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Filtering Protocol for Innovative Paving Materials; including waste-derived materials

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Foreword

Increasingly, non-bituminous, non-mineral and waste-derived products are being proposed as novel additives or components for inclusion in paving materials. While this may address the sustainability challenges of other industries, the potential impacts on the whole-life performance of these materials are often not fully addressed.

This Filtering Protocol is designed to support the assessment of any innovative material proposed for use as a paving material. A paving material could be anything from additives, modifiers, fillers, binders, natural or manufactured aggregates, hydraulically bound mixtures, asphalt mixtures and concrete, to all types of admixtures or any other constituent used in a mixture proposed to be incorporated in the structure of a pavement.

This Filtering Protocol applies to all innovative materials, independent of source (primary, by-product, manufactured, recycled and waste stream); however, some of the requirements are specific for by-products or materials originated from a waste stream and do not apply to materials coming from a primary source.

Note
This Filtering Protocol was drafted before the withdrawal of the United Kingdom from the European Union in January 2021. It includes references to European standards/regulations that **may or may not** be applicable at the time of reading. Where the Filtering Protocol references European standards/regulations, a note has been added to assist the reader. In such cases, it is the reader's responsibility to comply with the current applicable UK standards/regulations and/or equivalent European standards/regulations referenced in the Filtering Protocol.

Table of Contents

Glossary

Terms & abbreviations	Definition
Acceptance criteria	Pre-established standards or requirements a product or project must meet.
Asset Manager	The individual/organisation/group of organisations responsible for managing their own or a client's investments or assets.
Autoignition	The lowest temperature at which a substance spontaneously ignites in normal atmosphere without an external source of ignition, such as a flame or spark.
By-product	Article 5(1) of the Waste Framework Directive (WFD) provides that a substance or object, resulting from a production process, the primary aim of which is not the production of that item, may be regarded as a non-waste by-product – but only if all of the conditions set out in Article 5(1)(a)-(d) are met [1].
Carbon footprint	The total greenhouse gas emissions caused by an individual, event, organisation, or product, expressed as carbon dioxide equivalent.
Comparator	The agreed benchmark for assessing against the proposed material; ideally at the mixture rather than constituent level. This must be an existing material used in the pavement industry. This may or may not be the same as the comparator for the End of Waste assessment.
Competence	Ability to apply knowledge and skills to achieve intended results [2].
Compliant	Meeting or in accordance with rules or standards.
Conceptual model	This can be a textual or graphical representation of the relationship(s) between hazard source(s), pathway(s) and receptor(s) developed on the basis of problem formulation and refined during subsequent risk assessment phases [3].
Conformity	Fulfilment of a requirement [2].
Contaminants/ chemicals	Legal documents and directives may refer to substances or contaminants, but in the majority of cases these are chemicals. The term “chemical” is used in line with much of the European chemicals regulatory risk assessment guidance[1].
Disposal	Any operation which is not recovery, even where the operation has as a secondary consequence the reclamation of substances or energy [4].
End of waste	Materials that are waste can become non-waste in certain circumstances. This is known as achieving “End of Waste” [1].
Environmental Permit	Environmental permits issued or exemptions registered under the Environmental Permitting (England and Wales) Regulations 2010 [5].
Environmental Regulations	Regulations related to the Environment.
European Waste Catalogue (EWC)	European Waste Catalogue (EWC) (2002 and amendments) – a comprehensive list of waste codes and descriptions[1] based on waste source and type (Commission Decision 2000/532/EC amended by Commission Decisions 2001/118/EC and 2001/119/EC and Council Decision 2001/573/EC) [5].
Factory Production Control (FPC)	A management system focusing mainly on the production process which aims to ensure that product quality is consistently maintained to the required specifications.

[1] Referenced regulations may have been superseded following the withdrawal of the United Kingdom from the European Union in January 2021. It is the reader’s responsibility to comply with the applicable requirements at the time of reading.

Terms & abbreviations	Definition
Hazard	A situation or biological, chemical or physical agent that may lead to harm or cause adverse effects [3].
Hazardous waste	Any waste that displays one or more of the hazardous properties listed in Annex III of the WFD [4].
Impact assessment	Impact assessment is a structured process for considering the implications, for people and their environment, of proposed actions while there is still an opportunity to modify (or even, if appropriate, abandon) the proposals. It is applied at all levels of decision-making, from policies to specific projects.
Inert waste	Any waste: 1) that does not undergo any significant physical, chemical or biological transformations; and, 2) that does not dissolve, burn or otherwise physically or chemically react, biodegrade or adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm to human health; and 3) where its total leachability and pollutant content and the ecotoxicity of its leachate are insignificant and, in particular, do not endanger the quality of any surface water or groundwater. Please see Directive 1999/31/EC [4].
Innovation	Implementation of a new or significantly improved product (goods or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations [6].
Innovator	The individual/organisation/group of organisations proposing the new material to be assessed with this Filtering Protocol.
Leachant	Liquid that is brought into contact with the test portion in the leaching procedure (as per PD CEN/TS 15864:2015)
Leachate	A liquid that is formed when liquid filters through a material, it leaches or draws out, chemicals or constituents from that material
Leaching test	Test during which a material is put into contact with a leachant and some constituents of the material are extracted.
Method Statement of Production (MSP)	The document that outlines the way a process or task will be carried out.
Monitoring	Determining the status of a system, a process or an activity. Note 1 to entry: To determine the status, there may be a need to check, supervise or critically observe [2].
Non-conformity/Non-compliance/Non-conforming	Non-fulfilment of a requirement.
Non-waste comparator	The agreed benchmark for assessing against the proposed material during the End of Waste assessment. This may or not be the same as the comparator for the pavement industry specific assessment [7].
Persistent Organic Pollutants (POPs)	Persistent organic pollutants (POPs) are poisonous chemical substances that break down slowly and get into food chains as a result. In the past POPs were used in various products including pesticides and industrial chemicals and released during chemical and agricultural processes [8].
Primary (products)	Materials that are from a non-renewable source (also referred to as virgin materials) [4].
Process	Set of interrelated or interacting activities which changes inputs into outputs [2].

Terms & abbreviations	Definition
Producer	The operator(s) undertaking material processing [5]. This may be the Supply Chain or other operator producing a material for the Supply Chain.
Proposed material	Any innovative material or constituent proposed for use in pavements to be assessed by this Filtering Protocol.
Quality Protocol	A Quality Protocol sets out criteria for the production of a product from a specific waste type. Compliance with these criteria is to demonstrate that the recovered product can be regarded as having ceased to be waste and that it is no longer subject to waste management controls. Quality Protocols are provided by the Environment Agency. Each Quality Protocol document states if it applies in England, Northern Ireland and/or Wales [5].
REACH	Registration, Evaluation, Authorisation and restriction of Chemicals. If you are using, making, selling or importing chemicals in the UK, you need to follow UK REACH [9].
Recovery	Any operation, the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy [4].
Recycling (recycled)	The action or process of converting waste into reusable material [1].
Recyclable	A substance or object that can be recycled.
Regulation	Act of legally enforceable rule-making by a government or other authority in order to control the way something is done or the way people behave [6].
Responsible innovation	Careful consideration of, and action to address, the potential impacts of introducing a new product, service, process or business model [6].
Reviewer	The individual/organisation checking the information provided by the User.
Risk	Effect of uncertainty often characterized by reference to potential “events” (as defined in ISO Guide 73:2009, 3.5.1.3) and “consequences” (as defined in ISO Guide 73:2009, 3.6.1.3), or a combination of these [2].
Risk assessment	The formal process of evaluating the consequence(s) of a hazard(s) being realised and their likelihoods/probabilities.
Safety Data Sheet (SDS)	A well-established and effective mechanism for transmitting appropriate safety information along the Supply Chain on substances and mixtures which meet specific classification criteria. Also known as Material safety Data sheet (MSDS)
Sampling plan	All the information pertinent to a particular sampling activity [10].
Service life	The time during which a material/product remains usable for its primary function.
Supplier	A person or organization that provides a material, a product or a service.
Supply Chain	Relationship of organisations, people, activities, logistics, information, technology and resources engaged in activities and creating value from point of origin to point of consumption, including transforming materials/components to products and services for end users [2].
Technology Readiness Level	A method adopted by organisations for estimating the maturity of technology. In this protocol this term is specific to Highways England’s process for pavement innovations.
User	The individual/organisation/group of organisations gathering the required information to comply with this Filtering Protocol.
Waste stream	The complete flow of waste from its domestic or industrial source through to recovery, recycling or final disposal.

Terms & abbreviations	Definition
Waste	A material is considered to be waste when the Producer or holder discards it, intends to discard it, or is required to discard it [1].
Waste duty of care	The duty of care legislation makes provision for the safe management of waste to protect human health and the environment. The duty of care applies to anyone who imports, produces, carries, keeps, treats, disposes of, or are a dealer or broker that has control of waste (referred to as a "waste holder") [11].
Waste management controls	Controls under legislation that govern the treatment, handling, containment, transportation storage use and disposal of waste [5].
Waste transfer note	A written description of the waste is agreed and signed by the waste holder and the next holder. The description is part of the waste information the waste holder must provide [11].

Introduction

This Filtering Protocol sets out how to assess any innovative material or constituent proposed for use in pavements (herein referred to as the "proposed material"). It includes End of Waste (EoW) criteria for the production and use of any material coming from a waste source, by-product requirements and an impact assessment to evaluate the suitability of the proposed material for use in pavements.

The requirements included in this Filtering Protocol do not affect permitting or any other legal requirements, such as the obligations to comply with the construction product regulations, public contract regulations, or any obligations of Producers to hold an environmental permit (including an exception) and to comply with its conditions when transporting, storing and processing waste and by-products. This includes guidance on good practice to support the development of sustainable innovations for the pavement industry.

Who should be using this Filtering Protocol?

This Filtering Protocol may be used by any individual or organisation gathering the required information to assess a proposed material, herein referred to as the "User", or by any individual or organisation assessing or checking the information provided, herein referred to as the "Reviewer".

Based on the development stage of the proposed material, the User and the Reviewer may be one or more of the parties defined below (this is further explained in Section 0):

- An individual, organisation or group of organisations proposing the new material, herein referred to as the "Innovator".
- An individual, organisation or group of organisations that may incorporate the proposed material in their products or processes, herein referred to as the "Supply Chain".
- An individual, organisation or group of organisations responsible for authorising the use of the proposed material in a pavement asset, herein referred to as the "Asset Manager".

Please note that this Filtering Protocol has been produced as specifically relevant to UK Regulations, products and applications of those products on the Highways England network. Nonetheless, the principles of this Filtering Protocol may be generically applicable in other territories.

Purpose of this Filtering Protocol

The aim of this Filtering Protocol is to establish if any proposed material is suitable for development in the pavement industry. It has been developed to support sustainable innovation and efficient use of paving materials and their constituents. This Filtering Protocol should be read in conjunction with the "Assessment procedure of 'innovative' techniques and materials" [12] and the "Pilots and trials guidance" [13] particularly if the material is being proposed for use on trunk roads including motorways managed by Highways England.

In addition to this Filtering Protocol, it is advised to refer to the PAS 440:2020 Responsible Innovation - Guide [6] to understand responsible development of innovative solutions.

How to use this Filtering Protocol

The User is required to follow, step by step, the Filtering Protocol's assessment framework as detailed in Section 0 and complete the relevant checklists from Appendix A. If required, the checklists should be accompanied by the relevant documentation.

Notes for guidance are included to help the User compile the information and to help the Reviewer check the completeness of the submission and evaluate the proposed material.

Complying with this Filtering Protocol

The proposed material to be assessed by this Filtering Protocol can be classified as a material that originates from one of the following:

a. A waste stream.
b. Another process, as a by-product.
c. A primary source.

