Appendix 14.4: Technical Note for Option 1

Technical Note

Project:	Proposed Internal Power Generation Enhancement for Port Talbot Steelworks	Job No:	60275968
Subject:	Surface Water Environment Assessment – A Review of Water Balance Model Findings		
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1.1 Introduction

This technical note has been written in response to requests from the River Afan Management Group during a meeting held on 20th February 2014, where the preliminary findings of the River Afan Water Balance Model were presented to the group. Requests and actions from the meeting include:

1. Associated British Ports (ABP) requested to see confirmation that evaporative losses from the proposed cooling towers are minimal and do not affect the return of abstraction to the Port Talbot Docks. AECOM are to review the percentage of return assumed in the model for the proposed operating system and will re-run the model on a new percentage assumption.
2. AECOM are to review the numbers generated by the model for the percentage of the time the water levels are below the minimum dock level for impoundment.
3. AECOM are to provide confirmation on whether the percentage in dock abstraction return has a significant effect on dock water levels.

1.2 Request / Action 1

1. It was confirmed in the meeting 20th February 2014 by Guy Simms that the percentage return of abstraction to the Port Talbot Dock would be less than currently assumed in the model at 88%.

2. Tata Steel 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 Tata Steels 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 will still occur. The magnitude of these losses is unknown but will 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.

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3. Three new runs, assuming a 57.5% return rate of the proposed new abstraction volume of 47M m^3/yr, have been put through the model for the proposed operation scenarios. These include:

    - 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).

4. The results from model runs for the percentage of the time the dock level is below the minimum level required for impoundment are outlined below in Table 1.1.

Table 1.1: Percentage of time dock level below min level required for impoundment (over whole simulation period)

	Model run with assumed 88% return (47M m^3/yr abstracted, 41,36M m^3/yr returned, 5,64M m^3/yr lost)	**Model run with assumed 57.5% return** (47M m^3/yr abstracted, 27M m^3/yr returned, 20M m^3/yr lost)
Scenario 2 Proposed Operations Worst Case	5.6 %	15.8 %
Scenario 2 Proposed Operations Best Case (with impoundment)	14.8 %	25.6 %
Scenario 2 Proposed Operations Best Case (without impoundment)	17.6 %	33.2 %
Note: Scenario 1 Current Operations baseline (166M m^3/yr abstracted, 146M m^3/year returned, 20M m^3/yr lost) level is below minimum 10.7% of time.		

5. Table 1.1 shows that when the percentage of water returned to the dock is altered to 57.5% of the proposed abstraction (47M m^3/yr), the percentage of time the dock level is below the minimum level required for impoundment shows a similar trend to that achieved for the 88% return assumption and is increased for all proposed operation scenarios. The model results appear counter intuitive with an increased frequency of low dock levels despite the decrease in abstraction volume. This is reviewed further below.

1.3 Request / Action 2

6. A review of the simulated dock levels (and the percent of time the dock level is below the minimum level required for impoundment) presented to the River Afan Management Group on 20th February 2014 has been undertaken.

7. AECOM can confirm that the scenarios run through the model were correctly run and the statistical analysis undertaken on the run results is also accurate.

8. It has been concluded therefore, that the model is returning anomalous results. A volumetric reduction in dock abstraction is resulting in lower dock levels and increased frequency of failure to meet the minimum abstraction level threshold of 5.18m.

9. As the runs were simulated correctly in the model and as the statistical analysis is also accurate it is reasonable to assume there is an internal problem within the model itself. The results for simulated dock level can therefore not be viewed with any degree of confidence, which presents a limitation to this component of the surface water environment assessment.

1.4 Request / Action 3

10. There are three variables for abstraction and discharge that will change from the baseline levels for the proposed operations scenarios. These include:
    - An increase of abstraction from the River Afan (Dock Feeder Channel) from 10,000,000 m^3/yr to 15,000,000 m^3/yr (which should reduce the amount of water reaching the dock from the feeder channel);
    - Reduction of abstraction from the Port Talbot Dock from 166,000,000 m^3/yr to 47,000,000 m^3/yr; (which should generally raise dock levels); and
    - Change in dock return percentage from 88% to 57.5% (which requires quantification).

11. In order to establish whether the proposed development will have a significant effect on dock level, AECOM propose to compare the volume of water in the dock when an 88% assumed return rate is used for baseline abstraction, to the volume in the dock when a 57.5% assumed return rate is used for the proposed operation abstraction requirements. The approach reviews these volumetric changes in isolation, in order to establish a direct effect from Tata dock abstraction and return on dock level. This will be undertaken for the worst case scenario, where no improvement works (the control on the dock feeder channel and the refurbishment of lock gates) have been undertaken. The resulting water level impact is then reviewed against the measured variation in water levels in the dock.

