB via the following process: For the original release of BB, this started by Business engaging with Southern Water's Business Partner Managers (BPMs). The BPM worked with business to build the Business Case and this was submitted for review, approval, and prioritisation. Initially, BB was delivered using the Waterfall delivery, to achieve compliance with EA regulations and followed this process with this objective in mind. The project transitioned to an agile delivery model, with evolving objectives and goals governed by the PO, with ideas and themes being motivated by the business, external stakeholder groups and user needs.

An initial Assessment Forum will develop a product vision (presumably with a Business Case) – a product owner develops the vision and owns the objectives and theme. There is Business Requirements capture (with MoSCoW prioritisation), derived for BB in part from the Working Group – NOTE this meets on an ad hoc basis approx.. every 2 months. Requirements Traceability Matrix in Excel are held separately from the Jira repository. It is important to note other SW stakeholders were involved in the specification of user stories, specifically regarding SW branding



The Requirements are constituted as Epics that are 'groomed' with the 'three amigos' into User Stories and Features which involves scoping and "T shirt" sizing by the 3 Amigos (Tester/Developer/BA) for Sprint scope and planning (estimation and adjustment using PlanIT Poker points independent estimation and consolidation). This gives a Plan on a Page – see ref. [27] and [28] examples. As well there is analysis of the As Is with the To Be scenarios as the Target Operating Model, plus the selection of technology choices and creation of a formal design such as ref. [2]. On an ongoing basis there is backlog refinement using the 3 Amigos principle with pre story handover meetings with the product owner before they are added to the Jira backlog.

In Jira the 'items' to be delivered for an Epic (possibly across multiple Sprints) are not only User Stories but also include bug fixes, tasks and subtasks.

Jira Example:

Sprint 11, 23 Issues were planned and delivered including:

3 Stories, an example extract from the Jira repository is shown in the following for ABEW-392, with the 3 User Stories in the embedded pdf file.

AI.14 - Display "Not Reviewed" Spills in Release History Table as "Under Review"	ABEW-392	Story	Done	Medium(P3)	Done	04/07/2022 16:05	05/09/2022 16:33	15/07/2022 08:40	ABEW-Beachbuoy-Release2	<p><b>*Requirement*</b>          Currently when a spill has been detected and imported into Aspire and is awaiting manual intervention by an Aspire User, following the current CF and maintenance event logic, if the spill detected is not identified as a maintenance event, then this spill event is recorded in the BB Release History Table as "Not Reviewed". There is a need to change this wording to "Under Review" as this can be misleading to our BB users and is not a true reflection of SW5 ability to carry out spill analysis.</p> <p><b>*User Story*</b>          "As a" Public user of Beach Buoy          "I want" the release history table to display all "Not Reviewed" events that follow the current BB logic to be displayed as "Under Review"          "so that" I am informed that an event is under review until the Aspire users are able to carry out spills Analysis to determine whether the spill is 'Genuine' or 'Not Genuine'</p> <p><b>*Acceptance Criteria*</b>          Given that a spill has been detected and imported into Aspire          When the current CF and Maintenance logic is applied and there is a need to display a 'Not Reviewed' in the Release History Table          Then Beach Buoy will display all 'Not Reviewed' as 'Under Review' in the Release History Table</p> <p><small>[image-20220706-103036.png   width=91.66666666666666%]</small></p>
--	----------	-------	------	------------	------	------------------	------------------	------------------	-------------------------	---

Figure 13 Example extract from Jira for a User Story (Excel format)



Sprint 11 User Stories.pdf

It also includes 3 bug fixes, tasks and subtasks.

Actual delivery is, for SW, 2 week duration sprints with ~ 2 extra weeks for review and sign off (contiguous in time with no breaks) including:

- Coding
- Reporting (see below from ref.[29])
- Testing
  - Unit testing
  - Sanity testing (wide but shallow, to verify that the changes or the proposed functionality are working according to plan.
  - Integration testing
  - {Regression Testing}
  - Note APIs are stress tested, presumably for non-functional performance requirements.
- Sign off Sprint Test Acceptance Report / Update RAID / raise priority 3 / 4 defect tickets
- Review meeting (Product Owner to cross check tested delivery against user stories). Apparently for the sprint review (and presumably UAT) the notion of a User Group was discussed but never actioned.
- User Acceptance Test (by SW business as represented by the Product Owner)
- Retrospective Sprint team Meeting (continuous delivery performance improvement)
- Security Penetration Test (Pen Test)
- For Sprints bundled into a Release:
  - Release requests to Change Acceptance Board with test certificates
  - Approval and deployment into production and support NOTE for BB this is still outstanding.

Progress reporting (as listed in ref. [29] and [30]):



Report	Type	Frequency	Location
Stand-Up	Meeting	Daily	Teams
Jira Board	Report	Sprint	<a href="#">Jira Project Board</a>
Test Exit Report	Report	End of Sprint	Email / SharePoint
Review Meeting	Meeting	End of Sprint	Teams

**Figure 14 Required Sprint progress reporting**

In addition there are Retrospective meetings at the end of each Sprint for delivery process improvement.

NOTE for high priority changes / bug fixes there is a 24/48 hour remediation. Low priority changes may be rolled forward into the next sprint as part of the backlog. This can be seen for Sprints 11 and 12 in the Sprint Test Exit Reports (see ref. [31] and [32]) when compared to Jira (ref. [8]).

For Sprint 11

Test Exit Report		Jira (initial plan)	
Bugs	Stories	Bugs	Stories
ABEW-425	ABEW-392	ABEW-405	ABEW-388*
ABEW-397	ABEW-347	ABEW-425	ABEW-389*
	ABEW-186	ABEW-430	ABEW-392

For Sprint 12

Test Exit Report		Jira (initial plan)	
Bugs	Stories	Bugs	Stories
ABEW-451	ABEW-395		
ABEW-449	ABEW-391		
ABEW-430**	ABEW-389		
ABEW-405	ABEW-388		

**Table 3 Example Sprint work items showing backlog changes**

This is typical of a Scrum development where new User Stories are added via user engagement (in this case the SW Product Owner) and bugs found through testing are prioritised and added to the backlog.

Enhancements are changes to an existing product hence BB Phase 2 as a delivered product was enhanced via the creation of new Epics for the inclusion of tidal modelling. This process is still going on as per the requirements that emerged from the Working Group (see ref. [3] and [4]).

NOTE From a governance perspective ref. [29] states Sanity Testing, Functional Testing, and Regression Testing are to be carried out during each sprint. The required test schedule is shown below

Test Phase	Proposed	Responsible	Expected Delivery
Unit Test	Y	Development	Before moving Story to 'Ready for Test'
Sanity Testing	Y	BTS Test Team	2nd day of the Sprint (Week1)
System Integration Test ( Sprint )	Y	BTS Test Team	Sprint closure date
User Acceptance Test	Y	Business Users	After Sprint Review Meeting

**Table 4 Sprint Test scheduling requirements**

NOTE Non-functional requirements are deemed out of scope in ref. [29]. However, the Requirements Traceability Matrix document contains NFRs.

It is characteristic of Agile/Scrum developments that they tend not to have a fixed completion point but as User Stories are added and funding remains available they continue and can become misaligned with the original vision especially if, as in Beachbuoy, there are personnel changes such as with the Product Owner changes.





### 2.6.1.3. Release Control

Any app releases into production must be approved by the Change Approvals Board (CAB), an IT governance body that meets on a weekly basis. Any release that is planned for delivery into the SWS environment firstly has to be approved by CAB to ensure no possible conflicts with other projects delivering in that space, prior to implementation.

The approvers for the change will all be listed on a change request (for the BB Sept 12 2022 deployment this is CH0003941 – see ref. [33]). However, this is specifically an IT function to ensure checks and balances are in place, **post business confirming we are good to carry out the deployment.**

Due to the sensitivity of B/Buoy releases, all communication with external users and the working group were handled by the product application owner (name redacted) and the business corporate team. Only once they provided the green light to the Product Owner, would he in turn confirm the project could move to deployment, at which point the project would have raised the Change to CAB for approval.

