Transport Research Laboratory

Environmental Sustainability in Value Management for Highway Maintenance Schemes

A Road Map to Greater Quantification

by B Harris

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A Roadmap to Greater Quantification

by B Harris (TRL)

Prepared for: Project Record: TE2 (a) Sustainable Construction

Client: Highways Agency, NetServ

Matt Winter

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Executive summary

A significant proportion of the Highways Agency's yearly budget is spent on the maintenance of the network. The Highways Agency uses a system of value management to allocate budget based on the relative value of projects within an area. The assessment involves benchmarking projects, based on their outline design, on value for money. The value for money is determined by scoring the impact on aspects such as improving safety, improving journey time reliability and environmental sustainability. A number of different value management processes are used to determine the programme of works for maintenance projects across the network. The assessments seek to evaluate the schemes on a similar basis but they do not use common methods or assessments.

The Highways Agency Business Plan, Sustainability Action Plan, Environmental Strategy and Procurement Strategy identify the key priorities for environmental sustainability in the network. This includes improving environmental sustainability in the use phase and mitigating construction phase impacts. Currently the methods used to evaluate environmental sustainability do not reflect fully the Highways Agency's priorities. Because of the low score that is given to environmental sustainability, it is not given sufficient emphasis to cause any significant change in whether a project is selected. There is also no way of identifying priorities in terms of environmental sustainability across the network as a whole.

After the value management has been completed, project spend is then committed and work up and delivery takes place. On larger projects an environmental assessment takes place to ensure significant risk to the environment is avoided but this does not provide an incentive to improve environmental sustainability in the design and embed mitigation actions in the construction phase.

In a separate project TRL has recommended a solution to harmonising the value management process for maintenance projects so that there is a single evaluation mechanism. They have identified the Department for Transport New Approach to Appraisal, which is being evaluated for use in Local Network Management Schemes, as a potentially suitable method. Environmental sustainability can be addressed through this new system and the key priorities that are not currently being addressed can be taken into account.

To have a sufficient impact on the value management score, environmental sustainability should be at least 20% of the overall score; currently it is only 10%. The mechanisms used to evaluate environmental sustainability should be rationalised and a process should be put in place to ensure that those aspects with specific targets can be quantified to ensure strategic targets can be achieved. The methods should be integrated into the New Approach to Appraisal mechanism and any aspects that are not included currently should be introduced. The New Approach to Appraisal, as with all value management processes, is targeted at the individual project. To ensure national targets can be achieved, the score from the New Approach to Appraisal can be used to evaluate an individual aspect and ensure that targets will be met. The construction phase impacts can be added to this mechanism by scoring projects that identify mitigation actions favourably. To close this loop and evaluate the impact of the projects in construction, the process should be extended to the work up and delivery stage to embed construction phase mitigation actions and ensure priorities are met. A road map is set out in this report which provides following steps to achieving this:

- Step One: Harmonising the VM into a single process
- Step two: Introduce a strategic mechanism
- Step Three: Extend the VM process to include work up and design

This method has been identified to enable the Highways Agency to contribute ‘To lead the world in the environmental performance of roads’ through it’s maintenance programme and address strategic and project specific targets.

1 Introduction

The Highways Agency has developed the Value Management (VM) process to determine priorities for programme development and scheme development over a number of project areas. This process utilises various scoring mechanisms to compare project benefits and costs. Each scheme is assessed under a number of criteria such as safety, environment or disruption to service. This score allows the proposed projects to be compared and prioritised in terms of its value to the user, business and the private sector against the cost to the Highways Agency (HA).

The HA have defined their environmental priorities through the Business Plan, Sustainable Development Action Plan, Environment Strategy and Procurement Strategy. These documents identify a number of key priorities that the HA wish to address. In order for them to be evaluated they must be identified in the scheme proposal and subsequently evaluated through the programme proposals. Therefore, the HA's key priorities in terms of environmental sustainability must be identified and how they can be influenced by VM must be demonstrated.

The Network Delivery and Development Central (NDDC) is also reviewing the VM process for maintenance schemes, which presents an opportunity to incorporate actions to review the sustainability priorities in support of this harmonising project. This work will therefore build on the TRL Report, (Reeves et al. 2009) 'An overview of Highways Agency Cost Benefit Processes and Sustainability' and is intended to support the HA project (Bradbury and Viner, 2010) 'Harmonising the Value Management Approach'.