12. The preliminary findings of this approach are outlined below for your comment:

- Two methods were used to estimate the change in dock level linked to dock abstraction return rate (volume measures = m^3, depth measures = m) :
  - (1) Depth change = volume change / dock area
  - (2) Depth change = volume change * 0.0000027
- Calculation (1) assumes a fixed dock area of 468,000 m^2 across the range of dock water levels established for the model[1].
- Calculation (2) uses the relationship between dock depth and volume developed by Halcrow[1].
- Under current conditions 12% (baseline) (20M m^3) of the annual 166M m^3 abstracted dock water is lost to evaporation and blow down, this is equivalent to daily losses of 54,575 m^3 which equates to a depth reduction of 0.116 – 0.147 m using method (1) and (2) respectively.
- Assuming a worst case scenario where the change in dock return percentage is reduced from 88% to 57% for the proposed abstraction regime, 42.5% (29M m^3) of the annual 47M m^3 abstracted dock water is lost to evaporation and blow down. This is equivalent to daily losses of 54,575 m^3 which equates to a depth reduction of 0.116 – 0.147 m using method (1) and (2) respectively.
- A review of the historic record shows that daily dock level variation exceeds 0.14 - 0.11 m 30 - 40% of the time.
- When the depth reduction of 0.116 – 0.147 m as a result of the proposed development is compared to the historic record of dock level variation it can be seen that historically the dock level variation is greater than the variation established for the proposed development for 30 - 40% of the time. Therefore, it can be concluded that the dock level will not be significantly affected by the proposed development as a result of the dock return percentage change, even under the worst case scenario where no improvement works have been undertaken.

13. 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. For the purposes of the assessment AECOM, therefore propose to assume that no adverse effects on dock level will occur from the proposed development beyond the effect established in the worst case scenario. In this way, the assessment of potential effects will establish an upper limit for dock level change.

[1] Greenpark Weir Water Resources Flow Modelling Technical Note, Report No.: WN/GPAW/R4 - Rev C, February 2011 Environment Agency Wales

1.5 Other

River Afan Flow Duration Curves

14. As a result of the new 57.5% return rate to the dock assumed in the model, the percentage of time the WFD83 River Flow Objective (RFO) is met for the worst case scenario has not changed and remains at 4%, see Figure 1.1 below. However, this has decreased for the best case scenario runs (Runs 7 and 8), see Figures 1.2 and 1.3.