It was confirmed that neither the IT PM nor the IT team had any direct interaction with the external Working Group, apart from in the very early days when BB first started to deliver functionality on the Web based front end page, well before the Tidal Model discussions were initiated.

It was also confirmed the product application owner (name redacted) left the company soon after the Tidal Modelling deployment, but did send out comms to the external stakeholders via email (the BB subscription list apparently) outlining the revisions being made. The external working group were informed, and SW put information on Beachbuoy above the map to explain the change. However, given the adverse response it is the opinion of the author that this cannot be considered to be full and accurate information of what was a significant change especially for casual recreational users and consequently degraded public trust in the data being presented on the interface.

### 2.7. Future and in flight Beachbuoy related projects

There are two relevant future and in flight IT projects (excluding the wider infrastructure development and improvement projects), these are:

#### 2.7.1. Data Centres (SDDC)

Not directly affecting this Report other than the SDDC will improve disaster recovery capability and may improve performance of some apps.

#### 2.7.2. BB redevelopment

##### 2.7.2.1. BB To Be Architecture

See initial draft High Level Design (ref. [34]) and the Solution Architect meeting notes. The HLD is currently in review by the Southern Water Technical Design Authority. The main changes are technical as follows:

- Creation of separate SQL server databases for BB spills and inland water spills
- Code redevelopment using FME supported 'Low Code' tools
- Use of FME as the configurable 'middleware' between database and app components with data extract for publication (to web UI) based on a messaging hub publish and subscribe basis rather than the use of APIs
- The use of the ESRI ArcGIS map front end in place of Google maps

One notable exception is the retention of the Quartz scheduler between Aspire and the BB databases.

#### 2.7.3. Ongoing improvements

The ABEW work has continued with three notable areas of function change:



- Changing the web interface from one page to three as per the Working Group meeting (Feb 2023 – see Minutes ref. [3])
- Enhancing the Aspire review workflow and KPI reporting for review performance improvement
- Automating more of the review process via algorithms based on Check Values (see ref. [25])
- Enhancing BB event accuracy reporting such that this can be made more visible.

## 2.8. Comments & Concerns

1. Initial BB development (Phase 2 R#1, #2, & #3). Although it met the brief and delivered a sound technical architecture, delivered by a controlled Waterfall process, it suffered consequences. The project was, apparently, a reaction to the events of 2019, and as a consequence:
  - a. The brief was probably too narrow and not thought through in terms of the range of possible public user perspectives (a seemingly narrow casual recreational bathing water user, when there are other perspectives and constituencies;
  - b. There was a short “time to market” demand leading to taking low risk, quick to implement and predictable delivery choices, that although met the very narrow view of the user community (the casual recreational bathing water user) created technical debt for future change and a negative response from other user constituencies, specifically:
    - i. Taking a conservative view of BWS impact from a spill (highlighting BWS potentially at risk rather than *probably* affected).
    - ii. Building in a substantial potential (and unpredictable) delay in updating the BB UI / reports from actual spill start and identification times (the Quartz scheduler and stored procedure).
    - iii. Lack of search capability on the map (Google Map Services) and making visibility of outfall status dependent on BWS selection.
    - iv. Potentially high support cost due to fragmentation and mix of bespoke code and third party components.
2. The follow on enhancement (tidal impact assessment) was a response to the commercial constituency in refining the conservative ‘potentially at risk’ view to ‘probably impacted or non-impacted’ due to changing tidal conditions and spill durations. Although not changing the technical architecture it did change the data architecture both upstream in PI AF and Aspire through the tidal condition reference data. **The Aspire and BB databases are not fully documented (and this requires rectification not least by a Data Dictionary).** The major change was to move the development lifecycle to the Agile model with a Scrum delivery framework. In terms of Agile as a set of development lifecycle principles and the Scrum framework as how it is actually carried out, SW for the BB tidal impact enhancement project has a good, compliant and auditable process. Unfortunately a quality process does not necessarily ensure a fit for purpose outcome and this has led to a number of issues affecting user trust and indeed tracking fundamental decisions, namely:
  - a. Confusing icon state (colour) changes that are difficult to reconcile with the spill history report. This is in part because there are two interactions between the icon types (BWS icons and Outfall icons and the access mechanism in that the user cannot select to view just outfall icons, access has to be via the associated BWS icon (this is a many to many relationship in that a BWS may be affected by multiple outfalls and an outfall may affect multiple BWS. This direct (geographic) relationship is also qualified by the tide state / spill duration effect based on time of day and tide type at the BWS (high/low spring/neap), so although a BWS ‘could’ be affected by a spill from a linked outfall (and was previously shown as white, red or yellow if there was a spill) now it would show as blue (if deemed non-impacted due to tide state/spill duration) but if the tide changed at a point in time the relationship could change to impacted (whit/red/yellow). This assessment is computed in the BB app back office and is updated by a change in spill duration for an ongoing spill or subsequently closed which is recorded upstream of BB (in PI



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AF) and potentially delayed by at least an hour and 15 minutes (15 mins PI AF to Aspire and an hour Aspire to BB max). The author attempted to map the colour state changes but not all variations (such as upstream spill duration assessments) have been considered. This really requires a detailed set of scenarios reflecting the various points in time events can change and how this affects how the ultimate map icon displays change.



Table 5 Map pin colour state changes (Report author's interpretation)

Sequence step	Spill sequence	Outfall pin colour	Status	Release History Status col	Release History Bathing Site col	BWS pin colour	Status	Comments
1	No spill detected	Green	No release from outfall			Blue++	No release impacting bathing site	OK
2	Spill start detected at overflow / PI AF spill frame started / Aspire updated / BB updated on hour (overflow – outfall(s) – BWS(s) as event attributes?)	White	Unverified release from outfall	Under Review	Bathing site name*	White	Unverified release to bathing site	OK –NOTE tidal impact is assessed when a spill is passed to BB irrespective of validation status. Update from SW “This would be the case if the release from the outfall was ‘impacting’ based on the tidal modelling only *blue if not impacting”
3	Manual review (not genuine) & update in Aspire (spill record state) / BB updated on hour (spill record state)	Green	No release from outfall	Not Genuine	Not applicable	Blue	No release impacting bathing site	OK
4	Manual review (genuine) & update in Aspire (spill record state)/ BB updated on hour (spill record state) / tidal impact assessed (not impacted) - ?	Red	Release from outfall in last 24 hours	Genuine	Not impacted	Blue	No release impacting bathing site	Technically correct but for full info popup required
5	Manual review & update in Aspire / BB updated on hour / tidal impact assessed (impacted)	Red	Release from outfall in last 24 hours**	Genuine	Bathing site name*	Red	Release to bathing site in last 24 hours	OK
4a	Tidal impact changes from not impacted to impacted	Red	Release from outfall in last 24 hours**	Genuine	Bathing site name*	Red	Release to bathing site in last 24 hours	OK
5a	Tidal impact changes from impacted to non impacted	Red	Release from outfall in last 24 hours**	Genuine	Not impacted	Blue	No release impacting bathing site	Technically correct but for full info popup required
6	PI AF updated with spill end time / tide impact assessed (not impacted)	Yellow	Release from outfall in last 72 hours***	Genuine	Not impacted	Blue	No release impacting bathing site	Technically correct but for full info popup required



Sequence step	Spill sequence	Outfall pin colour	Status	Release History Status col	Release History Bathing Site col	BWS pin colour	Status	Comments
7	PI AF updated with spill end time / tide impact assessed (impacted)	Yellow	Release from outfall in last 72 hours***	Genuine	Bathing site name*	Yellow	Release to bathing site in last 72 hours	OK (see [ABEW-402] BBUX2a - Yellow Impacting condition Pop-up display)
6a	Tidal impact changes from not impacted to impacted	Yellow	Release from outfall in last 72 hours***	Genuine	Bathing site name*	Yellow	Release to bathing site in last 72 hours	OK - ? User story
7a	Tidal impact changes from impacted to non impacted	Yellow	Release from outfall in last 72 hours***	Genuine	Not impacted	Blue	No release impacting bathing site	Technically correct but for full info popup required
8	Spill end time > 72 hours from web page view***	Green	No release from outfall			Blue	No release impacting bathing site	OK
Ad hoc		Maint	Outfall monitoring under maintenance	?	?	?	?	Maintenance e.g. when the on site equipment is maintained / calibrated is flagged in BB (via the BB Admin function) to suppress any spill events as the sensor calibration / testing process can generate false threshold exceedences. Typically this is in dry weather when the chance of a real spill is low.
		?As per outfall state	?As per outfall state	?As per outfall state	?	Maint	Site monitoring under maintenance	If EDM maintenance is taking place at a site that also happens to relate to BB (about one fifth of all EDM sites) then the maintenance 'spanner' is placed on the relevant overflow on Beachbuoy to avoid false activations causing unnecessary and unwanted public communications. An EDM suppressor. These maintenance events are captured and stored for audit purposes.

