Appendix 14.2 Review of Water Balance Model Findings

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Contents

Abbreviations & Glossary

ABP	Associated British Ports
BTA	Boiler Turbo Alternator
DCO	Development Consent Order
EA	Environment Agency
EAW	Environment Agency Wales (now NRW)
EIA	Environmental Impact Assessment
EP	Environmental Permit
EPR	Environmental Permitting Regulations
ES	Environmental Statement
MWC	Main Works Contractor
NGR	National Grid Reference
NPTCBC	Neath Port Talbot County Borough Council
NRW	Natural Resources Wales (formally EAW and CCW)
NSIP	Nationally Significant Infrastructure Project
PEIR	Preliminary Environmental Information Report
PINS	Planning Inspectorate
SoS	Secretary of State
TA	Turbo Alternators (Differentiation - this is following by a number)
Tata Steel	The overarching company. Includes the applicant.
Tata Steel UK Limited	The Applicant
TSSP UK	Tata Steel Strip Products UK
WFD	Water Framework Directive
WIYBY	What's In Your Back Yard

1 INTRODUCTION

1.1 Introduction

1.1.1 This technical appendix has been prepared by AECOM to support Chapter 14 of the Environmental Statement (ES).

1.1.2 As requested by Natural Resource Wales (NRW) on 25th November 2013 AECOM has undertaken the modelling of water balance scenarios in order to inform the assessment of potential effects on the surface water environment from the proposed development.

1.1.3 AECOM received the River Afan Water Balance Model, previously developed by Halcrow on behalf of NRW, in January 2014. Some of the model data has been updated and used to simulate water balance scenarios for current operations and proposed operations as a result of the proposed development.

1.2 Scope

1.2.1 The scope of the modelling exercise reported in this technical appendix is as follows:

- To establish a baseline of current water resource availability in the River Afan – Port Talbot Dock system as a result of the existing water balance including the current abstraction – discharge regime;
- To provide details of the proposed abstraction – discharge regime as part of the proposed development;
- To outline the simulated scenarios based on the proposed abstraction – discharge regime;
- To simulate the scenarios and report on their effects on the River Afan residual flow and the Port Talbot Dock water levels; and

- To outline the assumptions used in the assessment of potential effects on the surface water environment.

1.3 Existing Water Resource Availability

1.3.1 Greenpark Weir lies on the River Afan in Port Talbot, South Wales (OS grid reference SS 760 897). The structure controls water levels for the feeder channel supplying Port Talbot Dock. The dock feeder channel off-take is located immediately upstream of the weir on the left bank and is the main water supply to the dock. It allows for the operation of the dock and provides the water for the licensed Tata Steel abstractions. Tata Steel UK Limited ("the Applicant") abstracts directly from the dock feeder channel and from the dock itself. A secondary watercourse, the Nant Ffrwdwyllt, flows directly into the dock and also provides a supply for an additional abstraction by the Applicant. This is summarised in Figure 14.1 of the ES.

1.3.2 Abstraction by the Applicant impacts on the flow of water over Greenpark Weir and the level of water in Port Talbot Dock. Dock water levels are also influenced by the Applicants abstraction returns as part of their recycling process as well as being influenced by evaporation, losses to groundwater and leakage through and spillage over the dock gates. Residual flow levels across Greenpark Weir are critical for fish passage and a new three tier larinier fish pass has been installed at the site. The pass is designed to be more responsive to changes in upstream head and flow availability allowing more water to go down the fish pass at higher flows.

1.4 WFD83 River Flow Objective (RFO) on the River Afan

1.4.1 River Flow Objectives (RFOs) are based on the principle of allowing a percentage of natural flow to be available for abstraction at given flow percentiles, which results in a variable flow regime. NRWs current preferred RFO for the required flow over Greenpark weir is the Water Framework Directive (WFD)83 RFO.

1.4.2 The WFD83 Standards for Freshwater Flows to Transitional Water Bodies extends the WFD48 water resource standards for freshwater flows to transitional water bodies, which are partly saline in character but are substantially influenced by freshwater flows. This is the situation on the

River Afan at Greenpark Weir. The sensitivity classification in WFD83 classes the River Afan as low sensitivity. However, the river flow is important for migratory salmonids and, NRW have applied a precautionary approach applying a high sensitivity to the river. The required WFD83 flow regime for Greenpark Weir is shown in Figure 14.2.1 below. This figure shows that the total flow in the River Afan upstream of the dock feeder channel, at Marcroft gauging station, is higher than the WFD83 RFO and so this is achieved.

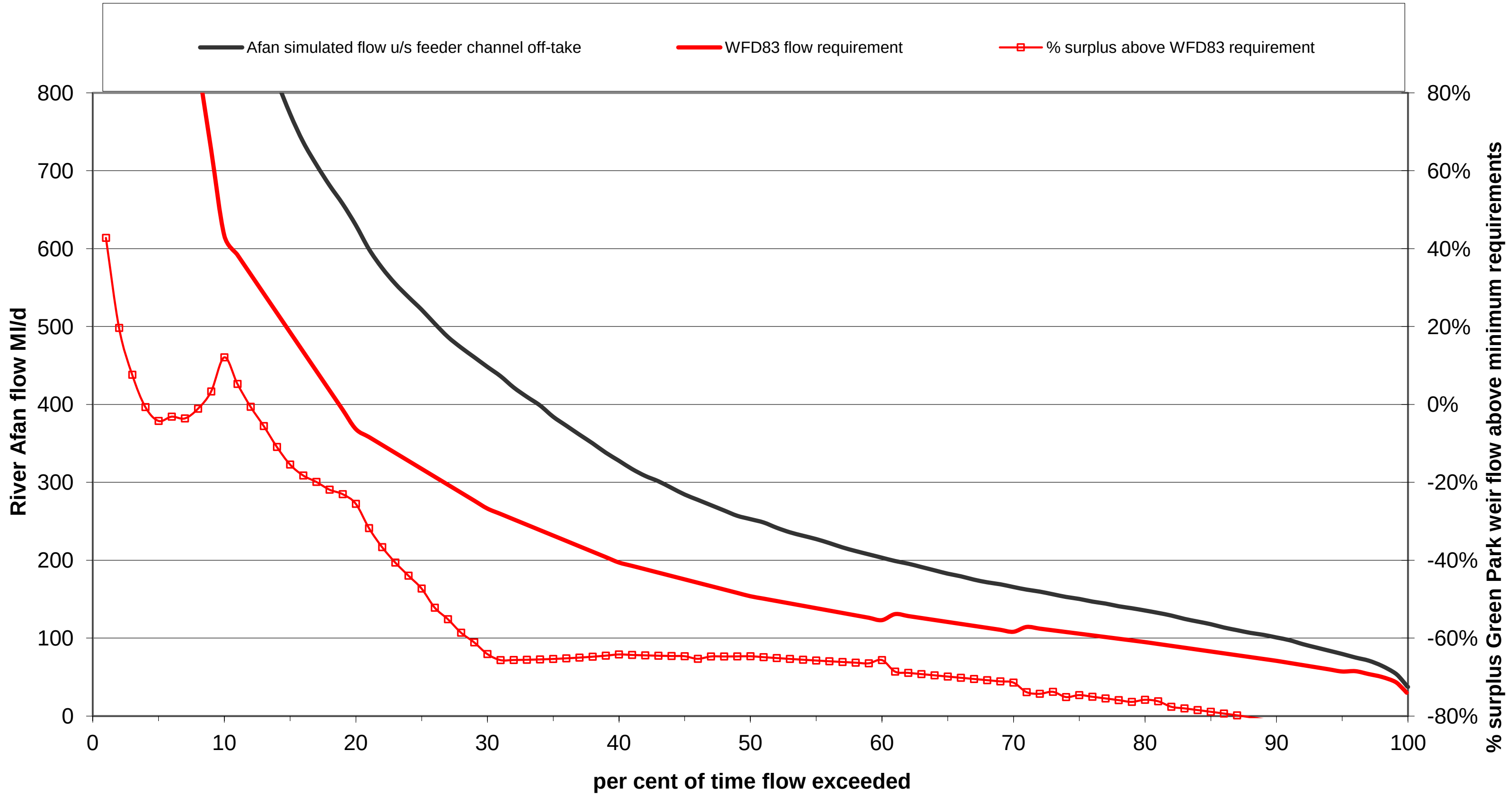

Figure 14.2.1 WFD83 River Flow Objective Relative to River Afan Flow at Marcroft Gauging Station Upstream of the Applicants Abstraction

1.5 Site Description and Setting

1.5.1 The site is located at the Tata Steel UK Port Talbot Steel works, situated immediately west of Margam, a suburb of Port Talbot. The proposed power generation site is centered on National Grid Reference 277275, 188429 with the associated electrical connection end centered on National Grid Reference 278475, 186081. A site location plan is provided as Figure 1.1 of the ES. The proposed development site is located at the north-east end of the Port Talbot site in Port Talbot.

1.5.2 The site covers approximately 19.8 hectares and is defined by the red line boundary shown in Figure 1.2 of the ES. The surrounding area is predominately industrial, situated within the Tata Steel UK Port Talbot Steelworks boundary, with residential areas to the north and east. Margam Docks are situated to the north west of the site. The overall topography of the site is generally level at an approximate height of 15m Above Ordnance Datum (AOD).

1.6 Description of the Proposed Development

1.6.1 The proposed development will consist of up to two boilers and their associated turbine sets and up to two stacks, enhancing and replacing some the existing power generation equipment. The existing equipment which will be decommissioned and replaced includes 4 boilers and 3 turbo alternators.