For categories a and b, the User must demonstrate that EoW or by-product status has been achieved for the proposed material. Notes for guidance for each category are included in the following chapters of this Filtering Protocol.

The proposed material may be regarded as potentially appropriate for development in the pavement industry provided it has:

- Achieved the EoW status if any of the components originate from a waste stream (category a) or it has achieved by-product status (category b).
- Been identified as a suitable material for the use in pavements through the impact assessment as described in this Filtering Protocol see Section 0 (categories a, b and c). This includes a market assessment.

Important Note

UK suppliers should be aware that in order for any product that falls within the scope of a European Harmonised and/or UK Designated Standard to be placed on the market, it is a legal requirement for the manufacturer to apply Conformity Assessment Marking, including an appropriate Declaration of Performance for that product. Specific provisions are applicable for products that fall within the scope of the Northern Ireland Protocol. The United Kingdoms' "Product Safety and Metrology etc. (Amendment etc.) (EU Exit) Regulations" and the European Commission's document "CE marking for construction products 'step-by-step' guide"[1] [14] can help to explain the process and provides guidance on application of Conformity Assessment Marking. Guidance is also provided in the Construction Leadership Council suite of Brexit related information [15].

[1] Referenced regulations may have been superseded following the withdrawal of the United Kingdom from the European Union in January 2021. It is the reader's responsibility to comply with the applicable requirements at the time of reading.

Non-compliance with this Filtering Protocol

The proposed material may be regarded as non-compliant with this Filtering Protocol if any of the following statements applies:

- It is still a waste.
- It has not achieved by-product status if comes from another process.
- It has not been proven to be suitable for use in pavements.

If the proposed material is not compliant with this Filtering Protocol, this may mean one of the following:

- The processing of the waste may need amendments to comply with EoW regulations.
- Further information needs to be provided to demonstrate EoW/by-product status.
- There are Health and Safety (H&S) concerns during production, installation or service life of the proposed material.
- There are environmental concerns during production, installation or service life of the proposed material.
- There is no established market for the proposed material, in accordance with this protocol.
- The production and performance of the proposed material does not currently present any efficiencies when compared to existing materials.
- The proposed material is not currently economically viable for its use in pavements.

Assessment framework

This chapter includes the stages and submission requirements to comply with this Filtering Protocol. Each stage aims to help the User and the Reviewer understand the information needed to evaluate the proposed material. This information is provided in two formats:

- Checklists.
- Reports.

To comply with this Filtering Protocol, the User must complete all 4 stages shown in Figure 1. Each stage has specific submission requirements (checklists and/or reports). The requirements for each stage are established in Sections 0 to 0 and summarised in Appendix A.

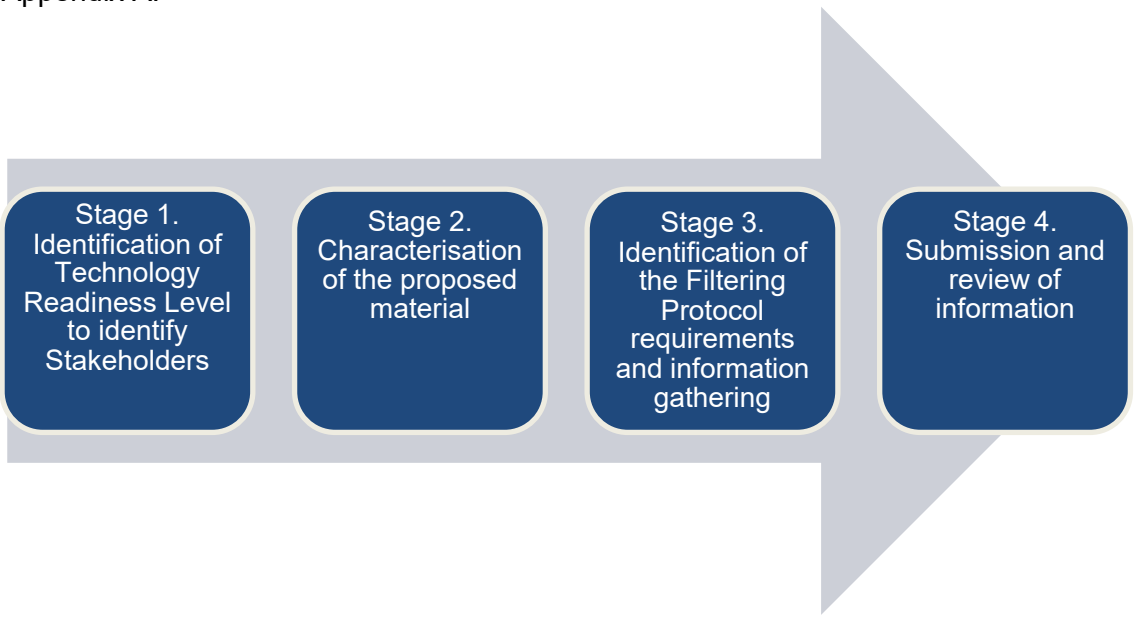


Figure 1. Filtering Protocol stages

Stage 1. Identification of Technology Readiness Level

The aim of Stage 1 is to identify the stage in development of the proposed material to select the parties to be involved in the discussion.

The Technology Readiness Level of the proposed material must be established based on Checklist A (Appendix A).

Early engagement with all parties involved in the process is recommended; however, depending on the Technology Readiness Level, the minimum parties that should be involved at the outset are:

- In the early stage of development, (Technology Readiness Level between 1 and 5) it is envisaged that the Innovator will be looking to engage with the Supply Chain to develop the proposed material. In this scenario the Innovator is the Filtering Protocol User and the Supply Chain the Reviewer. If the Innovator is the Supply Chain, this Filtering Protocol may be used to evaluate the suitability of the proposed material internally.

- In the later stages of development (Technology Readiness Level between 6 and 9), trials could be carried out on Highways England's network, or other suitable alternative; therefore, the involvement of the Asset Manager is essential. In this scenario, the Asset Manager is the Reviewer and the User is a combination of the Innovator and the Supply Chain.

Requirement of Stage 1: Complete Checklist A (Appendix A).

Stage 2. Characterisation of the proposed material

The aim of Stage 2 is to identify a suitable comparator for the assessment. This will help when completing and evaluating the checklists in Stage 3.

A comparator[2] is the agreed benchmark for assessing against the proposed material; ideally at the mixture rather than constituent level. This must be an existing material used in the pavement industry.

To select the comparator, the proposed material will be classified either as a mixture or as a constituent.

Requirement of Stage 2: Complete Checklist B (Appendix A).

Stage 3. Identification of the Filtering Protocol requirements and information gathering

The aim of Stage 3 is to identify and complete the checklists and/or reports that should be submitted and reviewed in Stage 4 to comply with this Filtering Protocol. For this, the Flowchart in Figure 2 should be used.

The Flowchart contains 7 questions (diamonds) that need to be answered (evidence for the answers given will be required for review). Depending on how the questions are answered, the Flowchart will guide the User to the appropriate requirements (checklists).

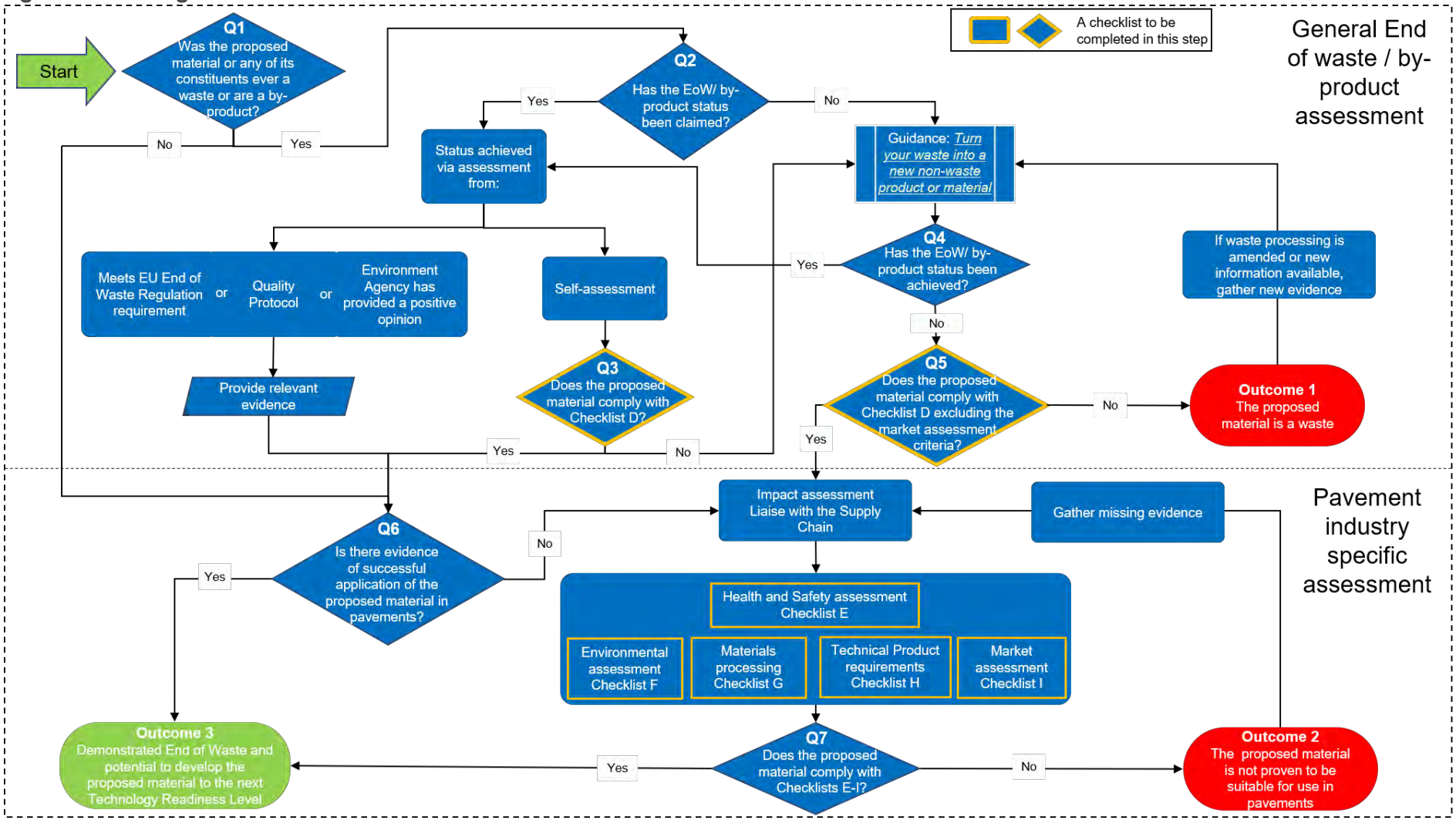
The User must navigate the Flowchart and gather the information required in each step. The notes for guidance and the checklists included in Appendix A should be used to assist in understanding the requirements of each step/question. The aim is to end up in one of the three Outcomes (1, 2 or 3) on the Flowchart.

If by answering the questions the result reaches either Outcome 1 or Outcome 2, then the proposed material is not currently considered suitable for use. This will direct the User to gather further information, re-consider their upstream processes, or if necessary, withdraw the proposal.

If by answering the questions the result reaches Outcome 3 then submission of the evidence/information gathered is recommended. If the Reviewer does not agree with the level of information provided or the answers given to the questions, further information may be requested from the User.

[2] Filtering Protocol Users and Reviewers should differentiate between the "comparator" as defined in Stage 2 and the "non-waste" comparator to be used in Checklist D of this Filtering Protocol. For clarification, see the Glossary and the Notes for Guidance provided in NG4.

Figure 2. Filtering Protocol Flowchart



Navigation through the Flowchart from Figure 2 will result in one of the outcomes shown in Table 1. Each outcome can be linked to the submission requirements (see Checklist C in Appendix A).