The tidal state is assigned based on the event start; all tidal states are future written into the PI archive, so when the eventframe is generated, it will pick up the relevant tidal state at the start of the event, no matter when the event is generated.

\*What if the outfall affects multiple bathing sites, how is this shown in the history report?

\*\*where spill end time (or last poll time if no end time from PI AF) within last 24 hours at time of viewing web page?

\*\*\*what happens if another spill starts before the 24 or 72 hour cut off on the previous spill? I think this is in a User Story

++ see ABEW-388 for blue icon scenarios.



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### **3. Review Questions Response**

The author's response to the individual questions is shown in the following section. For completeness and evidence reference is made to the detailed review described in the previous body of this report.



3.1. Review Questions re Software & Systems

The set of Review Questions relevant to Software and Systems with the Reviewers comments based on the investigation results documented in the previous sections is as follows:

Table 6 Review Questions and Software & Systems Review response

Specialism1 Water Quality Expert	Specialism 2 Oceanographic Modelling Expert	Specialism 3 User & Engagement Expert	Specialism 4 Software & Systems Expert	Review question	Software & Systems Expert response
		Y	Y	1. Propose how BB can be more open and transparent with regard to data being routinely and in some cases being <b>extensively manipulated, deleted and dismissed as false alarms in the release history. How does such misleading information affect BB users?</b> (User & Engagement Expert) (Software & Systems Expert)	<p>The overflow event and spill monitoring (EDM process) is compliant to the EDM Good Practice Guide and in meeting Enterprise Agency Reporting requirements as per the Overflow Permits.</p> <ol style="list-style-type: none"> <li>Spill data is, as a principle, not deleted kept as per the Data Retention requirements as a minimum (6 years) and in some cases for ~20 years where this is required for investment planning.             <ol style="list-style-type: none"> <li>raw data is archived in PI Historian for a minimum of 6 years as per the Environment Agency data retention rules in the Overflow Permits, automatically assessed spill frame data is archived in Aspire.</li> <li>PI AF spill event frames are not deleted but stored for analysis and Control Period investment planning (over 20 years data is currently stored).</li> <li>Aspire spill event data received from PI AF, since Aspire entered production), is retained. NOTE in addition when a user edits a spill record in Aspire, e.g. to change a state to genuine, this is logged in Aspire and these logs are also retained (for audit purposes).</li> </ol> </li> <li>Spills are validated as both genuine or non-genuine both by algorithms and manual validation and all decisions (state changes) are logged and are available for audit in the event of a query.</li> <li>New reporting has and is being introduced to report on BB event accuracy</li> <li>The only transformation is the sensor analogue signal into a state value wrt the threshold and where a positive state (threshold exceeded) is converted into an event frame start for a possible spill (in PI AF). Subsequently that spill record is not 'transformed' rather new data is added to it in terms of attribute values e.g. the tide type for the associate bathing water site for the event frame start time (in PI AF), the result of the validation (genuine or non-genuine) (in Aspire), and the spill impact due to tide and spill duration (in Beachbuoy).</li> <li>Filters are introduced into the publication of spills to reduce information overload from non-directly relevant information (BWS displays where spills do not affect that site for example assuming the user is a casual recreational bathing water user). The Reviewer recommends these filters are made more transparent and that they can be removed by users who have different points of view, such as environmental protection (User Interface functionality profiles set by user interest)</li> <li>The information about spills is correct and accurate, however, delays due to technology limitations can cause the spill data to be delayed in being published on the Beachbuoy web site and with publication delays possibly misinterpreted due to the functionality of the map interface. The Reviewer recommends greater transparency in giving reasons for delays on the user interface and more detail on the status of a review with a rationale for a decision. NOTE some of this is already in development</li> </ol>
		Y	Y	2. How can the BB manual review process be modified to avoid confusing, misleading and errant decisions. (Software & Systems Expert) (User & Engagement Expert)	<p>Given the worst case scenario detailed in response to the following question, some manual validation can be automated but not all. It is recognised in the EDM Good Practice guide that some manual validation is required in some circumstances. Southern Water is introducing automated validation as part of the Aspire Beachbuoy Enhancement project (see ref. [25]) but it is neither simple nor quick as dependency on algorithmic evaluation</p>



Specialism1 Water Quality Expert	Specialism 2 Oceanographic Modelling Expert	Specialism 3 User & Engagement Expert	Specialism 4 Software & Systems Expert	Review question	Software & Systems Expert response
					must in itself be tested and shown to be accurate and repeatable. Where implemented in Aspire the performance of all reviews both automated and manual is now subject to KPIs and reports as part of the ongoing performance improvement by the spills team, which increases transparency.
			Y	3. Fundamentally, manual reviews on ALL discharges (10,000+ of them in 2022 alone) are undertaken because Southern Water does not trust their own remote sensing instrumentation and requires human inspection. Are unsound remote sensing instruments causing any issues for BB users (Software & Systems Expert)	Not so, in order to be compliant to Environment Agency requirements in spill reporting all EDM events that are (pessimistically) deemed to be possible spills must be reviewed to determine if genuine. From the Check Factors a low probability event may be given a low review priority but it is still treated as a spill until proven otherwise. In summary the EDM system (sensors, telemetry, PRISM and PI AF) is trusted but can give erroneous readings due to the environment in which it operates (a rat on the weir, foam detected not water, etc.), so a worst case approach is taken. Overflows typically have multiple sensors (signals) which monitor water levels. If a measured level exceeds a threshold for a sensor it triggers a possible spill event even if the other sensors show no threshold exceedance. Southern Water is obligated to report spills accurately to the Environment Agency and Regulator so even with 1 out of say 4 sensors indicating a level threshold exceeded it must be reviewed. This may require corroboration from other data sources that cannot be processed automatically e.g. weather, throughput volumes, possible sewer blockages, etc. The fact that it was one out of 4 indicates a low confidence level that a spill actually has occurred, however, a) for overflows that discharge to sea outfalls and are mapped to bathing water sites (Beachbuoy sites) these are given the highest priority and are passed to Beachbuoy as unconfirmed spills as soon as possible, and b) dependent on the Environment Agency permit reporting requirements is prioritised for manual validation. The EDM site systems are maintained once per year and in addition failures can be detected and raised as alarms to the control centre (a PRISM function). Research has been carried out to assess if instrument drift is an issue, with other factors (the UKWIR project) – so far not, but in the hostile environment cables can stretch and when tolerances are in mm this can give a false positive, irrespective of this risk all spills are validated. In addition the converse is true in that a spill can only be indicated as ended if all the sensors indicate a level below the threshold. The worst case scenario, although fundamentally an Environment Agency requirement prioritises Beachbuoy users.
			Y	4. Why does it take so long for the review process to complete? Evidence is available demonstrating reviews are taking multiple days even weeks to complete, this is denying bather access to the water (Software & Systems Expert)	Without sight of the individual cases referenced comment on this assertion cannot be made. However, there are a number of issues with how review results are disseminated, primarily the one hour polling delay between Aspire and BB. The newly introduced reporting of the review times and results will make this more transparent. As well as prioritisation by probability there is always the issue of a fixed manual resources and a varying review demand which will peak in adverse weather conditions. However, increased automation is being introduced as a priority as well as improved reporting and performance improvements (review start times for a spill, if paused for a reason, rationale for result of review. The Reviewer recommends greater transparency in this reporting.
Y	Y		Y	5. Identify all of the data sources used in the manual review process and how the data is used for decision making. Establish if decisions are accurate and timely given the information used. (Software & Systems Expert) (Water Quality Expert) (Oceanographic Modelling Expert)	<p>The management of the review process for spill validation has been improved in Aspire as part of ongoing performance improvement (July / Aug 2023) via new reporting (see User Story ABEW-2053 copied below):</p> <p><i>Description</i></p> <p><i>The current User performance table in the Admin module requires enhancing to include some more meaningful metrics in order to support the Spills Reporting Team Manager during performance reviews and 1:1 with team members on their user performance activities</i></p> <p><b>User Story</b></p> <p><i>As a spills team manager</i>  <i>I want to see how many events are being Reviewed by spills users</i>  <i>So that I can use this to identify any potential improvement opportunities</i></p> <p><b>Acceptance Criteria</b></p>