Two options are being explored for the installation of the proposed development. These options are outlined below:

- Option 1: This is a single phased build and constitutes the complete installation and involves both boiler and associated turbine sets being installed and constructed at the same time. The existing power station would be decommissioned once the new equipment is in reliable and continuous operation, when the abstractions and discharges to the Port Talbot Dock will be reduced.
- Option 2: This is a phased build with two separate installations. This is an alternative scenario where project components are separated and

only one boiler and associated turbine sets is installed at a time (Phase 1), with the second to be installed up to 10 years later (Phase 2). During the interim period between the first and second installations, the existing power generation equipment would be operational and only be decommissioned once the second installation is complete and within reliable continuous operation. The existing abstractions and discharges from the Port Talbot Dock would not be reduced until the second phase of installation.

1.6.2 Both options have been modelled in the scenarios run through the water balance model. More details on the existing and proposed abstraction numbers used in the modelling are provided in Section 2 – Approach to Modelling and Modelled Scenarios.

2 APPROACH TO MODELLING AND MODELLED SCENARIOS

2.1 Introduction

2.1.1 This section describes the approach and methods used to simulate scenarios for the current water balance set up (baseline) and for the proposed development operating requirements in order to inform the assessment of potential effects on the surface water environment.

Sources of Information

2.1.2 The following information / data was received from NRW in order to model scenarios for the proposed development in the River Afan Water Balance Model:

- River Afan Water Balance Model input and output excel files;
- Water Resource Flow Modelling Technical Note;
- Greenpark Weir – Project Summary Report; and
- Hydraulic performance data of new fish pass installed at Greenpark Weir.

2.1.3 Data received from the Applicant to inform the model scenarios included the following:

- Current Environmental Permit;
- Current abstraction licenses;
- Details of volumes of water abstracted and discharged currently / historically;
- Grid references for current abstraction and discharge points; and
- Estimates of future water requirements.

2.2 River Afan Water Balance Model

2.2.1 The water balance model received from NRW is a Microsoft excel based workbook. The model has been calibrated against historic dock water level and uses various inputs, assumptions and outputs. Model inputs include:

- Rainfall;
- Open water evaporation;
- Marcroft gauging station flows;
- Ship passage data;
- Daily high tide levels; and
- Historic abstraction and return data.

2.2.2 Model assumptions include those for:

- Dock inflows; and
- Dock outflows.

2.2.3 The period of record modelled relates to the 17 years period from 1994 to 2010.

The model allows simulation of changes to current water balance control processes, including abstractions and discharges, to investigate the impact of various scenarios on:

- Residual flows in the River Afan over Greenpark weir critical to ecological functioning; and
- Water levels in Port Talbot Dock, which are critical to Associated British Ports (ABP) and the Applicants commercial operations.

2.2.4 Annual flow duration curve data for four River Flow Objectives (RFOs) for Greenpark weir are included in the model. The model allows predicted residual flows over Greenpark weir to be compared against the RFOs.

2.3 Simulated Scenarios

River Flow Objectives

2.3.1 The four available flow objectives that are available for modelling are as follows:

1. The Environmental Flow Indicator (EFI) RFO provided by NRW;
2. The Water Framework Directive (WFD) 83 RFO provided by NRW;
3. The EA minimum fish-pass flow RFO provided by NRW; and
4. A fixed minimum flow rate, 15 Ml/d used in the model calibration.

2.3.2 Of these, one is an additional flow objective, which was used by Halcrow to simulate the existing conditions at that time, with a lower priority given to the river flows. This fourth flow objective simulates a fixed residual minimum flow rate over Greenpark weir. Therefore, for comparative purposes, the various options modelled by Halcrow were simulated with the fourth RFO so that any change in river flows due to the simulated options could be assessed and compared to the other RFOs.

2.3.3 The model data has now been updated by AECOM to include a fifth river flow objective, which replaces the fourth objective previously used in the model and is used instead of to compare any changes to river flows due to the simulated options to the WFD83 RFO. This was undertaken to account for the changes to fish pass flows, due to the rebuild of the fish pass at Greenpark weir, which has made the fourth flow objective obsolete.

2.3.4 The new fish pass is a three tier larinier and was specifically designed to be more responsive to changes in upstream head and flow availability. This means that at higher flows more water passes down the fish pass. NRW advised that a new residual flow for the fish pass be developed and included in the model based on a variable residual flow according to flow percentile, similar to the EFI and WFD83 requirements already used in the model. In the interest of speed, it was suggested by NRW that the new fish pass residual flow could replace the data in the EFI RFO column in the model files, since the EFI RFO data is not being used in the model runs for comparative processes.

2.3.5 This approach was adopted by AECOM and has been used in the modelled scenarios. Hereafter, this new flow objective will be referred to as:

1. The new fish pass residual flow

2.3.6 The new fish pass residual flow is based on the hydraulic performance of the pass which is set out in Table 14.2.1 below, where the relationship between main river flow percentile and fish pass flow is already defined.

Table 14.2.1 Greenpark weir fish pass stage – discharge characteristic (post 2012)

				Stage (m AOD)	Flow (m^3/s)			
Pass 1	Pass 2	Pass 3			Pass 1	Pass 2	Pass 3	TOTAL
1.1	0.85	0.65		6.55	1.27	0.85	0.57	2.68
1.05	0.8	0.6	Q5	6.5	1.18	0.77	0.51	2.46
1	0.75	0.55		6.45	1.09	0.70	0.45	2.24
0.95	0.7	0.5	Q10	6.4	1.01	0.63	0.39	2.03
0.9	0.65	0.45		6.35	0.92	0.57	0.34	1.83
0.85	0.6	0.4		6.3	0.85	0.51	0.29	1.64
0.8	0.55	0.35	Q20	6.25	0.77	0.45	0.24	1.46
0.75	0.5	0.3		6.2	0.70	0.39	0.20	1.29
0.7	0.45	0.25		6.15	0.63	0.34	0.16	1.13
0.65	0.4	0.2		6.1	0.57	0.29	0.12	0.98
0.6	0.35	0.15	Q50	6.05	0.51	0.24	0.09	0.83
0.55	0.3	0.1		6	0.45	0.20	0.05	0.70
0.5	0.25	0.05		5.95	0.39	0.16	0.03	0.57
0.45	0.2	100mm baffles		5.9	0.34	0.12	0	0.46
0.4	0.15			5.85	0.29	0.09	0	0.37

Table 14.2.1 Greenpark weir fish pass stage – discharge characteristic (post 2012)

				Stage (m AOD)	Flow (m³/s)			
Pass 1	Pass 2	Pass 3			Pass 1	Pass 2	Pass 3	TOTAL
0.35	0.1		Q70	5.8	0.24	0.05	0	0.30
0.3	0.05			5.75	0.20	0.03	0	0.22
0.25	100mm baffles			5.7	0.16	0	0	0.16
0.2				5.65	0.12	0	0	0.12
0.15				5.6	0.09	0	0	0.09
0.1			Q90	5.55	0.05	0	0	0.05
0.05				5.5	0.03	0	0	0.03
100mm baffles			Q95	5.45	0	0	0	0
				5.4	0	0	0	0

2.3.7 Having taken into account the new fish pass hydraulics AECOM's model results show a notable increase in the amount of time during which Dock water levels fall below Tata Steel's minimum Dock operating level of 5.2 mAOD. This is contrary to the expected results and despite impounding taking place and suggests that the stage/flow percentile - discharge relationship (rating) for the pass does not properly represent the flow distribution at the site with the rating resulting in pass design flow being given priority at high flows reducing flow availability to the Docks Feeder.

2.3.8 NRW suggest that the existing rating is used for very low flows up to Q85 (stage of 5.7m, 0.16 m^3/s) with the fish pass flow then capped at 0.16 m^3/s.

2.3.9 Regardless of these changes, the relationship between stage and fish pass flow will be more complex due to the effect of debris blockage of the screens, screen type and in the future the influence of any intake control structures that may be in place (further detail on control structures is provided later in this section).

2.3.10 NRW requested the outputs of the modelling to include a comparison of modelled residual flows for the various scenarios against their target WFD83 RFO, as their objective is to achieve the WFD83 residual flow standard or as close to that as operationally practical. As such the outputs for River Afan flows provided in this technical appendix are compared against the WFD83 RFO.

Abstractions Modelled

2.3.11 The abstractions that have been modeled are the current and proposed operation abstractions for the proposed development. The Applicant proposes to abstract the additional abstraction required for the proposed development from the River Afan. Therefore, it has been assumed in the model that the additional abstraction requirement will be taken solely from the River Afan. This was done in order to inform the assessment of potential effects as a worst case and also to inform the mitigation measures that could be required, including a hierarchy of abstraction.

2.3.12 It was agreed with NRW during a conference call held on 18th February 2014 that, proposed abstractions from the River Afan during construction for commissioning did not need to be modeled as this would involve a small one-off abstraction only and would have a negligible impact on River Afan flows. Similarly, it was also agreed with NRW on the same conference call that a decommissioning scenario did not need to be modeled as it is not known what the site configuration would be after decommissioning has taken place, and would introduce a number of unknown variables to the water balance model.

<u>Current Abstractions</u>

2.3.13 Previously the model was run using the historical means of abstraction over the period from 1994 to 2010. Due to changes in onsite operations at the Port Talbot site in recent years and in order to best represent the current operational abstraction – discharge regime undertaken by the Applicant, the historical data has not been used in the scenario runs undertaken by AECOM.

2.3.14 The historical abstraction averages have been replaced and monthly means of abstraction data over the period from 2011-2012 have been used (as provided in Appendix 14.3 of the ES). This annual data has been used as it currently provides the most accurate representation of the current onsite abstraction – discharge regime. Although the 2012-2013 data is the most recent abstraction data that is available it is not representative because of the rebuild of Blast Furnace 4, which took approximately 5 months to complete. This reduced the abstraction requirements for the Blast Furnace but also meant that there was insufficient process gas available to run the power generation building at normal levels during the rebuild period with a consequent reduction in the abstraction requirements for turbo alternator cooling. At this stage 2013-2014 data is not yet available for analysis.

