Adran yr Economi a'r Seilwaith
Department for Economy and Infrastructure

Llywodraeth Cymru
Welsh Government

File Ref: WG/REB/OBJ0266 [6911] - Louise Davies

Objection Ref OBJ0266 [6911]

Supplementary Response to Objector's Evidence: Louise Davies

1. INTRODUCTION

1.1. Details

1.1.1. In the course of preparing for the hearing of Louise Davies' objection due on 10th May 2017, several typos have been picked up in Richard Graham's section of the rebuttal.

1.1.2. Moreover, Mr Graham also wishes to supplement his rebuttal with further information directly answering some of Lousie Davies' points.

1.1.3. This document therefore replaces Mr Graham's earlier contribution to the rebuttal.

2. SUPPLEMENTARY REBUTTAL

2.1. Richard Graham (Water Quality)

2.1.1. Response to **Point 6** (Suggested that there are other comparable case studies relating to chemical pollutants from road schemes, giving the example of Newbury Bypass, and specifically that the contamination effects on waterways has been referenced in this case. Outlined that Dr Neil I. Ward at the University of Surrey was responsible for evidencing the contamination effects related to Newbury Bypass and that he has published further research papers which evidence the contamination effects of motorways and in particular consider the effects of cadmium by thawing salt and effects of metal on human growth and development):

1. It is acknowledged that recently constructed road schemes in the UK have included systems design to treat road run off prior to discharge to water courses. In particular, the Newbury A34 bypass incorporates 9 water treatment areas of varying designs along the 13.5km section of dual carriageway, each with different catchments and specifications that include similar treatment systems to those proposed for the scheme including oil interceptors, sediment traps, grass channels, lagoons and reed beds.

2. I have reviewed two papers co-authored by Professor Ward, upon which he draws some comparisons on road run off treatment performance data. One is for two discharges from the A34 bypass at Newbury (Hares and Ward, 2004) - referred to as Pond J and Pond K - and the other is concerning discharges from the M25 at Oxted and Leatherhead (Hares and Ward, 1999). The Newbury discharges have been studied over a 3¼ year period starting from the year of commencement of operation in 1998 (Hares and Ward, 2004). For both treatment areas, run off flows through similar treatment areas prior to discharge into the River Lambourn. The treatment areas comprise an oil interceptor, silt trap incorporating a grass verge flowing into a combined flood attenuation pond and surface flow reed bed termed a biofiltration pond. The drained carriageways serving these treatment areas do not incorporate grass lined channels.

3. Heavy metals, comprising lead, cadmium, copper and zinc, were measured in sediments at both the inlet and outlet to the treatment areas allowing a treatment efficacy to be calculated. Pond J achieved reduction in sediment concentrations for the stated heavy metals of 59%, 59%, 65% and 76% respectively. Pond K achieved reduction in sediment concentrations for the stated heavy metals of 79%, 86%, 73% and 71% respectively. Both ponds showed higher degrees of efficacy at earlier stages of the 3 ¼ year operational life of the bypass.

4. For Pond K the conclusions of the study stated that a rapid decrease in heavy metal levels in sediment through the reed bed system was revealed and that the presence of a well-established reed bed system in this pond is responsible for dissipating stormwater inflow velocity thus allowing sedimentation processes to occur.

5. For Pond J, the study stated that in contrast, high heavy metal levels in sediments were reported throughout and also the outlet concluded to be due to an ill established reed bed system and thus a short residence time within this pond may limit sedimentation and filtration processes.

6. The M25 studies looked at heavy metal concentrations in water discharges. The designs of the two referenced treatment areas are different. The Oxted water treatment area comprises a silt trap leading to a dry pond, the outlet of which passes through an oil interceptor prior to discharge in the receiving watercourse. The Leatherhead system comprises a wet biofiltration, leading to an oil interceptor the outlet of which flows into sedimentation pond before passing through a second oil interceptor prior to discharge in the receiving watercourse. The drained carriageways serving these 2 treatment areas do not incorporate grass lined channels.

7. In conclusion, the M25 study states that the removal efficiencies of heavy metals within the biofiltration pond at Leatherhead are higher than those from the corresponding dry detention pond facility at Oxted and that the residence time is substantially longer at Leatherhead than at Oxted. It is noteworthy that all the proposed Scheme's water treatment areas comprise permanently wet attenuation lagoons acting as sedimentation ponds. The study also concludes that removal of particulate material through the attainment of a long residence time from motorway surface to receiving watercourse will predominantly the heavy metal removal efficiency, especially as a majority of the motorway-derived heavy metals exist either as insoluble species or adhered to insoluble particulate material. By contrast, the proposed Scheme's water treatment areas with the inclusion of grass lined channels will achieve higher residence times than is achieved at these M25 examples.