Specialism1 Water Quality Expert	Specialism 2 Oceanographic Modelling Expert	Specialism 3 User & Engagement Expert	Specialism 4 Software & Systems Expert	Review question	Software & Systems Expert response
					<p><b>AC1)</b> There will be a new field named 'Reviewed' that will be displayed to the Right of the 'Partial Reviewed (&gt;5 days)' field as per the mock up</p> <p><b>AC2)</b> This will field contain the total number of Reviewed events a spills user has actioned</p> <p><b>AC3)</b> The definition of Reviewed is:            An event that has been assigned to a Spills User in the Workflow Module, the Spills User has reviewed the Event and clicked 'Complete Review'</p> <p><b>AC4)</b> The data in this field will be configurable with the filters mentioned below</p> <ul style="list-style-type: none"> <li>• Source Site: When single or multiple Sites selected, new field will only display the Reviewed Events for the sites selected</li> <li>• User: When single or multiple Users selected, new field will only display the Reviewed Events for the Users selected</li> <li>• Start Date: When Start Date is selected, new field will only display the Reviewed Events from the Start Date</li> <li>• End Date: When End Date is selected, new field will only display the Reviewed Events from the End Date</li> <li>• Last One Month: a rolling 30 days view from todays date <b>(Covered in ABEW-2059)</b></li> <li>• Last One Week: a rolling 7 days view from todays date <b>(Covered in ABEW-2059)</b></li> <li>• Last 24hrs: the last 24hrs from todays date <b>(Covered in ABEW-2059)</b></li> </ul> <p><b>Note:</b> The current functionality for these existing filters is to remain the same where the filters have the ability to work as a combination or in isolation</p>
Y	Y		Y	1. Is the use of single "pixel" (just a few square metres on the ground) automatic "sampling" reasonable on a multi-km long beach particularly considering the juxtaposition of the "pixel" with outfall threats. (eg Eastney) (Water Quality Expert) (Oceanographic Modelling Expert) (Software & Systems Expert)	<p>This question is not understood, what is meant by automatic 'sampling'?</p> <p>Issues with the map display have been identified in terms of BWS pin location (outfalls are precise geographic locations). It is accepted that a) a BWS pin is a point location which by inference applies the spill impact warning to the whole site which may be a very long beach. This was a constraint of the use of Google maps and restrictions to the use of pins. The new ESRI ArcGIS system (a market leader in the GIS domain) will have the ability to map polygons in a multi layered OS derived map interface. It is understood initially pin point locations will be used, however, an extension to map physical beaches for more precise spill impact prediction could be tabled as an enhancement once the new development has been implemented as a Minimum Viable Product in Feb 2024.</p>
Y	Y	Y	Y	9. Are there any missing BB features from the reviewer's perspective (User & Engagement Expert) (Water Quality Expert) (Oceanographic Modelling Expert) (Software & Systems Expert)	<p>Yes and some of these are enabled by the in flight redevelopment of Beachbuoy using ESRI ArcGIS as the mapping front end rather than Google Web Services, also in the current Aspire development. Fundamentally this is the provision of more information to qualify the meaning of the map flags, the reason for a review decision, what the review involves (see the PI AF screen shots in the previous sections of the Report), user profiles for distinct stakeholder personas, etc. Other aspects such as consideration of the length of a beach are possible with ArcGIS but are not yet identified. NOTE in the Recommendations there are other aspects that should, in the Reviewers opinion, be implemented in relation to documentation, development process, etc.</p>



Specialism1 Water Quality Expert	Specialism 2 Oceanographic Modelling Expert	Specialism 3 User & Engagement Expert	Specialism 4 Software & Systems Expert	Review question	Software & Systems Expert response																				
		Y	Y	1. How do the developers know what users want/need. Would independent elicitation of system requirements be helpful over what developers think we need (Software & Systems Expert) (User & Engagement Expert)	<p>The 'developers' code to deliver functionality required in the form of User Stories (organised in Sprints of two weeks duration) given that the current development activity (from Jan 2022) follows Agile principles using a Scrum delivery framework. The redevelopment project will use the more traditional Waterfall lifecycle.</p> <p>User Stories are derived from Epics and Features (to use Agile terminology) which are elaborations of business requirements. The Southern Water Beachbuoy and Aspire Product Owners are the responsible and accountable people who own the product 'vision' and mediate the business need as cascaded from multiple business sources and including the Beachbuoy Working Group as representing the public user constituency. Essentially Beachbuoy is a Southern Water business response to the Environment Agency and OfWat's requirements to be open and transparent in communicating spill information to the public. The Working Group is the primary nominated representation of the public interest and has an obligation given their role as intermediary to accurately communicate a view of how that information is presented. The original Beachbuoy took, in the reviewers opinion, a narrow view of those presentation needs (for various reasons), tidal modelling of impact widened that view but complicated the actual information delivery. Technical issues (transmission delays) also complicate the interpretation of that information delivery at the user interface. It is the opinion of the Reviewer that, given the actual governance process around the project delivery constraints, stakeholder management could be improved, mediated through the Working Group potentially via special interest groups committed to detailed involvement in the Agile process but accountable to the Working Group. Selection/election may be contentious, as would be the required time commitment</p> <p>In addition a more passive approach would be via the app itself via encouragement of user feedback, comments, a rating system, etc.</p>																				
Y	Y		Y	3. Is BB reliable? Does it update metronomically every hour (no, it actually does not!) is this a problem from a user health perspective (Software & Systems Expert) (Water Quality Expert) (Oceanographic Modelling Expert)	<p>Beachbuoy updates every hour on the hour using Quartz scheduler and a stored procedure to poll data from Aspire tables to Beachbuoy tables.</p> <p>User health is a difficult term to respond to by the Software &amp; Systems Reviewer and is outside of the Reviewer's terms of reference. Beachbuoy is advisory on spills not pollution levels as these may be affected by other factors outside of the control of Southern Water.</p>																				
		Y	Y	4. Is BB reliable? Are the software updates seamless, well tested and problem free (no! See DMI introduction 12/9/22) should users expect properly tested software updates to keep them safe and well informed. (Software & Systems Expert) (User & Engagement Expert)	<p>See the previous Report sections detailing the testing processes. Testing is carried out on User Stories and Sprint delivered product, Tests include Sanity Tests, see table 4 reproduced below</p> <table border="1"> <thead> <tr> <th>Test Phase</th> <th>Proposed</th> <th>Responsible</th> <th>Expected Delivery</th> </tr> </thead> <tbody> <tr> <td>Unit Test</td> <td>Y</td> <td>Development</td> <td>Before moving Story to 'Ready for Test'</td> </tr> <tr> <td>Sanity Testing</td> <td>Y</td> <td>BTS Test Team</td> <td>2nd day of the Sprint (Week1)</td> </tr> <tr> <td>System Integration Test ( Sprint )</td> <td>Y</td> <td>BTS Test Team</td> <td>Sprint closure date</td> </tr> <tr> <td>User Acceptance Test</td> <td>Y</td> <td>Business Users</td> <td>After Sprint Review Meeting</td> </tr> </tbody> </table> <p>Testing is support currently It is also understood in the by the Jira Zephyr tool. Bugs are prioritised and if low priority rolled into the next Sprint backlog for remediation and retest. All test results are documented and subject to acceptance by the Test Manager. Sprint Test Exit reports are available and auditable Examples are available). In addition there are pre-production PEN tests for security, Regression tests, and APIs are stress tested for performance. The CAB release check is extensive and fully auditable with certification.</p> <p>In terms of process, execution and recording this is, in the opinion of the Reviewer, industry best practice. It is also understood that enhanced testing tools will be deployed for the new development, however, these were not specifically identified.</p> <p>Acceptance of the end product by the public as a third party is a different matter.</p>	Test Phase	Proposed	Responsible	Expected Delivery	Unit Test	Y	Development	Before moving Story to 'Ready for Test'	Sanity Testing	Y	BTS Test Team	2nd day of the Sprint (Week1)	System Integration Test ( Sprint )	Y	BTS Test Team	Sprint closure date	User Acceptance Test	Y	Business Users	After Sprint Review Meeting
Test Phase	Proposed	Responsible	Expected Delivery																						
Unit Test	Y	Development	Before moving Story to 'Ready for Test'																						
Sanity Testing	Y	BTS Test Team	2nd day of the Sprint (Week1)																						
System Integration Test ( Sprint )	Y	BTS Test Team	Sprint closure date																						
User Acceptance Test	Y	Business Users	After Sprint Review Meeting																						
			Y	6. How can BB be more responsive in managing field defects and new features. The agile software process lends itself well to this kind of thing - but product management seems to be blocking this and fixing things that users don't really care about. (Software & Systems Expert)	<p>Not sure what is meant by 'field defects'. With regard to new features yes Agile/Scrum does support adaptability and change via adding new stories to the backlog in principle although in actuality the danger is the product can morph uncontrollably without tight control by the Product Owner as mediated by the product vision and business requirements, the 'three Amigos' step in 'grooming' the requirements also helps. The perception that 'Product Management' seems to be blocking innovation should be addressed by the up front requirements elicitation. It is</p>																				