The term environmental sustainability has been used in the HA to determine the aspects of sustainability that relate to the environment. VM offers the opportunity to implement a quantifiable appraisal of programme environmental impact at an early stage and address environmental sustainability.

This project attempts to identify the potential to develop a more quantitative process for maintenance projects that addresses the key sustainability priorities of the HA. The focus of this report is on the following programmes:

- Local Network Management Schemes.
- Regional Roads Programme.
- Structures Renewal Programmes.

As part of the sustainable construction – development work project (Task Order 554(387)HTRL), in 2009 TRL reviewed the stages when environmental sustainability was considered in HA projects and proposed options for further consideration (Reeves et al. 2009). They identified that the VM process was the first stage where environmental sustainability was assessed. The assessments were found to be limited and did not take into account the full range of sustainability priorities and in particular impacts at the construction phase. Subsequently, as part of the annual review of the VM process for roads renewal projects, an additional qualitative assessment system was suggested for recycled content, waste management and energy use in construction. A set of statements, two positive, two negative and one neutral were developed for each of the aspects. A score ranging between -2 and +2 would be given depending on which statement was relevant to the project proposal. A reduced version was adopted which only asked if there would be a negative or positive impact, giving the project a -1 to +1 score.

The introduction of a greater number of criteria within the roads and renewals VM process has increased the profile of environmental sustainability within the scheme proposals. However, through discussions with interested parties it was highlighted that the current system does not give significant priority to environmental sustainability because of its low overall score. Whilst the assessment now includes a broad range of environmental sustainability aspects, because of the low overall score it will not have the effect of significantly influencing the decision to approve a particular scheme. As it

does not influence the scheme, little time is devoted to assessing the projects for environmental sustainability. To enable this to be more effective the scoring must have a greater effect on the overall score and should be calculated using a more quantitative method.

For a more quantitative assessment to take place, the score for environmental sustainability needs to increase. In the case of the roads renewals scheme it is suggested that this is increased from the present value of 10% to at least 20%.

2 Aims

The key aims for this roadmap are:

- Identify the DfT/HA Environmental Sustainability priorities
- Identify how the key priorities are addressed by the VM process
- Suggest a quantitative mechanism that would address current shortfalls
- Align the output with the VM Harmonising project

The assessment is made in the following way:

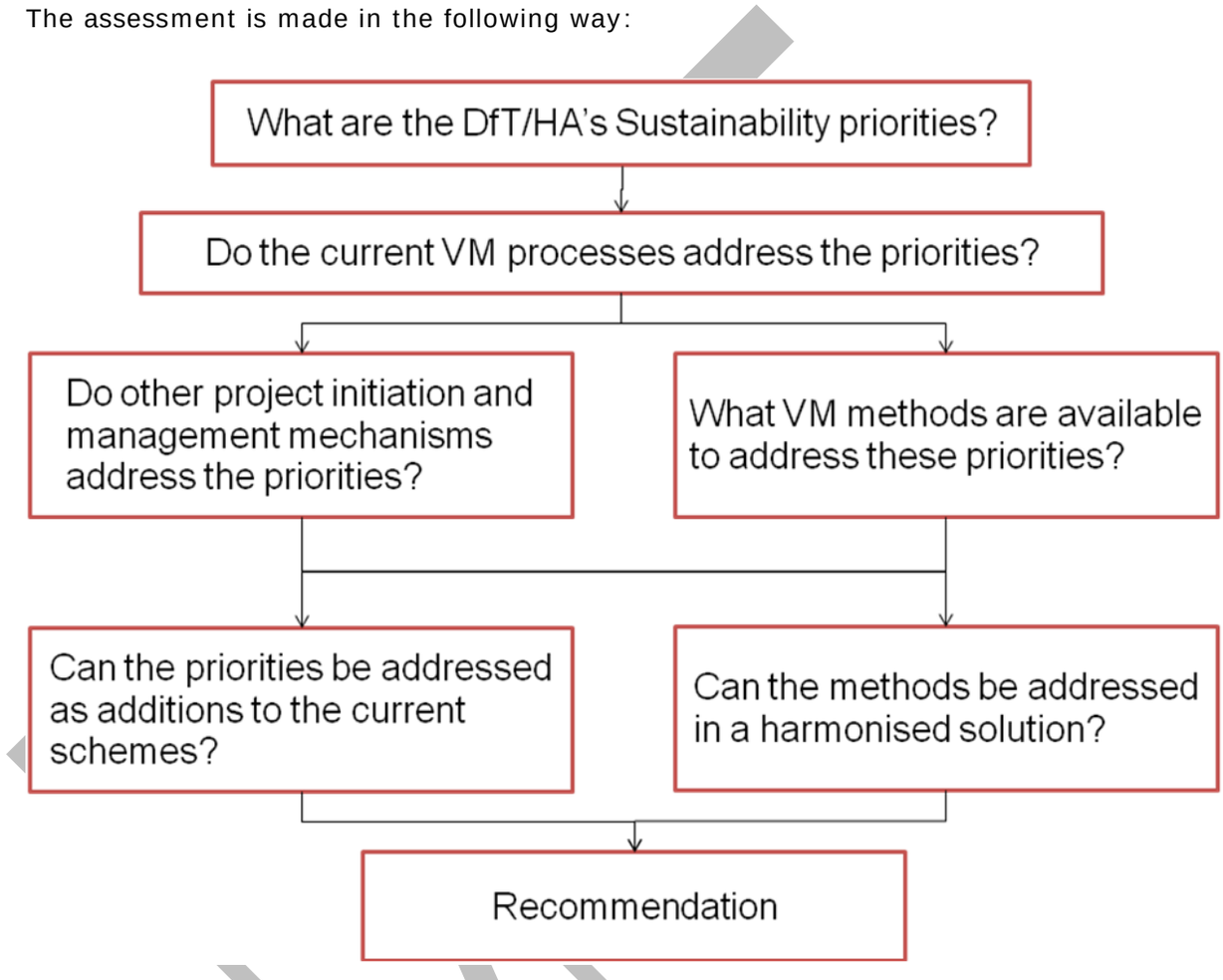


Figure 1 Document Plan

DfT's priorities in terms of sustainability are translated into the HA environmental strategy and business plan. The DfT NATA assessment is readdressed in section 5.1 which shows how the HA priorities build on this assessment. As the HA priorities go further than DfT's with respect to highway construction then the HA priorities are used for comparison during this report.

3 Environmental Drivers

The Highways Agency has committed, 'To lead the world in the environmental performance of roads'. There are two documents which outline the HA strategy for delivering sustainability, the new Environmental Strategy and the Sustainable Development Action Plan. Together they reflect the Agency's priorities in terms of sustainable development. The Sustainable Development Action Plan is paraphrased in the HA Business Plan; this shows the importance of these documents and the high level commitment to reducing carbon emissions and improving the environmental performance of the HA's activities.

The VM process should reflect how construction and maintenance can affect the sustainability of the HA's operations. As a government agency, the HA should reflect the actions required by the Strategy for Sustainable Construction (2008); and to lead the world, it should look at good practice in other government construction delivery programmes. The HA's approach to sustainability should address the areas identified in the Environment Strategy and the Sustainable Development Action Plan. To have the greatest impact, they should be addressed at as early a stage a possible. Table 1 shows the key priority areas of these reports.

Table 1 HA Sustainability Priority Areas

	Environment Strategy	Sustainable Development Action Plan	Strategy for Sustainable Construction
Environmental Priority		Sustainable Consumption and Production	
		Climate Change and Energy	Climate Change Mitigation
	Air Quality		Climate Change Adaptation
		Natural Resource Protection and Enhancement	
	Noise and Vibration		
	Material Resource and Waste		Waste
			Materials
	Soil and Geology		
	Nature Conservation		Biodiversity
	Drainage and water quality		Water
	Landscape		
	Cultural Heritage		
	Accessibility	Sustainable Communities	
	Society and Community		
	Spatial Planning		

Table 1 shows that there are a number of different priority areas which the HA need to address in their programme of work. If the HA is to address these priority areas they should be addressed in the procurement and delivery of construction and maintenance projects.

The HA have a number of policy statements which are associated with these sustainability objective areas. The HA procurement strategy 2009 also highlights key targets to achieve environmental sustainability. The objectives are outlined in table 2.