Table 1 Flowchart outcomes

Scenario	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Outcome
1	Yes	Yes[1]	Yes	-	-	Yes	-	Outcome 3: Demonstrated EoW/by-product status and potential to develop product
2	Yes	Yes[1]	Yes	-	-	No	Yes	Outcome 3: Demonstrated EoW/by-product status and potential to develop product
3	Yes	Yes[1]	Yes	-	-	No	No	Outcome 2: The proposed material is not proven to be suitable for use in pavements
4	Yes	Yes	No	Yes	Loop, see scenarios 1 to 3			
5	Yes	Yes	No	No	Yes	-	Yes	Outcome 3: Demonstrated EoW/by-product status and potential to develop product
6	Yes	Yes	No	No	Yes	-	No	Outcome 2: The proposed material is not proven to be suitable for use in pavements
7	Yes	Yes	No	No	No	-	-	Outcome 1: The proposed material is a waste
8	Yes	No	-	Loop, see scenarios 4 to 7				
9	No	-	-	-	-	Yes	-	Outcome 3: Demonstrated potential to develop product
10	No	-	-	-	-	No	Yes	Outcome 3: Demonstrated potential to develop product
11	No	-	-	-	-	No	No	Outcome 2: The proposed material is not proven to be suitable for use in pavements

Notes:
1 If EoW/by-product status was not achieved via a self-assessment, skip Q3 and go straight to Q6.

Requirement of Stage 3: Navigate the Flowchart to determine the outcomes, complete Checklist C, and the appropriate checklists/reports from D to I (Appendix A).

Stage 4. Submission and review of information

All the relevant information identified in Stages 1 to 3 is required to be submitted and reviewed.

In Checklists D, F, and I, all questions would need to have been answered “yes” to consider the proposed material compliant with this Filtering Protocol. If any question has been answered with “no”, it is considered that the proposed material does not comply with this Filtering Protocol. Unless actions are taken and all answers are “yes”, the proposed material should not be considered for development and/or use.

In Checklists E, G and H, the majority of the questions would need to have been answered “yes”; however, there are questions identified with “*” that may be answered with “no” and the proposed material still considered for development. In this case, further

review of the evidence provided is needed and the Reviewer should decide if the proposed material is acceptable (see notes for guidance in NG4).

The Flowchart from Figure 2 includes 3 different possible outcomes (Outcomes 1, 2 and 3):

- Outcome 1: The proposed material is a waste. In this case the information provided is not enough to demonstrate EoW/by-product status. Processing of the proposed material should be reviewed, or further information provided, or the proposal should be withdrawn.
- Outcome 2: The proposed material is not proven to be suitable for use in pavements. In this case, further evidence is needed to demonstrate the proposed material is appropriate for the selected application, or the proposal should be withdrawn.
- Outcome 3: Demonstrated EoW/by-product status or the proposed material was never a waste and there is potential to develop the material to be used in pavements. In this case, there is enough evidence to consider the development of the proposed material following the Technology Readiness Level process.

The checklists aim to help identify areas of concern or missing information. If the result of the Filtering Protocol is either Outcome 1 or Outcome 2, new evidence may be collected, any aspect of the waste/by-product processing amended, or the proposal should be dropped.

Requirement of Stage 4: Submit and review the required Checklist A to I (Appendix A) depending on the identified requirements of Stage 3. Review submitted documents and checklists and establish the Filtering Protocol result (Outcome 1, 2 or 3 in the Flowchart).

Summary

Stages 1 to 4 need to be completed to demonstrate compliance with this Filtering Protocol:

- Stage 1: Identify Technology Readiness Level, the User and Reviewer.
- Stage 2: Characterise the proposed material and select a comparator.
- Stage 3: Use the Flowchart (Figure 2) to identify the checklists/reports that are required to be submitted.
- Stage 4: Submit and review the information provided to ascertain compliance with this Filtering Protocol.

The submission requirements are given in Appendix A. A summary of the evidence required to support each checklist is included in NG5.

Appendix A

Checklist A Technology Readiness Level

Evaluation of the constituent or mixture which is used as part of an innovative technique or innovative paving material is supported by the use of this Filtering Protocol, together with the "Assessment procedure for 'Innovative' procedures and materials" [12] and the "Pilots and trials guidance" [13]. To facilitate the evaluation, the first part of any submission is to determine and select an innovation Technology Readiness Level [12]:

Checklist A

Technology Readiness Level	Description	Tick the relevant box
1	Basic principles observed and reported.	
2	Technology concept and/or application formulated.	
3	Analytical and experimental critical function and/or characteristic proof-of-concept.	
4	Technology validation in a laboratory environment.	
5	Technology basic validation in a relevant environment.	
6	Technology model or prototype demonstration in a relevant environment.	
7	Technology prototype demonstration in an operational environment.	
8	Actual technology completed and qualified through test and demonstration.	
9	Actual technology qualified through successful mission operations.	
Note: For this Protocol, this is specific to Highways England's process for pavement innovations.		

Checklist B Material characterisation and comparator selection

Supporting sustainable innovation requires benchmarking and measurement of performance. This Filtering Protocol supports this by assisting in the selection of a comparator. This will help answer questions in the following checklists. It is preferred to select a comparator at the mixture level; however, if justified, the comparator may be a constituent or a process.

Please select the type of material being evaluated and state a comparator.

Checklist B

Category	**Material**	**In accordance with the relevant part of:**	**Tick the relevant box/ add relevant information**
Mixture	Bituminous mixture	BS EN 13108	
	Concrete	BS EN 197	
	Hydraulically bound mixture	BS EN 14227	
	Unbound mixture	BS EN 13285	
Constituent	Additive	BS EN 13108 or BS EN 197	
	Admixture (typically for cementitious mixtures)	BS EN 197	
	Aggregate	BS EN 13043 or BS EN 12620 or BS EN 13242	
	Bituminous binder	BS EN 12591 or BS EN 13924 or BS EN 14023 or BS EN 13808	
	Cement	BS EN 197	
	Filler	BS EN 13108 or BS EN 12620	
	Hydraulic binder or their constituents	BS EN 197-1 or BS EN 15167-1 or BS EN 14227-4 or BS EN 459-1 or BS EN 13282	
	Modifier (typically for bituminous binders)	BS EN 12597	
-	Other[1]		
Please state the selected comparator[2]			

Notes:

1. If “other” is selected, please briefly describe the material and list the standard(s) it complies with.
2. Comparator as defined in the glossary

Checklist C Flowchart outcome identification and requirements identification

The following checklist will help the user and the reviewer identify supportive information requirements. These requirements are dependent on the flowchart outcomes (see Figure 2) and it should be followed to determine the relevant scenario.

Please highlight the appropriate scenario.

Checklist C

Checklist / Scenario	A	B	C	D	E	F	G	H	I
1[1]	✓	✓	✓	✓	x	x	x	x	x
2[1]	✓	✓	✓	✓	✓	✓	✓	✓	✓
3	✓	✓	✓	Submission of the information/evidence is not recommended in this case.					
4	✓	✓	✓	Follow the requirements of the selected outcome (scenarios 1, 2 or 3)					
5	✓	✓	✓	✓	✓	✓	✓	✓	✓
6	✓	✓	✓	Submission of the information/evidence is not recommended in this case.					
7	✓	✓	✓	Processing of the material should be amended, or further information provided.					
8	✓	✓	✓	Follow the requirements of the selected outcome (scenarios 4, 5, 6 or 7)					
9[2]	✓	✓	✓	x	x	x	x	x	x
10	✓	✓	✓	x	✓	✓	✓	✓	✓
11	✓	✓	✓	Submission of the information/evidence is not recommended in this case.					

Notes:

1. Checklist D only needs to be completed if EoW/by-product status was achieved via a self-assessment or if the market assessment criteria has not been met. If EoW/by-product status was achieved by any other route specified in the Flowchart, then evidence must be submitted as part of the EoW assessment submission (see notes for guidance).
2. Only Checklists A, B and C are required for submission if the outcome selected is number 9. However, evidence of successful application of the proposed material in pavements (linked to Technology Readiness Level [12]) must be demonstrated as detailed in the notes for guidance for Q6 of the Flowchart.

Checklist D End of waste/by-product

This is a checklist to support an assessment of compliance of the proposed material versus EoW/by-product regulations. Checklist D only needs to be completed if EoW/by-product status was achieved via a self-assessment or if the market assessment criteria has not been met. This guidance is based on current understanding of the Environment Agency requirements, and is not a substitute for going through the appropriate regulatory process.

The proposed material has achieved the EoW/by-product status only if all responses are "yes". Ticks in the "no" column highlight areas of non-compliance which should be targeted for compliance. If all answers to the questions are "yes" except for those related to the market assessment, the Flowchart from Figure 2 suggests the Innovator to liaise with the Supply Chain to explore the market possibilities.

If any answer is "no", the proposed material is considered a waste and it cannot be used as a product and it will be subject to Environmental Permitting Regulations (England and Wales).

Please answer yes or no to the following questions and provide the required supporting evidence.

Checklist D

No.	Description	Yes	No
Information related to the site producing, or processing, the waste, or by-product, (referred as "the site" in this checklist)			
D1	Does the site have the required environmental permit or exemption and is waste duty of care applied? ***This may not be applicable if the proposed material is a by-product.*** ***Supporting evidence:*** *Proof of permit or exemption, certificate of registration as a waste carrier, waste transfer notes*		
Information related to the incoming waste/by-product			
D2	Does the site have specific acceptance criteria procedures for the incoming waste/by-product? ***Supporting evidence:*** *Written acceptance criteria procedures*		
D3	Do the acceptance criteria include a list of waste/by-products that are accepted? ***Supporting evidence:*** *List of acceptable waste/by-products*		
D4	Are waste/by-product input records kept? ***Supporting evidence:*** *Input records*		
D5	Further to D2, does the site have established procedures for dealing with non-compliant incoming waste/by-products? ***Supporting evidence:*** *FPC or a written procedure for non-compliant incoming wastes; including, for example: rejection of loads, quarantine or disposal.*		
Information on the processing of the waste/by-product			
D6	Does the site have a Factory Production Control (FPC) system, which includes a Method Statement of Production (MSP), describing the waste recovery process or the material processing (for by-product), and the range of products produced? ***Supporting evidence:*** *Documented FPC and MSP*		
D7	Does the site produce the proposed material to established specifications and/or standards? ***Supporting evidence:*** *Specification and/or standards list and evidence of conformance.*		

No.	Description	Yes	No
D8	Have the procedures for maintenance and adjustment of processing equipment during production been defined? ***Supporting evidence:*** *Inclusion in FPC*		
D9	Are the waste/by-products stocked in a controlled manner at clearly identified locations? ***Supporting evidence:*** *Photographs/map of site.*		
D10	Are the waste/by-products taken from stock for processing checked for any deterioration or change? ***Supporting evidence:*** *Records outlining checks made.*		
D11	Is the proposed material identifiable up to the point of sale and procedures in place and implemented to maintain the quality of the product during handling, storage, transport and delivery? ***Supporting evidence:*** *Quality procedures and visual inspection.*		
D12	Are procedures for use, control, calibration and maintenance of inspection, measuring and test equipment set up and followed? ***Supporting evidence:*** *Inclusion in FPC*		
D13	Are personnel trained on the FPC (including acceptance criteria, procedures for non-compliant input wastes/by-products and output proposed material, sampling, testing and inspection)? ***Supporting evidence:*** *Training records*		
D14	Are records of relevant controls and inspections, calibrations, changes and training maintained for a suitable period of time (which is defined)? ***Supporting evidence:*** *Records*		
D15	Has the site defined what testing to undertake, and how often, for each product? ***Supporting evidence:*** *Inclusion in FPC*		
D16	Does the site testing regime conform to the relevant standard or specification for the proposed material? ***Supporting evidence:*** *Specification and/or standards list and evidence of conformance.*		
D17	Does the site have a procedure for dealing with non-conforming products (proposed material)? ***Supporting evidence:*** *Inclusion in FPC*		
D18	Can the Producer demonstrate that records of appropriate FPC documents are kept? ***Supporting evidence:*** *Examples of records include testing frequencies, test results, etc.*		
D19	Does the delivery ticket for outgoing products contain the description of the proposed material in accordance with the industry or client specification and does it include a statement that the proposed material was produced in accordance with the FPC? ***Supporting evidence:*** *Examples of delivery tickets.*		
Information on the proposed material (post processing)			
D20	Has a detailed description of waste/by-products inputs been provided, including European Waste Catalogue (EWC)[1] codes (note: these are not		

[1] Referenced regulations may have been superseded following the withdrawal of the United Kingdom from the European Union in January 2021. It is the reader's responsibility to comply with the applicable requirements at the time of reading.