Specialism1 Water Quality Expert	Specialism 2 Oceanographic Modelling Expert	Specialism 3 User & Engagement Expert	Specialism 4 Software & Systems Expert	Review question	Software & Systems Expert response
					necessary to also understand that in the Aspire Beachbuoy Enhancement Work, Aspire, as a SW internal business critical application necessary for timely Environment Agency reporting, has requirements that are not necessarily relevant to or communicated to or understood by the public stakeholders in Beachbuoy. One recommendation by the Reviewer is separation of Aspire (and other internal systems) from Beachbuoy in terms of project definition and management. Another Beachbuoy specific aspect is in terms of greater and more nuanced stakeholder engagement with improved communication channels to the Product Owner (and Project Board) more more transparent prioritisation of Beachbuoy specific requirements
			Y	7. BB Emails are currently worthless. This could be improved by appending the event data to which it pertains. This request has been outstanding for years! (Software & Systems Expert)	The Reviewer assumes this comment refers to the email content and as such should be directed to the User Interaction Reviewer. From the current technology view it would appear the email interface as part of the notification functionally is technically correct, especially in terms of spam differentiation. Data and information is available in the database, what is deemed appropriate and necessary as content could be configured.
			Y	1. Have industry standard software development and test processes been used in the creation of BB (Software & Systems Expert)	Yes, see previous section in the report and a previous answer.
			Y	2. How is the software properly validated against the system requirements and the system test specification at every software update (unambiguously not the case). Consider the potential benefits to Southern Water of including a 'User Acceptance' test phase as a standard element of the release schedule. User testers should be drawn from the Beachbuoy Stakeholder community. (Software & Systems Expert)	From the evidence provided yes the software is adequately tested against the User Stories and validated for release by the CAB based on other testing and confirmed checks. See previous report sections and answers above. For the tidal impact release (Sept 12th 2022) see the CAB Change Request and approval form ref. CHG0003941 (ref. [33]). User acceptance testing and review for Sprints is carried out by the Product Owner as delegated user representative with apparent reporting to the Working Group (see example Working Group Minutes as of Feb 2023 re the Tidal Modelling release and further requirements capture, ref. [3]). System testing (and Unit Testing, and Regression Testing, and Pen Testing, and API stress testing) is carried out and signed off by the Test Manager with stored and auditable reports.
			Y	3. Why are users are finding serious problems with the software on "upgrades" What can be done to improve BB public health information software in this regard (Software & Systems Expert)	Without specific information on these problems the Reviewer cannot provide a response. The Reviewer has made extensive comments and recommendation as to how the map interface functionality can lead to misinterpretation of the spill data being provided (see previous answers and the report). These issues are not problems with the software, it works as specified and has the necessary assurance that it does work. Inevitably some unforeseen bugs will occur and there is an established process for reviewing reported bugs, planning and remediating these bugs (via the Sprint backlog) and rolling the fixes into future planned releases (standard software engineering practice for both COTS and bespoke developments). Potential improvements are recommended to the requirements elicitation and stakeholder communication.
			Y	4. How are ALL icon state transition diagrams validated against specification (there are currently serious faults with them) (Software & Systems Expert)	No, the Reviewer has not seen any state transition diagrams. See the Reviewer's partial icon state transition matrix for some insight into how these work in a partial sense. The display works as implemented without 'faults', however, how it works and the interdependencies is not transparent to the public end user.  There are spill and BWS entity state attributes with an added layer of rules re how these are to be displayed as icon colours. There are a number of interacting factors in how spill states change, how consequential bathing water site states change and how both sets of these entity states are rendered on the map as coloured pins. In addition these entity state changes (which are affected by where the entity record is stored, how it is time dependent updated and as a consequence of other factors changing such as tidal state) that complicate how icon colours represent these states (the web page update process will also have an effect).  In the Reviewer's opinion these state transition steps should be detailed in different scenarios related to: <ul style="list-style-type: none"> <li>- Spill (outfall) and BWS relationships mediated by tidal state and spill duration</li> <li>- Spill data supply chain delays (polling, review updates)</li> <li>- Map display rules for pin colours</li> <li>- User web page interaction effects (auto refresh)</li> </ul>



Specialism1 Water Quality Expert	Specialism 2 Oceanographic Modelling Expert	Specialism 3 User & Engagement Expert	Specialism 4 Software & Systems Expert	Review question	Software & Systems Expert response
					It is difficult to see how the specific dynamic complexity and dependencies that underpin the map display when opened by a user (and left open) at a point in time can be conveyed to give understanding (and trust) but this needs addressing.
		Y	Y	5. What process is reasonable to protect user health and safety should software upgrades demonstrate software behaviours potentially harmful to its users (as occurred Sept 12th 2022) (Software & Systems Expert) (User & Engagement Expert)	<p>The Reviewer has not seen any evidence that the Sept 12th release of Beachbuoy demonstrated behaviours potentially harmful to users and from observation the map interface works as specified, albeit in a non-intuitive way.</p> <p>The Beachbuoy app is remitted to delivery information about overflow spills that may impact bathing water sites. There is no information as to the potential health risks other than the red/yellow colour coding to indicate the time since the spill ended based on the give 72 hour duration for bacteria to degrade in sea water. These aspects are better addressed by the other reviewers. It is assumed a Safety Case (and Safety Impact assessment) is not required as the Reporter has seen no reference to these in the design documents made available, but this requires confirmation from Southern Water.</p> <p>It is the opinion of this Reviewer the substantive changes implemented in the Sept 12th release should have been extensively piloted with a cross section of stakeholders based on the remit for the change (and chain of accountability raising and approving the change) with rework if necessary based on a consensus as to acceptability and usefulness.</p>
		Y	Y	6. Review the user experience of BB on mobile phones, is it fit for purpose what could be improved as most users will be accessing BB from mobile devices. (Software & Systems Expert) (User & Engagement Expert)	<p>Beachbuoy has never had a mobile app in scope although this is under consideration for the new development. The interface was always a web page with access via a browser, so from a design and build perspective the technical issue was browser compatibility (Chrome, Microsoft Edge, etc.). The web page design should have followed good practice for browser access on multiple devices but this Reviewer cannot comment as these considerations sit with the User Engagement Reviewer</p>
Y	Y	Y	Y	1. Is current supplementary BB information in the public domain misleading or inaccurate. This needs to be corrected. (Water Quality Expert) (Oceanographic Modelling Expert) (Software & Systems Expert) (User & Engagement Expert)	This question has been answered by other reviewers.



