SPaTS2 T0549 – National Highways 2030 Water Quality Programme

DESIGN PALETTE TECHNICAL NOTE

Project No. NH619526

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EXECUTIVE SUMMARY

This technical note gives a detailed overview of how the Technical Partner (TP) has developed a design palette of various pollution mitigation options to give designers a short list of potential solutions to mitigate the risk of pollutants from highway surface water runoff from entering downstream watercourses.

The TP has also produced a mitigation selection decision tree to provide guidance on the most suitable options for each given site and result in a single preferred solution type. The intention is that the design process then reviews the best way to apply the solution on a site-specific basis.

This revision of the design palette has been produced in the context of the work expected to be undertaken by the TP during the current commission which includes the FY25/26 period and is focussed primarily on design delivery.

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INTRODUCTION

1. INTRODUCTION

1.1. PROJECT CONTEXT

National Highways (NH) Environment Sustainability Strategy & Standards Group has commissioned a Technical Partner (TP) to provide a range of specialist technical and programme management support services to accelerate delivery of commitments made within its *2030 Water Quality Plan: Mitigating high risk outfalls and soakaways*.

The key objectives of this project are:

- Provision of project management function to support the delivery of the plan's commitments in Road Period 2 (2020-2025) and Road Period 3 (2025-2030).
- Development of preliminary designs for the water quality programme. Delivery of tranche 1 and 2 schemes in line with NH Operations governance for onward delivery by NH Operations.
- Development of a long-term strategy and implementation plan to integrate the outputs of the Rapid Prioritisation Tool with the outputs from the validation and verification of the 1,236 into the RP3 Programme.
- Provision of programme office function to support the delivery of the plan's commitments in Road Period 2 (2020-2025) and Road Period 3 (2025-2030).
- Development of an inspection programme for 100 selected sites that have been validated, verified and through a Technical Quality Check (TQC) and their final risk status has changed from Cat A or B to Cat C, D or X.

1.2. PRELIMINARY DESIGN OBJECTIVES

The aim is to develop an end-to-end process for the preliminary design stages for surface water pollution mitigation schemes and produce an initial set of scheme designs following the proposed process.

The products and solutions created by the TP have been guided by the following design principles which are to;

Figure 1-1 – Design Principles

Further details of the approach to the preliminary design task can be found in the Design Playbook, ref NH619526-WQT-GEN-XX-XX-RP-CD-0001.

PRELIMINARY DESIGN PROPOSED DOCUMENTS

Figure 1-2 shows the purpose and level of detail of the proposed suite of documents being produced to support the work expected to be undertaken by the TP during the current commission.

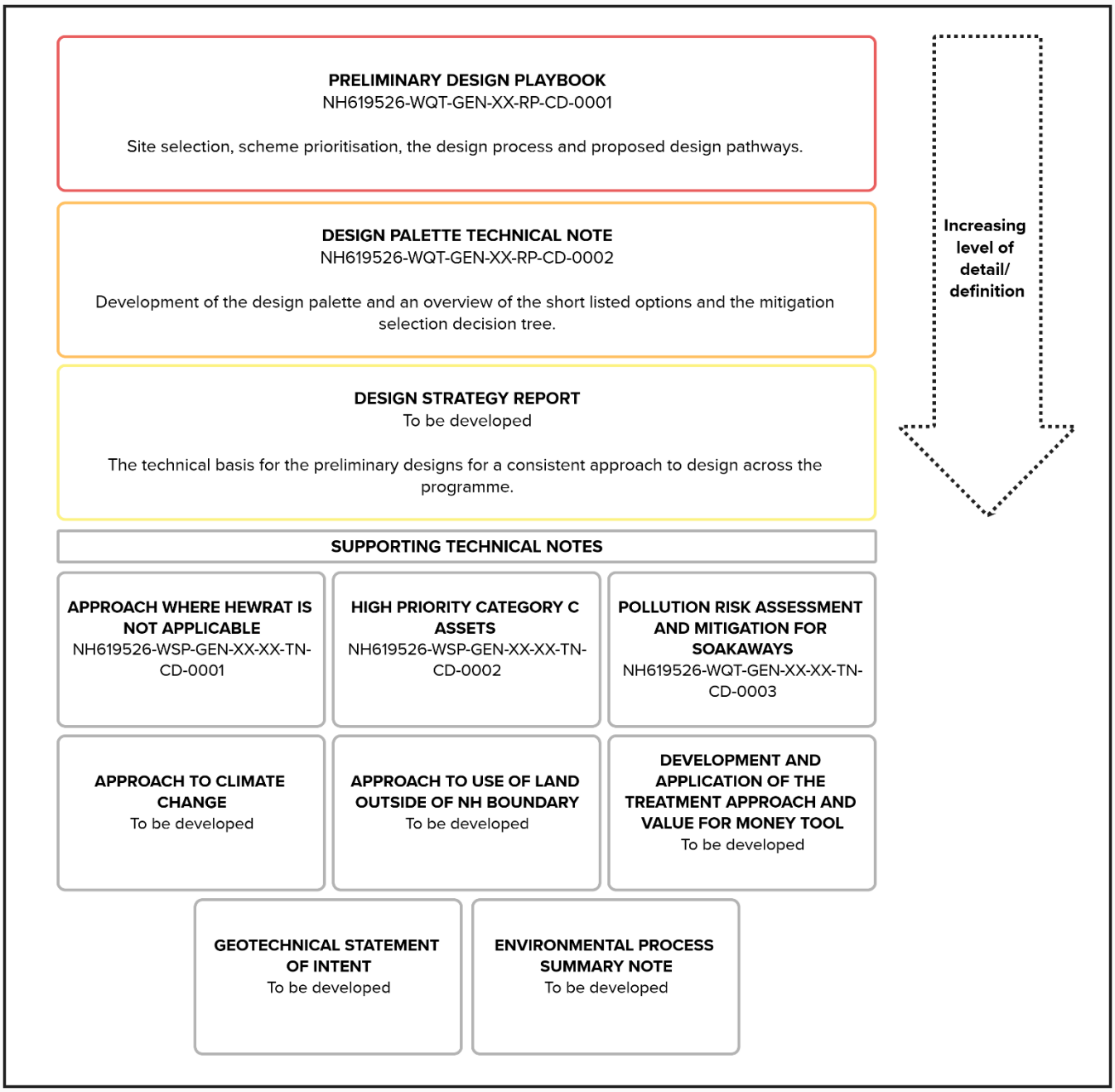

Figure 1-2 – Preliminary design documents

1.3. PURPOSE OF THE DESIGN PALETTE TECHNICAL NOTE

The TP, in collaboration with NH, has standardised the preliminary design process where possible to improve efficiency in delivering solutions that mitigate pollutants in highway runoff.

A design palette of standardised options has been developed to support design teams in producing efficient and consistent designs.

This technical note outlines the methodology used to develop the design palette and introduces a mitigation selection decision tree to help identify the most suitable solution for each site. Together, these tools guide designers to a preferred option, which is then refined through site-specific application.

This revision of the design palette has been produced in the context of the work expected to be undertaken by the TP during the current commission which includes the FY25/26 period and is focussed primarily on design delivery.

1.4. DESIGN PALETTE DEVELOPMENT

The design palette has been compiled using NH's Design Manual for Roads and Bridges (DMRB) documents, The CIRIA SuDS Manual C753, DEFRA National standards for sustainable drainage systems (2025), manufacturer's websites, case studies, and previous project examples including international best practice

The design palette includes following key features:

- Long list – all treatment mitigation measures,
- Short list – preferred mitigation measures selected for the preliminary design.
- Mitigation selection decision tree – to support the designer to identify an optimum solution for a site depending on the site characteristics and treatment requirement.

The solutions proposed in this task promote the sustainable design, construction, operation and maintenance of the identified assets. The considerations listed here have been agreed in engagement with stakeholders concerned with the whole life of the asset.

TARGETED POLLUTANTS

SURFACE WATER OUTFALLS

The pollutants of concern and associated thresholds for surface water outfalls were agreed with the Environment Agency (EA) and adopted by NH in 2009. The targeted pollutants included in the design palette are based on the pollutants which are covered by the NH routine runoff and surface water quality assessment tool (HEWRAT).

SOAKAWAYS

The NH Priority Soakaway Worksheet does not identify which pollutants need mitigating for soakaways based on individual site factors. The TP has produced a technical note, NH619526-WQT-GEN-XX-XX-TN-CD-0003, which includes a high-level review of studies undertaken on behalf of NH and identifies the pollutants the TP consider to be critical for soakaways.

1.5. STAKEHOLDER ENGAGEMENT

Consultation with specific stakeholders for the development of the design palette and mitigation selection decision tree has been undertaken. The short list and mitigation selection decision tree have been presented to Safety, Engineering & Standards (SES) Environment, SES Drainage and Operations Directorate (OD) Drainage Liaison Engineers (DLE), and comments raised have been incorporated into the technical note. A NH Drainage Design Working Group (DDWG) has been established and will be consulted during the preliminary design programme. Engagement with representatives from the Department for Transport (DfT), the EA, the Department for Environment, Food and Rural Affairs (Defra), the Chartered Institution of Water and Environmental Management (CIWEM) and Natural England is planned through periodic roundtable discussions.

Further details of the proposed stakeholder engagement for the TP preliminary designs are included in the Design Playbook, ref NH619526-WQT-GEN-XX-XX-RP-CD-0001.

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LONG LIST OF MITIGATION OPTIONS

2. LONG LIST OF MITIGATION OPTIONS

2.1. OVERVIEW AND APPROACH

The following approach and technical standards have been used by the TP to compile the long list of treatment options:

- Experience and lessons learned from current and previous projects shared by the TP and contributors including DLEs.
- DMRB CG501 Design of highway drainage systems Table 8.3.2N1
- CIRIA C753 The SuDS Manual (2015)
- DEFRA National standards for sustainable drainage systems (2025)

Each option included in the long list was reviewed using the following criteria. This discussion was used to identify the most suitable options to be taken forward onto the short list.

- Targeted pollutants and pollutant removal efficiency
- Cost – initial cost and whole life cost
- Space requirements
- Safety considerations
- Design considerations including Departures from Standard (DfS)
- Construction requirements
- Maintenance requirements
- Additional benefits

Manufacturer's websites, case studies, the DMRB and previous project experience have been used to collate the details for each option.

The targeted pollutants noted in the long list are based on the pollutants which are included in HEWRAT. The removal efficiencies are based on the efficiency quoted in the DMRB or given by suppliers for proprietary products.

This design palette has been produced for the work expected to be undertaken by the TP during the commission which includes the FY25/26 period and therefore is based on the current national standards. It is recognised that further research into future pollutants and actual removal efficiencies would be beneficial to the wider water quality programme.

Should additional mitigation options be identified during the programme, they will be added to the long list, reviewed against the same criteria and a decision made on whether they are a suitable solution to be added to the shortlist. The full long list and discussion is included in Appendix A.

2.2. LONG LIST MITIGATION OPTIONS

The long list of mitigation options compiled by the TP comprises of three drainage asset groups as listed below:

- Drainage collector systems
- Proprietary products
- Nature-based solutions

Table 2-1 summarises the mitigation options considered in each of the three drainage asset groups. The key features of each of the mitigation options and discussion against each of the criteria noted above is presented in Appendix A.

Table 2-1 – Summary of long list mitigation options

Drainage asset group	Name of mitigation options

Drainage collector systems	• Filter drains
	• Grassed surface water channels (GSWCs)
	• Retrofit/improvement options to existing assets.
	  - Filter drains + engineered filter media
	  - GSWC + Biochar (high organic content soil)
	• Kerb and gullies
	• Combined kerb drainage
	• Reservoir pavement/pervious asphalt
	• Rain garden/bioretention areas
	• Sediment trap (catchpit)

Proprietary products	• Hydrodynamic vortex separators • Filter tanks/ filtration systems • Engineered filter media • Biochar/biomulch • By-pass separator • Penstock/valve
Nature- based solutions	• Swale/Ditch • Pond • Dry detention basin • Infiltration basin/ soakaway • Wetland (surface flow) • Forebay

Table 2-2 summarises the mitigation options assessed and omitted as part of the long list evaluation process in order to create the short list of options. This table also includes the justification of why the option was excluded from the short list of options.