No.	Description	Yes	No
	applicable to by-products) and descriptions, any other non-waste/non-by-product materials used for the production of the proposed material? ***Supporting evidence:*** *Written description and list of all ingredients included within the FPC.*		
D21	Is it clear what waste/by-products are being used in the manufacture of the proposed material, where they come from and what function they will fulfil? ***Supporting evidence:*** *Written description.*		
D22	Has the waste being used been assessed in accordance with Guidance on the Classification and Assessment of Waste (1st edition v1.1) Technical Guidance (WM3) [16], including the assessment of chemical properties to ensure no chemicals found in the material are above legal limits? **This may not be applicable if the proposed material is to be considered as a by-product.** ***Supporting evidence:*** *WM3 assessment.*		
D23	Has laboratory testing to determine chemical composition been conducted and the results assessed against Registration, Evaluation, Authorisation and restriction of Chemicals (REACH) and Persistent Organic Pollutants (POPs) regulations to ensure no limits are breached? ***Supporting evidence:*** *Laboratory results assessed against REACH and POP regulation limits*		
D24	Taking into account potential accumulation effects, are Annex I of POPs and Annex XVII of REACH considered? ***Supporting evidence****: Laboratory results and results assessed against REACH and POP regulation limits.*		
D25	Does the sampling plan have at least 20 no. samples? ***Supporting evidence:*** *sampling plan*		
D26	Does the sampling plan outline sample procedures and frequency? ***Supporting evidence:*** *sampling plan which should be included within the FPC, if applicable (depending on Technology Readiness Level).*		
D27	Has analysis for contaminants been conducted? ***Supporting evidence:*** *Full data, copies of laboratory test certificates*		
D28	Has leaching behaviour of the waste/by-product derived material been determined? ***Supporting evidence:*** *Full data, copies of laboratory test certificates*		
D29	Is data presented on the chemical constituents for all inputs to the proposed material (waste, by-product and non-waste)? ***Supporting evidence:*** *Full data, copies of laboratory test certificates*		
D30	Has an assessment of homogeneity been carried out? Including an assessment of viability, and whether the composition changes overtime. ***Supporting evidence:*** *Full data, copies of laboratory test certificates*		
Comparison with a non-waste comparator (see Glossary)			
D31	Which material is being used as a non-waste comparator and is it suitable? ***Supporting evidence:*** *Written assessment justifying non-waste comparator selection*		
D32	Can the proposed material be used in the same way as the non-waste comparator it would replace? ***Supporting evidence:*** *Written assessment and comparison table*		
D33	How does the proposed material compare to the non-waste comparator?		

No.	Description	Yes	No
	Supporting evidence: *Written assessment and comparison table. Full data, copies of laboratory test certificates*		
Information regarding marketability of the proposed material			
D34	Is there evidence of an established market for example sales evidence or purchaser affidavits? ***Supporting evidence:*** *Written assessment of anticipated markets, purchaser affidavits.*		
D35	Is the proposed material suitable for use in the proposed pavement construction? ***Supporting evidence:*** *See questions D31-D33. Comparison with a non-waste comparator Evidence used in this section can also be used for this question.*		
D36	From an EoW perspective, does the proposed material meet relevant product specifications/standards? ***Supporting evidence:*** *Written assessment and comparison table. See D7.*		
Information on environmental risks			
D37	Has a conceptual model been produced defining the uses of the proposed material and the relationships to receptors? ***Supporting evidence:*** *Conceptual model, risk assessment and conclusion that the risks are acceptable. This should be appropriate for the Technology Readiness Level at the time of the assessment.*		
D38	Are the following compartments defined in the risk assessment: air, land, water? ***Supporting evidence:*** *Conceptual model with environmental compartments defined.*		
D39	Has the risk assessment been completed according to a relevant standard?		
D40	Has a summary of the risk assessment process and findings been provided? ***Supporting evidence:*** *Written assessment and data.*		
D41	Has a comparison with a non-waste comparator been made? ***Supporting evidence:*** *Written assessment and comparison table. Full data, copies of laboratory test certificates. Evidence used in the other sections can be used to answer this question.*		
D42	Does the comparison demonstrate that when used, the proposed material has no worse environmental effects than the chosen non-waste comparator? ***Supporting evidence****: Written assessment and comparison table. Full data, copies of laboratory test certificates*		
D43	Are details of how the proposed material will continue to meet the required specification or product standard provided? ***Supporting evidence:*** *Written assessment*		
D44	Does the proposed material still require some measure of control above and beyond the non-waste comparator? ***Supporting evidence:*** *Written assessment*		

Checklist E Health and Safety

This checklist is provided to support sustainable innovation. It is not a substitute for demonstration of compliance with health and safety regulations and legislations. It is a check list to enable an overview of status of an innovative paving material, which should be supported by risk assessment (see HSE website [17]) and a COSHH assessment (see the Control of Substances Hazardous to Health Regulations (COSHH) [18].

Questions identified with "*" may be answered with "no" and the proposed material still considered for development. In this case, further review of the evidence provided is needed and the Reviewer should decide if the proposed material is acceptable (see notes for guidance in NG4).

Please answer yes or no to the following questions and provide the required supporting evidence.

Checklist E

No.	Description	Yes	No
E1	Has a risk assessment of the proposed material been completed? ***Supporting evidence:*** *Risk assessment*		
E2	Does the proposed material have a Safety Data Sheet (SDS) specific for use in the pavement industry? ***Supporting evidence:*** *SDS*		
E3	Are the potential hazards associated with the proposed material the same or lower than the comparator? This includes the full lifecycle of the proposed material. ***Supporting evidence:*** *Technical report*		
E4	Has it been demonstrated that any change (relevant to health and safety) to the proposed material during transportation, storage or mixing has been assessed? ***Supporting evidence:*** *SDS, technical report*		
E5	Has evidence been provided to demonstrate that toxic fumes or gases will not be released during transportation, storage, production, installation and in-service life of the proposed material? ***Supporting evidence:*** *Risk assessment, SDS*		
E6	Has evidence been provided to demonstrate that harmful levels of respirable dust will not be released during the production/installation and in-service life of the proposed material? ***Supporting evidence:*** *Risk assessment, SDS*		
E7*	Will the mixing temperature of the proposed material be the same or lower than the mixing temperature of the comparator? ***Supporting evidence:*** *Technical report*		
E8*	Will the laying temperature of the proposed material be the same or lower than the laying temperature of the comparator? ***Supporting evidence:*** *Risk assessment, technical report*		
E9	Has evidence been provided to demonstrate that the autoignition temperature of the proposed material is higher than the maximum temperature it will reach during transportation, storage, production, installation and service life? ***Supporting evidence:*** *Risk assessment, SDS*		
E10	Has evidence been provided to demonstrate that the flash point temperature of the proposed material is higher than the maximum temperature it will reach during transportation, storage, production, installation and service life? ***Supporting evidence:*** *Risk assessment, SDS*		

No.	Description	Yes	No
E11	Have suitable/unsuitable extinguishing media in case of fire of the proposed material been identified? ***Supporting evidence:*** *SDS*		
E12	Has evidence been provided to demonstrate that the proposed material is not flammable under normal conditions? ***Supporting evidence:*** *SDS*		
E13	Has evidence been provided to demonstrate that the proposed material is not explosive under normal conditions? ***Supporting evidence:*** *SDS*		
E14	Has evidence been provided to demonstrate that the proposed material is not explosive in case of fire? ***Supporting evidence:*** *SDS*		
E15*	Has evidence been provided to demonstrate that the proposed material is not radioactive under normal conditions? ***Supporting evidence:*** *Risk assessment*		
E16	Have all the necessary first-aid measures related to production/use of the proposed material been identified? (consider all of the following for your answer): a. First-aid measures after inhalation b. First-aid measures after skin contact c. First-aid measures after eye contact d. First-aid measures after ingestion ***Supporting evidence:*** *SDS*		
E17*	Are the necessary personal protective equipment required when handling the proposed material, the same or less than the comparator? ***Supporting evidence:*** *Technical report*		
E18*	Has evidence been provided to demonstrate that there are no special requirements related to the storage of the proposed material? ***Supporting evidence:*** *SDS*		
E19	Have all the precautions that should be taken in case of accidental release of the proposed material been identified? ***Supporting evidence:*** *SDS*		
E20	Is the proposed material's chemical stability characterised as stable under normal conditions? ***Supporting evidence:*** *SDS*		
E21	Have all conditions such as temperature, pressure, light, shock, static discharge, vibrations or other physical stresses that could result in hazardous situations been identified for the proposed material? ***Supporting evidence:*** *SDS*		
E22	Have materials that are incompatible with the proposed material been identified? ***Supporting evidence:*** *SDS*		
E23	Have all the hazardous decomposition products produced during transportation, storage, production, installation or service life of the proposed material been identified? ***Supporting evidence:*** *SDS*		
E24	Has all the relevant toxicological information associated with the production/use of the proposed material been identified? ***Supporting evidence:*** *SDS*		

No.	Description	Yes	No
E25	Has evidence been provided to demonstrate that the proposed material is not classified as dangerous for transport? ***Supporting evidence:*** *SDS*		
E26*	Has evidence been provided to demonstrate there are not any special requirements related to the transport of the proposed material pre-use? ***Supporting evidence:*** *SDS*		

Checklist F Environmental assessment

This checklist should be compiled to ascertain the environmental impacts of the proposed material. All answers should be "yes" in order to consider the proposed material for further development.

Please answer yes or no to the following questions and provide the required supporting evidence.

Checklist F

No.	Description	Yes	No
F1	Has evidence been provided to demonstrate that the acquisition of materials for producing the proposed material is in line with responsible sourcing principles? ***Supporting evidence:*** *Technical report, carbon emissions report*		
F2	Has evidence been provided to demonstrate that the production of the proposed material does not generate any adverse environmental effects? ***Supporting evidence:*** *Technical report*		
F3	Has evidence been provided to demonstrate that the installation of the proposed material does not generate any adverse environmental effects? ***Supporting evidence:*** *Technical report*		
F4	Has evidence been provided to demonstrate that the use/maintenance of the proposed material does not generate any adverse environmental effects? ***Supporting evidence:*** *Technical report*		
F5	Has evidence been provided to demonstrate that the proposed material does not generate any adverse environmental effects in the end of its service life? ***Supporting evidence:*** *Technical report*		
F6	Will the proposed material have the same waste classification as the comparator at the end of service life? ***Supporting evidence:*** *Technical report*		
F7	Will the proposed material be suitable for recycling (using the comparator as a benchmark) at the end of its service life? ***Supporting evidence:*** *Technical report*		
F8	Based on the answers provided, is the environmental risk of the proposed material lower or the same than the comparator?		

Checklist G Materials production, installation and use

This checklist will help the User and the Reviewer understand how the proposed material may be processed and used. It is designed to support sustainable innovation in paving materials; including consideration of plant and equipment.