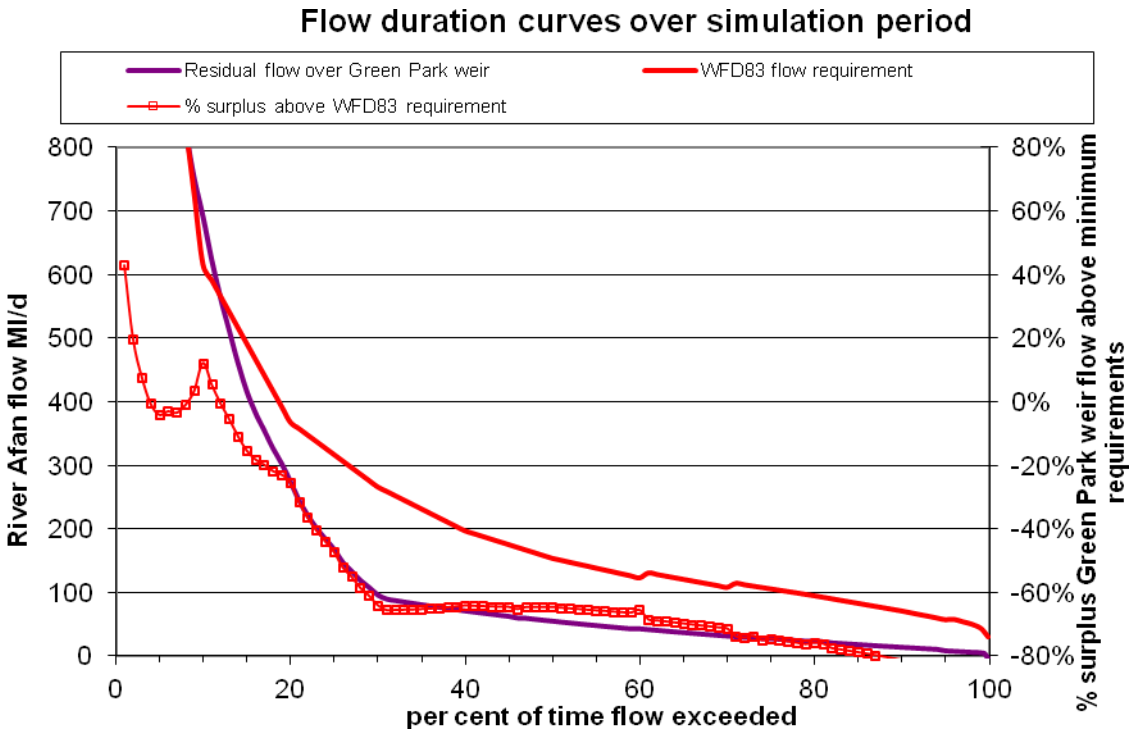

Figure 1.1 Run 6 Scenario 2 Proposed Operations Worst Case assuming required flow over Green Park weir is variable flow regime and uses Proposed Operations abstraction data.

15. Figure 1.2 demonstrates that for Run 7 - Scenario 2: Proposed Operations Best Case (with impoundment) the WFD83 RFO is met for 38% of the time. This is an 8% decrease from the 46% achieved in Run 4 – Scenario 2: Proposed Operations Best Case (without impoundment).

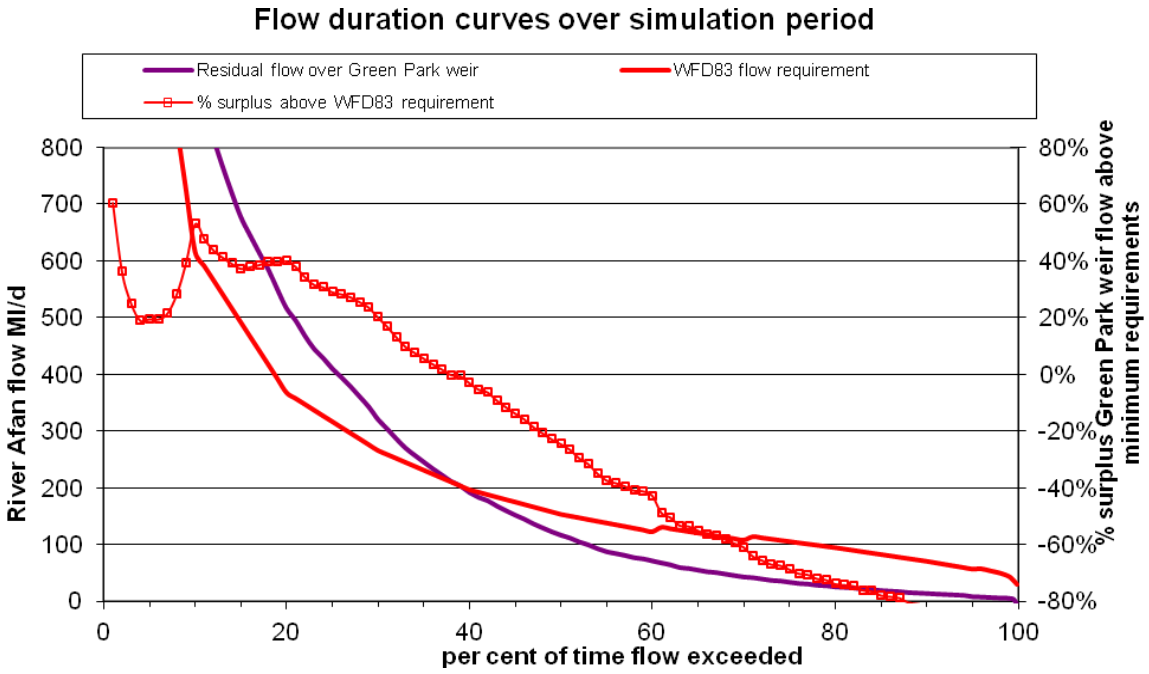

Figure 1.2: Run 7 Scenario 2 Proposed Operations Best Case (with impoundment) assuming required flow over Green Park weir is variable flow regime and uses Proposed Operations abstraction data.

16. Figure 1.3 demonstrates that for Run 8 - Scenario 2: Proposed Operations Best Case (without impoundment) the WFD83 RFO is met for 37% of the time. This is an 8% decrease from the 45% achieved in Run 4 – Scenario 2: Proposed Operations Best Case (without impoundment).