Proposed Operation Abstractions

2.3.15 Using the yearly means for the Applicants abstraction in the period from 2011-2012, it was possible to establish the baseline annual abstraction volumes for the River Afan, the Port Talbot Dock and the Nant Ffrwdwyllt. These volumes have been rounded to establish an upper limit to current abstraction upon which estimated values of the additional proposed abstraction (also rounded) have been added. This has been done to establish a worst case scenario of abstraction requirements, to account for any variations in the estimated values that might occur in reality.

2.3.16 Using this baseline data, plus or minus the estimated abstraction required for the proposed development it has been possible to appropriately establish the future water resource availability in the River Afan – Port Talbot Dock system under the proposed operating regime and to model scenarios in order to identify any potential effects.

Discharges Modelled

2.3.17 As with the abstractions modeled, the discharges that have been modeled are the current and proposed operation discharges for the proposed development only.

Current Discharges

2.3.18 The model assumes that the abstraction returned to the Port Talbot Dock is 88% under the existing abstraction – discharge regime. Therefore, the baseline scenario simulations have been run using this assumption.

Proposed Operation Discharges

2.3.19 The original scenarios run through the model for proposed operations that were presented to the River Afan Management Group, assumed a return percentage of 88%. However, during the presentation / meeting it was established that the return percentage would decrease for the operations of the proposed development. This is explained below:

- The Applicant currently abstract 166,000,000 m^3/yr directly from the Port Talbot Dock. The model originally assumed that 88% of this water is returned to the dock, with the rest (20,000,000 m^3/yr) lost to evaporation and blow down. The proposed change to the Applicants operations will result in less water being abstracted from the Port Talbot Dock (47,000,000 m^3/yr), however, losses due to evaporation and blow down would still occur. The magnitude of these losses is unknown but would not be greater than the present losses from the system. A worst case scenario has been modelled using the new abstraction rate of 47,000,000 m^3/yr and continued losses of 20,000,000 m^3/yr. This equates to a 57.5% dock return.

2.3.20 Therefore, it was requested by NRW and Associated British Ports (ABP) of the River Afan Management Group, that new scenarios would need to be run through the model to account for the reduction in return percentage. A breakdown of scenario runs are provided later on in this section.

Abstraction and Discharge Data and Units

2.3.21 The volumes of the current and proposed abstractions are provided in Figures 14.2 of the ES (Option 1) and 14.3 (Option 2).

2.3.22 The current annual abstractions established from 2011-2012 data used to establish a baseline are provided below:

- 10,000,000 m^3/yr from the River Afan;

- 900,000 m^3/yr from the Nant Ffrwdwyllt;
- 166,000,000 m^3/yr from the Port Talbot Dock; and
- The percentage of dock abstraction return is assumed at 88%.

2.3.23 The proposed abstractions, assuming the River Afan is the primary source of abstraction are:

For Option 1 –

- 15,000,000 m^3/yr from the River Afan;
- 900,000 m^3/yr from the Nant Ffrwdwyllt;
- 47,000,000 m^3/yr from the Port Talbot Dock; and
- The percentage of dock abstraction return is assumed at 57.5%.

For Option 2 –

Phase 1 –

- Just over half of the additional proposed abstraction for Option 1 (5,000,000 m^3/yr) is required from the River Afan (Dock Feeder Channel) at approximately 3,000,000 m^3/yr, giving a total 13,000,000 m^3/yr to be abstracted;

  Note: This is more than half of Option 1, as the abstraction required for the boiler is not negated by the decommissioning of the 4 existing boilers. This is however negated for Option 1 because the 4 existing boilers have been decommissioned, meaning the additional abstraction requirement in Option 1 does not account for the boiler abstraction, whereas for Option 2, Phase 1 the boiler abstraction is accounted for.

- The existing assets will not be decommissioned so the abstraction from the Port Talbot Dock remains the same at 166,000,000 m^3/yr;
- The percentage of dock abstraction returned to the dock remains the same as the current rate at 88%; and
- The volume of water abstracted from the Nant Ffrwdwyllt will remain the same at 900,000 m^3/yr.

Phase 2 –

- As a result of the installation of the second boiler and turbine in Phase 2, the abstraction and discharge required for the second phase is effectively the same as already outlined for Option 1, as this constitutes the complete installation. Therefore, the scenarios run through the model for Option 1 have not been repeated for Option 2.

2.3.24 The abstraction data used in the scenario runs have been converted from an annual volume in units of m^3/yr into a monthly volume in units of Ml/d using the following calculation:

- Y / 1000 / 365 = X Ml/d

2.3.25 Using a monthly average spread over the year is a suitable resolution of data as the proposed development would be in continuous operation over the year. It is expected that the proposed development will be operational for 99.5% of the year.

Planned Improvement Works

2.3.26 Engineering improvements to Greenpark Weir are currently being planned. The works most likely to affect the future residual flows in the River Afan and the level in the Port Talbot Dock are outlined below:

- Installing a control on the dock feeder flow to restrict off-take when the dock is nearly full; and
- The refurbishment of the lock gates which is currently in the ABP maintenance programme, which would reduce the existing leakage through the gates.

2.3.27 These water management options were included in the model when developed by Halcrow and have been used in the modelling to provide best case scenarios, where it is assumed these improvement works have been undertaken.

2.3.28 The scenario runs, and the associated assessment of potential effects on the surface water environment, show no dependence on the planned improvement works being undertaken as worst case scenarios have also been modelled, where it is assumed the engineering improvements have not been undertaken.

Scenario Runs

2.3.29 The scenarios that have been run through the model are outlined below.

2.3.30 The following are the original model runs that were presented to the River Afan Management Group:

- **Run 1 – Scenario 0: Old baseline without new fish pass residual flows.** This was run to demonstrate the difference in River Afan flows between the old fixed flow previously used by the model (RFO option 4) and the new fish pass residual flow used in the following model runs.
- **Run 2 – Scenario 1: Current Operations.**

  This was run to provide a baseline of current operations and uses the 2011-2012 abstraction data.
- **Runs 3, 4, 5 – Scenario 2: Proposed Operations.**

  Three runs have been made in the model for Scenario 2 Proposed Operations. This has been done to account for the potential improvement works that are likely to be in place during operation of the proposed development. The runs are outlined below:

  - **Run 3 - Scenario 2: Proposed Operations Worst Case.**

    This is a worst case scenario where it is assumed that no control on the dock feeder flow has been installed and that no refurbishment of the lock gates has been undertaken.
  - **Run 4 – Scenario 2: Proposed Operations Best Case (with impoundment rate).**

    This is the best case scenario where it is assumed the control on the dock feeder flow has been installed and the refurbishment of the lock gates has been undertaken. This scenario also keeps the Applicants impoundment rate the same as at present.

- **Run 5 – Scenario 2: Proposed Operations: Best Case (without impoundment rate).**

  This is also a best case scenario run with the same assumptions as Run 4, but assumes the Applicant no longer needs to undertake impounding. By changing the rate of impoundment it is possible to establish whether impoundment will still be required by the Applicant in the future if improvements are made.

2.3.31 The following are the additional model runs requested by the River Afan Management Group, taking into account the dock return percentage reduction. These therefore constitute the updated scenarios modelled for the single phase installation operations (Option 1), making runs 3-5 obsolete:

- **Run 6 –** Scenario 2 Proposed Operations Worst Case;
- **Run 7 –** Scenario 2 Proposed Operations Best Case (with impoundment); and
- **Run 8 –** Scenario 2 Proposed Operations Best Case (without impoundment).

2.3.32 The following are the scenarios modelled for Phase 1 of Option 2:

- **Run 9 –** Scenario 3: Proposed Operations Worst Case;
- **Run 10 –** Scenario 3: Proposed Operations Best Case (with impoundment); and
- **Run 11 –** Scenario 3: Proposed Operations Best Case (without impoundment).

2.3.33 A further 6 model runs have been completed by AECOM capping the fish pass flow at the Q85 flow (0.16m3/s). This will allow flood flows into the dock feeder channel and is assumed to be more realistic of operations at the site. Runs 12-14 constitute the updated scenario 2 runs 6-8 modelled for Option 1 and 15-17 update scenario 3 runs 9-11 for Phase 1 of Option 2.

- **Run 12 –** Scenario 2 Proposed Operations Worst Case, capped fish pass flow;

- **Run 13 –** Scenario 2 Proposed Operations Best Case, capped fish pass flow (with impoundment); and
- **Run 14 –** Scenario 2 Proposed Operations Best Case, capped fish pass flow (without impoundment).

2.3.34 The following are the scenarios modelled for Phase 1 of Option 2:

- **Run 15 –** Scenario 3: Proposed Operations Worst Case, capped fish pass flow;
- **Run 16 –** Scenario 3: Proposed Operations Best Case, capped fish pass flow (with impoundment); and
- **Run 17 –** Scenario 3: Proposed Operations Best Case, capped fish pass flow (without impoundment).

2.3.35 The assumptions made in these model runs are outlined below in Table 14.2.3 and a complete list of data and assumptions inputted into the scenario runs are provided in Table 14.2.4.