Table 2-2 – Mitigation options excluded from the short list

Name of mitigation options	Justification for the omission from short list
Kerb and gullies	Removal of pollutants is likely to occur but there is insufficient evidence available to quote indicative treatment efficiency. (*DMRB, CG501, Table 8.3.2N1*)
Combined kerb drainage	Removal of pollutants unlikely to occur. (*DMRB, CG501, Table 8.3.2N1*)
Rain gardens/ bioretention area	Typically small systems and only suitable for small catchments Suitable for urban areas to manage and treat the runoff from footpaths, roundabouts etc.
Reservoir pavement/pervious asphalt	Not suitable to be located in the running lanes. Could only be used in layby areas, but therefore would not remove pollutants from the majority of the surface water runoff.
Sediment trap (catchpit)	Removal of pollutants likely to occur but insufficient evidence available to quote indicative treatment efficiency. (*DMRB, CG501, Table 8.3.2N1*)
Penstock	Only provides spillage control, removal of pollutants is unlikely to occur

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SHORT LIST OF MITIGATION OPTIONS

3. SHORT LIST OF MITIGATION OPTIONS

3.1. OVERVIEW

The short list of mitigation options has been compiled by the TP as preferred solution types based on the justification made for each solution type listed in the long list of mitigation options, refer to Appendix A.

The short list of mitigation options comprises of six options to provide flexibility of choice to the designer depending on the site and the treatment requirement. The order of the options is not intended to indicate a preference on the type of solution to be used. The proposed solution will be guided by the mitigation selection decision tree described in Section 4.

- Hydrodynamic vortex separators
- Ditches/swales
- GSWC or filter drains
- Ponds, basins, wetlands, or forebays
- Proprietary solutions (enhanced filter media or biochar)
- Proprietary solutions (by-pass separators or filtration systems)

The options are described in Sections 3.2 to 3.7 using the following criteria.

- Key details - targeted pollutants and treatment efficiencies
- Justification for selection in the shortlist of options
- Technical standards/suppliers' details
- Design criteria/requirements and applications
- Benefits and disadvantages
- Risks
- Construction, operation and maintenance and requirements

The targeted pollutants noted against the short list options in the section below are based on the pollutants which are included in the HEWRAT.

MAINTENANCE

For all solutions, consideration will be given to maintenance access and maintenance responsibilities during the preliminary design stage. This will include engagement and consultation with the maintaining authority to understand the current maintenance schedule and access arrangements for the current assets and outfall as well as what requirements they have for any proposed new assets. The maintenance requirements described below and in the long list in Appendix A for the mitigation options will form the basis of engagement and consultation with maintaining authorities.

It is assumed that any new water treatment or drainage systems that may be installed in third party land (i.e. land beyond the existing highway boundary) will, as the default position, be owned and maintained by National Highways. By retaining ownership and maintenance responsibility, National Highways will have greater control over the assets to ensure that they are properly maintained and safeguarded in the future. It is understood that, if required, consultation and discussions with landowners will be coordinated and undertaken by NH and supported by the TP.

FURTHER PRODUCT RESEARCH AND SPECIFICATION

For proprietary products which don't have treatment efficiencies stated in the DMRB, the TP has researched potential suppliers, and a standard treatment efficiency is provided in this technical note for designers to use. Further research into the available products, utilising the supply chain feedback will continue throughout the project, with updates to the information captured within this report. Product specifications will ensure a level playing field with design requirements identified. The approach will be similar to that taken for vortex separators (Design Manual for Roads and Bridges (DMRB) CD 528).

Previous project examples, existing DfS and case studies of the proposed short list solutions will be collated where possible.

DMRB GG104 CATEGORISATION OF ACTIVITY TYPE

Example GG104 categorisations have been included in Appendix B, these are based on the current understanding of national acceptance of activity types. Designers will review and confirm any site-specific variations and update if any specific concerns are raised by local NH OD teams.

3.2. HYDRODYNAMIC VORTEX SEPARATORS

OVERVIEW

Hydrodynamic vortex separators are proprietary treatment products. They remove sediments, fine particles, and floatable debris from the highway runoff to protect the receiving water environment.

Hydrodynamic vortex separators can be installed within a chamber or as a standalone device. A typical schematic of a vortex separator is shown in Figure 3-1 below.

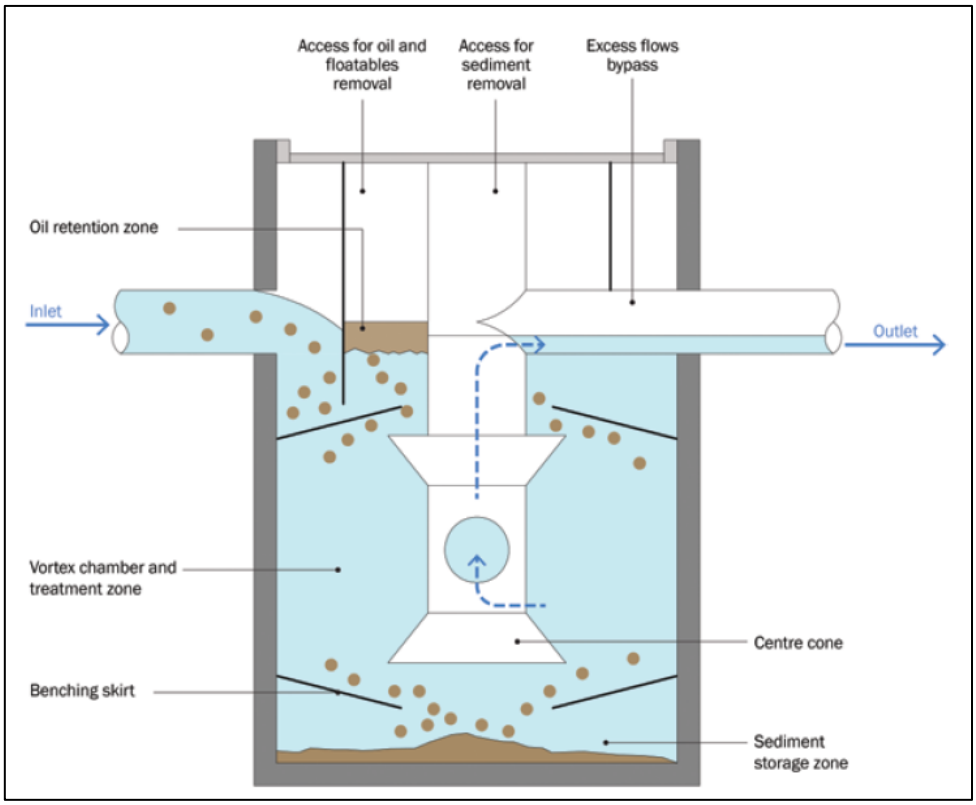

Figure 3-1 – Typical schematic of a hydrodynamic vortex separator unit[1]

[1] Reference - CIRIA SuDS Manual C753

KEY INFORMATION

Table 3-1 summarises the key information and justification considered by the TP to include hydrodynamic vortex separators in the short list of preferred options.

Table 3-1 – Hydrodynamic vortex separators

Description	Key findings
Targeted pollutants and treatment efficiencies	Suspended solids - 40% Dissolved zinc - 15% Dissolved copper - 0% *(Reference - DMRB CG501[2])* *Suppliers quote a higher removal efficiency for suspended solids*
Justification for selection	• Standard solution • Can be used as a pre-treatment for existing mitigation measures • Small footprint • Cost effective solution where sites are constrained or when retrofitting existing sites
Standards	DMRB CG 501 Design of highway drainage systems DMRB CD 528 Vortex separators for use with road drainage systems

DESIGN CRITERIA/REQUIREMENTS AND APPLICATIONS

Hydrodynamic vortex separators can be installed within an existing pipe network. Pipe invert levels will need to be checked to ensure that required level differences between the inlet and outlet pipes of the vortex separator can be accommodated. Design flow rates are required to size vortex separators in order to achieve the quoted treatment efficiencies.

Hydrodynamic vortex separators can be used as an upstream component of the treatment train to enhance and protect the downstream mitigation measures by capturing sediments, which may reduce the maintenance frequency required for the downstream assets.

[2] Some suppliers quote higher treatment efficiencies for the targeted pollutants, however the TP preliminary designs will be based on the treatment efficiency stated in the DMRB.

Access for routine inspection and maintenance to these assets will be considered during the preliminary design stage. It is expected that the Interface Project Manager (IPM) will provide regional maintenance and operational input into the preliminary design, for more information refer to the Design Playbook ref NH619526-WQT-GEN-XX-RP-CD-0001. The information given in this technical note is based on the current understanding of the general, national requirements for maintenance, designers will review and confirm any site-specific variations and update as required.

The use of hydrodynamic vortex separator will only require a DfS application if plastic chambers are proposed.

BENEFITS, DISADVANTAGES AND RISKS

Table 3-2 summarises the key benefits, disadvantages and risks associated with the use of vortex separators.

Table 3-2 – Benefits, disadvantages and risks

Benefits	Disadvantages	Risks
Effective removal of sediments by gravity. Small footprint allows use where sites are constrained or when retrofitting existing sites. Ability to work alongside SuDS solutions such as ponds, swales, wetlands etc. Cost effective solution. Known methods for installation and maintenance. Can be maintained from the surface and no confined space entry required.	Non-vegetated solution Does not remove dissolved copper.	Hazards involved with lifting operations for the larger units and potentially deep excavations. Possible clash with existing utilities. Regular maintenance required in order to continue to remove pollutants. May require a departure from standards depending on the product selected.

CONSTRUCTION, OPERATION AND MAINTENANCE REQUIREMENTS

Hydrodynamic vortex separator installation should be carried out to the manufacturer's recommendations. Generally, hydrodynamic vortex separator units are prefabricated.

Construction considerations include;

- Adequate preparation and compaction of foundations to avoid uneven settling.
- Levels of the inlet and outlet pipes
- Backfilling sequence (as per manufacturer's recommendations)

The selection and siting of a hydrodynamic vortex separator for a specific site will be dependent on the access to the device to suit the size of maintenance vehicle for future maintenance. The siting of the hydrodynamic vortex separator should be located to minimise on-carriageway traffic management requirements during maintenance operations.

Hydrodynamic vortex separators require routine inspection and maintenance to ensure their operation remains effective. Maintenance activities and frequencies will be based on the specification provided by the suppliers, general advice and further details are given in DMRB CD 528, DMRB GS 801 and the CIRIA SuDS Manual (C753).

3.3. DITCHES/SWALES

OVERVIEW – DITCHES

Ditches are vegetated open channels designed to convey, treat and, in some cases attenuate, the surface water runoff from the road and can be lined or unlined. Unlined ditches have the potential to allow infiltration. Ground conditions and risk to groundwater shall therefore be considered.

They are generally located along the edge of the road and can also be designed to intercept runoff from adjacent natural catchments.

Vegetated ditches can be used as a pollution control measure to remove the pollutants from the highway runoff to protect the receiving water environment. The pollutant treatment potential is less than that of a swale due to their shape and water depth, however, they can have a narrower cross section than a swale, therefore requiring less land. Unlined ditches which act as a soakaway could also treat the runoff through capture of pollutants within the subsoil.

Non-vegetated ditches (e.g., concrete lined) do not have any pollutant removal potential but can act as spillage containment basins to control the spillage risks.

An example photograph of a typical ditch is shown in Figure 3-2 below.

Figure 3-2 – Typical ditch

A typical unlined ditch profile is shown in Figure 3-3 below.

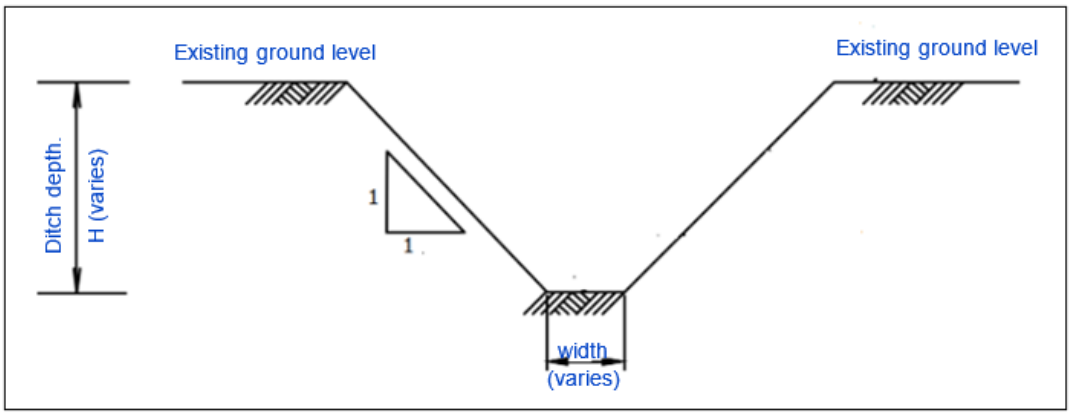

Figure 3-3 – Typical unlined ditch profile

OVERVIEW – SWALES

Swales, although similar to ditches, have a significant difference in cross section with gentler side slopes and a reduced allowable depth of flow. They are usually located as close to the road as possible where the road is on a gently sloping embankment to collect, convey and treat the surface water runoff.