Questions identified with "*" may be answered with "no" and the proposed material still considered for development. In this case, further review of the evidence provided is needed and the Reviewer should decide if the proposed material is acceptable (see notes for guidance in NG4).

Please answer yes or no to the following questions and provide the required supporting evidence.

Checklist G

No.	Description	Yes	No
G1	Has information been provided regarding description and intended use of the proposed material? ***Supporting evidence:*** *Technical report*		
G2	Has information been provided regarding the composition of the proposed material? ***Supporting evidence:*** *Technical report*		
G3	Has information been provided regarding requirements for the production/processing when using the proposed material? ***Supporting evidence:*** *Technical report*		
G4*	Has information been provided to demonstrate that the production/processing with the proposed material does not involve plant modification and/or other special equipment? ***Supporting evidence:*** *Technical report*		
G5*	Has information been provided to demonstrate that the installation of the proposed material does not involve any special techniques/equipment or that specialist equipment has been provided? ***Supporting evidence:*** *Technical report*		
G6	Have the specific intended and non-permissible applications of the proposed material been identified? ***Supporting evidence:*** *Technical report*		
G7*	Has the proposed material been used before in the pavement industry? (UK or internationally) ***Supporting evidence:*** *Technical report*		
G9	Has information been provided regarding the variability/production control of the proposed material? ***Supporting evidence:*** *Technical report*		

Checklist H Technical requirements

Technical requirements are to be checked in the context of the "Technology Readiness Level" [12] and the "Pilots and Trials Guidance" for Highways England targeted product applications [13]. The following questions only aim to understand the technical advantages of using the proposed material.

Questions identified with "*" may be answered with "no" and the proposed material still considered for development. In this case, further review of the evidence provided is needed and the Reviewer should decide if the proposed material is acceptable (see notes for guidance in NG4).

Please answer yes or no to the following questions and provide the required supporting evidence.

Checklist H

No.	Description	Yes	No
Technical requirements should be checked as part of the Technology Readiness Level assessment [12]. Process for this assessment has not been included in this Protocol.			
H1*	Does the proposed material meet the same recognised applicable technical standard, product standard as the comparator? Specify the standards it complies with. ***Supporting evidence:*** *Technical report*		
H2*	Is it anticipated that the proposed material will perform equally or better than the comparator? ***Supporting evidence:*** *Technical report*		

Checklist I Market assessment

A market assessment is recommended to ascertain the marketability of the proposed material. The following questions aim to help understand if the proposed material has the appropriate market in the pavement industry. All questions should be answered “yes” to progress the innovation.

This market assessment may also help obtain the EoW or by-product status if this has not been done previously.

Please answer yes or no to the following questions and provide the required supporting evidence.

Checklist I

No.	Description	Yes	No
I1	Are there any advantages of using the proposed material over the comparator? If "Yes", provide details ***Supporting evidence:*** *Technical report, market assessment study*		
I2	Have the drivers for the use of the proposed material been identified and are they aligned with the Asset Managers? ***Supporting evidence:*** *Market assessment study*		
I3	Are there any customer contracts or arrangements in place to supply/use the proposed material for the intended purpose? ***Supporting evidence:*** *Market assessment study*		
I4	Is there an established or potential market for the intended use of the proposed material? ***Supporting evidence:*** *Market assessment study*		
I5	Is there an economic benefit from using the proposed material over the comparator? Consider the following: • How much of the proposed material will be used annually? (if the assessment is done for a constituent, specify the amount of constituent to be used per ton of material) • How much proposed material can be produced annually? • What are the plant modification costs involved? • What are the costs related to the proposed material’s end of service life? (for example. disposal or recycle costs and how does that compare with the comparator?) • Where is the proposed material produced and how far is it from the area of intended use? • How many batching plants can be supplied with the proposed material and what are the related haulage costs? • Considering the above, what is the total annual financial benefit from using the proposed material over comparator? • Whole life cycle of pavement? ***Supporting evidence***: *Market assessment study*		

Notes for guidance

NG1 Stage 1. Identification of Technology Readiness Level

Any paving material used on Highways England SRN must comply with the Manual of Contract Documents for Highways Works (MCHW), or if the material does not comply with the MCHW requirements, a Departure from Standard (DfS) shall be submitted to Highways England along with appropriate evidence to support the application.

To evaluate any material to be used in the SRN, this Filtering Protocol, together with the "Assessment procedure for 'Innovative' procedures and materials" [12] should be used. Both documents help the Innovator, the Supply Chain and the Asset Manager understand the development level of any innovation and the requirements to comply with H&S and environmental regulations. Technical, operational, legal and market aspects need to be clearly articulated.

It is also crucial in this stage to understand the roles of the User and the Reviewer. The User is the individual/organisation gathering the required information to comply with this Filtering Protocol and the Reviewer is the individual/organisation checking the information.

In early stages of the proposed material development:

- The User is likely to be the Innovator (for example the individual/organisation proposing to produce use a new material or constituent).
- The Reviewer will normally be someone from the Supply Chain, since the Innovator will need to find someone to produce the proposed material, or the Innovator and Supply Chain may be (in part) the same organisation.
  In this scenario, the Supply Chain may use this Filtering Protocol as an internal check to ascertain that all regulations are met and that the progression of the innovation is in-line with Highways England's requirements. This will be useful in the future when moving to higher Technology Readiness Levels.

Once the material has been validated in a relevant environment,(trafficked demonstration off HE network) the next step is to undertake trials approved by Asset Manager(s) of the target application highway networks.

- The User will probably be a member of Supply Chain, as they want to progress the production of the proposed material.
- The Reviewer in this case will be the Asset Manager to ascertain if the material is suitable to be used in their assets.

In all scenarios, it is recommended that early input from all parties involved in the development and assessment of the proposed material is beneficial to successful development and uptake.

NG2 Stage 2. Characterisation of the proposed material

To be able to answer some of the questions in the checklists of Stage 3, it is important to select a comparator. The aim is to understand the differences between the proposed material and existing materials permitted for use on the SRN.

This comparator needs to be selected to compare processing, installation and in-service life with the proposed material. This is why the comparison should be done at a mixture level, instead of at a constituent level. However, if justified, a comparator may be a constituent.

For example: If it is proposed to use a new manufactured aggregate for asphalt surface mixtures, it is recommended that the comparator is either a Thin Surface Course System (TSCS) or a Hot Rolled Asphalt (HRA) used as surface course, instead of comparing the manufactured aggregate with other aggregates, since a true picture of the performance of the alternative will only become apparent in an application scenario.

A comparator selected in early stages could be re-assessed during the Filtering Protocol assessment. There is no barrier to this, and the comparator used within an assessment can be changed. In this scenario, the assessment needs to be restarted.

The comparator in this stage is different from the non-waste comparator to be used for completing Checklist D. See Glossary.

The non-waste comparator is the agreed benchmark for assessing against the proposed material during the EoW assessment. A non-waste comparator is used only in Checklist D. It may or may not be the same as the comparator to be identified in Stage 2 of this Filtering Protocol.

NG3 Stage 3. Identification of the Filtering Protocol requirements

The Flowchart shown in Figure 2 is divided in two distinct sections:

- The upper part of the Flowchart labelled “General EoW/by-product assessment”.
- The lower part of the Flowchart labelled “Pavement industry specific assessment”.

The upper part of the Flowchart is used only if the proposed material (or any of its constituents) has been classified as waste in their lifecycle or if it is or has been a by-product. This section of the Flowchart can be used either at the mixture level (final proposed material) or at the constituent level.

The lower part of the Flowchart is used to ascertain if the proposed material is suitable for its use in a pavement application.

In the Flowchart there are 7 questions. Guidance on how to answer these questions is included below.

Q1 Was the proposed material or any of its constituents ever a waste or are a by-product?

Waste is defined in the EU Waste Framework Directive as “any substance or object which the holder discards or intends or is required to discard” [19][1].

[1] Referenced regulations may have been superseded following the withdrawal of the United Kingdom from the European Union in January 2021. It is the reader’s responsibility to comply with the applicable requirements at the time of reading.

A by-product is defined in the EU Waste Framework Directive[1] as "a substance or object, resulting from a production process, the primary aim of which is not the production of that item, may be regarded as not being waste referred to in point 1 of Article 3 but as being a by-product only if the following conditions are met:

- Further use of the substance or object is certain.
- The substance or object can be used directly without any further processing other than normal industrial practice.
- The substance or object is produced as an integral part of a production process.
- Further use is lawful, that is the substance or object fulfils all relevant product, environmental and health protection requirements for the specific use and will not lead to overall adverse environmental or human health impacts.

Defra provides guidance on the legal definition of waste and its application [20].

The IsItWaste tool [21] can be used to help decide whether a material is a waste or by-product and is based on the "by-products" (article 5) and "end of waste" (article 6) parts of the Waste Framework Directive (WFD 2008/98/EC) [19][6].

If the question is answered "yes", waste management controls and waste duty of care [11] are required and will be required until the material has achieved EoW status. Go to Q2.

If the question is answered "no", waste management controls do not need to be applied to the proposed material or any of its constituents and an EoW/by-product assessment is not required. Go to Q6.

Q2 Has the EoW/by-product status been claimed?

EoW status can be achieved via one the following ways:

- EU End of Waste Regulation – EU end of waste criteria[6].
- Quality Protocol.
- Environment Agency has provided an opinion – EoW assessment.
- Self-assessment – EoW assessment completed but not sent to the Environment Agency for an opinion.

By-product status can be achieved via one of two ways:

- Environment Agency has provided an opinion – by-product assessment.
- Self-assessment – by-product assessment completed but not sent to the Environment Agency for an opinion.

Firstly, check whether the waste-derived products already meet the requirements of an EU End of Waste Regulation[6]. EU end of waste criteria specify when certain waste ceases to be waste and obtains a status of a product (or a secondary raw material).

[1] Referenced regulations may have been superseded following the withdrawal of the United Kingdom from the European Union in January 2021. It is the reader's responsibility to comply with the applicable requirements at the time of reading.

According to Article 6 (1) and (2) of the Waste Framework Directive 2008/98/EC [19][1], certain specified waste shall cease to be waste when it has undergone a recovery (including recycling) operation and complies with specific criteria to be developed in line with certain legal conditions, in particular:

- The substance or object is commonly used for specific purposes.
- There is an existing market or demand for the substance or object.
- The use is lawful (substance or object fulfils the technical requirements for the specific purposes and meets the existing legislation and standards applicable to products).
- The use will not lead to overall adverse environmental or human health impacts.

There are EU criteria for the following waste types:

- Iron, steel and aluminium scrap [22][7]:
- Glass cullet [23][7]:
- Copper scrap [24][7]:.

The criteria, self-monitoring requirements and the requirement to produce a statement of conformity are outlined in each of the three documents listed above.

More information on the EU EoW Regulations is available on the European Commission website [25][7].

If there is no EU EoW criteria[7] for the material the next step is to check whether there is an applicable Quality Protocol which applies to your operation. Quality Protocols are frameworks which explain how to achieve EoW status for certain waste-derived materials. Further information is available on the government's website - Quality Protocols [26].

If there is no applicable EU EoW regulation[7] or Quality Protocol the Producer will need to assess whether the waste-derived product meets EoW on a case by case basis. The Producer will need to undertake an EoW assessment on the basis of the relevant case law. The Court of Appeal OSS EoW test generally represents all the case law requirements for the EoW test:

- The waste has been converted into a distinct and marketable product; including that:
  - The waste has been turned into a completely new product.
  - The new product is different from the original waste.
  - There is a genuine market for the material so it will definitely be used – if it is stored indefinitely with little prospect for use the material remains waste.
- The processed substance can be used in exactly the same way as a non-waste.
- The processed substance can be stored and used with no worse environmental effects when compared to the material it is intended to replace.