Table 14.2.3 Simulated Model Run Assumptions

Run ID	Option and Complete / Phased Installation	Fish Pass	Dock Impoundment	Control on Dock Feeder Flow	Refurbishment of Lock Gates	Abstraction Data Used	Port Talbot Dock Abstraction Return (%)
1	Scenario 0 Current Power generation building	Original fish pass	Yes	No	No	Historic	88
2	Scenario 1 Current Power generation building	New fish pass	Yes	No	No	2011-2012 data	88
3	Scenario 2 Option 1 – Complete Installation	New fish pass	Yes	No	No	2011-2012 annual data + / - proposed abstraction requirements	88
4	Scenario 2 Option 1 – Complete Installation	New fish pass	Yes	Yes	Yes	2011-2012 annual data + / - proposed abstraction requirements	88
5	Scenario 2 Option 1 – Complete Installation	New fish pass	No	Yes	Yes	2011-2012 annual data + / - proposed abstraction	88

Table 14.2.3 Simulated Model Run Assumptions							
Run ID	**Option and Complete / Phased Installation**	**Fish Pass**	**Dock Impoundment**	**Control on Dock Feeder Flow**	**Refurbishment of Lock Gates**	**Abstraction Data Used**	**Port Talbot Dock Abstraction Return (%)**
						requirements	
6	Scenario 2 Option 1 – Complete Installation	New fish pass	Yes	No	No	2011-2012 annual data + / - proposed abstraction requirements	57.5
7	Scenario 2 Option 1 – Complete Installation	New fish pass	Yes	Yes	Yes	2011-2012 annual data + / - proposed abstraction requirements	57.5
8	Scenario 2 Option 1 – Complete Installation	New fish pass	No	Yes	Yes	2011-2012 annual data + / - proposed abstraction requirements	57.5
9	Scenario 3 Option 2 – Phase 1 Half Installation	New fish pass	Yes	No	No	2011-2012 annual data + / - proposed abstraction requirements	88
10	Scenario 3	New fish	Yes	Yes	Yes	2011-2012	88

Table 14.2.3 Simulated Model Run Assumptions							
Run ID	**Option and Complete / Phased Installation**	**Fish Pass**	**Dock Impoundment**	**Control on Dock Feeder Flow**	**Refurbishment of Lock Gates**	**Abstraction Data Used**	**Port Talbot Dock Abstraction Return (%)**
	Option 2 – Phase 1 Half Installation	pass				annual data + / - proposed abstraction requirements	
11	Scenario 3 Option 2 – Phase 1 Half Installation	New fish pass	No	Yes	Yes	2011-2012 annual data + / - proposed abstraction requirements	88
12	Scenario 2 Option 1 – Complete Installation	New fish pass Capped flow	Yes	No	No	2011-2012 annual data + / - proposed abstraction requirements	57.5
13	Scenario 2 Option 1 – Complete Installation	New fish pass Capped flow	Yes	Yes	Yes	2011-2012 annual data + / - proposed abstraction requirements	57.5
14	Scenario 2 Option 1 – Complete Installation	New fish pass Capped	No	Yes	Yes	2011-2012 annual data + / - proposed abstraction	57.5

Table 14.2.3 Simulated Model Run Assumptions

Run ID	Option and Complete / Phased Installation	Fish Pass	Dock Impoundment	Control on Dock Feeder Flow	Refurbishment of Lock Gates	Abstraction Data Used	Port Talbot Dock Abstraction Return (%)
		flow				requirements	
15	Scenario 3 Option 2 – Phase 1 Half Installation	New fish pass Capped flow	Yes	No	No	2011-2012 annual data + / - proposed abstraction requirements	88
16	Scenario 3 Option 2 – Phase 1 Half Installation	New fish pass Capped flow	Yes	Yes	Yes	2011-2012 annual data + / - proposed abstraction requirements	88
17	Scenario 3 Option 2 – Phase 1 Half Installation	New fish pass Capped flow	No	Yes	Yes	2011-2012 annual data + / - proposed abstraction requirements	88

Note: The assumptions for Phase 2 of Option 2 are not provided as these are equivalent to those used in the Option 1 modelling scenarios.

Table 14.2.4 Data and Assumptions Inputted to Model (Runs 1-11)

General	Run ID		1	2	3	4	5	6	7	8	9	10	11
	Description	Units	Scenario 0 original baseline without fish pass	Scenario 1 Current Operations	Scenario 2 Proposed Operations Worst Case	Scenario 2 Proposed Operations Best Case with impoundm ent rate	Scenario 2 Proposed Operations without impoundm ent rate	Scenario 2 Proposed Operations Worst Case	Scenario 2 Proposed Operations Best Case with Impoundm ent Rate	Scenario 2 Proposed Operations Best Case without Impoundme nt Rate	Scenario 3 Proposed Operations Worst Case	Scenario 3 Proposed Operations Best Case with Impoundme nt Rate	Scenario 3 Proposed Operations Best Case without Impoundme nt Rate
	Date		18/02/14	16/02/14	18/02/14	18/02/14	18/02/14	25/02/14	25/02/14	25/02/14	04/03/14	04/03/14	04/03/14
	Abstraction data file name		Old fish.xls	baseline.xl s	scenario 2.xls	scenario 2.xls	scenario 2.xls	scenario 2.xls	scenario 2.xls	scenario 2.xls	Scenario 3.xls	Scenario 3.xls	Scenario 3.xls
	Tide Table data filename:		Tide tables.xls	Tide tables.xls	Tide tables.xls	Tide tables.xls	Tide tables.xls	Tide tables.xls	Tide tables.xls	Tide tables.xls	Tide tables.xls	Tide tables.xls	Tide tables.xls
	Historic dock level data filename:		Historical dock level data_v2.x ls	Historical dock level data_v2.xl s	Historical dock level data_v2.xl s	Historical dock level data_v2.xl s	Historical dock level data_v2.xl s	Historical dock level data_v2.xl s	Historical dock level data_v2.xl s	Historical dock level data_v2.xls	Historical dock level data_v2.xls	Historical dock level data_v2.xls	Historical dock level data_v2.xls
	Ship displacement data filename:		Ship_Dis placemen t.xls	Ship_Displ acement.xl s	Ship_Displ acement.xl s	Ship_Displ acement.xl s	Ship_Displ acement.xl s	Ship_Displ acement.xl s	Ship_Displ acement.xl s	Ship_Displa cement.xls	Ship_Displa cement.xls	Ship_Displa cement.xls	Ship_Displa cement.xls
	Residual flow option		4	1	1	1	1	1	1	1	1	1	1
	Min GPW flow	Ml/d	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
	Historic or proposed operation licence simulation?		Historic	2011-2012 data	Option 1 - Proposed Operations estimate	Option 1 - Proposed Operations estimate	Option 1 - Proposed Operations estimate	Option 1 - Proposed Operations estimate	Option 1 - Proposed Operations estimate	Option 1 - Proposed Operations estimate	Option 2 - Phase 1 Proposed Operations estimate	Option 2 - Phase 1 Proposed Operations estimate	Option 2 - Phase 1 Proposed Operations estimate
	Start year		1994	1994	1994	1994	1994	1994	1994	1994	1994	1994	1994
	Macroft additional flow calibration factor:		0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Additional inflows	Arnallt Brook inflow to docks max	cume cs	0	0	0	0	0	0	0	0	0	0	0
	Arnallt Brook inflow to docks	Ml/d	No	No	No	No	No	No	No	No	No	No	No
	when docks level <	m AOD	5.72	5.72	5.72	5.72	5.72	5.72	5.72	5.72	5.72	5.72	5.72
	Afan DCWW STW discharge to docks max	cume cs	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Afan DCWW STW discharge inflow to docks		No	No	No	No	No	No	No	No	No	No	No
	SUDS inflow to docks		No	No	No	No	No	No	No	No	No	No	No
	Over area	sq m	49000	49000	49000	49000	49000	49000	49000	49000	49000	49000	49000

Table 14.2.4 Data and Assumptions Inputted to Model (Runs 1-11)													
General	**Run ID**		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
	SUDS assumed storage	cu.m	2500.00	2500.00	2500.00	2500.00	2500.00	2500.00	2500.00	2500.00	2500.00	2500.00	2500.00
	Long sea outfall discharge to docks max	cumecs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Long sea outfall discharge to docks		No	No	No	No	No	No	No	No	No	No	No
	Default max when no data	Ml/d	30	30	30	30	30	30	30	30	30	30	30
	Impounding pump from sea	Ml/d	40	40	40	40	0	40	40	0	40	40	0
	when docks level <	m AOD	5.18	5.18	5.18	5.18	5.18	5.18	5.18	5.18	5.18	5.18	5.18
Parameter values	Docks feeder flow constraint	Ml/d	350	350	350	350	350	350	350	350	350	350	350
	Min feeder flow to maintain pump head	Ml/d	5	5	5	5	5	5	5	5	5	5	5
	Dock plan area	sq.km	0.468	0.468	0.468	0.468	0.468	0.468	0.468	0.468	0.468	0.468	0.468
	Dock water level at top of dock gates	m AOD	5.82	5.82	5.82	5.82	5.82	5.82	5.82	5.82	5.82	5.82	5.82
	Max dock water level above top of gates	m	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	Feeder flow constrained by dock storage?		No	No	No	yes	yes	No	yes	yes	No	yes	yes
	Lock gate max leakage when low high tide	Ml/d	50	50	50	0.00	0.00	50	0.00	0.00	50	0.00	0.00
	Proportion of max leak when no tide data	%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
	Quantity 1 for sluicing of dock water to sea	Ml/d	250.00	250.00	250.00	250.00	250.00	250.00	250.00	250.00	250.00	250.00	250.00
	Level 1 for sluicing of dock water to sea	mb TWL	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	Quantity 2 for sluicing of dock water to sea	Ml/d	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00
	Level 2 for sluicing of dock water to sea	mb TWL	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
	Historic or simulated ship entries		Historic	Historic	Historic	Historic	Historic	Historic	Historic	Historic	Historic	Historic	Historic
	Lock loss during entry/exit of ship if no data	Ml/d	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8
	Average no of ships entering docks		0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
	Lock plan area	sq.m	4069.5	4069.5	4069.5	4069.5	4069.5	4069.5	4069.5	4069.5	4069.5	4069.5	4069.5
Annual Licence	Corus docks feeder abstn	Ml/d	23.52	26.24	41.10	41.10	41.10	41.10	41.10	41.10	35.62	35.62	35.62
	Corus docks abstn	Ml/d	350.19	438.50	128.77	128.77	128.77	128.77	128.77	128.77	454.79	454.79	454.79