8. Removal efficiencies are stated in the study for a wide range of heavy metals. For the metals studied in the A34 study, i.e. lead, cadmium, copper and zinc, the Leatherhead treatment area achieves a reduction in concentrations in water of 89%, 90%, 93% and 87% respectively. The study findings for the Oxted water treatment area were 89%, 95%, 88% and 84% respectively.

9. There is a difficulty in making comparisons with these and other roads. Two principal differences are present when making such a comparison.

10. Firstly, these existing water treatment systems do not match those proposed in scale and design, particularly in respect to the grass lined channels, attenuation lagoons and reed beds. A number of the WTAs for the M4CaN include the use of grass lined channels as a method of conveyance to the WTA. The use of the grass lined channels of the length proposed for each WTA (up to a maximum length of 3,600m, with an average of 1,550m) offers a number of benefits:

    a) settling and trapping of sediment in vegetation;

    b) adhesion of sediment and pollutants to plants;

    c) filtering and absorption in the underlying soils and plant roots;

    d) nutrient uptake by plants;

e) provide storage to capture and immobilise spills on the highway;

f) convey runoff from extreme rainfall events through the swale at low velocities without significantly remobilising sediment or causing erosion.

11. The Newbury bypass treatment areas only include grass slopes for water to flow down prior to entry into the main lagoon. The maximum length of the grass slopes is approximately 10m. The capacity for water treatment of the proposed scheme's grass lined channels is substantially larger in comparison.

12. The Newbury bypass treatment areas provide a single 'biofiltration' lagoon which is designed to provide simultaneous storm water volume balancing and biological treatment by reeds or other aquatic plants. Such biofiltration lagoons have reduced treatment efficacy due to compromised design requirements making them of considerably smaller volume and surface area of the separate lagoons and reed beds respectively than those proposed for the M4CaN scheme. As an example, the Newbury bypass treatment area Pond J is reported to have a drained area of 3.4Ha and a pond storage volume of 5,400 m^3. The ratio of these properties of a treatment area is a factor for the comparison of designs. Pond J therefore has a ratio of approximately 490 m^3/Ha. The ratio for Pond K is approximately 560 m^3/Ha on the published data. Another study on a different Newbury bypass water treatment area termed Area 'C' is reported to have a drained area of 1.6Ha and a pond storage volume of 1,050 m^3 (Pontier et al., 2001). Pond C therefore has a ratio of approximately 650 m^3/Ha.

13. The ratios for the proposed M4CaN WTAs range from approximately 800 to 3,500 m^3/Ha with a mean value of 1140 m^3/Ha. This results in the proposed M4CaN lagoons providing greater dilution, lower flow velocities, increased sedimentation residence times and provides volume for sediments to settle and be retained. Taken together, and with the additional and significant addition of grass lined channels – features absent from the A34 Newbury and M25 examples – it is my opinion that the treatment provision of the proposed M4CaN Water Treatment Areas will outperform these already highly functional systems. Furthermore, the

commitment to inspect and maintain the Scheme's WTAs, including the grass lined channels, will ensure high levels of treatment efficacy are reached. Further, more detailed consideration of the reasoning for this is provided as follows.

14. The proposed M4CaN WTAs incorporate separate reed bed systems designed to ensure satisfactory functionality and treatment efficacy. The use of a separate, bespoke reed bed sized to optimise the residence times of water according to design standards results in a far higher performance than the planted reeds will achieve within a biofiltration pond. Furthermore, the biofiltration ponds contain standing open water where the majority of water during storm events is not in contact with reed roots and will receive no water quality benefit as a result. In comparison, the proposed M4CaN WTA reed beds are sub surface flow systems which results in 100% of water flowing through the root zone of the reed bed ensuring maximum filtration potential for solids and conversion of metals from dissolved to non-dissolved forms. As this reed bed is not acting as a balancing pond as is the case for the Newbury bypass treatment areas, water flows at a slow and uniform rate ensuring long residence times as required by guidance on the construction of wetlands. This is simply not achievable given the design compromises inherent in a dual purpose biofiltration pond as used more commonly on the highways estate.