Table 2 Policy statement and targets (Priorities)

Aspect	Policy statement	Target
Climate Change Mitigation	Our control and influence of the construction, maintenance and operation of the strategic road network needs to drive towards a low carbon future. We also need to take opportunities to influence the users of our network, so they can reduce the GHG emissions from their journey choices. (HA, 2009a)	The Highways Agency is contributing to the Government's commitment to reduce greenhouse gas emissions (primarily CO2) by at least 80% by 2050, compared to 1990. (HA, 2009a) 15% reduction in carbon emissions from construction and maintenance processes and associated transportation by 2012 (compared with 2008 levels). Key suppliers will demonstrate a positive contribution, in line with UK and Highways Agency carbon reduction targets, for trunk road related activity. (HA, 2009b)
Climate Change Adaptation	We must adapt to inevitable change. The impacts of climate change on our network need to be better understood and the risks from a changing climate require measured and timely action planning and intervention. (HA, 2009a)	
Air Quality	We are committed to delivering the most effective solutions to minimise the air quality impacts resulting from traffic using our network. We will operate and develop our network in a way that is compatible with working toward compliance with statutory air quality limits. (HA, 2010a)	
Noise and Vibration	We will continue to work with other Government departments to deliver the requirements of the Environmental Noise Directive. Managing noise levels at priority locations and working towards meeting the requirements of the Government's noise action plans will be given a high priority over the coming years. (HA, 2010a)	
Material Resource and Waste	We are committed to ensuring that a legal and responsible approach to materials and waste management is adopted in all our activities. We will work towards meeting the national waste strategy target of halving waste to landfill by 2012 over the next two years. (HA, 2010a)	25% (minimum) of products used in construction projects to be from schemes recognised for responsible (sustainable) sourcing by 2012. (HA, 2009b)

Aspect	Policy statement	Target
		50% reduction of waste to landfill from construction and demolition activities by 2012 (compared with 2008). by 2020, the recovery of non-hazardous construction and demolition. (HA, 2009b)
Soil and Geology	Our priority in this area for the next five years will be to recognise and respond to the challenges presented by the EU and Defra soil strategies. By doing so, we will minimise the impact of our activities on soils and vulnerable geological features. (HA, 2010a)	
Nature Conservation	Our aim will be to maximise opportunities for protecting and enhancing our diverse natural environment, and supporting its ability to adapt to the likely effects of climate change. We will continually update and implement our Biodiversity Action Plan, ensuring it is well embedded within our work. (HA, 2010a)	
Drainage and water quality	We are responding to the requirements of recent legislation and also the flooding events that have occurred over the last few years. Our priority here will be to continue to review and assess the network's resilience to flooding and develop contingency plans accordingly. (HA, 2010a)	20% reduction in water usage in construction and manufacturing phases (compared with 2008 usage). (HA, 2009b)
Landscape	We will continue to give a high priority to our work on developing ways to enhance the integration of our network into the landscape and to protect the landscape quality. We will focus on reviewing our assessment and design advice and to ensure that landscape design objectives are included in all future road improvement projects. (HA, 2010a)	
Cultural Heritage	Our priorities here are to preserve and manage our cultural heritage assets in a proactive manner. We will also respond to increasing Government and general public recognition of the historical significance of 20th century transport features. (HA, 2010a)	
Accessibility	We have a duty to improve links along and across our network for vulnerable users and to improve access to public transport for disabled users by 2016. Our priorities in this area are to consider the needs of vulnerable users at all stages of network improvements and to work in partnership with other organisations to promote accessibility. (HA, 2010a)	
Society and Community	Our aim is to consider community and social issues at all stages of developing and improving the network, and to improve the assessment methodology for social and community issues. (HA, 2010a)	

Aspect	Policy statement	Target
Spatial Planning	We will focus our efforts on reducing demand for road use by encouraging the adoption of sustainable locations for development and by supporting more sustainable travel choices. We will work closely with stakeholders to help manage the social impacts of planning decisions, and with users to help reduce the need to travel. (HA, 2010a)	

Table 2 shows that there are priorities in terms of policy and in terms of targets that need to be addressed. It also highlights the need to prioritise how these policy drivers are addressed in the project delivery process. The targets highlight the need to monitor the performance of these activities across the schemes so that these targets can be measured. This supports the aim to show how the priorities are embedded into the VM process and follow through the project lifecycle. The HA should be able to prioritise work to ensure that it complies with its obligations and show how construction projects meet the targets set in the procurement strategy.