Table 14.2.4 Data and Assumptions Inputted to Model (Runs 1-11)													
General	**Run ID**		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
	% of abstn returned to docks	%	88.00	88.00	88.00	88.00	88.00	57.50	57.50	57.50	88.00	88.00	88.00
	Corus Ffrwd Wyllt abstn	Ml/d	2.93	2.64	2.47	2.47	2.47	2.47	2.47	2.47	2.47	2.47	2.47
	Civil & Marine docks abstn	Ml/d	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Seepage to gw	Base permeability (silty clay), k =	m/d	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	Head differential estimate, h =	m	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
	Saturated thickness estimate, s =	m	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00

Table 14.2.4 Data and Assumptions Inputted to Model (Runs 12-17)								
General	**Run ID**		**12**	**13**	**14**	**15**	**16**	**17**
	Description	Units	Scenario 2 Proposed Operations Worst Case	Scenario 2 Proposed Operations Best Case with Impoundment Rate	Scenario 2 Proposed Operations Best Case without Impoundment Rate	Scenario 3 Proposed Operations Worst Case	Scenario 3 Proposed Operations Best Case with Impoundment Rate	Scenario 3 Proposed Operations Best Case without Impoundment Rate
	Date		06/05/14	06/05/14	06/05/14	06/05/14	06/05/14	06/05/14
	Abstraction data file name		scenario 2.xls	scenario 2.xls	scenario 2.xls	Scenario 3.xls	Scenario 3.xls	Scenario 3.xls
	Tide Table data filename:		Tide tables.xls	Tide tables.xls	Tide tables.xls	Tide tables.xls	Tide tables.xls	Tide tables.xls
	Historic dock level data filename:		Historical dock level data_v2.xls	Historical dock level data_v2.xls	Historical dock level data_v2.xls	Historical dock level data_v2.xls	Historical dock level data_v2.xls	Historical dock level data_v2.xls
	Ship displacement data filename:		Ship_Displacement.xls	Ship_Displacement.xls	Ship_Displacement.xls	Ship_Displacement.xls	Ship_Displacement.xls	Ship_Displacement.xls
	Residual flow option		1 (capped at Q85)	1 (capped at Q85)	1 (capped at Q85)	1 (capped at Q85)	1 (capped at Q85)	1 (capped at Q85)
	Min GPW flow	Ml/d	15.00	15.00	15.00	15.00	15.00	15.00
	Historic or proposed operation licence simulation?		Option 1 - Proposed Operations estimate	Option 1 - Proposed Operations estimate	Option 1 - Proposed Operations estimate	Option 2 - Phase 1 Proposed Operations estimate	Option 2 - Phase 1 Proposed Operations estimate	Option 2 - Phase 1 Proposed Operations estimate
	Start year		1994	1994	1994	1994	1994	1994
	Macroft additional flow calibration factor:		0.98	0.98	0.98	0.98	0.98	0.98
Additional inflows	Arnallt Brook inflow to docks max	cumecs	0	0	0	0	0	0
	Arnallt Brook inflow to	Ml/d	No	No	No	No	No	No

Table 14.2.4 Data and Assumptions Inputted to Model (Runs 12-17)								
General	**Run ID**		**12**	**13**	**14**	**15**	**16**	**17**
	docks							
	when docks level <	m AOD	5.72	5.72	5.72	5.72	5.72	5.72
	Afan DCWW STW discharge to docks max	cumecs	0.000	0.000	0.000	0.000	0.000	0.000
	Afan DCWW STW discharge inflow to docks		No	No	No	No	No	No
	SUDS inflow to docks		No	No	No	No	No	No
	Over area	sq m	49000	49000	49000	49000	49000	49000
	SUDS assumed storage	cu.m	2500.00	2500.00	2500.00	2500.00	2500.00	2500.00
	Long sea outfall discharge to docks max	cumecs	0.00	0.00	0.00	0.00	0.00	0.00
	Long sea outfall discharge to docks		No	No	No	No	No	No
	Default max when no data	Ml/d	30	30	30	30	30	30
	Impounding pump from sea	Ml/d	40	40	0	40	40	0
	when docks level <	m AOD	5.18	5.18	5.18	5.18	5.18	5.18
Parameter values	Docks feeder flow constraint	Ml/d	350	350	350	350	350	350
	Min feeder flow to maintain pump head	Ml/d	5	5	5	5	5	5
	Dock plan area	sq.km	0.468	0.468	0.468	0.468	0.468	0.468
	Dock water level at top of dock gates	m AOD	5.82	5.82	5.82	5.82	5.82	5.82
	Max dock water level above top of gates	m	0.3	0.3	0.3	0.3	0.3	0.3
	Feeder flow constrained by dock storage?		No	Yes	Yes	No	Yes	Yes
	Lock gate max leakage when low high tide	Ml/d	50	0.00	0.00	50	0.00	0.00
	Proportion of max leak when no tide data	%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
	Quantity 1 for sluicing of dock water to sea	Ml/d	250.00	250.00	250.00	250.00	250.00	250.00

Table 14.2.4 Data and Assumptions Inputted to Model (Runs 12-17)

General	Run ID		12	13	14	15	16	17
	Level 1 for sluicing of dock water to sea	mb TWL	0.01	0.01	0.01	0.01	0.01	0.01
	Quantity 2 for sluicing of dock water to sea	Ml/d	30.00	30.00	30.00	30.00	30.00	30.00
	Level 2 for sluicing of dock water to sea	mb TWL	0.20	0.20	0.20	0.20	0.20	0.20
	Historic or simulated ship entries		Historic	Historic	Historic	Historic	Historic	Historic
	Lock loss during entry/exit of ship if no data	Ml/d	4.8	4.8	4.8	4.8	4.8	4.8
	Average no of ships entering docks		0.25	0.25	0.25	0.25	0.25	0.25
	Lock plan area	sq.m	4069.5	4069.5	4069.5	4069.5	4069.5	4069.5
Annual Licence	Corus docks feeder abstn	Ml/d	41.10	41.10	41.10	35.62	35.62	35.62
	Corus docks abstn	Ml/d	128.77	128.77	128.77	454.79	454.79	454.79
	% of abstn returned to docks	%	57.50	57.50	57.50	88.00	88.00	88.00
	Corus Ffrwd Wyllt abstn	Ml/d	2.47	2.47	2.47	2.47	2.47	2.47
	Civil & Marine docks abstn	Ml/d	0.00	0.00	0.00	0.00	0.00	0.00
Seepage to gw	Base permeability (silty clay), k =	m/d	0.01	0.01	0.01	0.01	0.01	0.01
	Head differential estimate, h =	m	20.00	20.00	20.00	20.00	20.00	20.00
	Saturated thickness estimate, s =	m	10.00	10.00	10.00	10.00	10.00	10.00

2.4 Limitations to Modelling

2.4.1 The modelling has been undertaken based on the model provided to AECOM from NRW. The outputs generated are based on the baseline water resource data that was currently available and provided in the model files received from NRW. Therefore, information, views and conclusions drawn are based, in part, on the data supplied to AECOM by other parties. AECOM accepts no liability for any inaccurate conclusions, assumptions or actions taken resulting from any inaccurate information supplied to AECOM from others.

2.4.2 Some anomalous results have been generated from the modelled scenarios under conditions where the fish pass flow hydrograph preferentially channels high flows down the fish pass. These outputs have been reviewed internally by AECOM and it has been confirmed that the scenarios run through the model were correctly simulated and the statistical analysis undertaken on the run outputs is accurate. The results of these runs can therefore, not be viewed with any degree of confidence, which presents a limitation to this component of the surface water environment assessment.

2.4.3 Further model runs capped the fish pass flow at the Q85 flow with the intention of simulating excess flood water to pass down the dock feeder channel and enter the dock. The model outputs did not show a great deal of change in the balance with the capped fish pass flows suggesting there may still be an imbalance.

2.4.4 The model outputs have however, shown consistent trends in water resource availability for the various simulated scenarios. These trends have therefore been used to make informed assumptions of future water resource availability, based on probability, for the assessment of potential effects on the surface water environment. These assumptions are outlined in chapter 4 of this technical appendix and are used in Chapter 14 of the ES.

3 MODEL RESULTS

3.1 Runs 1& 2: Scenario 0 & 1 Baseline & Current Results

River Afan Residual Flows over Greenpark Weir

3.1.1 Figure 14.2.2 demonstrates the difference in River Afan flows between the old fixed flow previously used by the model (RFO option 4) and the new fish pass residual flow used in these model runs.