The treatment potential of a swale is greater than a ditch and can therefore be used when higher levels of mitigation are required to resolve the water quality issue. The surface runoff is treated through filtering by vegetation in the channel. They can be designed to promote infiltration where the soil and groundwater conditions allow.

An example photograph of a typical swale is shown in Figure 3-4 below. Note that this example is not on the Strategic Road Network and that a vehicle restraint system may be needed if a swale deeper than 200mm is in close proximity to the edge of carriageway.

Figure 3-4 – Typical swale

KEY INFORMATION

Table 3-3 summarises the key information and justification considered by the TP to include ditches and swales in the short list of preferred options.

Table 3-3 – Ditches/swales

Description	Key findings
Targeted pollutants and treatment efficiencies	<u>Ditches</u> Suspended solids - 25% Dissolved zinc - 15% Dissolved copper - 15% *(Reference - DMRB CG501)* <u>Swales</u> Suspended solids - 80% Dissolved zinc - 50% Dissolved copper - 50% *(Reference - DMRB CG501)*

Description	Key findings
Justification for selection	Standard vegetative solution. Can be integrated into landscape management. Low capital cost. Potentially less land take than pond/basin solution. Known methods of inspection and maintenance No departure required.
Technical standard	DMRB CG 501 Design of highway drainage systems DMRB CD 532 Vegetated drainage systems for highway runoff CIRIA C753 SuDS Manual.

DESIGN CRITERIA/REQUIREMENTS AND APPLICATION

Access for routine inspection and maintenance to these assets will be considered during the preliminary design stage. It is expected that the IPM will provide regional maintenance and operational input into the preliminary design, for more information refer to the Design Playbook ref NH619526-WQT-GEN-XX-RP-CD-0001. The information given in this technical note is based on the current understanding of the general, national requirements for maintenance, designers will review and confirm any site-specific variations and update as required.

DITCHES

Ditches may be proposed within the existing drainage system, where space allows, to provide additional treatment. They will not always be suitable as the primary means of treatment due to the limited treatment potential they offer. The design application options are described below:

- New ditch in place of an outfall pipe
- Replacing a section of existing carrier drain with an open ditch
- Amend existing ditches into linear ponds or wetland with increased treatment performance.
- Lengthen existing ditches for increased treatment.
- Upgrade existing ditches using proprietary products.

The capacity and sizing of new ditches should be calculated using Manning's equation. The cross-sectional shape of the ditch is generally trapezoidal with 1:1.5 side slopes, although this should be confirmed by a geotechnical engineer. A minimum longitudinal gradient of 0.2% should be used wherever possible. Designers should consider the length of ditch and review whether the proposed design will provide sufficient treatment in line with the treatment potential outlined in the DMRB. Designers should consider the length of ditch and review whether the proposed design will provide sufficient treatment in line with the treatment potential outlined in the DMRB.

SWALES

Swales are generally designed with a bottom width of 0.5m-2.0m and with a maximum depth of 400-600mm. The depth of the swale is dependent on the invert level of the incoming pipe.

The cross-sectional shape of the swale is generally trapezoidal. A maximum side slope of 1 in 3 is recommended although a 1 in 4 side slope is preferred where space allows as this makes mowing easier during maintenance operations. Designers should consider the length of swale and review whether the proposed design will provide sufficient treatment in line with the treatment potential outlined in the DMRB.

They are used on sites with relatively flat longitudinal slopes. Check dams can be used if swales are proposed on steeper areas. Stone check dams will also provide an additional filtration function.

If swales are proposed along the edge of carriageway in the verge as a surface water collector system, a vehicle restraint system may be required. This may need to be assessed using the Road Restraint Risk Assessment Process (RRRAP).

BENEFITS, DISADVANTAGES AND RISKS

Table 3-4 summarises the key benefits, disadvantages and risks associated with the ditches and swales.

Table 3-4 – Benefits, disadvantages and risks

Benefits	Disadvantages	Risks
Vegetative solutions. Easy to incorporate into landscaping for added amenity values. Low capital cost. Known methods for installation and maintenance when accessible.	Not suitable for steep sites. Ditches have limited treatment capability compared to swales. Treatment potential is dependent on the length of the ditch or swale.	Hazards associated with potentially deep ditches/swales Dependent on the invert level of an existing outfall. Interface with other constraints - existing utilities / existing trees Could require remote access away from the carriageway.

CONSTRUCTION, OPERATION AND MAINTENANCE REQUIREMENTS

During ditch or swale construction, design levels and slopes for inlets, and ditch or swale base and side slopes should be constructed accurately to avoid water ponding. The ditch or swale should not receive any surface runoff until the vegetation is fully established. Temporary drainage provision may be required to manage the runoff until the vegetation is well rooted. Natural fibre geotextile matting laid on the bed and side slopes can help accelerate vegetation establishment and provide erosion protection, although this will increase construction costs.

The selection and siting of a ditch or swale for a specific site will be dependent on providing access to the location which suits the size of the required maintenance vehicle. Discussions regarding maintenance activities and frequencies will be based on the details are given in DMRB GS 801 and the CIRIA SuDS Manual (C753).

3.4. FILTER DRAINS OR GRASSED SURFACE WATER CHANNELS (GSWC)

OVERVIEW – FILTER DRAINS

Filter drains are gravel filled trenches, usually with a perforated pipe at the base of the trench, that collect, convey, and treat the surface water runoff, shown in Figure 3-5. They are located at the side of the carriageway to drain the surface and sub-surface runoff. The top of the filter drain can have various surface treatments, as shown on Highway Construction Detail B15 and can be used with a grassed surface water channel.

Figure 3-5 – Typical filter drain

OVERVIEW – GRASSED SURFACE WATER CHANNELS

GSWC are similar to swales but are located at the edge of carriageway. A major difference is that the depth of the channel is limited to 200mm unless a vehicle restraint system is used in front of the channel. They are also typically narrower than a swale and require less area. An example photograph of GSWC is shown in Figure 3-6.

Figure 3-6 – Example of a GSWC

GSWC are typically located adjacent to the carriageway to collect and treat the surface water runoff prior to discharge to either an outfall or ground. The surface runoff will be treated through filtering by the vegetation in the channel.

They can be designed to promote infiltration where the soil and groundwater conditions allow and can be used in combination with a filter drain or carrier drain system.

KEY INFORMATION

Table 3-5 summarises the key information and justification considered by the TP to include filter drains and GSWC in the short list of preferred options.

Table 3-5 – Filter drains and GSWC

Name of measure	Description	Key findings
Filter drains	**Targeted pollutants and treatment efficiencies**	Suspended solids - 60% Dissolved zinc - 45% Dissolved copper - 0% *(Reference – DMRB CG501)*
	Justification for selection	Standard solution Pollutant removal potential is relatively high compared to other options. Minimal land take and fits within the verge. No departure required.

Name of measure	Description	Key findings
	Technical standard	DMRB CG 501 Design of highway drainage systems DMRB CD 525 Design of combined surface and sub-surface drains and management of stone scatter MCHW Highway construction details for drainage MCHW Specification for highway works, Series 500.
GSWC	**Targeted pollutants and treatment efficiencies**	Suspended solids - 80% Dissolved zinc - 50% Dissolved copper - 50% *(Reference - DMRB CG501)*
	Justification for selection	Vegetative solution. Can be used as an additional treatment option. Pollutant removal potential is relatively high compared to other options. Can be an economical solution. Relatively small footprint and may fit within the verge. No departure required.
	Technical standard	DMRB CG 501 Design of highway drainage systems DMRB CD 521 Hydraulic design of road edge surface water channels and outlets MCHW Highway construction details for drainage MCHW Specification for highway works, Series 500

DESIGN CRITERIA/REQUIREMENTS AND APPLICATIONS

Access for routine inspection and maintenance to these assets will be considered during the preliminary design stage. It is expected that the IPM will provide regional maintenance and operational input into the preliminary design, for more information refer to the Design Playbook ref NH619526-WQT-GEN-XX-RP-CD-0001. The information given in this technical note is based on the current understanding of the general, national requirements for maintenance, designers will review and confirm any site-specific variations and update as required.

FILTER DRAINS

Filter drains are a standard surface water runoff collector system, typically used where the road is in cutting. Access chambers (catchpits) are required for filter drains for cleaning by jetting or rodding.

The hydraulic design of filter drains includes the following elements:

- Design of the filter material for adequate percolation of water and to store water.
- Design of the perforated pipe system to convey the runoff.

GSWC

GSWC are generally triangular or trapezoidal in cross section. Side slopes of 1 in 5 and 1 in 4.5 are recommended for triangular channels and trapezoidal channels respectively.

If GSWC are proposed along the edge of pavement in the verge as a surface water collector system, a vehicle restraint system may be required if the depth of channel exceeds the maximum requirement. This may need to be assessed using the Road Restraint Risk Assessment Process (RRRAP).

BENEFITS, DISADVANTAGES AND RISKS

Table 3-6 summarises the key benefits, disadvantages and risks associated with filter drains and GSWCs.

Table 3-6 – Benefits, disadvantages and risks

Benefits	Disadvantages	Risks
Filter drains Standard solution No additional land required, fits within the verge. **GSWC** Vegetative solution. Low capital cost. Fits within the verge.	**Filter drains** Not suitable for steep sites High clogging potential Difficult to see the build-up of pollutants/blockages. Potential maintenance/longevity problems. Does not provide dissolved copper mitigation. Not suitable for embankments unless risk to earthworks is mitigated. **GSWC** Not suitable for steep sites Regular grass cutting required.	**Filter drains** Stone scatter risk. **GSWC** VRS may be required for GSWC. Repairs to rutting may be required after vehicle overrun. **Both** Interface with VRS and existing utilities. If not maintained, can increase risk of surface water flooding and also cause water ingress to the road pavement. Regular inspection and maintenance required for blockages, clogging, standing water and structural damage.

CONSTRUCTION, OPERATION AND MAINTENANCE REQUIREMENTS

Filter drain trench excavations should follow best construction practice and be supported with trench supports if required.

Filter drains and GSWC require regular inspection and maintenance to ensure continuing operation to provide effective treatment.

Details on the maintenance requirements for GSWC are given in Appendix K of DMRB CD521, a summary is described below

- Grass cutting
- Weed control
- Removal of litter and debris
- Patching of damaged grass

Discussions regarding maintenance activities and frequencies will be based on the details are given in DMRB GS 801 and the CIRIA SuDS Manual (C753).

3.5. PONDS, BASINS, WETLANDS OR FOREBAYS

OVERVIEW

Ponds are surface water storage systems which provide flow control through attenuation of the surface water runoff and facilitate settling of pollutants from the runoff.

Wetlands are shallow vegetated basins with marshy areas and surface flow, which are generally used to improve water quality rather than to provide attenuation.

Ponds and wetlands generally retain a permanent pool of water that provides treatment.

Basins are shallow vegetated depressions that are intended to be dry for extended periods and detain surface water runoff immediately following storm events.

Ponds, basins and wetlands are generally located towards the end of the treatment train to allow pollutants to settle out of the highway runoff prior to its discharge into the receiving environment.

Example photographs of a pond, a wetland and a basin are shown in Figure 3-7, Figure 3-8 and respectively.

Figure 3-7 – Example pond

Figure 3-8 – Example wetland

Figure 3-9 – Example basin

Forebays are generally located upstream of treatment systems such as ponds, basins or wetlands, as shown in Figure 3-10.

A forebay is an excavated basin or bermed area, designed to slow the incoming surface water before it reaches the pond, basin or wetland. This helps promote sedimentation of suspended solids within the forebay.

Figure 3-10 – Example forebay

KEY INFORMATION

Table 3-7 summarises the key information and justification considered by the TP to include, ponds, basins, wetlands and forebays in the short list of preferred options.