15. I am of the opinion that biofiltration ponds as employed on the Newbury A34 bypass and the M25 motorway at Oxted and Leatherhead, whilst achieving good levels of road run off attenuation have a reduced treatment efficacy compared to separate lagoons and reed beds and are as such not comparable with the M4CaN WTA, which will provide far higher treatment provision.

16. Secondly, the primary issues considered responsible for unfavourably low treatment efficacy identified in many road run off treatment systems are the low residence times afforded to drainage water within the treatment and the lack of maintenance to ensure long term functionality.

17. To achieve good levels of water treatment efficacy, water residence times need to be appropriate for the systems employed. Low residence times limit the opportunity for filtration, dilution, stilling, sedimentation, biodegradation of organic substances and chemical transformation of metals from soluble to non-dissolved forms.

18. Typically, low residence times are a consequence of inappropriate or compromised sizing of treatment areas, for example as a consequence of limited land provision for such systems that require large areas. The design of the M4CaN WTA has been undertaken from the outset by the project team given the sensitive setting of the proposed discharges thus ensuring appropriate design and associated high functionally. The provision of systems capable of accommodating a 1 in 100 year extreme rainfall event including a 30% additional provision for climate change has ensured that the grass lined channels, attenuation ponds and reed beds are of a size capable of delivering high treatment efficacy. This is particularly important within the grass lined channels and attenuation lagoon where higher residence times result in the removal of sediments and within the reed beds where higher residence times within the root zone of reeds allows a higher degree of potential water pollutant removal to occur.

19. Water treatment systems designed for road run off require regular inspection and maintenance to ensure long term viability and treatment efficacy. This is recognised by DMRB and guidelines are provided (see Table 6.1 in DMRB Volume 4 Section 2 Part 1 HA103/06) to achieve this. Insufficient or untimely maintenance for such systems is identified as a contributing factor for many road treatment systems with the highway estate. A principal requirement of road scheme water treatment areas is to capture and retain suspended solids as these are associated with the majority of potential pollutants in run off and can cause impact to rivers from smothering of plants and river beds. It is therefore important that sediment accumulation and recovery/disposal is undertaken as accumulation of sediment reduces filtration potential of grass lined channels and reed beds as well as increasing the risk of remobilising sediment within lagoons. Sediment accumulation also reduces storm

water storage volumes and thus compromises the functionality of treatment areas for flood risk mitigation following extreme rainfall events.

20. The M4CaN scheme will therefore be subject to appropriate inspection and maintenance to DMRB standards and also to NRW requirements to be included within the Register of Commitments for the scheme. This includes requirements for grass lined channel mowing and sediment management as well as lagoon and reed bed de-silting.

21. I am of the opinion that the scope of the inspection and maintenance schedule proposed will ensure the proposed WTA will be able to function at an acceptably high standard and thus maintain the necessary standard of treatment to afforded protection to the Gwent Levels SSSIs.

22. Cadmium is a potential pollutant of concern present in low concentrations within road run. The DMRB guidance on road run risk assessment (HAWRAT) states an average Event Mean Concentration (EMC) for total cadmium of 0.63 ug/L. The prescribed annual average Gwent Levels SSSIs NRW trigger level for cadmium is aligned with that of the Water Framework Directive at 0.15 ug/L. To reduce this cadmium EMC concentration to the prescribed NRW Trigger Level concentration would require a treatment attenuation factor of approximately 76%. Given the achievement reported for the 4No. studies undertaken on the A34 and M25 treatment areas for cadmium removal of between 59% and 86% for sediments and between 90% and 95% for water, I am satisfied that the proposed water treatment areas are capable of delivering this annual average magnitude of efficacy for the removal of cadmium, which will comprise both soluble and non-dissolved forms.

23. To determine compliance of the proposed WTA with the NRW trigger levels, long term monitoring is proposed to determine any impact on water quality arising from proposed discharges. This will form part of the Register of Commitments for the scheme. In addition to this commitment, further commitments have been provided to ensure that all water discharges from the proposed WTA will meet WFD and SSSI requirements prior to entering the reen network.

24. Regarding road salt application and effect on salinity on waters discharging from WTA and the effect on sensitive ecology within reens, the use of ecologically appropriate, non-chloride based road treatment agents is agreed with NRW to be implemented between 1st March and 30th September each year.

2.1.2. I confirm that the statement of truth and professional obligations to the inquiry from my main proof still applies.