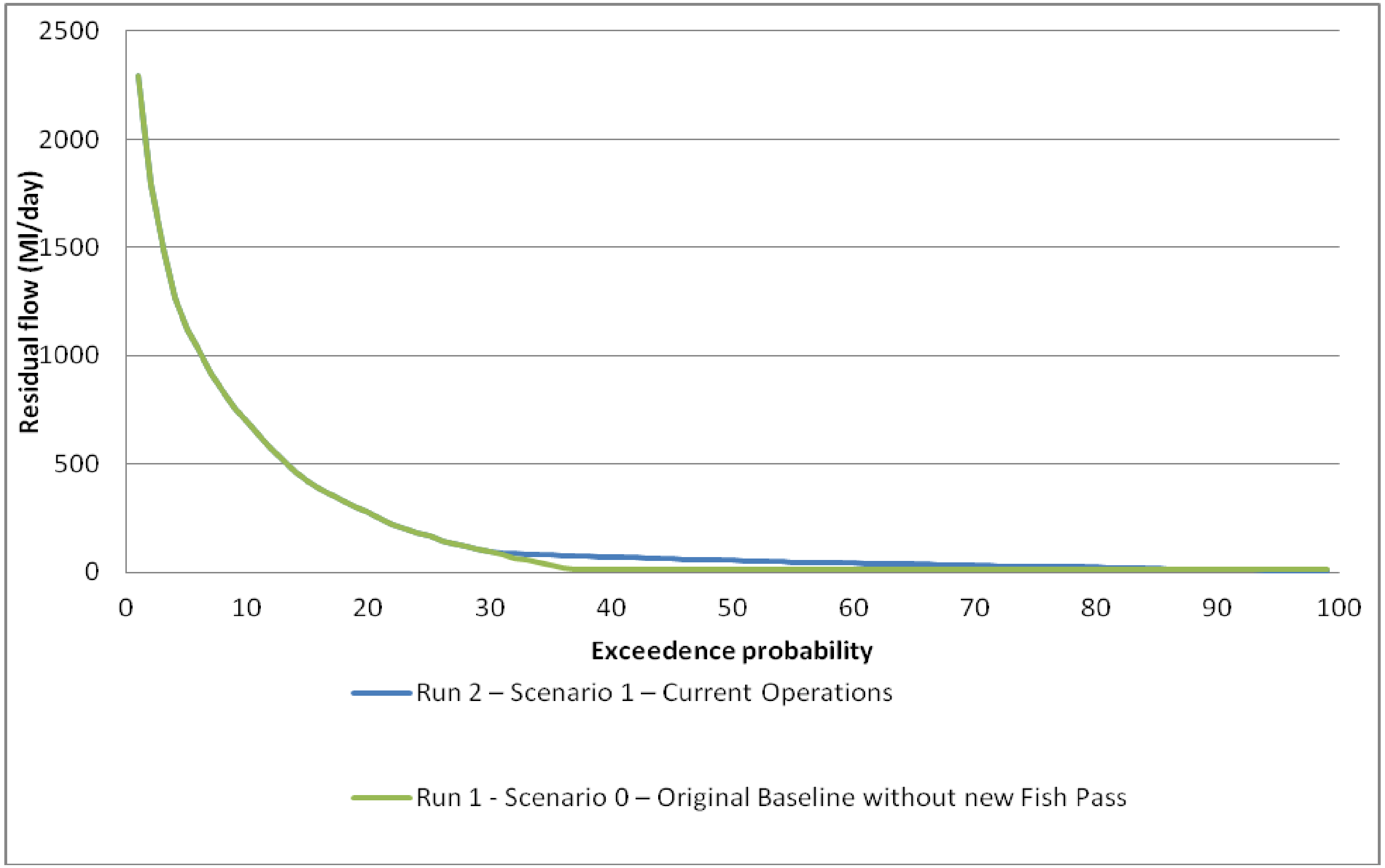

Figure 14.2.2 River Afan Residual Flow over Greenpark Weir. Run 1 – Scenario 0 Old Baseline without new fish pass residual flows, compared to Run 2 – Scenario 1 Current Operations.

3.1.2 Modelled residual flow over Greenpark weir for the 17 years of simulation based on the historic flow record were compared with that required under the WFD83 standard.

3.1.3 Figure 14.2.3 below illustrates that under Scenario 1 current operations, using the 2011-2012 abstraction data, the WFD83 RFO is met for 4% of the time.

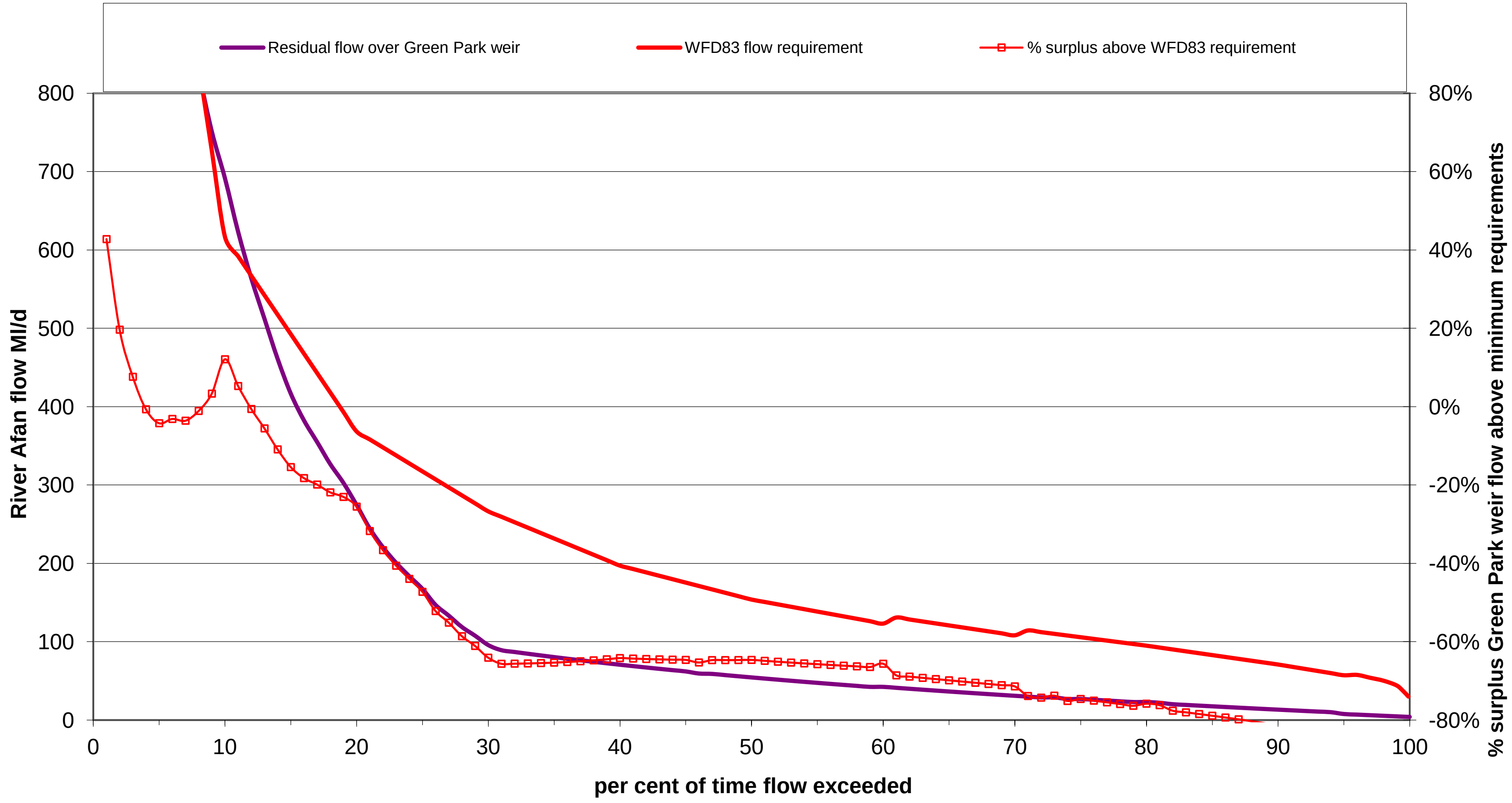

Figure 14.2.3 River Afan Flow Duration Curve. Run 2 – Scenario 1 Current Operations.

Port Talbot Dock Levels

3.1.4 The modelled water levels in the Port Talbot Dock for the 17 years of simulation based on the historic flow record were compared with the minimum water levels required by the Applicant to operate their abstraction pumps and not impound. A critical minimum water level of 5.18 mAOD has been used to establish the percentage of time the dock level falls below the critical level.

3.1.5 Figure 14.2.4 below shows that under Scenario 1 current conditions, the percent of time the Port Talbot Dock level is below the critical minimum level at 5.18 mAOD is 11%, over the whole simulation period.