Table 3-7 – Ponds, basins, wetlands or forebays

Description	Key findings
Targeted pollutants and treatment efficiencies	Ponds Suspended solids - 60% Dissolved zinc - 40% Dissolved copper - 30% *(Reference - DMRB CG501)* Basins Suspended solids - 50% Dissolved zinc – 0% Dissolved copper - 0% *(Reference - DMRB CG501)*

	Wetlands Suspended solids - 60% Dissolved zinc - 30% Dissolved copper - 50% *(Reference - DMRB CG501)* Forebays Treatment efficiencies are site and design dependent. Further assessment will be undertaken by water quality scientists during the preliminary design if a forebay is identified as a possible mitigation option.
Justification for selection	Vegetative system Can be used for storage Forebays are less expensive pre-treatment systems compared to proprietary products. No departure required.
Technical standard	DMRB CG 501 Design of highway drainage systems DMRB CD 532 Vegetated drainage systems for highway runoff CIRIA C753 SuDS Manual.

DESIGN CRITERIA/REQUIREMENTS AND APPLICATION

Ponds, basins and wetlands are appropriate to use as a new treatment measure and for use in retrofit situations where existing levels and land availability allow. The sizing of these assets will be determined by the catchment area draining to it.

Ponds are generally designed with depths between 0.5m and 2m and side slopes between 1 in 3 to 1 in 10, for slope stability, safety purposes and for ease of maintenance. The pond depth is dependent on the invert level of the incoming pipe and its location.

Wetlands are suitable on ground with a slope no greater than 1% and they are designed with an area of a wetland to be between 0.5% to 5% of the catchment area draining into them. The depth of permanent water in a wetland is generally between 0.15m and 0.3m.

Basin storage volumes should be based on the size of the catchment. The maximum depth of water in the basin should not exceed 2m for safety reasons. A basin can be designed to allow infiltration, subject to infiltration rates being suitable. There must be a separation of at least 1.2m between the base of the basin and the sites' highest recorded groundwater level. This is necessary to protect the groundwater from contamination.

Forebays are appropriate for use in new construction and in retrofit situations, as an additional treatment measure with ponds, basins and wetlands. The sizing of forebays depend on the catchment area and the depth of the feature.

Where it is not possible to treat all the water in a rainfall event, the systems can be designed to treat the first flush separately.

Appropriate access for routine inspection and maintenance to these assets must be included during the preliminary design stage. It is expected that the IPM will provide regional maintenance and operational input into the preliminary design, for more information refer to the Design Playbook ref NH619526-WQT-GEN-XX-RP-CD-0001. The information given in this technical note is based on the current understanding of the general, national requirements for maintenance, designers will review and confirm any site-specific variations and update as required.

BENEFITS, DISADVANTAGES AND RISKS

Table 3-8 summarises the key benefits, disadvantages and risks associated with, ponds, basins, wetlands and forebays.

Table 3-8 – Benefits, disadvantages and risks

Benefits	Disadvantages	Risks
Vegetative systems. Risk reduction for both flooding and pollution downstream. Amenity benefits. Can be used as storage.	Additional land take. Depth of the system may be constrained by inlet and outlet levels. Not suitable for steep sites.	Hazards associated with potentially deep excavations and open water. Negotiations with adjacent landowners may be required. Negotiations with utility companies may be required (for diversion of any existing utilities) Loss of existing vegetation for additional land take

CONSTRUCTION, OPERATION AND MAINTENANCE REQUIREMENTS

During construction, the bottom and side slopes of the basins should be prepared to ensure that they are structurally sound, and the grading should be uniform to prevent water from ponding.

Ponds, basins and wetlands require regular inspection and maintenance to ensure continuing operation to provide effective treatment. Forebays require more frequent cleaning to reduce the sediment load entering the primary treatment systems. Discussions regarding maintenance activities and frequencies will be based on the details are given in DMRB GS 801 and the CIRIA SuDS Manual (C753).

3.6. PROPRIETARY SOLUTIONS (ENHANCED FILTER MEDIA OR BIOCHAR)

OVERVIEW – ENHANCED FILTER MEDIA

Enhanced filter media is an engineered media that performs various functions, including filtration, adsorption, ion exchange, phosphate and retention, in order to remove pollutants from surface water runoff.

Enhanced filter media can primarily be used in filter drain trenches, however depending on the site-specific design requirements it could be used in ponds/basins and ditches/swales. It captures suspended solids and absorbs heavy metals, as well as helping to break down hydrocarbons in the surface water runoff.

Research has been conducted by the TP into potential suppliers, however given the bespoke nature of the product further consultation will be required depending on the site-specific constraints.

Figure 3-11 shows an example enhanced filter media application within a basin.

Figure 3-11 – Enhanced filter media example application[3]

[3] R*eference – Stormwater Management Ltd*

OVERVIEW – BIOCHAR

Biochar is a material similar to charcoal which can be used as a sorbent material for contaminants in water treatment. Biochar can be combined with other elements to create biomulch or formed into a biomulch matting. The inclusion of biochar can provide significant water quality benefits as well as providing a natural, green solution.

Biomulch matting can be used as GSWC or as a surface treatment to filter drains, refer to Figure 3-12. There may be additional applications of biochar, for example to enhance the treatment efficiency of infiltration basins or soakaways.

Figure 3-12 – GSWC on the A11 and the Norwich Northern Relief Road[4]

[4] R*eference – Salix*

KEY INFORMATION

Table 3-9 summarises the key information and justification considered by the TP to include enhanced filter media and biomulch/biochar in the short list of preferred options.

Table 3-9 – Proprietary solutions - Enhanced filter media or Biomulch matting

Description	Key findings	
Targeted pollutants and treatment efficiencies	**Enhanced filter media** Suspended solids – approx. 60% *(CG 501 filter drain – to be confirmed with suppliers).* Dissolved zinc - 85% Dissolved copper - 82% *(Reference – Stormwater Management Ltd)*	**Biomulch matting** Suspended solids - 85% Dissolved zinc - 80% Dissolved copper - 80% *(Reference - Salix)*
Justification for selection	Enhanced filter media Treatment efficiencies for heavy metals are high compared to other options. Filter media can be incorporated into existing SuDS as an additional treatment option (e.g. pond, swales). Long service life (depending on design application)	**Biomulch matting** Nature based solution. Treatment efficiencies for heavy metals are high compared to other options.

DESIGN CRITERIA/REQUIREMENTS AND APPLICATION

Access for routine inspection and maintenance to these assets will be considered during the preliminary design stage. It is expected that the IPM will provide regional maintenance and operational input into the preliminary design, for more information refer to the Design Playbook ref NH619526-WQT-GEN-XX-RP-CD-0001. The information given in this technical note is based on the current understanding of the general, national requirements for maintenance, designers will review and confirm any site-specific variations and update as required.

ENHANCED FILTER MEDIA

Enhanced filter media can be used to increase the treatment efficiency in existing drainage components, such as filter drains, swales, infiltration basin and ponds.

It is recommended that a pretreatment unit is installed to capture sediments from the runoff prior to the filter stage through the filter media. Enhanced filter media treatment is dependent on the ratio of the catchment area to filter media and discharge rate.

Research has been conducted into potential suppliers and design applications, however given the bespoke nature of the product further consultation will be required depending on the site-specific constraints.

The use proprietary products will require a DfS application as part of the design.

BIOCHAR

Biochar can provide enhanced treatment benefits and can be used to enhance the treatment potential of existing drainage assets. Biomulch matting, which contains biochar, can be used with GSWC or as a surface treatment for filter drains.

Research has been conducted into potential suppliers and design applications, however given the bespoke nature of the product further consultation will be required depending on the site-specific constraints.

The use proprietary products will require a DfS application as part of the design.

BENEFITS, DISADVANTAGES AND RISKS

Table 3-10 summarises the key benefits, disadvantages and risks associated with proprietary products, enhanced filter media and biomulch/biochar.

Table 3-10 – Benefits, disadvantages and risks

Benefits	Disadvantages	Risks
Enhanced filter media Enhanced filter media can be added to existing drainage assets to enhance the pollution mitigation. Long service life 10-20 years, depending on design application. **Biomulch/Biochar** Can be used to enhance the treatment efficiency of other mitigation solutions.	**Enhanced filter media** High clogging potential Dependent on the ratio between catchment area and filter surface DfS required. **Biomulch/Biochar** DfS required. **Both** Application of these products may be limited and is highly dependent on site specific constraints.	Further research is required on specific design applications. Not trialled on NH networks (or results of trials are unavailable), therefore treatment potential is unconfirmed. Filter media depth is dependent on depth and the existing invert levels. Availability of product vulnerable if company ceases trading. Monitoring may be required of upstream pollutant loading and downstream pollutant levels.

CONSTRUCTION, OPERATION AND MAINTENANCE REQUIREMENTS

Installation of the proprietary products should be carried out according to the manufacturer's specification and instruction. Installation may need to be carried out by specialist contractors and to bespoke details.

Enhanced filter media can have an expected service life of between 10 and 20 years, depending on the design application. However, the enhanced filter media cannot be washed and reused as with standard filter media and would need to be fully replaced. Service life and maintenance requirements for biomulch matting are to be confirmed.

3.7. PROPRIETARY SOLUTIONS (FILTRATION SYSTEMS OR BY-PASS SEPARATORS)

OVERVIEW – FILTRATION SYSTEMS

Filtration systems can capture sediments, oils and dissolved metals from surface water runoff. They can provide a multi-stage treatment train (sedimentation, screening and filtration) to remove the pollutants in a small footprint device.

They can be used as a pre-treatment device for other mitigation options such as ponds and swales and as a retrofit treatment option for space constrained areas.

OVERVIEW – BY-PASS SEPARATORS

By-pass separators are generally used in highway drainage systems to prevent sediments and oil products from entering watercourses. Supplier data indicates that, if designed, installed and maintained correctly they can provide more effective suspended solids removal than the value given for vortex separators in the DMRB.

KEY INFORMATION

Table 3-11 summarises the key information and justification considered by the TP to include filtration systems and by-pass separators in the short list of preferred options.

Table 3-11 – Proprietary solutions – Filtration systems and by-pass separators

Name of proprietary system	Description	Key findings
Filtration systems	Targeted pollutants and treatment efficiencies	Suspended solids - 80% Dissolved copper - >70% when installed with proprietary filter media mix. Dissolved zinc - >70% when installed with proprietary filter media mix. *(Reference - Hydro International)*
	Justification for selection	Small footprint Can be used as an additional treatment system in the treatment train. Can be used as retrofit option for space constrained areas.

Name of proprietary system	Description	Key findings
By-pass separators	Targeted pollutants and treatment efficiencies	Suspended solids - 80% Dissolved copper - 0% Dissolved zinc - 0%
	Justification for selection	Can be used as additional or alternative solution if needed. Can potentially provide higher suspended solid capture than a vortex separator

DESIGN CRITERIA/REQUIREMENTS AND APPLICATION

Access for routine inspection and maintenance to these assets will be considered during the preliminary design stage. It is expected that the IPM will provide regional maintenance and operational input into the preliminary design, for more information refer to the Design Playbook ref NH619526-WQT-GEN-XX-RP-CD-0001. The information given in this technical note is based on the current understanding of the general, national requirements for maintenance, designers will review and confirm any site-specific variations and update as required.

FILTRATION SYSTEMS

The sizing of filtration system components can be standardised for installation into and existing manhole, however, if they are used for larger catchment areas custom built vaults may be required.

The use of filtration tanks/systems will require a Departure from Standard application as part of the design, explaining the justification for the use of these products.

Establishing a regular maintenance schedule during the design stage is required to identify any potential issues with specifying filtration systems.

BY-PASS SEPARATORS

By-pass separators are designed for specific flow rates from a catchment area and sized on the basis of capturing and treating a specific volume of runoff.

The use of a by-pass separator will require a DfS application as part of the design, explaining the justification for the use of these products.

BENEFITS, DISADVANTAGES AND RISKS

Table 3-12 summarises the key benefits, disadvantages and risks associated with filtration systems and by-pass separators.

Table 3-12 – Benefits, disadvantages and risks

Benefits	Disadvantages	Risks
Filtration systems Small footprint. Easy to handle and install. Can be used as retrofit option for space constrained areas. Can be used as an additional treatment system within the treatment train. **By-pass separators** Also suitable to treat the runoff from pollution by oils. Can be used as additional or alternative solution if needed. Can potentially provide higher suspended solid capture than a vortex separator.	**Filtration systems** Potential requirement for specialist maintenance teams. Departure required. **By-pass separators** Compared to other options, these treatment facilities rely heavily on frequent routine maintenance. Potential requirement for specialist maintenance teams. No dissolved metal mitigation. DfS required.	**Filtration tanks** Recent technology in the UK – not many case studies are available. Short design life and frequent maintenance requirement. Availability of product vulnerable if company ceases trading. **By-pass separators** Will not work if not maintained properly. Underground system and therefore difficult to see the pollutants trapped in the system and can contribute to downstream pollution if not maintained correctly. Availability of product vulnerable if company ceases trading.