## 4. Conclusions and recommendations

### 4.1. Conclusions:

From the review of the end to end spill (EDM) monitoring, determination and reporting (both EA and BB) the following conclusions can be drawn:

#### 4.1.1. The positives:

- The EDM architecture, information flow and automated processing of the data is compliant to industry Good Practice delivering high quality/high accurate information about spills that should meet EA and OfWat reporting requirements in terms of integrity.
- The use of well established and industry strength COTS products (PRISM and OSIssoft PI (historian and AF)).
- The enablement of detailed mapping between site – overflow – outfall – bathing water site (BWS) and linking to the EA Permit requirements in terms of EA reporting and email notification as reference data (the CALMS and Catalogue systems), which facilitates the accurate reporting to OfWat and the EA of spills by location, impact and compliance in the bespoke Aspire system. NOTE the EA differentiate spills by duration only (as well as downstream potential amenity impact), spill volume and strength are not currently EA reportable requirements.
- No data is deleted within the requirements for Data Retention (Permit requirements – a minimum of 6 years), with some data kept for ~20 years to facilitate investment planning and OfWat control period financial determinations.
- The transform of analogue water level signals to binary threshold exceedance / non exceedance and then check values is based on an auditable configuration strategy for assigning a confidence level given Check Value Limit values.
- The adoption of a conservative and false negative risk averse strategy in the determination of possible spills (and their termination) is to be commended especially as it increases the number of identified potential spills, all of which require review with different priorities. It inevitably increases the number of false positives due to equipment malfunction, environment factors, which is actually a positive result (akin to the reporting of 'near misses' where more is better which seems counter intuitive). The consequence for BB users is of course increased uncertainty as potential (unverified) spills affecting BWS are flagged as soon known in BB (subject to the transmission delays). A better safe than sorry approach.
- Because of the complexity of assuring a spill is genuine (multiple sensors for an overflow, technical and environmental causes of threshold exceedance (the dead rat on a weir)) the Good Practice Guide accepts manual review is necessary on a case by case (overflow) basis. This does introduce delays which is not significant for EA reporting (for which the EDM system was designed) but very significant for BB which has the aspiration to be near real time. SW is addressing this BB frustration by: a) improving review automation based on multiple check factor and Check Factor Limit assessment; and b) improved control, reporting and process improvement of the manual review process.
- The use of system log files for auditability which record spill and reference data edits e.g. to manually or through automation the edit of a spill from in review to review



complete and from unknown to genuine or non-genuine. Statistics are available on reporting accuracy.

- A rigorous and well documented (in Jira) Agile/Scrum process for Epics/User Stories which was applied to the Tidal Impact enhancement to the original BB app (which was developed using the Waterfall project lifecycle model), and is still being applied as new enhancements to both Aspire and BB are being identified. Jira embeds attachments for mock ups, sql script fragments, comments and queries and includes the Jira Zephyr Testing tool. Change (code) specification docs and Test Exit Reports are held in Sharepoint. This project lifecycle follows industry good practice for Agile/Scrum with the front end planning using the 'three Amigos' approach to 'grooming' business requirements into Epics/Stories, 2 week development sprints, Sprint reporting and review, and multiple tests sign off.
- A rigorous corporate IT process for release approval (CAB review and sign off) which is an absolute necessity given a complex corporate IT ecosystem, which benefits what are essentially small scale projects such as BB.
- A good technical architecture implemented for the original BB implementation and suitable for the original vision, and maintained for the Tidal Impact release (functional change only) with clarity on the applicable cyber security aspects.
- Recognition that the original technical implementation, although adequate for the required business response to the 2019 findings driven by the business and public pressure, is a) not scaleable to meet future business needs (inland water spill public reporting); and b) has limitations in terms of the map display, leading to the now in flight replacement project due for delivery in Feb 2024.

#### 4.1.2. The in between:

- The EDM process:
  - The 15 minute sampling of the sensor data in the telemetry outstation which is clock / block based. This can cause minor errors in spill determination dependent when a spill starts with respect to the 15 minute clock separator. This is a telecoms constraint because of dialup links. This should improve over time with the elimination of PSTN links. The *analogue* telemetry data tends to be stored using either 15m instantaneous or 15m average or both sample frequency. However, for the majority of sites (where site electric mains are present) the hydromanager that processes the *digital* event generation (active/normal states) is working in real time. So if an event occurs between 15m samples the true start / end is detected and used to generate the eventframes as part of the PIAF templates. This is sometimes frustrating for short duration events, as the analogue data may not reflect the digital events, however, the analysts do tend to see something reflected in the corresponding analogue data to be able to determine validity. Very short events tend to suffer from a low check factor because of this analogue sampling frequency issue. SW hope ADSL in the not too distant future will allow the capture of analogue readings at 1m intervals as a minimum, but battery powered sites may not follow suit for power conservation purposes.
  - The 30 minute delay in PI AF for event frame start transmission to Aspire to cater for late arriving data and the changes to Check Factors. Again this is a consequence of the telecoms technology and the way PRISM has to cycle through 200,000 RTU signal data points in uploading data to PI AF.
  - No current disaster recovery although this will be implemented when the new data centre (SDDC) is complete so addressed.



#### 4.1.3. The negatives

These are mostly retrospective given they were based on historical decisions some of which are in the process of being amended or changed:

- Technical:
  - The use of a BB schema in the Aspire SQL Server database rather than a separate database instance is not good practice.
  - BB as a set of components including some bespoke code (C sharp), some third party (Google map services, Quartz scheduler) which is high maintenance and restricts future development (technical debt) and scalability.
  - The technically enforced delay (1 hour on the hour) between Aspire data processing and import to the BB schema (Quartz scheduler and stored procedure polling). NOTE although the aspiration is 15 minutes apparently for project risk reasons this 1 hour on the hour interface will be retained in the new redevelopment. In the opinion of the Reviewer this will still affect the acceptability of the end user geographic display as the disjoint between icon display and the release history will remain and in addition it will continue to generate a false impression of icon update delay causality and disappoint expectations in what is claimed to be a near real time app.
- Functional
  - A questioner asked if analysis of spill state change and how icons change colour was carried out. The Reviewer has found no evidence this was ever done. The combination of real time spill changes e.g. start/stop, prioritisation, confirmation, etc. and the inherent delays both with clock triggered fixed duration delays (data polling) and variable (review times updates), the separate but real time tidal changes (at a BWS), filtering rules and the relationships between outfalls and BWS created a very complex set of changing BWS and outfall map display states (colours) which can be very confusing to public end users especially if they have environmental interests rather than casual recreational interests. This lack of information in why a colour has changed from these various factors inherently reduces trust in the system especially when trust is already low and the information provider (SW) is viewed with suspicion.
  - In the map interface there are barriers to intuitive use, partly as a consequence of the narrow (recreational) user view, which require significant Human Factors analysis. From this reviewers perspective the following are negatives:
    - No search facility (inc. grid refs as well as names, postcodes, etc.)
    - Zooming brings up Google embedded sites which are a distraction
    - It is not clear how the map relates to OS maps
    - Only being able to see the outfalls via the associated BWS is restrictive
    - Implying a no spill by a blue BWS icon when in fact there is a spill from an associated outfall but which has been deemed non-impacting (the popup does explain this but at first sight it can be taken as being misleading if there is low trust/suspicion