The VM process should therefore reflect the need to address these priorities and ensure that the above statements are embedded at the start of the project. This is particularly important where the environmental impact of the identified priority can only be addressed through the prioritisation of schemes and not through the mitigation of the impact in the work up and design phase.

4 Delivery Structure

Figure 2 is a flow diagram of the HA's delivery structure for maintenance projects.

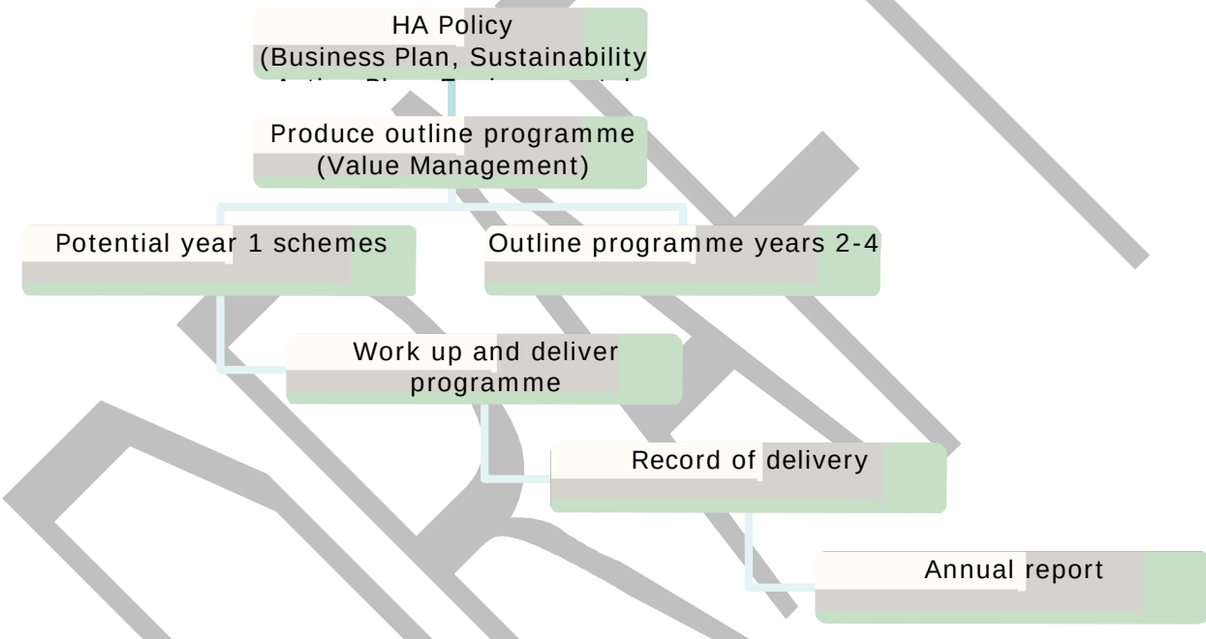


Figure 2 HA Maintenance Programme Delivery Process

Environmental Sustainability is addressed at different stages of the project in different ways. The HA should be able to show how they are addressing each of the priorities outlined as policy drivers for each of their programmes of work. The approach should be scalable so that undue time and resources are not allocated to ineffective work and the approach should be joined up. The first stage at which Environmental Sustainability is addressed is the VM assessment. For the Roads Renewals, Structures Renewals and Local Network Management Schemes they are addressed as follows.