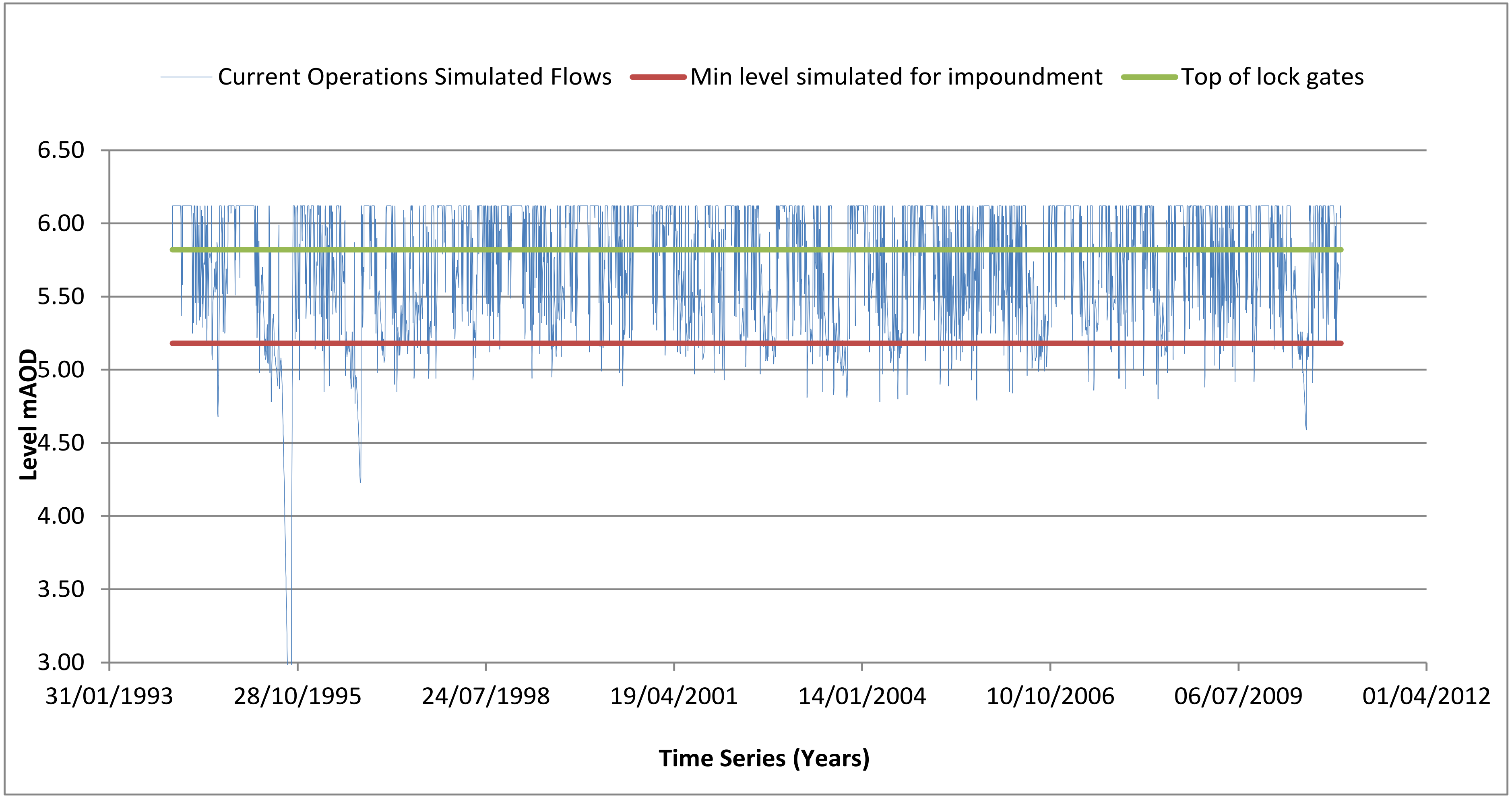

Figure 14.2.4 Port Talbot Dock simulated level time series plot for whole simulation period. Run 2 – Scenario 1 Current Operations.

3.2 Proposed Operation Results

River Afan Residual Flows over Greenpark Weir

Runs 3, 4 and 5: Scenario 2 Option 1 88% dock return rate

3.2.1 It should be noted that runs 3, 4 and 5 presented below are now obsolete. These runs are replaced by runs 6, 7 and 8 respectively, where the assumed 88% return rate for Port Talbot Dock abstraction has been amended to represent the worst case water balance situation for the proposed development at 57.5%.

3.2.2 The model outputs suggest that even for a worst case scenario, where improvement works are assumed to have not been undertaken, the WFD83 RFO is met for 4% of the time, which represents no change from the baseline, where the WFD83 RFO is also met for 4% of the time (as shown above in Figure 14.2.3).

3.2.3 Simulated results for a best case scenario, where improvement works are assumed to have been undertaken, the WFD83 RFO is met for 46% of the time, which represents a significant increase from the 4% compliance achieved for the baseline.

3.2.4 This demonstrates that the planned improvement works, including the control on the dock feeder off take and refurbishments of the lock gates, will improve the residual flows over Greenpark Weir even when the abstraction requirement is increased for the proposed development.

3.2.5 Under the best case scenario, where improvement works are assumed to have been undertaken but no impoundment occurs, the WFD83 RFO is predicted to met for 45% of the time, which also represents an increase from the 4% compliance achieved for the baseline.

3.2.6 Also demonstrating that the planned improvement works, including the control on the dock feeder off take and refurbishments of the lock gates, means that the residual flows over Greenpark Weir are improved even when the abstraction requirement is increased for the proposed development.

3.2.7 Further to this, when impoundment by the Applicant is not undertaken the residual flows over Greenpark Weir are still improved to a considerable degree.

Runs 6, 7 and 8: Scenario 2 Option 1 57.5% dock return rate uncapped fish pass flows

3.2.8 As mentioned, Runs 6, 7 and 8 replace Runs 3, 4 and 5 presented above.

3.2.9 Similar trends to that established for runs 3, 4 and 5.

3.2.10 For Run 6 (the worst case scenario) the percentage of time the residual flow over Greenpark Weir meets the WFD83 RFO remains unchanged from the baseline and from Run 3 at 4%.

3.2.11 Similarly, for Run 7 (best case, with impoundment rate), this percentage is increased to 38% and for Run 8 (best case, without impoundment rate) the percentage is also increased to 38%, showing a similar trend of improved residual flow when planned improvement works are assumed to have been undertaken, as with Runs 4 and 5.

Runs 9, 10 and 11: Scenario 3 Phase 1 Option 2 88% dock return rate uncapped fish pass flows

3.2.12 Similar trends to that established for runs run for Option 1 (Runs 3, 4 and 5, and Runs 6, 7 and 8) have been simulated for Option 2, Phase 1.

3.2.13 For Run 9 (the worst case scenario) the percentage of time the residual flow over Greenpark Weir meets the WFD83 RFO remains unchanged from the baseline and from Option 1 runs (Runs 3 and 6) at 4%.

3.2.14 Similarly, for Run 10 (best case, with impoundment rate), this percentage is increased to 41% and for Run 11 (best case, without impoundment rate) the percentage is also increased to 39%, showing a similar trend of improved residual flow when planned improvement works are assumed to have been undertaken, as with runs for Option 1 (Runs 4 and 5, and Runs 7 and 8).

Runs 12, 13 and 14: Scenario 2 Option 1 57.5% dock return rate capped fish pass flows

3.2.15 As mentioned, Runs 12, 13 and 14 replace Runs 6, 7 and 8 presented above.

3.2.16 For Run 12 (the worst case scenario) the percentage of time the residual flow over Greenpark Weir meets the WFD83 RFO remains unchanged from the baseline, from Run 3 and from Run 6 at 4%.

3.2.17 Similarly, for Run 13 (best case, with impoundment rate), this percentage is increased to 39% and for Run 14 (best case, without impoundment rate) the percentage is also increased to 38%, showing a similar trend of improved residual flow when planned improvement works are assumed to have been undertaken, as with Runs 7 and 8.

Runs 15, 16 and 17: Scenario 3 Phase 1 Option 2 88% dock return rate capped fish pass flows

3.2.18 Runs 15, 16 and 17 replace Runs 9, 10 and 11 presented above.

3.2.19 As occurred for Runs 9, 10 and 11, similar trends to that established for runs run for Option 1 (Runs 3, 4 and 5, and Runs 6, 7 and 8) have been simulated for Option 2, Phase 1 Runs 15, 16 and 17.

3.2.20 For Run 15 (the worst case scenario) the percentage of time the residual flow over Greenpark Weir meets the WFD83 RFO remains unchanged from the baseline and from Option 1 runs (Runs 3, 6 and 12) at 4%.

3.2.21 Similarly, for Run 16 (best case, with impoundment rate), this percentage is increased to 41% and for Run 17 (best case, without impoundment rate) the percentage is also increased to 40%, showing a similar trend of improved residual flow when planned improvement works are assumed to have been undertaken, as with runs for Option 1 (Runs 4 and 5, Runs 7 and 8, Runs 13 and 14).

3.2.22 Table 14.2.3 provides a summary of the residual flow over Greenpark weir relative to the WFD83 RFO flow requirements under the various scenarios simulated for the proposed development.

Table 14.2.3 Residual Flow over Greenpark Weir relative to WFD83 Flow Requirement		
Run	**Option and Plant Installation**	**Percentage of Time the WFD83 RFO is exceeded (%)**
1	Present operations with original fish pass	4
2	Present operations with new fish pass	4
3	Option 1 - Complete Installation: Worst case, 88% dock return.	4
4	Option 1 - Complete Installation: Best case (with impoundment rate), 88% dock return.	46
5	Option 1 - Complete Installation: Best case (without impoundment rate), 88% dock return.	45
6	Option 1 - Complete Installation: Worst case, 57.5% dock return.	4
7	Option 1 - Complete Installation: Best case (with impoundment rate), 57.5% dock return.	38
8	Option 1 - Complete Installation: Best case (without impoundment rate), 57.5% dock return.	38
9	Option 2 – Phase 1: Worst case, 88% dock return. Phased installation.	4
10	Option 2 - Phase 1: Best case (with impoundment rate), 88% dock return. Phased installation.	41
11	Option 2 – Phase 1: Best case (without impoundment rate), 88% dock return. Phased installation.	39
12	Option 1 - Complete Installation: Worst case, 57.5% dock return. Capped fish pass flow.	4
13	Option 1 - Complete Installation: Best case (with impoundment rate), 57.5% dock return. Capped fish pass flow.	39
14	Option 1 - Complete Installation: Best case (without impoundment rate), 57.5% dock return. Capped fish pass flow.	38
15	Option 2 – Phase 1: Worst case, 88% dock return. Phased installation. Capped fish pass flow.	4

16	Option 2 - Phase 1: Best case (with impoundment rate), 88% dock return. Phased installation. Capped fish pass flow.	41
17	Option 2 – Phase 1: Best case (without impoundment rate), 88% dock return. Phased installation. Capped fish pass flow.	40

Port Talbot Dock Level Results

Runs 3, 4 and 5: Scenario 2 Option 1 88% dock return rate

3.2.23 It should be noted that runs 3, 4 and 5 presented below are now obsolete. These runs are replaced by runs 6, 7 and 8 respectively, where the assumed 88% return rate for Port Talbot Dock abstraction has been amended to represent the worst case water balance situation for the proposed development at 57.5%.