- It is unclear if long sea outfalls (and medium sea outfalls) are displayed given LSO spills have no impact on a BWS (and other filtering rules), this also gives a mismatch with EA reporting.
- The BWS pin location as a point, although related to the EA sampling points (not displayed) is effectively arbitrary in relation to a long beach say, where tidal conditions can vary a spill impact along that beach.
- The popups are a fixed size with a short sentence and a large amount of white space, they can hide the pins dependent on the zoom level. This may be a function of the overlay mechanism where the boxes are of a fixed size rather than being dynamically sized by content.
- There is no indication if an unverified spill is in review or if the review is paused.
- There is no indication as why a spill is reviewed as not genuine
- There is no indication as to when (in real time) a review should be completed
- The associated history report cannot be exported to Excel (or .csv)
- Due to the proliferation of User Stories and the change in vision it is very difficult to understand:
  - The various filters that are applied to the spill records and their purpose in relation to the BB public interface (this is NOT spill record deletion as all spills have to be reported to the EA under the Permit conditions). These are effectively design decisions related to data and it is inferred by the Reviewer that the rationale is not to overload the public user with information that is not relevant to **bathing water** (e.g. long sea outfall spills) or of those with a very low probability of being subsequently proved correct. Although sensible these decisions affect public trust so require logging and being available on request.
  - The way functionality has evolved and why. Agile requires heavy end user involvement and is mostly geared around the subject actor being a real person/role. Where the subject is an internal system object then the User Story becomes less applicable.
  - The User stories are very detailed and granular and although detailing colours and fonts for example it detracts from getting a broader picture of what is being delivered. Epics should deliver this higher view but it is still unclear to the Reviewer, even with the Low Level Documentation grouping the User Stories. NOTE this Low Level Documentation (see ref[36]) is not a design but a statement of User Stories delivered..
- Vision and Requirements Analysis:
  - Requirements analysis (as part of Business Analysis) seems to have been superficial both in the original waterfall development and the subsequent Agile/Scrum activity. There is no evidence of categorisation of requirements and in various places a specific exclusion of non-functional requirements (which may have highlighted some of the information flow delay issues if included), nor evidence of the application of elicitation techniques (workshops/focus groups, BPMN modelling, To Be conceptual modelling/Concept of Operations, or even the 5 Why's). There should also be





data requirements in terms of timeliness, completeness, accuracy, etc. which again do not seem to have been included. The Requirements Traceability Matrix shows original requirements (and non-functionals) but with limited traceability in terms of ownership and rationale and test traceability. The RTM also gets confused by the inclusion of development roadmaps and no real chronology.

- Requirements should meet certain standards in terms of acceptance criteria, being atomic, having an owner, etc. and being traceable through the development process to testing against the acceptance criteria. Jira does support these aspects via the decomposition/translation into User Stories, however, what is missing is a single view – the Requirements Traceability Matrix, and the current version (see ref.[35]) does not deliver this view.
- Since the initiation of the Agile development as the Aspire / Beachbuoy Enhancement Work (ABEW) in Jan 2022 the 'vision' seems to have morphed from:
  - an initial, possibly kneejerk, response to a commercial constituency view that the BWS warnings were too pessimistic (erring on the side of caution) by in effect filtering the warnings to identify a BWS impact or no impact from a spill due to tide and spill duration;
  - to, changes to the BB web page (1 page to 3) from the Feb 2023 Working Group;
  - and now, improvements to the Review process via changes in Aspire for a) automation and b) process reporting and monitoring via KPIs for continuous process improvement.

This adaptability in Agile, although a fundamental characteristic, does not appear to have been managed sufficiently. This is not a responsibility of the Project Manager, the **Product** Owner should own the vision (and act as **Project** Sponsor), and there have been 3 since Jan 22, however, governance over the vision change and project trajectory (as well as progress, finance, etc.) normally lies with a Project (Management) Board. By default this seems to have been the Working Group which is not good practice given they raise requirements and only meet on an adhoc basis.

- Stakeholder management. This is perceived to be very poor with at BB project level, no stakeholder analysis, no stakeholder management plan and no perception of varying expectations, attitudes and behaviours on the part of stakeholders in the public domain. This should include how new releases are piloted and messaged to the varying public stakeholder personas ranging from casual bathing site visitor to environment monitor.
- Process:
  - Development Lifecycle:
    - The original waterfall development (2021) was incompletely documented and although heavy on technology and technical detail in the High Level Design was very light on the data architecture and business analysis (requirements and perceived end user/public expectations), even though a narrow (recreational bathing water user role) was taken. This lack of balance (technology over data and business analysis) was perpetuated and increased in the subsequent Agile/Scrum development where the concept of a data architecture (and database design) seemed non-existent. The request for a physical database model / data dictionary returned initially a set of



migration code scripts then a piece of code to apparently create a set of tables.

- Formal (single object) design documentation is poor or non-existent as opposed to project reporting documentation such as Test Exit Reports and user story change specifications (usually at code level). The original High Level Design was adequate if light in parts. A 'Low Level Documentation' for the Agile BB development was supplied, however, this not a 'design' but a list of User stories grouped by Features within an Epic with links to the Change documents (specifications), useful as an As Built technical description but not a single integrated (design) view of the product.
- For the Tidal Impact development using Agile/Scrum the conflation of enhancements to Aspire, BB (and PI AF) in a single 'project' using Agile/Scrum makes it difficult to get clarity on where a User Story sits, especially since the start in Jan 22 of the Agile lifecycle model over 2000 Jira 'items' have been created, admittedly 'Items' can be epics, stories, bugs, tasks and sub tasks so the number of actual stories is probably in the order of 500.

## 4.2. Recommendations

Many of the deficiencies identified in this review and summarised in the previous section are recognised by SW and efforts are under way to rectify some if not all of these, however, the following are necessary in the opinion of the Reviewer. These are differentiated in time terms as:

- Immediate/short term (to complete in next 3 months);
- Medium term (by end June 2024)
- Long term (by mid 2025)

### 4.2.1. Retrospective corrections

- Documentation (Immediate/short term) This is necessary for the BB redevelopment given a) a new SQL Server database and b) recoding moving from the original C sharp code to the FME Low Code:
  - Collating the business rules which are identified in the user stories into one view of how spill data is filtered before it arrives at the BB interface.
  - Detailed state-change scenarios need to be documented for how the pins change colour.
  - A database physical model needs designing with a data dictionary for interface design.

### 4.2.2. Going Forward

#### 4.2.2.1. Givens and assumptions:

- Some of the telemetry bandwidth restrictions, PI AF performance in polling will improve through technology innovation (and possibly migration to the new data centre), however, this is probably **long term**.
- Backup and disaster recovery will be delivered by the new data centre, the timeline for this essentially 2024, so **probably medium term**.



- The new in flight BB redevelopment will solve the map UI issues via the ESRI ArcGIS implementation (**medium term**).
- Reduce the 1 hour clock based batch delay in passing data from Aspire to BB (NOTE Given the current High Level Design the extension to include Aspire rivers spill data via using the existing Quartz interface will probably compromise performance even further).
  - Short term redesign interface
  - Medium term build and test interface as part of new development.
- The new inflight BB redevelopment will address the extension to inland water via a separate database (**medium term**).
- The new BB redevelopment will address integration and workflow issues through the implementation of FME (**medium term**).
- The new BB redevelopment will address the maintenance cost and maintainability via the FME Low Code development platform (**medium term**).
- The Solution Architect stated the new BB redevelopment project will adopt the Waterfall project lifecycle (see meeting notes). However, this was later corrected in the SW review of V0.3 of this document by the BB Product Owner to state Agile would be used from December 2023 for 'Beachbuoy 2.0'. It is unknown whether this will continue the use of the current Jira repository or if a new instance is to be used for Beachbuoy 2.0.