[1] Referenced regulations may have been superseded following the withdrawal of the United Kingdom from the European Union in January 2021. It is the reader's responsibility to comply with the applicable requirements at the time of reading.

In England if a product from waste/by-product is produced, an EoW/by-product assessment can be carried out and the Environment Agency may be asked for an opinion on the waste status of the material. There is a charge to use the service and the IsItWaste tool must be used. A self-assessment using the IsItWaste tool [21] may also be used to help decide whether the material is likely to be a waste/by-product (an indicative outcome), there is no charge associated with using the tool. The tool is for England only and the outputs can be used as evidence. The tool holds a checklist which sets out the minimum information required to do an EoW assessment. This checklist is replicated with additional guidance notes in Checklist D of this Filtering Protocol.

If the question is answered "yes", evidence should be supplied to support the EoW status claim. If a self-assessment is carried out, see Q3. If the EoW/by-product status has been achieved by complying with the EU EoW Regulation[1], a Quality Protocol or the Environment Agency has provided an opinion – EoW assessment, go to Q6.

If the question is answered "no", follow the notes for guidance above (Q2) to achieve EoW/by-product status. Then, continue with Q4.

Q3 Does the proposed material comply with Checklist D? (EoW)

See notes for guidance to complete Checklist D in Section NG4.

If the question is answered "yes", Checklist D completed needs to be submitted/reviewed. Then, continue with Q6.

If the question is answered "no", follow the notes for guidance included in Q2 to achieve EoW/by-product status. Then, continue with Q4.

Q4 Has EoW/by-product status been achieved?

If the question is answered "yes", See notes for guidance for Q2 above.

If the question is answered "no", go to Q5.

Q5 Does the proposed material comply with Checklist D excluding the market assessment criteria?

It is acknowledged that at early stages of the material's development there may not be an established market for the material or customer contracts or arrangements in place to supply/use the new material for the intended purpose. Therefore, where all other questions in Checklist D are given a "yes", the material can be considered in the pavement specific assessment. However, it must be noted that the material has not achieved EoW/by-product status and once the arrangements are established, the EoW/by-product status should be claimed and achieved before using the proposed material in a pavement.

[1] Referenced regulations may have been superseded following the withdrawal of the United Kingdom from the European Union in January 2021. It is the reader's responsibility to comply with the applicable requirements at the time of reading.

If the question is answered “yes”, complete the impact assessment and go to Q7.

If the question is answered “no”, the proposed material is considered a waste and is not permitted for use. The processing of the material should be amended, or the missing information provided in order to continue with the Filtering Protocol until Q2 or Q5 are answered “yes”.

Q6 Is there evidence of successful application of the proposed material in pavements?

The successful application of the proposed material in pavements should be based on the Highways England Technology Readiness Level and associated innovations technical assessment procedures.

If the answer to this question is “yes” this implies confidence that the proposed material can be used in pavements without H&S and environmental concerns, that the production, installation and use has been proven to be successful and that it is marketable. However, this proposed material and its specific application should still be assessed, and a Technology Readiness Level assigned.

If the answer to this question is “no”, an impact assessment should be carried out. Checklists E to I need to be used to check if the available information is enough to ascertain the suitability of the proposed material. Go to Q7.

Q7 Does the proposed material comply with Checklists E-I? (impact assessment)

See notes for guidance to complete Checklist E to I in Section NG4.

If the question is answered “yes”, Checklists E to I need to be submitted/reviewed.

If the question is answered “no”, the proposed material is not proven to be suitable for the use in pavement. This may mean that information is missing or that the production/installation processes are not appropriate, or that further discussion is required with the Asset Manager. If new information is gathered or any process amended so that questions in Checklists E to I may be answered differently, complete the impact assessment again and resubmit.

NG4 Stage 4. Submission and review of information

In this stage the checklists included in Appendix A need to be completed depending on the scenario selected (see Table 1 and Checklist C). The following notes for guidance aim to help the User and the Reviewer complete and check the information provided.

Checklist D – End of waste

This is an assessment checklist to assess the compliance of the proposed material with EoW/by-product regulations.

Checklist D only needs to be completed if EoW/by-product status was achieved via a self-assessment or if the market assessment criteria has not been met. See also Flowchart (Figure 2) and Checklist C Flowchart outcome identification and requirements identification.

Where the Producer has completed a self-assessment and has not submitted this to the Environment Agency for an opinion, the Checklist D will help the Reviewer understand if the information provided is sufficient to claim the EoW/by-product status for the proposed material. When a self-assessment is completed and not submitted to the Environment Agency for an opinion there remains a risk that the Environment Agency may not agree with the self-assessment and therefore the material is still classed as a waste.

The proposed material has achieved the EoW/by-product status only if all responses are "yes". Ticks in the "no" column highlight areas of non-compliance which should be targeted for improvement.

If all answers to the questions are "yes" except for those related to the market assessment, the Flowchart from Figure 2 suggests the Innovator to liaise with the Supply Chain to explore the market possibilities. However, it must be noted that the material has not achieved EoW/by-product status. Pavement material constituents that are produced by a process not fully compliant with the EoW regulations are likely to be a waste and be subject to Environmental Permitting Regulations (England and Wales). If any other answer is "no", the proposed material is considered a waste and it cannot be used as a product unless the non-compliance areas have been revised.

The User can complete the Excel version of the EoW checklist and/or use the output from the IsitWaste tool as evidence of compliance.

If an EoW/by-product opinion has not been provided by the Environment Agency please consider the process and activities of your Suppliers and tick "yes" or "no" as applicable for each question, by referring to the accompanying Notes for Guidance for further details.

The checklist is separated into seven sections:

- Information related to the waste processing site or the site where the by-product will be used/processed. This site may be different to the site where the proposed material is incorporated to the paving material.
- Information related to the incoming waste/by-product.
- Information on the processing of the waste/by-product.
- Information on the proposed material.
- Comparison with a non-waste comparator. This may be different to the comparator defined in Section 0.
- Information regarding marketability of the proposed material.
- Information on environmental risks.

Information related to the waste processing site or the site where the by-product will be processed (referred as "the site" in this checklist).

D1: *Does the site have the required environmental permit or exemption and is waste duty of care applied?*

This may not be applicable if the proposed material is a by-product.
The waste duty of care code of practice provides statutory and practical guidance on how to meet waste duty of care requirements in England and Wales. If waste activities are authorised or registered in Scotland [27] or Northern Ireland [28] but the Supplier's deal with waste in England or Wales, they will need to follow waste duty of care code of

practice for England and Wales. If they operate across borders, they need to follow Scotland's and Northern Ireland's codes of practice alongside the waste duty of care code of practice for England and Wales.

The regulators for duty of care are the Environment Agency (EA) in England and Natural Resources Wales (NRW) in Wales and local authorities.

Duty of care applies to anyone who imports, produces, carries, keeps, treats, disposes or are a dealer or broker that has control of, controlled waste (referred to as a "waste holder").

The duty of care requirements are summarised below, the Supplier must take all reasonable steps to:

- Prevent unauthorised or harmful deposit, treatment or disposal of waste.
- Prevent a breach (failure) by any other person to meet the requirement to have an environmental permit, or a breach of a permit condition.
- Prevent the escape of waste from your control.
- Ensure that any person you transfer the waste to has the correct authorisation.
- Provide an accurate description of the waste when it is transferred to another person.

The operator of a waste treatment, recovery or disposal activity needs an environmental permit or to register an exempt waste operation.

If transporting waste, including waste from the Supplier's own construction, excavation and demolition operations, the Supplier must have a certificate of registration as a waste carrier.

If the Supplier is accepting waste from others and for all residues leaving the site as waste the Supplier must use Waste Transfer Notes (WTNs). The Supplier is required to keep WTNs for at least two years.

Information related to the incoming waste/by-product

D2: *Does the site have specific acceptance criteria procedures for the incoming waste/by-product?*

The process of waste/by-product acceptance described in the acceptance criteria should as a minimum include a visual inspection of the incoming waste/by-product at receipt (either at the weighbridge or on the site of arising) and at tipping/stockpiling.

D3: *Does the acceptance criteria include a list of waste/by-products that are accepted?*

This may not be applicable if the proposed material is to be considered as a by-product.
If the proposed material is from a waste the Supplier must use the same codes used in the WTNs, referring to the List of Waste Regulations/European Waste Codes[1].

[1] Referenced regulations may have been superseded following the withdrawal of the United Kingdom from the European Union in January 2021. It is the reader's responsibility to comply with the applicable requirements at the time of reading.

D5: *Further to D2, does the site have established procedures for dealing with non-compliant incoming waste/by-products?*

The Supplier must demonstrate how they deal with non-conforming incoming waste/by-products for example rejection of loads, quarantine or disposal. Records must be kept of how the procures has been implemented.

Information on the processing of the waste/by-product

D6: *Does the site have a Factory Production Control (FPC) system, which includes a Method Statement of Production (MSP), describing the waste recovery process or the material processing (for by-product) and the range of products produced?*

An FPC manual documents how the FPC is implemented and procedures for establishing approval, issue, distribution and administration of documentation and data for internal and external use. The Producer should nominate a management representative responsible for implementing the FPC. The FPC should be periodically reviewed by the Supplier management to ensure its continuing suitability and effectiveness, and records of such reviews maintained. The Suppliers should define how any subcontractors will be controlled. An example of an FPC for bituminous mixtures is BS EN 13108-21.

The MSP should be a description or representation of the production process for each product type, to include input materials, equipment used, action undertaken at each stage from acceptance of waste to allocation to product stockpiles. The MSP represents the recovery process for the incoming waste/material, and it is part of the FPC. The MSP can be represented by a flowchart.

D15: *Has the site defined what testing to undertake, and how often, for each product?*

A formalised testing plan, defining sampling, test methods and testing frequencies must be provided, and the test results must be available for demonstrating compliance. This is a requirement of the FPC.

D17: *Does the site have a procedure for dealing with non-conforming products (proposed material)?*

The Producer must demonstrate that a procedure for non-compliant products is in place in accordance with the FPC.

D18: *Can the Producer demonstrate that records of appropriate FPC documents are kept?*

The Producer should be able to supply purchasers on request, test results from the testing regime undertaken on each product. Historic records and/or summaries of past testing results must be available.

Information on the proposed material (post processing)

D20: *Has a detailed description of waste/by-product inputs been provided, including European Waste Catalogue (EWC) codes*[1] *(note; these are not applicable for by-products) and descriptions, any other non-waste/non-by-product materials used for the production of the proposed material?*

The waste/by-product may constitute the whole of the proposed material, replace a material used for the production of a proposed material or may be part of a proposed material.

D22: *Has the waste being used been assessed in accordance with Guidance on the Classification and Assessment of Waste (1st edition v1.1) Technical Guidance (WM3)* [16]*, including the assessment of chemical properties to ensure no chemicals found in the material are above legal limits?*

This may not be applicable if the proposed material is to be considered as a by-product.
As part of duty of care waste must be classified:

- Before it is collected, disposed or recovered.
- To identify the controls that apply to the movement of waste.
- To complete waste documents and records.
- To identify suitably authorised waste management option.
- To prevent harm to people and the environment.

This assessment may have been conducted by the initial Producer of the waste. WM3 explains how to classify waste and identity its hazardous properties [29]. The waste classification and assessment process is as follows:

Steps to classify the waste:

- Check if the waste needs to be classified.
- Identify the code(s)that may apply to the waste.
- Identify the assessment needed to select the correct code.

Steps to assess the waste:

- Determine the chemical composition of the waste.
- Identify if the substances in the waste are “hazardous substances” or POPs.
- Assess the hazardous properties of the waste.
- Assign the classification code and describe the classification code.