CONSTRUCTION, OPERATION AND MAINTENANCE REQUIREMENTS

FILTRATION SYSTEMS

Filtration tanks can be delivered to site as pre-cast concrete chambers complete with internal components already installed and the installation is similar to standard drainage chamber installation.

Filtration systems within the tanks are self-activating with no moving parts and no external power requirements. They are designed to operate as a treatment train by incorporating multiple treatment processes into a single device.

Maintenance works include periodic inspections to remove sediments, floatable trash, oils, and other debris from the sump and removal and replacement of the filtration systems. Maintenance activities and frequencies will be based on the specification provided by the suppliers, general advice and further details are given in DMRB GS 801 and the CIRIA SuDS Manual (C753).

BY-PASS SEPARATORS

The installation of by-pass separators should be carried out to the manufacturer's recommendations and instructions.

By-pass separators will require routine inspection and maintenance to ensure continuing operation. A suitable access with hard paved area should be provided and always be accessible to carry out maintenance activities.

Maintenance activities and frequencies will be based on the specification provided by the suppliers, general advice and further details are given in DMRB GS 801 and the CIRIA SuDS Manual (C753).

4

MITIGATION SELECTION DECISION TREE

4. MITIGATION SELECTION DECISION TREE

4.1. PURPOSE

The decision tree has been developed to assist the designer in choosing appropriate water quality risk mitigation solution from the proposed short list. The scenarios covered in the decision tree are not an exhaustive list but gives a guide to designers based on the most likely site-specific situations. A designer may also identify multiple solutions which could mitigate the risk at the site.

The mitigation options within the decision tree have been identified as either primary solutions or additional/alternative solutions.

- Primary solutions are in-standard solutions that don't require a DfS application and maximise vegetative treatment where space allows.
- Additional or alternative solutions include proprietary products.

The decision tree is intended to be a live document which will be updated as the project progresses, and feedback is received from the trial designs. Refer to Appendix C for the mitigation selection decision tree.

Details of the proposed end-to-end design process, including stakeholder engagement, is included in the Design Playbook, NH619526-WQT-GEN-XX-RP-CD-0001.

4.2. STEPS

Step 1 identifies the discharge mechanism type, either soakaway or surface water outfall.

Following Step 1, sites which use existing soakaways to discharge the runoff will be assessed for complexity (whether it is a borehole soakaway) and whether spillage containment is needed. Sites which use existing soakaways to discharge the runoff will then proceed straight to Step 3.

NOTE: The Priority Soakaway Worksheet should be checked to ensure that the correct build type has been accounted for in the risk assessment.

Step 2 is only applicable to surface water outfall sites.

This identifies if infiltration could be a potential solution to the water quality issue. Using infiltration to discharge highway runoff aligns with the first priority of the SuDS hierarchy[5], and opportunities for use should be reviewed. Infiltration also offers a potential treatment mechanism as an unsaturated zone beneath an infiltration device can contain a high portion of pollutants (DMRB CD530).

[5] DMRB CG501 Design of highway drainage systems & UK National standards for sustainable drainage systems (SuDS)

If infiltration is determined to be a high possibility, then the scheme will likely require additional groundwater surveys or investigations to confirm soil types and groundwater levels. If infiltration is not deemed feasible then the scheme will progress to step 3.

Step 3 is where the designer identifies the type of treatment failure to be mitigated and the level of treatment required.

The type of failure will guide the decision on mitigation solution choice. For example, failures associated with soluble metals will often require a vegetative or proprietary solution to mitigate the issue.

For soakaways, the level of treatment required will be identified in the NH Priority Soakaway Worksheet. The type of failure/ critical pollutants will be identified in the TP technical note, NH619526-WQT-GEN-XX-XX-TN-CD-0003.

For surface water outfalls, the type of failure and level of mitigation required will be identified in the site specific HEWRAT assessment.

For surface water outfalls which outfall to surface waterbodies where HEWRAT is not applicable, for example lakes, canals and tidally influenced watercourses, the type of failure and level of mitigation required has been identified in the TP technical note “Approach to outfalls discharging to surface water bodies where HEWRAT is not applicable”, NH619526-WQT-GEN-XX-XX-TN-CD-0001. This review concludes that sediment load including sediment bound pollution from these specific outfalls is the primary pollution mechanism.

Step 4 requires the designer to identify and assess the existing pollution mitigation measures within the drainage network for the outfall being investigated. The type of existing mitigation measures determines potential retrofit options. The decision tree lists the likely existing treatment systems but may not cover all eventualities.

NOTE: The HEWRAT assessment or Priority Soakaway Worksheet should be checked to ensure that any existing treatment measures are included in the risk assessment. To accurately assess the level of treatment required the existing level of treatment should be quantified and included in the risk assessment.

Step 5 requires the designer to identify the land currently available for pollution mitigation solutions within the highway boundary. Consideration should be given to the topography, existing assets & utilities in the verge area which may impact viability of different options.

The area available for interventions will be critical in the choice of solution. The designer will consider topography, useable space and maintenance access. The decision tree has split the categorisation of available land into small, medium and large. These definitions may be reviewed and updated as scheme designs progress, the current definitions are:

SMALL: area within highway boundary will allow for small interventions e.g. vortex separator (3m diameter chamber), approximate area available for mitigation measures is below 600m2

MEDIUM: area within highway boundary will allow for appropriately sized vegetative treatment system, approximate area available for mitigation measures is between 600m2 to 2000m2

LARGE: Area within highway boundary will allow for appropriately sized vegetative treatment system or systems, approximate area available for mitigation measures is greater than 2000m2

The following steps assist the designer in highlighting the mitigation measures most likely to be suitable for that locality based on the criteria selected in the first 5 steps. It is noted that two or more separate mitigations can be used in the treatment train.

Step 6 identifies the primary solution options likely to be available.

Primary solutions are in-standard solutions that don't require departures, vegetative treatment solutions where possible or have a potential to retrofit existing measures with enhancements.

If the primary solution doesn't mitigate the water quality risk, alternative or additional treatment measures shall be investigated.

Step 7 is where the use of non-standard proprietary systems is introduced. The designer should determine whether these systems can be used in conjunction with a primary solution or in place of a primary solution.

Additional or alternative solutions include the use of proprietary products which will require DfS. They can be used together with a primary solution to improve treatment efficiency and have potentially higher levels of treatment than primary solutions but will require each product's treatment efficiencies in the design palette technical note to be verified by the designer for the particular location.

There may be a number of potential solution combinations. The designer will need to capture the options within their design report and identify an optimum solution to mitigate the risk.

If there are no suitable treatment measures available within the highway boundary, the designer should consider the following options;

- the feasibility of changing the collector system, e.g. replacing a slot drain with filter drains. However, the potential safety implications, sustainability and the impact on customers of this option should be considered and discussed with NH prior to implementation.
- progress the scheme as an extended site and use the mitigation selection decision tree to identify options which will be compared using the value for money tool[6]. These options may require additional land or may not provide the treatment required to achieve a HEWRAT pass. Further detail and description of the proposed design pathways and value for money tool are given in the Design Playbook NH619526-WQT-GEN-XX-RP-CD-0001

[6] A policy note will be produced by the TP which will give details on the development and application of the value for money tool.

4.3. SUMMARY

The decision tree provides guidance on the potential optimum mitigation solutions for a site. It won't cover every eventuality but will assist understanding the options and their priority for use.

As noted previously this is a live document and feedback from designers using examples of successes and issues is encouraged and will help to guide the development of the decision tree.

APPENDICES

APPENDIX A. LONG LIST OF OPTIONS

Drainage Asset Group	Name of Mitigation Options	Shortlist Inclusion/Exclusion	Targeted pollutants and pollutant removal efficiency	Spillage control	Cost - Initial Cost & Whole Life Cost	Space Requirements	Safety Considerations (Construction/Operation/ Maintenance/Demolition)	Design Considerations	Departure Required?	Construction Requirements	Maintenance Requirements	Other notes (e.g. carbon cost, additional pollutants and retrofit options)
Drainage collector systems	Filter Drains	Included	Suspended solids - 60% Dissolved zinc - 45% Dissolved copper - 0% *(DMRB CG501)*	Yes	Low capital cost Medium maintenance costs Low whole life cost	Low - Constructed within existing verge	- Stone scatter risk - Interface with VRS and existing utilities - Surcharge of water onto carriageway	- Interface with VRS & existing utilities - Only used where road is in cutting with groundwater risk - Not suitable for steep sites - Access chambers for cleaning by jetting or rodding - Consider pre-treatment to trap silt and reduce maintenance frequency Designers shall consider sustainability, suitability and safety of replacing existing systems with filter drains - for example, to review the cost/benefit of replacing recently installed CKDs with filter drains	No	- Standard solution - Filter drain trench excavations should follow best construction practice and be supported with trench supports if required.	- Removal of litter and debris and routine inspection (CIRIA C753 - recommended frequency: Monthly) (DMRB GS 801 - recommended frequency: Annually) - Weed spray (DMRB GS 801 - recommended frequency: Every 2 years) - Renewal of filter stone and replacement of geotextiles (CIRIA C753 & DMRB GS 801 - recommended frequency: every 5 years) - Jetting of pipework (CIRIA C753 - recommended frequency: As required) (DMRB GS 801 - recommended frequency: Every 2 years)	- GSWC/topsoil can be added as a covering (HCD B15) to filter drains to provide additional treatment potential. - If considered as a retrofit options, designers shall consider sustainability, suitability and safety of replacing existing systems with filter drains
	Grassed Surface Water Channel (GSWC)	Included	Suspended solids - 80% Dissolved zinc - 50% Dissolved copper - 50% *(DMRB CG501)*	Yes	Low capital cost Medium maintenance costs Low whole life cost	Low - Constructed within existing verge	-Increased road worker exposure to hazards due to frequent maintenance. -Design needs to ensure mitigation of vehicle overrun -Surcharge of water onto carriageway	-Groundwater receptor sensitivity for infiltration sites -Need to consider sub-surface drainage -Not suitable for steep sites -Depth of GSWC is limited to 200mm unless a vehicle restraint system is used in front of the channel. Designers shall consider sustainability, safety implications and suitability of replacing existing concrete channels with GSWCs - preference to retrofit GSWC on top of existing filter drains	No	Standard solution	Maintenance requirements for GSWCs are given in Appendix K1 of DMRB CD521 - Grass cutting, weed control, removal of litter and debris (discussions with OD representatives suggest that this could be done during routine verge maintenance/grass cutting) - Patching/ repair of damaged grass (as required)	- Vegetative solution - Considered to be a lower carbon option - Could provide at source attenuation and infiltration if ground suitable.
	Filter drains + engineered filter media	Included	Suspended solids - approx. 60% *(CG 501 filter drain - to be confirmed with the suppliers)* Dissolved zinc - 85% Dissolved copper - 82% *(Extracted from a case study - Stormwater Management Ltd)*	Yes	High capital cost Low maintenance costs High whole life cost	Low - Constructed within existing verge	-Stone scatter risk -Interface with VRS and existing utilities -Surcharge of water onto carriageway	- Interface with VRS & existing utilities - Only used where road is in cutting with groundwater risk - Not suitable for steep sites - Consider pre-treatment to trap silt and reduce maintenance frequency	Yes - Proprietary products, one known existing departure	Careful installation required as per manufacturer's instructions.	- Expected service life is over 15 years as per information provided by manufacturers, filter stone requires replacing and cannot be washed and re-used. - Removal of litter and debris and routine inspection (CIRIA C753 - recommended frequency: Monthly) (DMRB GS 801 - recommended frequency: Annually) - Weed spray (DMRB GS 801 - recommended frequency: Every 2 years) - Jetting of pipework (CIRIA C753 - recommended frequency: As required) (DMRB GS 801 - recommended frequency: Every 2 years)	- Enhanced treatment when compared with normal filter drains. - Could be useful in mitigating higher sensitivity receptor sites. - Can be added to existing filter drains.
	GSWC + biochar/high organic content soil	Included	Suspended solids - 85% Dissolved zinc - 80% Dissolved copper - 80% *(Salix)*	Yes	High capital cost Low maintenance costs High whole life cost	Low - Constructed within existing verge	-Increased road worker exposure to hazards due to frequent maintenance. -Design needs to ensure mitigation of vehicle overrun -Surcharge of water onto carriageway	-More research on this product may be required by the design team. -Timescales for evidence if used in first package of WQT schemes Designers shall consider sustainability, safety implications and suitability of replacing existing concrete channels with GSWCs - preference to retrofit GSWC on top of existing filter drains	Yes - Proprietary products	Careful installation required as per manufacturer's instructions.	Supplier to confirm maintenance requirements of biochar matting.	- Potentially higher treatment values through use of this products when compared to normal grassed surface water channels. - Considered to be a lower carbon option - Could be useful in mitigating higher sensitivity receptor sites. - Can be added to existing GSWC and/or filter drains
	Kerb and gullies	Not considered further due to lack of evidence of pollutant removal capability. Excluded	Removal of pollutants likely to occur but insufficient evidence available to quote indicative treatment efficiency. *(DMRB CG501)*	Yes	Low capital cost Low maintenance costs Low whole life cost	Low - Space in hard strip only	Flow width within running lane	Flow width and outlet spacing	Yes - as pollution mitigation	Standard solution	- Routine Inspection (DMRB GS 801 - recommended frequency: Every 1 year) - De-silting (DMRB GS 801 - recommended frequency: Every 2 years)	-
	Combined kerb drainage	Not considered further as it does not contribute to pollutant reduction. Excluded	Removal of pollutants unlikely to occur *(DMRB CG501)*	Yes	Low capital cost Medium maintenance costs Low whole life cost	Low- Space along kerb line	Flow width within running lane	Flow width and spacing	Yes - as pollution mitigation	Standard solution	- Routine Inspection (DMRB GS 801 - recommended frequency: Every 1 year) - De-silting/jetting (DMRB GS 801 - recommended frequency: Every 2 years	-
	Reservoir pavements/ pervious asphalt	Not considered further due to limited application on National Highways Excluded	Suspended solids - 50% Dissolved zinc - 0% Dissolved copper - 0% *(DMRB CG501)*	No	High capital cost Medium maintenance costs High whole life cost	Cannot be located in running lanes, potentially suitable for use in lay-bys	Collapse of pavement Low friction value of pavement	Could only be used in layby areas and therefore not removing pollutants from the majority of the surface water runoff.	Yes - Covered by DMRB but not in HCD	High - Reconstruction of pavement	- Brushing/jetting and suction wash to reduce silt accumulation and blockages	-
	Rain gardens/ bioretention areas	Not considered further due to limited application on National Highways Excluded	Suspended solids - >90% Dissolved zinc - 60% Dissolved copper - >90% *(SuDS manual, Table 18.1)*	Partial	Low capital cost Medium maintenance costs Medium whole life cost	Additional land take may be required and can be used in wide verges	Risk of standing water adjacent to carriageway.	- Offset distance from the carriageway - Could only be used for small catchments (recommended 0.8ha) - Coordination with landscape team as the plant selection is important for the performance of the system. - Could be integrated within existing landscaped areas.	Yes	Medium	- Removal of litter and debris and routine inspection (CIRIA C753 - recommended frequency: Monthly) - Grass cutting required. - If spillage occurred then may require complete renewal of filter and planting material.	- Vegetative system. - Amenity benefits
	Sediment trap (catchpit)	Not considered further due to lack of evidence of pollutant removal capability. Excluded	Removal of pollutants likely to occur but insufficient evidence available to quote indicative treatment efficiency. *(DMRB CG501)*	No	Low capital cost Low maintenance costs Low whole life cost	Low - space in the verge	Standard solution when in the verge	Capacity of silt storage	Yes - as pollution mitigation	Standard solution	- Routine Inspection (DMRB GS 801 - recommended frequency: Every 1 0 years, 10% a year) - Clear/empty silt and debris (DMRB GS 801 - recommended frequency: Every 1 year)	-