#### 4.2.2.2. Recommendations:

- Project Management (as this relates primarily to the new BB redevelopment this is short term (business/requirements analysis) to medium term (UAT):
  - Separation / clear boundaries / project interfaces (control agreements). The proposed BB redevelopment in flight project (as a medium term activity) should demonstrate: traceable governance via a Project Board; the separation from the Aspire work, which has different objectives; and, more complete up front design. Although upfront design is more of a characteristic of the Waterfall lifecycle it is, in the opinion of the Reviewer, a fundamental need in a Regulated organisation. Some Regulated organisations such as Network Rail in their Intelligent Infrastructure Programme, have opted for a hybrid approach with substantive design artefacts mandated for the initial quality gates followed by Agile delivery.

It is accepted that although Aspire and BB are separate products, they are both aligned with the objective of providing accurate spill data to stakeholders (aspire = EA; BB = public) and are therefore closely related. However, in the opinion of the Reviewer the mode of communication and the level of detail have different trust needs and require different filters and as such require a degree of separation for example management dashboards and EA compliance is substantially different to public information requirements. It is also acknowledged that SW has set up different working groups for internal and external user engagement but at the detailed user story level there could still be confusion in a single project administration.

- Full stakeholder analysis and the production of a stakeholder management plan is required for the BB redevelopment. NOTE this is non trivial as stakeholders include local councils, lobbying groups, the media, politicians,



land owners, etc. and managing stakeholder interactions whether via meetings, presentations, public town hall events, social media, media campaigns will be a difficult, costly and time consuming activity if trust is created in the product and the SW process of spill reporting.

- In depth Business and Investment case development referencing:
  - The Risks quadrants, typically categorising corporate risk in terms of financial, operational, reputational and compliance. In the case of BB Reputational damage risk mitigation trumps financial and possibly regulatory compliance for SW.
  - Process Organisation Technology Information (POTI) analysis. POTI analysis was used in the Network Rail Intelligent Infrastructure programme to help specify project dossiers / briefs (exemplars available) as an output of the programme blueprint that set the direction of travel for the programme. These artefacts were the initial stage of programme control designed to shine a light on the next level of detail. The principle being that decision makers could have confidence that delivery had thoroughly analysed the business problem from an architectural perspective (where this includes change for process, organisation, technology and information architectures), and had a high level idea of how the problem was to be met from these perspectives. What NR was trying to do was to ensure that the programme was truly transformational and not just a technology factory. BB seems to the Reviewer to be a technology factory in how it is being delivered.
  - Corporate Risk analysis mitigation and management is a wider consideration. BB plays a part and, in the Bow Tie approach to risk analysis, the upstream spill identification and verification is a control in terms of mitigating the non-Compliance consequences of a spill event and BB the reputational consequence through transparency.
- Project Lifecycle and Governance
  - Where Agile is preferred, given the nature of SW as an organisation and the Regulatory environment it is inevitable that Agile has to be accommodated in a hybrid lifecycle model with project beginning/end and governance requiring waterfall type artefacts and quality gates. This hybrid model requires formalising as an IT (company) Standard. This may apply to the ongoing Aspire work as this should be separated from the new redevelopment of BB which is essentially a technology migration. As such is a short term change requirement in project management.
  - Testing to include external representation, although not necessarily feasible at Sprint Testing in Scrum is a must for full UAT prior to release (a possible change to current CAB requirements which are currently essentially a mitigation of impact on existing apps). This also relates to Release management. Given the post report V0.3 design decision to use Agile for the new BB development the author recognises the intent to ensure that external user engagement validates new functionality / release prior to public launches as a replacement for full system UAT.
  - Business Analysis requires more formal application with recognised techniques, for example:
    - Business Process Modelling (BPM)
    - Brainstorming
    - CATWOE
    - MoSCoW (Must or Should, Could or Would)



- MOST (Mission, Objectives, Strategies, and Tactics) Analysis
- PESTLE Analysis
- SWOT Analysis
- Six Thinking Hats
- The 5 Whys
- Non-Functional Requirement Analysis
- Design Thinking

The SW IT dept may want to consider creating a Business Analysis centre of excellence or at least a recognised discipline group. Although the new BB development (with or without integration with the Aspire changes) has been determined to be an Agile development the Reviewer emphasises that it requires a predictable scope which will require extensive Business / Requirements Analysis taking into account: the end to end spill data flow and state changes; the potential multiple user personas and how this will define information needs and tailored interface profiles. Given the BB redevelopment timeline this is an immediate/short term activity.

- Release management should consider, when into the public domain, extensive messaging, pilot trials, education, etc. with feedback, when justified, requiring rework. Rework should be minimised through initial user engagement but some is inevitable. Part of this could be considered extended UAT. In the BB redevelopment timeline this is a medium term activity but should be catered for in the project plan now so this planning is immediate/short term.
- Architecture and analysis
  - Technology
    - For BB the one hour on the hour delay must be addressed (the Quartz / stored procedure method (effectively a batch process) must be replaced by something closer to real time updating) in order to meet the Environment Act requirement of 1 hour end to end from start of spill to public. This can be considered medium term if included in the BB redevelopment design.
    - Integration and reference data updates (from CALMS and CATalogue in the first instance, as this is mastered reference data. It is understood this cascaded to Aspire (and possibly PI AF) but whether and how this is cascaded from Aspire to BB is unclear given the BB Admin portal. These configurations being available via the public interface add to the user trust, this should be considered as a medium term extension to the BB redevelopment and evaluated as part of the Business Analysis in the short term. The association of other location reference data such as EA sample points could be included, however, the reporting of cross correlation of sample test data with spills may require exception investigation (the no spill but high contamination scenario). This is more medium to long term.
    - Mobile app development for pull info access, push notifications in addition to current email notifications and SaS API integration. This should be considered a long term aspiration, however, there may be synergy with a potential development capability for internal SW hand held apps such as for field asset maintenance use.
  - Data
    - The BB database needs formal design both for the relational aspects including reference data and the transactional data (spill records) Given the BB redevelopment timeline this design is short term.



- The Aspire database needs documenting, with redesign if necessary for performance / compliance to third Normal form if deemed necessary, and putting under change control. This should be considered a short term objective.
- Fields for the enhanced Aspire information specifically wrt the review process (times, status, reasons) should be identified for inclusion in reports for different profiles/personas in BB as part of the BB redevelopment and this will affect the Aspire BB interface spec. so this is a short term design objective as part of the Business Analysis.
- Control, i.e. inclusion of authorisation/escalation/user authentication for sensitive data (e.g. BB Admin functions for changes to tidal mapping for example). This should be considered as high priority and included in the design as a short term objective. Typically this is a two stage process in that a change is proposed and then authorised. It is accepted that user authentication may mean a user has both change and authorisation privileges, however, this depends on how accountability is implemented for audit purposes.
- Business rule documentation and change control e.g. for Control Factor Limit values and filter settings for downward flow of spill records to BB and BB public interface, How this is published according to the different BB user personas should be part of the Business Analysis as a short term objective.
- Functionality:
  - UI – the functionality associated with the map colours needs redesign by a Human Factors expert as part of the BB redevelopment as a short term objective
  - The business rules included in the various filters across the whole spill data supply chain need formalising in one place with associated governance with any specific BB filters incorporated in the new BB redevelopment design and documentation. This is necessary for a number of SW internal reasons, viz: a) handover to IT maintenance & support as a production app (usually for handover the support function requires full and complete documentation inc. program specs); b) to facilitate any retrospective forensic examination in the event of an incident or challenge regarding a spill. Some form of abstraction/simplification of the end to end logic, not to the level of check factor limit values would, in the author's opinion, be useful as part of the communications / PR effort in gaining public trust.