D23: *Has laboratory testing to determine chemical composition been conducted and the results assessed against Registration, Evaluation, Authorisation and restriction of Chemicals (REACH) and Persistent Organic Pollutants (POPs) regulations to ensure no limits are breached?*

POPs used for waste classification are listed in Box 2.2 of WM3, additional information is provided in Appendix C of WM3 including concentration limits. More information on using POPs can be found on the government’s website [8].

[1] Referenced regulations may have been superseded following the withdrawal of the United Kingdom from the European Union in January 2021. It is the reader’s responsibility to comply with the applicable requirements at the time of reading.

If you are using, making, selling or importing chemicals in the EU, you need to follow REACH. More information on how to comply with REACH chemical regulations can be found on the government's website [9].

D24: *Taking into account potential accumulation effects, are Annex I of POPs and Annex XVII of REACH considered?*

Testing results should be shown in full. Any chemicals identified should have the results shown against the limits set out in either REACH or the POPs regulations.

A list of substances subject to POPs Regulations are listed on the European Chemicals Agency (ECHA) website [30][1].

A list of substances restricted under REACH are listed on ECHA website [31][11].

D25: *Does the sampling plan have at least 20 no. samples?*

Issues such as input variability, process control, seasonality, confidence levels, etc. all need to be considered when defining the number of samples required. Guidance is available in the Resource Conservation and Recovery Act (RCRA) - Waste Sampling Draft Technical Guidance [32].

D26: *Does the sampling plan outline sample procedures and frequency?*

BS EN 14899: 2005 Characterization of waste. Sampling of waste materials. Framework for the preparation and application of a sampling plan [10] notes that waste can be heterogenous and it will be necessary therefore to specify in the testing programme the amount of material for which the characteristics of interest need to be defined.

D27: *Has analysis for contaminants been conducted?*

Reference should be made to the hazard screening outputs (see D37). Full data, copies of laboratory test certificates are required. All data and limits of quantification should be evidenced. General requirement for the competence of testing and calibration laboratories is available in BS EN ISO/IEC 17025: 2017 [33].

D28: *Has leaching behaviour of the waste/by-product derived material been determined?*

Leaching tests are conducted to examine mass transfer from a solid to a liquid. Depending on the characteristics of the material, its end use scenario and the surrounding environment, the leachant may flow through the material to form leachate, this may contaminate the surrounding environment. Therefore, leaching behaviour should be determined to ascertain there is no contamination risks.

There are several standardised test methods for conducting routine leaching tests, which are applicable to original waste. Leach test standards are variable, and the suitability of the test carried out has to be related to the end use scenario and any regulatory good practice requirement. The Environment Agency has identified that flow percolation tests

[1] Referenced regulations may have been superseded following the withdrawal of the United Kingdom from the European Union in January 2021. It is the reader's responsibility to comply with the applicable requirements at the time of reading.

give the most useful data (for example, BS EN 14405:2017 [34]) and batch leaching tests (BS EN 12457-1,2,3,4:2002 [35]). Waste Acceptance Criteria (WAC) testing is not appropriate as a leaching test.

Further information can be found on page 14-15 of the Environment Agency risk assessment guidance [36].

All data and limits of quantification should be evidenced.

Comparison with a non-waste comparator (see Glossary)

D31: *Which material is being used as a non-waste comparator and is it suitable?*

The Producer should justify the non-waste comparator selection and provide a written assessment of why it is a suitable comparator for the waste-derived/by-product material. The Environment Agency has published a series of reports detailing the findings of research to characterise non-waste materials as comparators. The "ordinary" material comparators include 15 non-waste comparators including construction materials such as limestone aggregate [7].

This non-waste comparator may not be the same as the one selected in Stage 2 of this Filtering Protocol.

D32: *Can the proposed material be used in the same way as the non-waste comparator it would replace?*

The Producer should provide a written assessment and review of analytical data, for example provide a summary table showing a comparison of product performance and specification including a direct and detailed comparison of all components.

D33: *How does the proposed material compare to the non-waste comparator?*

The Producer should provide a written assessment and review of analytical data. Direct comparison of compositional data of final waste-derived material against the non-waste comparator including a clear indication of which substances fail this screening exercise. The assessment should relate to chemical contaminants. A waste comparator tool is available on the government's website [7].

Information regarding marketability of the proposed material

D34: *Is there evidence of an established market for example sales evidence or purchaser affidavits?*

Evidence to include purchaser affidavits for example emails. Description of the existing anticipated markets.

The proposed material may have an established market, but this may be different from the pavements market.

D35: *Is the proposed material suitable for use in the proposed pavement construction?*

Comparison with non-waste comparator and product specifications, written assessment and review of data.

D36: *From an EoW perspective, does the proposed material meet relevant product specifications/standards?*

Comparison with non-waste products and relevant product specifications.

Information on environmental risks

D37: *Has a conceptual model been produced fully defining the uses of the proposed material and the relationships to receptors?*

Guidance has been produced by the Environment Agency [36] to help those making an environmental and human health impact assessment for EoW decision making. It covers the principles for conducting a risk assessment for a material under specified uses to determine whether it is likely to cause an unacceptable level of harm to the environment or human health.

The development of the conceptual model is central to the risk assessment process, as it defines the way in which subsequent stages of the risk assessment are followed and ensures that each relevant pollutant linkage is assessed.

In assessing the risks for an EoW decision for a generally applicable product, the end goal is to produce a generic conceptual model for an application or an "end use scenario" rather than a site-specific conceptual model. As a result, the generic conceptual model is often represented by realistic or reasonable worst-case conditions. If the product requires complex and site-specific risk assessment before use (other than within general risk management guidelines) then it may not be suitable for an EoW decision, where the risks are intended to be broadly negligible or low under a wide range of circumstances.

D38/D39: *Are the following compartments defined in the risk assessment: air, land, water? Has the risk assessment been completed according to a relevant standard?*

Receptors or environmental compartments are an entity (for example human, animal, controlled water, plants, buildings, air, soil, sediment) which is vulnerable to the adverse effects of a hazardous substance or agent. The risk assessment should identify which environmental compartments are vulnerable to the material, and to what extent there is a pollutant linkage. Further guidance:

- Groundwater risk assessment for your environmental permit [37].
- CL:AIRE's WALL Assessing risks to human health [38].
- CL:AIRE's WALL Assessing risks to the water environment [39].

D42: *Does the comparison demonstrate that when used, the proposed material has no worse environmental effects than the chosen non-waste comparator?*

The proposed material must not possess properties which could lead to higher environmental impacts, for example as a consequence of contaminants or trace components, or by creating different characteristics or released scenarios to that of the material it is intended to replace.

D44: *Does the proposed material still require some measure of control above and beyond the non-waste comparator?*

For instance, handling requires respiratory equipment whereas the comparator does not or a limitation on pH of receiving environmental because of high zinc content of material meaning that in certain situations there is the potential for zinc level to be harmful. In these situations, there is a characteristic that has been retained by the waste-derived material that is not present in the comparator.

Checklist E – Health and Safety

The aim of this checklist is to ascertain that there are no risks in terms of H&S during transportation, storage, production, installation or use of the proposed material.

Most questions should be answered "yes" in this checklist. However, questions E7, E8, E17, E18 and E26 may be answered "no". Guidelines on how to evaluate the questions are compiled below.

E1: *Has a risk assessment of the proposed material been completed?*

A risk assessment of the proposed material must be submitted. The UK Health and Safety Executive (HSE) website describes the following steps to be considered when assessing the risks of your business:

- Identify the hazards.
- Decide who might be harmed and how.
- Evaluate the risks and decide on precautions.
- Record your significant findings.
- Review your assessment and update if necessary.

Information on how to compile a risk assessment and assisting templates can be found on the HSE website [17]. The risk assessment to be based on information included in the SDS (see notes for guidance in E2).

An alternative to the link provided above is following the advice and guidance to employers on assessing their activities under the Control of Substances Hazardous to Health Regulations (COSHH) [18].COSHH assessment concentrates on the hazards and risks from substances in the workplace.

E2: *Does the proposed material have a Safety Data Sheet (SDS) specific for use in the pavement industry?*

An SDS must be provided for compliance with this Filtering Protocol. The SDS to be produced based on the guidelines provided by REACH. REACH addresses the production and use of chemical substances, and their potential impacts on both human health and the environment. The SDS should include as minimum the following fields:

- Identification of the substance/mixture and of the company/undertaking.
- Hazards identification.
- Composition/information on ingredients.
- First-aid measures.
- Fire-fighting measures.
- Accidental release measures.
- Handling and storage.
- Exposure controls/personal protection.
- Physical and chemical properties.

- Stability and reactivity.
- Toxicological information.
- Ecological information.
- Disposal considerations.
- Transport information.
- Regulatory information.

More information on SDSs can be found on the HSE website [40].

E3: Are the potential hazards associated with the proposed material the same or lower than the comparator? This includes the full lifecycle of the proposed material.

The answer of this question should be based on findings of the risk assessment, the SDS and the comparison between the proposed material with the comparator.

E4: *Has it been demonstrated that there will be no chemical reactions taking place during transportation, storage and mixing?*

Chemical reactions between the proposed material's constituents should not occur during transportation, storage or mixing of the new proposed material, as this will affect the composition of the proposed material. The compositional analysis of the proposed material must be included in the technical report to be submitted as supporting evidence.

E5/E6: *Has evidence been provided to demonstrate that harmful odours, toxic fumes or gasses will not be released during transportation, storage, production, installation and in-service life of the proposed material? Has evidence been provided to demonstrate that harmful levels of respirable dust will not be released during the production/installation and in-service life of the proposed material?*

To be answered either on the risk assessment or the SDS. Comparison with the exposure control limits. Refer to EH40/2005 Workplace exposure limits [41].

E7*: *Will the mixing temperature of the proposed material be the same or lower than the mixing temperature of the comparator?*

If the mixing temperature of the proposed material is higher than the mixing temperature of the comparator, further analysis is needed to determine if this may be a H&S or environmental issue. This evaluation should be carried out in each case scenario and considering the plant capabilities and any additional associated operating costs.

In any case, the proposed mixing temperature should never be higher than the autoignition temperature, the flash point or the recommended production temperatures of any of the components of the proposed material. If this is the case, the use of the proposed material should not be permitted.

E8*: *Will the laying temperature of the proposed material be the same or lower than the laying temperature of the comparator?*

If the installation temperature needed is higher, the need for special equipment and personal protective equipment for workers should be considered.

In any case, the proposed installation temperature should never be higher than the autoignition temperature, the flash point or the recommended installation temperatures

of any of the components of the proposed material. If this is the case, the use of the proposed material should not be permitted.

E9: *Has evidence been provided to demonstrate that the autoignition temperature of the proposed material is higher than the maximum temperature it will reach during transportation, storage, production, installation and service life?*

The autoignition temperature of the proposed material to be stated on the SDS. The range of temperatures regarding production, installation, service life, transportation and storage of the new proposed material to be stated either in the risk assessment or the SDS.

E10: *Has evidence been provided to demonstrate that the flash point temperature of the proposed material is higher than the maximum temperature it will reach?*

The flash point temperature of the proposed material to be stated on the SDS. The range of temperatures regarding production, installation, service life, transportation and storage of the proposed material to be stated either in the risk assessment or the SDS.

E15*: *Has evidence been provided to demonstrate that the proposed material is not radioactive under normal conditions?*

If the proposed materials is suspected for levels of radioactivity, this must be clearly stated in the risk assessment and further review will be needed to evaluate if the proposed material is appropriate for its use in pavements. In general, if a material is naturally radioactive, this should not be a barrier to be used in pavements unless other risks are identified or the risk assessment does not recommend it.

More information regarding legal requirements of radioactive materials can be found in the Defra document [42].