Drainage Asset Group	Name of Mitigation Options	Shortlist Inclusion/Exclusion	Targeted pollutants and pollutant removal efficiency	Spillage control	Cost - Initial Cost & Whole Life Cost	Space Requirements	Safety Considerations (Construction/Operation/ Maintenance/Demolition)	Design Considerations	Departure Required?	Construction Requirements	Maintenance Requirements	Other notes (e.g. carbon cost, additional pollutants and retrofit options)
Proprietary products	Hydrodynamic vortex separators	Included	Suspended solids - 40% Dissolved zinc - 15% Dissolved copper - 0% *(DMRB CG501)* Suppliers quote a higher removal efficiency for suspended solids (HydroInternational)	Yes	Medium capital cost Low maintenance costs Low whole life cost	Low - could be added to a new chamber in the existing networks.	- Can be large if draining sizable catchment. - Safety consideration with lifting operations for the larger units and potentially deep excavations. - Possible clash with existing utilities. - Maintenance access required	- Design flow rates are required for vortex separator sizing depending on the site-specific requirements (catchment size). - Design will require geotechnical design input, ground stability and floatation calculations - Ease of access for maintenance and inspection	No May require a departure from standards depending on the product selected (if plastic chambers are proposed)	- Installation of vortex separators to be carried to the manufacturer's instruction - Adequate preparation and compaction of foundations to avoid uneven settling - Levels of the inlet and outlet pipes - Backfilling sequence (as per manufacturer's recommendations)	- Removal of litter and debris and routine inspection (CIRIA C753 - recommended frequency: Six monthly) - Removal of sediment, oil, grease and floatables (CIRIA C753 - recommended frequency: as necessary, indicated by inspections or immediately after a spill) - Design can accommodate large sediment storage capacity to increase maintenance frequency to every 2 years - Follow suppliers specification for maintenance activities and frequencies	- Can be used as retrofit option for space constrained areas. - Can be used as an additional treatment system within the treatment train.
	Filter tanks/ filter systems	Included	Suspended solids - 80% Dissolved copper - 0% (70% when installed with proprietary filter media mix) Dissolved zinc - 0% (70% when installed with proprietary filter media mix) *(HydroInternational)*	No	High capital cost High maintenance costs (if proprietary filter media mix) High whole life cost (if proprietary filter media mix)	Medium	-Can be large if draining sizable catchment. -Safety consideration with lifting operations for the larger units and potentially deep excavations. -Maintenance access required	-Flow rates and treatment requirement are required for sizing -Filter systems can be installed into an existing chambers, If they are used for larger catchment area custom built vault may be required, refer to manufacturer's instruction for further information. -Ease of access for maintenance and inspection -Preparation of maintenance plans	Yes. Existing departure ID 100727. This departure notes NH intention to do a trials with different configurations	-Can be delivered to site as pre-cast concrete chambers complete with internal components already installed and the installation can be carried out similar to standard chamber installation on site	-Regular inspection during the first year of installation and every six month after first year -Removal of sediment and floatables/oils I (every 6 to 12 months or following a contaminated spill -Filter media replacement (once per year)	-Can be used as retrofit option for space constrained areas. -Can be used as an additional treatment system within the treatment train.
	Engineered filter media	Included	<u>Dependent upon solution</u> Suspended solids - approx. 60% (CG 501 filter drain - to be confirmed with the suppliers) Dissolved zinc - 85% Dissolved copper - 82% (Extracted from a case study - Stormwater Management Ltd)	No	High capital cost Low maintenance costs High whole life cost	This product could have multiple applications - a specific example has been detailed in the drainage collector section of this table for a Filter Drain with Engineered filter media. Other application may be practical dependent upon where this material is applied and site and network constraints.						
	Biomulch/Biochar	Included	<u>Dependent upon solution</u> Suspended solids - 85% Dissolved zinc - 80% Dissolved copper - 80% *(Salix)*	No	High capital cost Low maintenance costs High whole life cost	This product could have multiple applications - a specific example has been detailed in the drainage collector section of this table for a Grass SWC with Biomulch. Other application may be practical dependent upon where this material is applied and site and network constraints.						
	Penstock/valve	Not considered further as it does not contribute to pollutant reduction. Excluded	Removal of pollutants unlikely to occur	Yes	Low Capital Cost Low Maintenance Costs	Removal of pollutants unlikely to occur Only provides spillage control						
	Bypass separator	Included	Suspended solids - 80% Dissolved copper - 0% Dissolved zinc - 0% *(SPEL Stormceptor)*	Yes	Medium capital cost Low maintenance costs Low whole life cost	Medium - more space required than a vortex separator	- Can be large if draining sizable catchment. - Safety consideration (e.g. when lifting larger units and potentially deep excavation) - Confined space entry	- Available space - Access for maintenance - Maintenance plan and schedule - Catchment area and the flow rate generated by the catchment	Yes	-Installation of by-pass separators to be carried to the manufacturer's instructions by a competent contractor - Manufacturer's advice needs to be followed to protect bypass separators construction phase runoff	- Removal of litter and debris and routine inspection (CIRIA C753 - recommended frequency: Six monthly) - Removal of sediment, oil, grease and floatables (CIRIA C753 - recommended frequency: as necessary, indicated by inspections or immediately after a spill) - Potential requirement for specialist maintenance teams - Historically these have not been adequately maintained by OD and their use has declined	- Can be used as additional or alternative solution if needed.