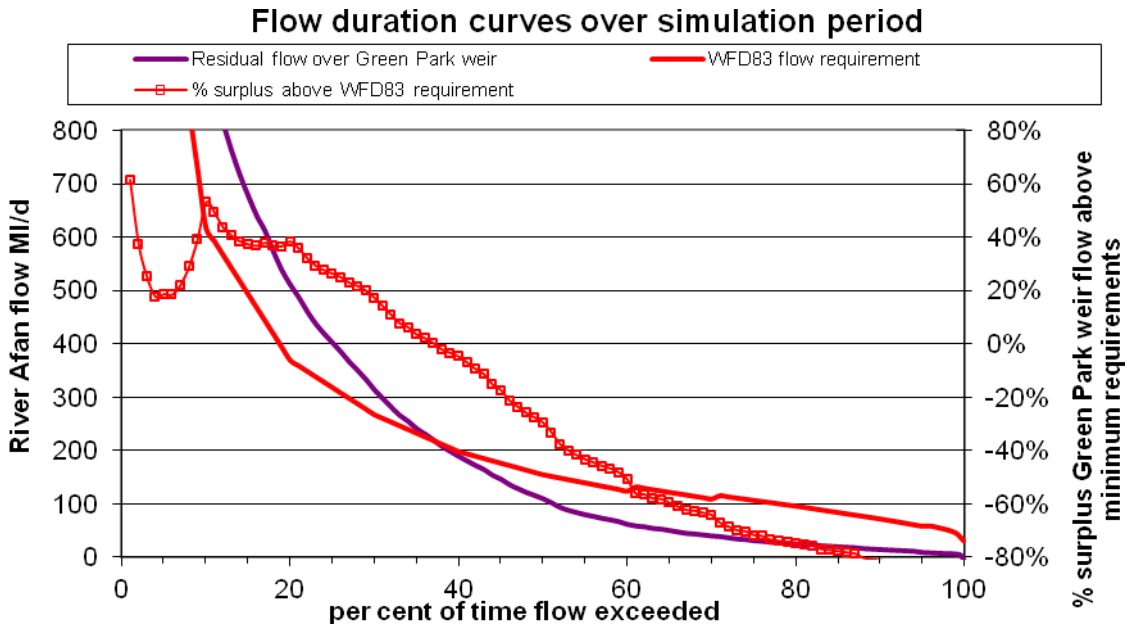

Figure 1.3: Run 8 Scenario 2 Proposed Operations Best Case (without impoundment) assuming required flow over Green Park weir is variable flow regime and uses Proposed Operations abstraction data.

17. Although the updated results for River Afan flows have changed as a result of the dock return percentage amendment, a similar trend is achieved to the results presented on 20th February 2014, where better flows for the best case scenario model runs (where the WFD83 RFO is met for a higher percentage of time) and same flows for the worst case scenario model runs (where the WFD83 RFO is met for 4% of the time) are achieved.

18. However, it is considered that the changes to the River Afan flow regime as a result of the change in dock return percentage are anomalous, further suggesting there is an internal problem within the model. These updated results for River Afan flows can therefore not be viewed with any degree of confidence, which also presents a limitation to this component of the surface water environment assessment. Therefore, for the purposes of the assessment AECOM propose to base the assessment of potential effects 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.

    Note: The ES assessment for the Surface Water Environment will show no dependence on the planned improvements works being undertaken as a worst case scenario will be assessed as well as the best case scenarios.

    <u>Dock Temperature</u>

19. In response to a request from NRW via Gideon Carpenter during a con call held 18th February 2014, it can be confirmed that no assessment will be made on the change to dock temperature as it has been previously agreed with NRW, in a meeting held on 25th November 2013, that the priority of concern for assessment is the effects of abstraction from the River Afan (Dock Feeder Channel) and improvement works on the River Afan rather than the ecological impacts on the Dock.

1.6 Requests from AECOM

20. Please find attached a summary of the assessment for the surface water environment using the approach outlined in this technical note and provide comments.

21. Please provide your comments on the proposed approach for the assessment of potential effects on the Port Talbot Dock level and the preliminary findings for this.

22. Please provide your comments on the proposed approach for assessment of effects on the River Afan flows and whether this effects NRWs position on the agreement made between Tata and NRW on 20th February 2014 that:

    - A hierarchy of abstraction will be utilised, with flows at the Marcroft gauging station to be monitored by NRW and an operational advisory notice to be issued to Tata when flows are not expected to meet the additional abstraction required as a result of the proposed development.

23. Please also provide any other comments you have on the details provided in this technical note.