E17/E18/E26*: *Are the necessary personal protective equipment required when handling the proposed material, the same or less than per the comparator?; Has evidence been provided to demonstrate that there are no special requirements related to the storage of the proposed material?; Has evidence been provided to demonstrate there are not any special requirements related to the transport of the proposed material pre-use?*

If extra personal protective equipment is needed, or if the storage and transportation requirements are different, it should be evaluated to ascertain all risks can be mitigated.

For all these questions, it will be the Reviewer's responsibility to assess if the use of the extra measures (where needed) are justified when compared to the advantages of using the proposed material.

If any questions other than E7, E8, E17, E18 and E26 have been answered with "no" or the evaluation of these questions is not satisfactory, it is considered that there are H&S risks related to the transportation, storage, production, installation and/or use of the proposed material. Unless these risks are mitigated, the proposed material should not be considered for development and/or use.

Checklist F – Environment

The aim of this checklist is to ascertain if there are environmental advantages when using the proposed material. For answering the questions, please consider the following aspects for production, storage, transportation, installation/application and service life of the proposed material:

- Carbon footprint.
- Air quality.
- Water quality (including leaching during service life).
- Biodiversity impact.
- Noise pollution.

To answer these questions a Life Cycle Assessment (LCA) of the proposed materials could be carried out. A comparison with the LCA of the comparator may also be useful (see BS EN ISO 1404 [43] and BS EN 14804 [44] for guidance).

All questions should be answered "yes" in this checklist. If any question has been answered with "no", it is considered that there are environmental risks on the use of the proposed material. Unless these risks are mitigated, the proposed material should not be considered for development and/or use. If Checklist D has been completed, some of the responses can be used to answer Checklist F.

A tool to calculate carbon emissions for operational, construction and maintenance activities undertaken on behalf of Highways England can be found on the government's website [45]. In the website there is also available guidance on how to use the tool. The asphalt Pavement Embodied Carbon Tool (asPECT [46]) may also be used.

Suppliers must report on the carbon associated with activities undertaken on behalf of Highways England on a quarterly basis. The User should liaise with the Supply Chain to understand how the output of the carbon tool for the proposed material is compared against the comparator.

The User should state how the proposed material will assist in addressing Highways England's objectives in terms of Key Performance Indicators (KPIs) and/or Performance Indicators (PIs). Highways England's Sustainable development strategy document can also be used for this purpose [47]. The KPIs and PIs established by Highways England for the delivery of better environmental outcomes at the time of publication of this Filtering Protocol are:

- Number of noise important areas mitigated (KPI).
- Delivery of improved biodiversity, as set out in Highway's England biodiversity plan [48] (KPI).
- Number of air quality pilot studies completed (PI).
- Carbon dioxide equivalents (or CO_{2e}) in tonnes associated with Highways. England's activities (PI).
- Carbon dioxide equivalents (or CO_{2e}) in tonnes associated with the Supply. Chain's activities (PI).
- The number of flooding hotspots and culverts (high risk and very high risk). mitigated (PI).
- The number of outfalls and soakaways (high risk and very high) mitigated (PI).

Checklist G – Materials production, installation and use

To evaluate if the proposed material can be used in the pavement industry it is necessary to understand how the material will be processed.

It will be the Supply Chain's responsibility to evaluate if the need for a plant modification or specialised equipment is justified checking the technical (Checklist H) and market advantages (Checklist I). The Asset Manager may consider the use of the proposed material in this case.

Checklist H – Technical Requirements

It is anticipated that the technical requirements will be checked during the Technology Readiness Level assessment. However, answering the following questions could assist in understanding the advantages/disadvantages of the proposed material during service life.

H1*: *Does the proposed material meet the same recognised applicable technical standard, product standard as the comparator?*

Specify the standards it complies with.

This question may be answered as "no" in Technology Readiness Levels 1 to 8; however, standards should be developed for the proposed material to move to in Technology Readiness Level 9.

Common standards to classify paving materials can be found in Checklist B.

The proposed martial should be permitted by the MCHW for a Technology Readiness level 9.

H2*: *Is it anticipated that the proposed material will perform equally or better than the comparator?*

If the answer is "Yes" do you have the relevant evidence?

This question may be answered no if, somehow, the use of the proposed material brings other advantages that overcome the technical performance. However, it is unlikely that a proposed material that performs worse than existing material is considered for development. In the case this is answered as "no", this should be accompanied by a report clarifying the advantages of the use of the proposed material versus the technical disadvantages, including whole life cycle considerations. The Supply Chain and/or Asset Manager will need to decide to support the innovation or not based on the information provided.

Checklist I – Market assessment

It is recommended to carry out a market assessment study to understand the tradability of the proposed material.

In this case, it is anticipated that the Innovator and the Supply Chain should work together to complete this study. This study will help the Innovator and the Supply Chain understand if the development of the proposed material is economically viable. Also, this

study may be used to demonstrate to the Asset Manager the economic advantages of using the proposed material; including whole life cost.

NG5 Summary of supporting evidence required for each checklist

Supporting evidence for Checklist D – End of waste/by-product

Waste management requirement	Proof of permit or exemption.
	Certificate of registration as a waste carrier.
	Waste Transfer Notes (WTNs).
Acceptance of incoming waste	Written acceptance criteria procedures.
	Written list of acceptable wastes.
	Input records.
	Written procedure for non-conforming incoming wastes.
Production requirements, inspection and testing of the product documentation	Documented Factory Production Control system and Method Statement of Production including: • Description of how processing equipment is maintained and adjusted during production. • Procedures for use, control, calibration and maintenance of inspection, measuring and test equipment. • Testing to be undertaken, how often, for each product. • Procedure for dealing with non-conforming products.
	Specification and/or standards list and evidence of conformance.
	Photographs/map of site to evidence that input material are stocked in a controlled manner and in clearly identified locations.
	Records outlining checks made for input material stock deterioration.
	Quality procedures, visual inspection to evidence that the finished product is identifiable, and procedures are in place an implemented to maintain quality during handling, storage, transport and delivery.
	Training records.
	Examples of records include testing frequencies, test results, etc.
	Examples of delivery tickets.
Material/product characterisation	Written description and list of all constituents
	Written description of wastes used, where they come from and what function they will fulfil.
	WM3 assessment.
	Laboratory results and results assessed against REACH and POP regulation limits.
	Sampling plan.
	Full data, copies of laboratory test certificates.
Can the material be substituted for a non-waste?	Written assessment justifying non-waste comparator selection.
	Written assessment and comparison table. Full data, copies of laboratory test certificates.
Is the material marketable?	Written assessment of anticipated markets, purchaser affidavits.
Does the material pose an environment risk when used?	Conceptual model with environmental compartments defined.
	Risk assessment and conclusion that the risks are acceptable.

Supporting evidence for pavement impact assessment Checklists E-I

Evidence	Description	Required for Checklist
Risk assessment	Assess each hazard in accordance with the HSE. See also NG for question E1 (Section NG4).	**E**
SDS	Produce an SDS in accordance with REACH to address the production and use of chemical substances, and their potential impacts on both human health and the environment. See NG for question E2 (Section NG4).	**E**
Carbon emissions report	Carbon emissions for operational, construction and maintenance activities related to the proposed material need to be calculated as described in NG for Checklist F (Section NG4).	**F**
Technical report	A technical report must be submitted explaining how the proposed material will be produced and its intended use. Th report will also detail the differences between the proposed material and the selected comparator in the questions requiring the technical report as supporting evidence. The compositional analysis of the proposed material will be also included in this report. The technical report must include as a minimum supporting evidence for questions included in Checklists E, F, G, H and I where required.	**E, F, G, H, I**
Correlation with Highways England KPIs and PIs or Sustainable Development Strategy [47]	Correlation of the proposed material with Highways England KPIs and PIs as described in NG for Checklist F (Section NG4). This can be part of the technical report or a separate document.	**F**
Market assessment study	Quantitative and qualitative assessment of the market. Must include demand for the proposed material, analysis of activities in regard to such influences as location, demand, and competition. Supporting evidence to the questions of Checklist I must be included as minimum.	**I**

References

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[4] Highways England, Transport Scotland, Welsh Government, Department for Infrastructure, *DMRB, LA 110 Material assets and waste,* 2019.

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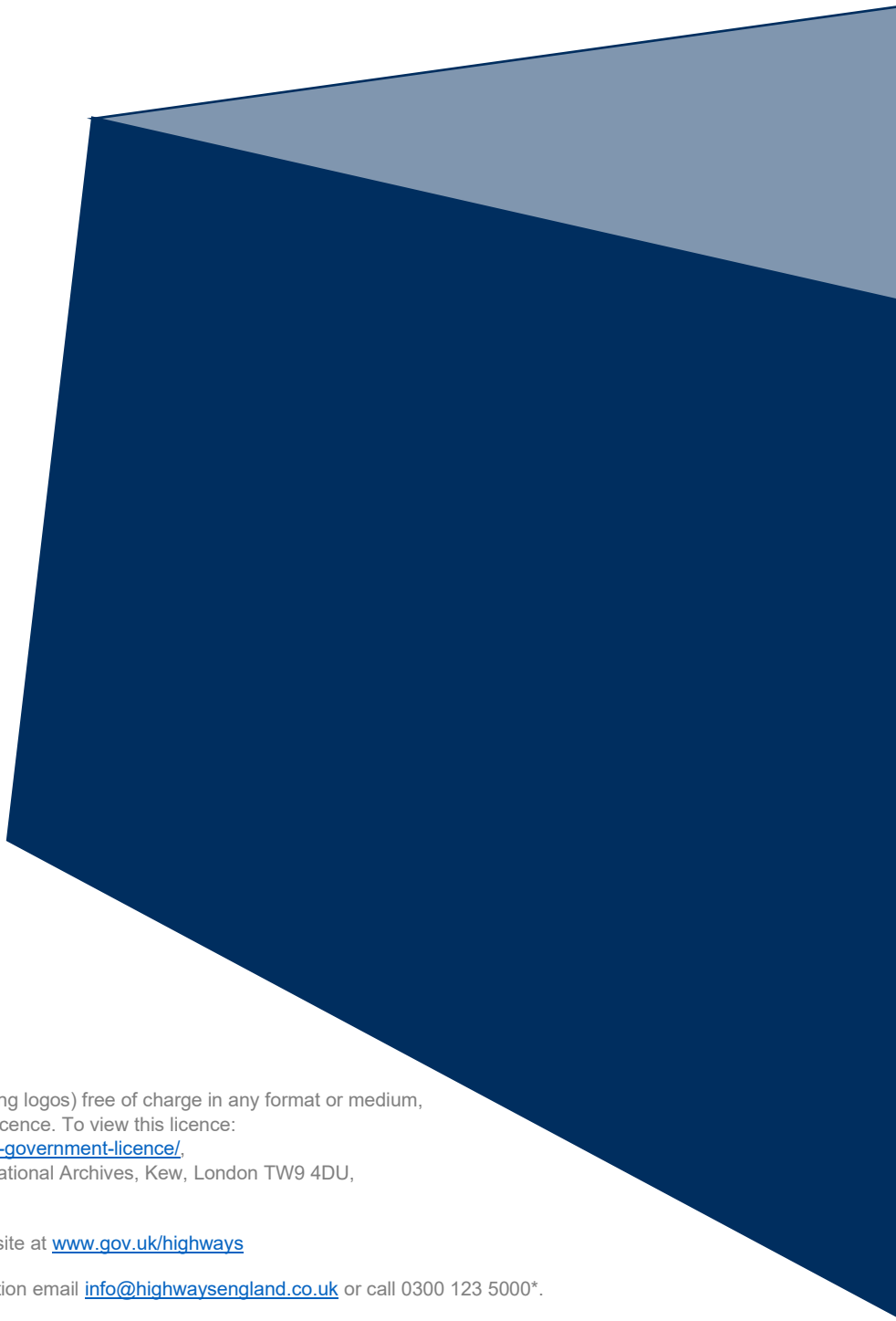

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