Drainage Asset Group	Name of Mitigation Options	Shortlist Inclusion/Exclusion	Targeted pollutants and pollutant removal efficiency	Spillage control	Cost - Initial Cost & Whole Life Cost	Space Requirements	Safety Considerations (Construction/Operation/ Maintenance/Demolition)	Design Considerations	Departure Required?	Construction Requirements	Maintenance Requirements	Other notes (e.g. carbon cost, additional pollutants and retrofit options)
Nature based solutions	Swale/ditch	Included	Unlined Ditch Suspended solids -25% Dissolved copper -15% Dissolved zinc -15% *(DMRB CG501)* Swale Suspended solids -80% Dissolved copper - 50% Dissolved zinc - 50% *(DMRB CG501)*	Yes (lined)	Low capital cost Low maintenance costs Low whole life cost	-Medium (depending on proximity of the highway boundary and the width needed) -If existing ditches/swales could be improved then minimal land would be required.	- To be separated from traffic - Safety consideration with potentially deep excavations. - Hard to access if at base of embankment	- Not suitable for steep sites (check dams can be used on steep sites) - Minimum distance from highway - VRS may be required (Road Restraint Risk Assessment Process. - Dependent on the invert level of an existing outfall - Interface with other constraints - existing utilities / existing trees	No	- Design levels and slopes for inlets and ditch or swale base and sides should be constructed accurately to avoid water ponding. - Ditch or swale should not receive any surface runoff until the vegetation is fully established	-Provision of adequate access for inspection and maintenance -Grass cutting to retain grass height within the specified height and removal of litter and debris (CIRIA C753 - recommended frequency: Monthly (dependant on the type of vegetation proposed)) (DMRB GS 801 - recommended frequency: 3 time per year (swales)) - Inspection of inlets and overflows for any blockages and for structural damage (CIRIA C753 - recommended frequency: 6 monthly) (DMRB GS 801 - recommended frequency: Every 1 year)	- Vegetative solution - Considered to be a lower carbon option - Could utilise existing ditches/swales with improvement e.g. planting, weirs, wetland areas. - Amenity benefits - Potentially less land required than a pond/basin solution.
	Pond	Included	Suspended solids - 60% Dissolved zinc - 40% Dissolved copper - 30% *(DMRB, CG501)*	No	Low capital cost Low maintenance costs Medium whole life cost	High - Additional land take likely required	- Access for maintenance. - Safety consideration with potentially deep excavations. - Designed for safety e.g. maximum depths of water - Standing Water	- Selection of siting (near the outlet of the highway drainage system and close proximity to the receiving watercourse) - Ground stability by assessing site soil and groundwater levels - Invert level of the outlet of the highway drainage system and the receiving watercourse. - Typical pond depth is to be between 0.5-2m for safety reasons with a permanent water depth of 0.5m - Assessment for pre-treatment measure if required - Safe routing of exceedance flow.	No	- The bottom and side slopes of should be constructed to ensure that they are structurally sound. - Ensure pond can retain runoff without significant erosion damage.	- Grass cutting and removal of litter and debris (CIRIA C753 - recommended frequency: Monthly (dependant on the type of vegetation proposed)) (DMRB GS 801 - recommended frequency: 3 time per year) -Inspection of inlets and overflows for any blockages and for structural damage (CIRIA C753 - recommended frequency: 6 monthly) (DMRB GS 801 - recommended frequency: Every 1 year) - Sediment removal (CIRIA C753 - recommended frequency: 5 yearly) - Remedial action, if required (replanting/erosion repairs etc.)	- Vegetative system - Considered to be a lower carbon option - Can be used as a storage system. - Risk reduction in both flooding and pollution downstream - Amenity benefits
	Dry detention basin	Included	Suspended solids - 50% Dissolved zinc - 0% Dissolved copper - 0% *(DMRB, CG501)*	No	Low capital cost Low maintenance costs Medium whole life cost	High - Additional land take likely required	- Access for maintenance. - Safety consideration with potentially deep excavations. - Designed for safety e.g. maximum depths of water	- Selection of siting (near the outlet of the highway drainage system and close proximity to the receiving watercourse) - Ground stability by assessing site soil and groundwater levels - Invert level of the outlet of the highway drainage system and the receiving watercourse - Typical pond depth is to be between 0.5-2m for safety reasons with a permanent water depth of 0.5m - Assessment for pre-treatment measure if required - Safe routing of exceedance flow	No	- The bottom and side slopes of should be constructed to ensure that they are structurally sound. - Ensure pond can retain runoff without significant erosion damage.	- Grass cutting and removal of litter and debris (CIRIA C753 - recommended frequency: Monthly (dependant on the type of vegetation proposed)) (DMRB GS 801 - recommended frequency: 3 time per year) -Inspection of inlets and overflows for any blockages and for structural damage (CIRIA C753 - recommended frequency: 6 monthly) (DMRB GS 801 - recommended frequency: Every 1 year) - Sediment removal (CIRIA C753 - recommended frequency: 5 yearly) - Remedial action, if required (replanting/erosion repairs etc.)	- Vegetative system - Considered to be a lower carbon option - Can be used as a storage system. - Risk reduction in both flooding and pollution downstream - Amenity benefits
	Infiltration basin/soakaway	Included	Infiltration of water facilitates the removal of dissolved metals and solids *(DMRB, CG501)*	No	Low capital cost Low maintenance costs Medium whole life cost	Soakaways Low - minimal land take required Infiltration basins High - Additional land take required	- Access for maintenance. - Safety consideration with potentially deep excavations. - Designed for safety e.g. maximum depths of water - Standing Water	- Site's soil type and infiltration capacity - Upstream spillage containment device to capture accidental spillages prior to discharge into the infiltration system. - Adopt a minimum distance of 1.2m between the base of the infiltration systems and maximum groundwater levels to protect the groundwater from runoff pollutants - Assessment of the followings need to be included in the design of infiltration systems: -risk of ground instability and slope stability -risk of groundwater pollution -risk of groundwater flooding	No	- Construction process need careful planning and implementation for the performance of the infiltration system - Construction phase runoff and sediments need to be managed separately	- Grass cutting and removal of litter and debris (CIRIA C753 - recommended frequency: Monthly (dependant on the type of vegetation proposed)) (DMRB GS 801 - recommended frequency: 3 time per year) -Inspection of inlets and overflows for any blockages and for structural damage (CIRIA C753 - recommended frequency: 6 monthly) (DMRB GS 801 - recommended frequency: Every 1 year) - Sediment removal (CIRIA C753 - recommended frequency: 5 yearly) - Remedial action, if required (replanting/erosion repairs etc.) - Inspection of infiltration surfaces for compaction and ponding	- Infiltration basins are vegetative systems - Considered to be a lower carbon option - Can be used as a storage system.
	Wetland (surface flow)	Included	Suspended solids - 60% Dissolved zinc - 30% Dissolved copper - 50% *(DMRB, CG501)*	No	Low capital cost Low maintenance costs Low whole life cost	High - Additional land take required	- Access for maintenance. - Safety consideration with potentially deep excavations. - Designed for safety e.g. maximum depths of water - Standing Water	- Selection of siting (near the outlet of the highway drainage system and close proximity to the receiving watercourse) - Ground stability by assessing site soil and groundwater levels - Invert level of the outlet of the highway drainage system and the receiving watercourse. - Area of a wetland to be set between 0.5% to 5% of the catchment area draining into it. - Depth of permanent water in the wetland to be between 0.15m and 0.3m. - Assessment for pre-treatment measure if required. - Safe routing of exceedance flow.	No	- The bottom and side slopes of should be constructed to ensure that they are structurally sound. - Ensure wetland can retain runoff without significant erosion damage.	- Grass cutting and removal of litter and debris (CIRIA C753 - recommended frequency: Monthly (dependant on the type of vegetation proposed)) -Inspection of inlets and overflows for any blockages and for structural damage (CIRIA C753 - recommended frequency: 6 monthly) (DMRB GS 801 - recommended frequency: 2 times per year) - Sediment removal (CIRIA C753 - recommended frequency: 5 yearly) (DMRB GS 801 - recommended frequency: Every 9 years ((1/3 every 3 years))) - Remedial action, if required (replanting/erosion repairs etc.)	- Vegetative system - Considered to be a lower carbon option - Can be used as a storage system. - Risk reduction in both flooding and pollution downstream - Amenity benefits
	Forebay (just to treat first flush)	Included	Suspended solids – to be confirmed. Dissolved zinc – to be confirmed. Dissolved copper – to be confirmed.	Yes	Generally used as a pre-treatment measure			- Access for inspection and maintenance with a hardened surface. -Design depend on the catchment area and the depth and arrangement of the downstream pond/basin. -Depth of forebay should not exceed 300mm. -Provision of earth embankment and gabion/riprap wall -The plan area of the forebay needs to be 10% of the total pond/basin area. -recommended side slope is 1:3 - A fixed sediment depth marker to be installed to measure the depth of accumulated sediment depth -Maintenance plans and schedule	No	- Construction of a berm to the required level to retain water with a gabion/riprap wall - Construction of an outlet structure/spillway	- Grass cutting and removal of litter and debris (CIRIA C753 - recommended frequency: Monthly (dependant on the type of vegetation proposed)) (DMRB GS 801 - recommended frequency: 3 time per year) -Inspection of inlets and overflows for any blockages and for structural damage (CIRIA C753 - recommended frequency: 6 monthly) (DMRB GS 801 - recommended frequency: Every 1 year) - Sediment removal (CIRIA C753 - recommended frequency: 5 yearly) - Remedial action, if required (replanting/erosion repairs etc.)	- Can be used as retrofit option to enhance the treatment

APPENDIX B. EXAMPLE GG104 CATEGORISATION OF ACTIVITY TYPE

Example GG104 categorisations have been included to support design teams and are based on the current understanding of national acceptance of activity types. Designers shall review and confirm any site-specific variations and update if any specific concerns are raised by local NH OD teams.

Red text = designer will need to add in the relevant information - i.e. location or design specific information

Purple text = notes and guidance for the designer when selecting categorisation

HYDRODYNAMIC VORTEX SEPARATORS

Feature	Type	Indicator	Justification
Extent of prior experience of activity The degree of knowledge available from undertaking the activity previously or the degree to which knowledge is available from the activity being undertaken by other industries or organisations.	**A**	Activities for which there is significant experience within National Highways. Previous safety studies and data are available, and some activity features are codified in a standard or formal procedure.	There is significant experience within National Highways of implementing pollution mitigation measures into existing road drainage systems, including vortex separator sizing requirements and associated interactions with drainage infrastructure such as outfalls, catchpits etc. Implantation of vortex separators are an approved pollution mitigation solution as per DMRB CD528 and are in widespread use on the strategic road network. Area X has [significant/some/limited/transferable/no – select as appropriate] experience in the operation and maintenance of vortex separators. [if 'no' or 'transferable' – state which similar drainage assets are in use within the Area?] Design team engagement with Operations Directorate within National Highways Area X has not raised any concerns with the implantation, operation and maintenance of new vortex separators within X. [if OD / maintainers have raised concerns, the location has unique features and there is no previous or transferable experience in using vortex separators, consider changing to B – otherwise Type A]
	B	Activities for which there is limited experience within National Highways but there is transferable experience elsewhere in the UK or internationally. Activities for which there is limited experience in National Highways but there is experience elsewhere in the UK or internationally, including in different industries, which is deemed sufficiently like the activity in question to be deemed relevant. Activities for which there is experience within National Highways, but that experience is in a different application of the activity and some adaptation will be required. There might also be local and site-specific issues to consider that can affect the relevance of the available experience.	
	C	Activities for which there is no previous applicable experience from either National Highways or other industries.	
Statutory and formal processes and procedures (including standards and legislation) Consideration of the applicability of current standards, formal processes, or procedures, guidance, and legislation.	**A**	The activity is substantially or entirely within the scope of existing standards, guidance, formal processes or procedures and applicable legislation. The activity requires minimal or no safety related departures from standard or safety related changes to formal processes or procedures (including any legislation). The nature and type of a departure is the most important element in determining the categorisation and so a single safety departure may change this.	Vortex separator design parameters, operation and maintenance are fully covered within DMRB CD 528. There are no safety related departures. [unless there are safety related departures this will be Type A]
	B	The activity is largely within the scope of existing standards, guidance, formal processes, or procedures. There can be some safety related departures from standards needed and/or safety related changes to formal processes or procedures. The activity can need minor changes to existing legislation. Whilst the number of safety departures from standards, formal processes or procedures can affect the categorisation, the most important element in determining this is the nature and type of the departures.	
	C	Activities that are not within the scope of existing standards, formal processes or procedures and require new ones to be developed. Activities for which significant departures from standards, formal processes or procedures are required. Activities which require significant changes to existing legislation or new legislation to be written. Whilst the number of safety departures from standards, formal processes or procedures can affect the categorisation, the most important element in determining this is the nature and type of the departures. For example, many safety departures that can be addressed straightforwardly will have less impact on feature type than a single safety departure that cannot and requires a detailed risk assessment to support it.	
Impact on the organisation The effect that the activity will have on current National Highways processes, procedures, structure, roles	**A**	The activity has no impact on National Highways. The activity has a minor impact on any of these for a finite period. Length of time National Highways is affected by decision to undertake the activity is short term.	[Generally, if the vortex separators are new to the region / Area team – i.e. these assets are not currently in operation and maintenance, this would suggest a Type B as the MSP will need to implement a new maintenance processes / methodology, risk assessments and staff training. If the vortex separators are already in use within the region / Area, and the roadside environment

Feature	Type	Indicator	Justification
and responsibilities, competencies, policies, and strategy, in addition to contractual and workforce arrangements.	**B**	The activity can lead to permanent minor changes to any of these. These minor changes can introduce new roles and responsibilities, policies, contractual and workforce arrangements. The activity can require a change to organisational arrangements. Length of time National Highways is affected by decision to undertake the activity is medium term.	does not instigate unusual complexities that would impact the above considerations, use Type A as the activity will have no fundamental impact on the National Highways' supply chain.] [**Type A text below – use of delete as appropriate**] There is no fundamental impact on National Highways or its supply chain – nominally the Area X MSP. As existing vortex separators are currently maintained at the roadside in comparable locations, current working processes, methodologies and risk assessments can be used or easily adapted to cover the ongoing maintenance of the new assets. [**Type B text below – use of delete as appropriate**] The activity can lead to permanent minor change for National Highways' supply chain. The operation and maintenance of new vortex separator assets should not pose operational or maintenance difficulties, however as a new asset type in Area X, this will introduce new (albeit non-complex) maintenance processes / methodologies, risk assessments and staff training. The Area X team will be required to update their processes to provide appropriate temporary traffic management to accommodate a vacuum tanker designed for hazardous waste, potential surface water retention in the event of an emergency spillage which could cause a pollution incident, authorised entry only into the confined space (the cover shall remain locked outside of maintenance activities) and appropriate training for maintenance operatives. Maintenance of catchpits will also need to be considered by Area X. [remember to select the correct Type and indicator in the columns to the left] [Note: engagement with OD / Area MSP will definitively answer the question as to the impact of the new assets]
	C	The activity has significant impact on any of these. The activity can change core safety roles and responsibilities. Length of time National Highways is affected by decision to undertake the activity is long term.	
Activity scale Consideration of the size and/or scale of the activity. Does or can the activity have an impact on the motorway and all-purpose trunk roads, either directly or indirectly.	**A**	The impact of the activity is limited in nature or scale.	The impact of the activity is limited in nature and has local scale as it relates to the implementation of X at X location. There is expected to be negligeable impact on road users with the main impact being during construction when installation of the drainage solution will take place under temporary traffic management. [This activity will almost always be Type A unless the scope covers whole routes or schemes (over multiple links) with corresponding road closures for construction)]
	B	The impact of the activity is significant in nature or scale.	
	C	The impact of the activity is wide ranging across the network, and/or significantly impacts infrastructure, interventions, or workforce.	
Technical Measure of technical and/or technological novelty and/or innovation the activity involves.	**A**	An activity where any processes, techniques, methodologies and/or technologies involved are currently in widespread use and re-examination is unlikely to be needed.	CD 528 governs the locations, the principal function, operation and maintenance of the vortex separator device. The design principles of integrating vortex separators into existing roadside drainage systems, and the construction techniques are well understood. [Add further detail only if there is something unusual or innovative to consider – see notes below] Ongoing maintenance of the vortex separators are covered by CD528. The new assets will share the same general maintenance processes, methodologies and means of access as other roadside vortex separators installed on the SRN. [unless there is something unusual / highly innovative in the design that requires a different approach to operating or maintaining these assets, this will be Type A. Use engagement with OD / Area MSP to guide categorisation if unsure – in most scenarios the design and maintenance will be well understood as these are not technically complex assets]
	B	There can be some experience of the processes, techniques, methodologies and/or technologies. The experience can be from use in either another application, or by another road authority, supplier, industry or perhaps from overseas in which case some additional work can be required to adapt them and/or to demonstrate that safety can be assured for the intended application.	
	C	Activities that use new processes, techniques, methodologies and/or technologies for which there is no previous experience in the UK or elsewhere.	