3.2.24 For a worst case scenario, where improvement works are assumed to have not been undertaken, the percent of time the Port Talbot Dock level is below the critical minimum level at 5.18 mAOD is 6%, over the whole simulation period. This represents a decrease in percentage compared to the baseline at 11%.

3.2.25 For a best case scenario, where improvement works are assumed to have been undertaken, the percent of time the Port Talbot Dock level is below the critical minimum level at 5.18 mAOD is 15%, over the whole simulation period. This represents an increase in percentage compared to the baseline at 11%.

3.2.26 Further to this, when impoundment by the Applicant is not undertaken the percent of time the Port Talbot Dock level is below the critical minimum level at 5.18 mAOD is also increased from the baseline (11%) to 18%, over the whole simulation period.

3.2.27 The percentage of time the dock level is below the minimum level required for impoundment by the Applicant appears counter intuitive, as the percentage is increased for Runs 4 and 5 (best case scenarios) where it is logical to expect a reduction as the improvement works are assumed to have been undertaken. This is thought to be due to the fish pass – feeder channel flow split used in these scenarios and in investigated further. Despite this issue it remains clear that, the percentage does increase slightly in Run 5 compared to Run 4, due to the change in impoundment assumption. The percentage also decreases for Run 3 (worst case) compared to Run 2 (baseline) due to the decrease in required abstraction from the dock during operation of the proposed development.

Runs 6, 7 and 8: Scenario 2 Option 1 57.5% dock return rate uncapped fish pass flows

3.2.28 When the percentage of water returned to the dock is altered to 57.5% of the proposed abstraction, the percentage of time the dock level is below the critical minimum level has a similar trend to that achieved for the 88% return assumption and increases from the baseline (11%) for all proposed operation scenarios, at 16%, 26% and 32% respectively.

3.2.29 As with Runs 3, 4 and 5 the model results appear counter intuitive with an increased frequency of low dock levels despite the decrease in net abstraction volume. This is investigated further in runs 12-14 where fish pass flow requirements are capped at the Q85 percentile.

Runs 9, 10 and 11: Scenario 3 Phase 1 Option 2 88% dock return rate uncapped fish pass flows

3.2.30 For Option 2, Phase 1, the percentage of time the dock level is below the critical minimum level has a similar trend to that achieved for Option 1 and increases from the baseline (11%) for all proposed operation scenarios, at 14%, 25% and 31% respectively.

3.2.31 It is logical to expect the increase in abstraction volume from the River Afan, to increase the percentage of time the critical minimum level is not met, although the increase in abstraction volume may not be large enough to change the percentage. Additionally, for the best case scenarios it is also logical to expect a percentage reduction as the improvement works are assumed to have been undertaken. Therefore, as with runs for Option 1, the model results appear counter intuitive with an increased frequency of low dock levels, despite the abstraction and discharge taken directly from the Port Talbot Dock remaining unchanged from the current regime. This is investigated further in runs 15-17 where fish pass flow requirements are capped at the Q85 percentile.

Runs 12, 13 and 14: Scenario 2 Option 1 57.5% dock return rate capped fish pass flows

3.2.32 With a capped fish pass flow when the percentage of water returned to the dock is altered to 57.5% of the proposed abstraction, the percentage of time the dock level is below the critical minimum level has a similar trend to that achieved for the 88% return assumption and increases from the baseline (11%) for all proposed operation scenarios, at 16%, 26% and 32% respectively.

3.2.33 The model results appear counter intuitive with an increased frequency of low dock levels despite the decrease in net abstraction volume.

Runs 15, 16 and 17: Scenario 3 Phase 1 Option 2 88% dock return rate capped fish pass flows

3.2.34 With a capped fish pass flow for Option 2, Phase 1, the percentage of time the dock level is below the critical minimum level has a similar trend to that achieved for Option 1 and increases from the baseline (11%) for all proposed operation scenarios, at 14%, 25% and 31% respectively.

3.2.35 It is logical to expect the increase in abstraction volume from the River Afan, to increase the percentage of time the critical minimum level is not met, although the increase in abstraction volume may not be large enough to change the percentage. Additionally, for the best case scenarios it is also logical to expect a percentage reduction as the improvement works are assumed to have been undertaken. Therefore, as with runs for Option 1, the model results appear counter intuitive with an increased frequency of low dock levels, despite the abstraction and discharge taken directly from the Port Talbot Dock remaining unchanged from the current regime.

3.2.36 Table 14.2.4 provides a summary of the Port Talbot Dock level relative to the minimum critical water level under the various scenarios simulated for the proposed development.

Table 14.2.4 Port Talbot Dock Level Relative to the Minimum Critical Water Level at 5.18 mAOD		
Run	**Option and Plant Installation**	**% time dock level below minimum required for impoundment (5.18 mAOD)**
1	Present operations with original fish pass	7
2	Present operations with new fish pass	11
3	Option 1 - Complete Installation: Worst case, 88% dock return.	6
4	Option 1- Complete Installation: Best case (with impoundment rate), 88% dock return.	15
5	Option 1 - Complete Installation: Best case (without impoundment rate), 88% dock return.	18
6	Option 1 - Complete Installation: Worst case, 57.5% dock return.	16
7	Option 1- Complete Installation: Best case (with impoundment rate), 57.5% dock return.	26
8	Option 1 - Complete Installation: Best case (without impoundment rate), 57.5% dock return.	32
9	Option 2 – Phase 1: Worst case, 88% dock return. Phased installation.	14
10	Option 2- Phase 1: Best case (with impoundment rate), 88% dock return. Phased installation.	25
11	Option 2 – Phase 1: Best case (without impoundment rate), 88% dock return. Phased installation.	31

Table 14.2.4 Port Talbot Dock Level Relative to the Minimum Critical Water Level at 5.18 mAOD		
Run	**Option and Plant Installation**	**% time dock level below minimum required for impoundment (5.18 mAOD)**
12	Option 1 - Complete Installation: Worst case, 57.5% dock return. Capped fish pass flow.	14
13	Option 1- Complete Installation: Best case (with impoundment rate), 57.5% dock return. Capped fish pass flow.	28
14	Option 1 - Complete Installation: Best case (without impoundment rate), 57.5% dock return. Capped fish pass flow.	35
15	Option 2 – Phase 1: Worst case, 88% dock return. Phased installation. Capped fish pass flow.	13
16	Option 2- Phase 1: Best case (with impoundment rate), 88% dock return. Phased installation. Capped fish pass flow.	27
17	Option 2 – Phase 1: Best case (without impoundment rate), 88% dock return. Phased installation. Capped fish pass flow.	33

4 CONCLUSIONS AND ASSUMPTIONS

4.1 River Afan Residual Flow over Greenpark Weir

4.1.1 The results of residual flows over Greenpark Weir show similar trends on all model runs, where better flows compared to the baseline for the best case scenario model runs (where the WFD83 RFO is met for a higher percentage of time) and same flows to the baseline for the worst case scenario model runs (where the WFD83 RFO is met for 4% of the time) are achieved. The results do, however, change slightly between the original results presented on 20th February 2014 to the River Afan Management Group (Runs 3, 4 and 5), the updated runs that replaced these (Runs 6, 7 and 8) and the runs for Option 2, Phase 1 (Runs 9, 10 and 11).

4.1.2 Therefore, it is considered that, under an uncapped fish pass flow regime, the changes to the River Afan flow regime are anomalous, as it is reasonable to assume the changes in dock return percentage should not impact on River Afan flows. This suggests an issue with flow apportionment between the fish pass and feeder channel and further capped runs (12-17) have been carried out to investigate this. Little change was predicted to the dock level regime as a result of fish pass flow capping suggesting that some other factor is responsible for the anomalously low dock water levels in these scenarios.

4.1.3 Therefore, for both options of the proposed development the assessment of potential effects will be based on the probability that:

A. The percentage of time the River Afan flows meets the WFD83 RFO will remain unchanged for the worst case scenario; and

B. The percentage of time the River Afan flows meets the WFD83 RFO will be improved for both best case scenarios, where improvement works are assumed to have been undertaken.

4.2 Port Talbot Dock Level

4.2.1 The results on all model runs for dock level change show similar trends in results for both worst case and best case scenarios. Under a worst case scenario (no improvement works) there is a slight increase in the percentage of time the level of the Port Talbot Dock is below the minimum level required for impoundment by Tata. However, as the results for best case scenario runs are counter intuitive with an increased frequency of low dock levels, despite the improvement works being undertaken, it is considered that there is an anomaly in the model. Therefore, the assessment of potential effects, for both Options, will be based on the probability that:

A. The percentage of time the level of the Port Talbot Dock is below the minimum level required for impoundment by Tata will slightly increase for the worst case scenario; and

B. For a best case scenario no adverse effects on dock level will occur as a result of the proposed development beyond that established in the worst case scenario. In this way, the assessment of potential effects establishes an upper limit for dock level change.

4.2.2 The probability that the dock level will be adversely affected for the best case scenarios, (where it is assumed improvement works have been undertaken) is very low, as it is reasonable to assume the improvement works will maintain the level in the dock above the level established for the worst case scenario.

4.2.3 The assumptions made for the assessment of potential effects on the surface water environment, show no dependence on the planned improvement works being undertaken as assumptions have been based on a worst case scenario, where it is assumed the planned improvement works have not been undertaken.