Feature	Type	Indicator	Justification
Stakeholder impact and interest The quantity and/or impact of stakeholders, their interest in and resulting ability to influence or/impact on the activity. The degree to which the safety issues, as perceived, are capable of being understood and fully addressed.	**A**	Activities for which the quantity and/or impact of stakeholders, their interest in and resulting ability to influence or impact the activity is low.	The activity will involve small number of stakeholders who will be engaged with during the design. There are a few key internal stakeholders from National Highways, including from within the Operations Directorate, the Area X Maintenance Service Provider and Safety Engineering and Standards [note: from a preferred drainage solution perspective even where there are no safety elements of substance]. External stakeholders that have an interest in roadside drainage and pollution mitigation would include the Environment Agency and the Lead Local Flood Authorities. There is substantial stakeholder interest related to environmental issues, of which the use of pollution mitigation assets is an element. Safety implications of the activity are low. The activity is unlikely to generate significant safety discussion and stakeholder interest on this point. [Unlikely to change from Type B]
	B	Activities that have only a single or a few stakeholders but their impact, in terms of their attitude towards, or ability to influence, and/or interest in the successful achievement of the activities aim can be significant. Alternatively, it will represent an activity that has several stakeholders but the amount, or type, of safety issues involved are limited.	
	C	Activities for which there are many stakeholders and their impact in terms of their attitude towards, or ability to influence can be significant. Stakeholders with a strong interest in the potential safety impact of the activity on themselves. Activities where there are conflicting needs arising from different stakeholders or stakeholder groups.	

Based on the individual activity type categorisations, the overall categorisation of the activities detailed in accordance with GG104 can be considered Type A. Such a categorisation means that a Safety Control Review Group does not need to be established to approve the proposed category but rather such selection can be approved by the person responsible for managing the activity, in this case the National Highways project manager.

DITCH/SWALE

The example GG104 categorisation for ditches will be incorporated into the design palette once available.

FILTER DRAINS

The example GG104 categorisation for filter drains will be incorporated into the design palette once available.

GRASSED SURFACE WATER CHANNELS (GSWCs)

Feature	Type	Indicator	Justification
Extent of prior experience of activity The degree of knowledge available from undertaking the activity previously or the degree to which knowledge is available from the activity being undertaken by other industries or organisations.	**A**	Activities for which there is significant experience within National Highways. Previous safety studies and data are available, and some activity features are codified in a standard or formal procedure.	There is significant experience within National Highways of implementing pollution mitigation measures into existing road drainage systems. Implementation of grassed surface water channels are an approved pollution mitigation solution as per DMRB CD521 and are in widespread use on the strategic road network. Area X has [significant/some/limited/transferable/no – select as appropriate] experience in the operation and maintenance of GSWCs. [if 'no' or 'transferable' – state which similar drainage assets are in use within the Area?] Design team engagement with Operations Directorate within National Highways Area X has not raised any concerns with the implantation, operation and maintenance of new GSWCs within X. [if OD / maintainers have raised concerns, the location has unique features and there is no previous or transferable experience in using GSWCs, consider changing to B – otherwise Type A]
	B	Activities for which there is limited experience within National Highways but there is transferable experience elsewhere in the UK or internationally. Activities for which there is limited experience in National Highways but there is experience elsewhere in the UK or internationally, including in different industries, which is deemed sufficiently like the activity in question to be deemed relevant. Activities for which there is experience within National Highways, but that experience is in a different application of the activity and some adaptation will be required. There might also be local and site-specific issues to consider that can affect the relevance of the available experience.	
	C	Activities for which there is no previous applicable experience from either National Highways or other industries.	
Statutory and formal processes and procedures (including standards and legislation) Consideration of the applicability of current standards, formal processes, or procedures, guidance, and legislation.	**A**	The activity is substantially or entirely within the scope of existing standards, guidance, formal processes or procedures and applicable legislation. The activity requires minimal or no safety related departures from standard or safety related changes to formal processes or procedures (including any legislation). The nature and type of a departure is the most important element in determining the categorisation and so a single safety departure may change this.	GSWCs design parameters, operation and maintenance are fully covered within DMRB CD 521. There are no safety related departures. [unless there are safety related departures this will be Type A]
	B	The activity is largely within the scope of existing standards, guidance, formal processes, or procedures. There can be some safety related departures from standards needed and/or safety related changes to formal processes or procedures. The activity can need minor changes to existing legislation. Whilst the number of safety departures from standards, formal processes or procedures can affect the categorisation, the most important element in determining this is the nature and type of the departures.	

Feature	Type	Indicator	Justification
	C	Activities that are not within the scope of existing standards, formal processes or procedures and require new ones to be developed. Activities for which significant departures from standards, formal processes or procedures are required. Activities which require significant changes to existing legislation or new legislation to be written. Whilst the number of safety departures from standards, formal processes or procedures can affect the categorisation, the most important element in determining this is the nature and type of the departures. For example, many safety departures that can be addressed straightforwardly will have less impact on feature type than a single safety departure that cannot and requires a detailed risk assessment to support it.	
Impact on the organisation The effect that the activity will have on current National Highways processes, procedures, structure, roles and responsibilities, competencies, policies, and strategy, in addition to contractual and workforce arrangements.	A	The activity has no impact on National Highways. The activity has a minor impact on any of these for a finite period. Length of time National Highways is affected by decision to undertake the activity is short term.	[Generally, if the GSWCs are new to the region / Area team – i.e. these assets are not currently in operation and maintenance, this would suggest a Type B as the MSP will need to implement a new maintenance processes / methodology, risk assessments and staff training. If the GSWCs are already in use within the region / Area, and the roadside environment does not instigate unusual complexities that would impact the above considerations, use Type A as the activity will have no fundamental impact on the National Highways' supply chain.] [**Type A text below – use of delete as appropriate**] There is no fundamental impact on National Highways or its supply chain – nominally the Area X MSP. As existing GSWCs are currently maintained at the roadside in comparable locations, current working processes, methodologies and risk assessments can be used or easily adapted to cover the ongoing maintenance of the new assets. [**Type B text below – use of delete as appropriate**] The activity can lead to permanent minor change for National Highways' supply chain. The operation and maintenance of new GSWCs should not pose operational or maintenance difficulties, however as a new asset type in Area X, this will introduce new (albeit non-complex) maintenance processes / methodologies, risk assessments and staff training. The Area X team will be required to update their processes to provide appropriate temporary traffic management to accommodate a vacuum tanker designed for hazardous waste, potential surface water retention in the event of an emergency spillage which could cause a pollution incident, authorised entry only into the confined space (the cover shall remain locked outside of maintenance activities) and appropriate training for maintenance operatives. Maintenance of catchpits will also need to be considered by Area X. [remember to select the correct Type and indicator in the columns to the left] [Note: engagement with OD / Area MSP will definitively answer the question as to the impact of the new assets]
	B	The activity can lead to permanent minor changes to any of these. These minor changes can introduce new roles and responsibilities, policies, contractual and workforce arrangements. The activity can require a change to organisational arrangements. Length of time National Highways is affected by decision to undertake the activity is medium term.	
	C	The activity has significant impact on any of these. The activity can change core safety roles and responsibilities. Length of time National Highways is affected by decision to undertake the activity is long term.	
Activity scale Consideration of the size and/or scale of the activity. Does or can the activity have an impact on the motorway	A	The impact of the activity is limited in nature or scale.	The impact of the activity is limited in nature and has local scale as it relates to the implementation of X at X location. There is expected to be negligeable impact on road users with the main impact being during construction when installation of the drainage solution will take place under temporary traffic management.
	B	The impact of the activity is significant in nature or scale.	

Feature	Type	Indicator	Justification
and all-purpose trunk roads, either directly or indirectly.	C	The impact of the activity is wide ranging across the network, and/or significantly impacts infrastructure, interventions, or workforce.	[This activity will almost always be Type A unless the scope covers whole routes or schemes (over multiple links) with corresponding road closures for construction)]
Technical Measure of technical and/or technological novelty and/or innovation the activity involves.	A	An activity where any processes, techniques, methodologies and/or technologies involved are currently in widespread use and re-examination is unlikely to be needed.	CD 521 governs the locations, the principal function, operation and maintenance of the GSWC. The design principles of integrating GSWCs into existing roadside drainage systems, and the construction techniques are well understood. [Add further detail only if there is something unusual or innovative to consider – see notes below] Ongoing maintenance of GSWCs are covered by CD521. The new assets will share the same general maintenance processes, methodologies and means of access as other roadside GSWCs installed on the SRN. [unless there is something unusual / highly innovative in the design that requires a different approach to operating or maintaining these assets, this will be Type A. Use engagement with OD / Area MSP to guide categorisation if unsure – in most scenarios the design and maintenance will be well understood as these are not technically complex assets]
	B	There can be some experience of the processes, techniques, methodologies and/or technologies. The experience can be from use in either another application, or by another road authority, supplier, industry or perhaps from overseas in which case some additional work can be required to adapt them and/or to demonstrate that safety can be assured for the intended application.	
	C	Activities that use new processes, techniques, methodologies and/or technologies for which there is no previous experience in the UK or elsewhere.	
Stakeholder impact and interest The quantity and/or impact of stakeholders, their interest in and resulting ability to influence or/impact on the activity. The degree to which the safety issues, as perceived, are capable of being understood and fully addressed.	A	Activities for which the quantity and/or impact of stakeholders, their interest in and resulting ability to influence or impact the activity is low.	The activity will involve small number of stakeholders who will be engaged with during the design. There are a few key internal stakeholders from National Highways, including from within the Operations Directorate, the Area X Maintenance Service Provider and Safety Engineering and Standards [note: from a preferred drainage solution perspective even where there are no safety elements of substance]. External stakeholders that have an interest in roadside drainage and pollution mitigation would include the Environment Agency and the Lead Local Flood Authorities. There is substantial stakeholder interest related to environmental issues, of which the use of pollution mitigation assets is an element. Safety implications of the activity are low. The activity is unlikely to generate significant safety discussion and stakeholder interest on this point. [Unlikely to change from Type B]
	B	Activities that have only a single or a few stakeholders but their impact, in terms of their attitude towards, or ability to influence, and/or interest in the successful achievement of the activities aim can be significant. Alternatively, it will represent an activity that has several stakeholders but the amount, or type, of safety issues involved are limited.	
	C	Activities for which there are many stakeholders and their impact in terms of their attitude towards, or ability to influence can be significant. Stakeholders with a strong interest in the potential safety impact of the activity on themselves. Activities where there are conflicting needs arising from different stakeholders or stakeholder groups.	

Based on the individual activity type categorisations, the overall categorisation of the activities detailed in accordance with GG104 can be considered Type A. Such a categorisation means that a Safety Control Review Group does not need to be established to approve the proposed category but rather such selection can be approved by the person responsible for managing the activity, in this case the National Highways project manager.

POND/BASIN

The example GG104 categorisation for ponds/basins will be incorporated into the design palette once available.

PROPRIETARY PRODUCTS

GG104 categorisations for proprietary solutions shall be completed on a scheme specific basis due to the individual nature of these solutions.

APPENDIX C. MITIGATION SELECTION DECISION TREE

NH619526-WQT-GEN-XX-RP-CD-0002 APPENDIX C Mitigation Selection Decision Tree