Table 3 Environmental Sustainability Assessment in VM

Aspect	Roads and Renewals	Structures	Local Network Management Schemes
Climate Change Mitigation	Qualitative Assessment of energy during construction	Risk based assessment does not require assessment of specific areas, rather an assessment of the overall risk to the environment. The overall score for environment is low but where a high risk is determined for sustainability or environment the project is classified only as desirable.	Modelled (Monetised model for GHG emission) for projects >£250k, qualitative for <£250k
Climate Change Adaptation			
Air Quality	Qualitative Assessment		Modelled (Monetised model for emissions) for projects >£250k, qualitative for <£250k
Noise and Vibration	Qualitative Assessment		Modelled (monetised model for noise) for projects >£250k, qualitative for <£250k
Material Resource and Waste	Qualitative Assessment of management of construction waste and approach to recycled content of works		
Soil and Geology			
Nature Conservation	Qualitative Assessment		Qualitative Assessment
Drainage and water quality	Qualitative Assessment		Qualitative Assessment
Landscape	Qualitative Assessment		Qualitative Assessment
Cultural Heritage			Qualitative Assessment
Accessibility			
Society and Community			Qualitative Assessment
Spatial Planning			Qualitative Assessment

Currently not all of the Highways Agencies priorities are being addressed by the Value Management process. Table 3 shows that the assessments vary in their scope and detail between the topics within programmes and between programmes. VM is the main point at which the HA is able to decide upon which projects should go forward, based on assessing the value of implementing a scheme on its benefits to users, businesses and private sector. After the schemes have been chosen, the next step is to mitigate any impact and maximise any benefit. For roads renewals projects and LNMS this is through an environmental assessment which highlights any significant impacts that need to be addressed. During work up and design the schemes are then assessed further through surveys before a reassessment of the costs, risks and benefits. This, however, does not affect whether the scheme goes forward. Also, the final design can differ from that proposed when the VM process was conducted.

At each stage of the project life cycle it is important to address the environmental sustainability impacts and also how the decisions made at the VM and work up stages translate to actual actions.

During the course of the project the waste champions for the Maintenance Area Contractors (MAC) were consulted on the current VM system. They identified that the VM process for roads renewals did not take Environmental Sustainability into account effectively. Currently, environment scores 10% of the overall value in the VM process. This does not encourage much effort to be made in evaluating the environmental sustainability of the individual projects. As there are eight categories, a change between -1 and + 1 only affects the overall score by 2.5%. As it is a qualitative assessment, it is difficult to be accurate to any degree, or ensure a consistent approach across the HA. This ultimately results in the score for environmental sustainability being undervalued to the point where it has little effect on the overall scheme decisions.

It was therefore suggested that the score is increase to at least 20% of the overall score. Both Document Owner of Roads Renewals VM Guidance in HA NetServ and the Waste Champions in the MAC identified that at this level a quantifiable approach to environmental sustainability in VM can be taken.

Currently the structures renewals process only includes an assessment of risk to the environment which is qualitative and has a low impact on the overall scores. It is used to identify significant risks rather than to select projects based on their net benefit to the environment. It also separates environment from sustainability.

The LNMS schemes and the use of PAR require the most quantifiable data although they do not capture the full range of sustainability priorities and targets. A review is currently underway on the assessment of LNMS project to include the DfT New Approach to Appraisal. This is discussed in section 5.

5 Harmonising the VM Approach

The VM process enables decisions to be made on the schemes that should go forward to address the Environmental Sustainability priorities outlined by the HA. To ensure that these priorities are addressed across the different programmes effectively and in a consistent way it is suggested that the VM approach is harmonised. Currently there is no way of comparing the VM results of the different schemes as they are not comparable in their assessments. The schemes need to address the same Environmental Sustainability priorities in a consistent way to ensure that the HA meets their strategic objects and that they are getting value for money for the tax payer in reducing the environmental impact of the HA maintenance activity.

Bradbury and Viner (2010) suggest utilising the LNMS procedure for environmental assessment in the value management process. The LNMS process utilises the Project Appraisal Report (PAR) and has a number of advantages compared to other scoring methods for VM. Firstly the PAR requires a different level of assessment for different project values. Secondly the top level of assessment requires a more quantitative assessment, using modelling techniques, for air quality, noise and greenhouse gas emissions. Currently, however, the assessment does not take into account materials and resource efficiency, soil and geology and climate change adaptation.

Table 4 suggests how each aspect could be addressed with current assessment mechanisms available for LNMS, Roads Renewals and Structures.

Table 4 Rationalising the VM approach

Aspect	Value Management Assessment
Climate Change Mitigation	Modelled for projects >£250k, qualitative for <£250k (LNMS) Separate qualitative assessment at the use phase. (Roads Renewals)
Climate Change Adaptation	
Air Quality	Modelled for projects >£250k, qualitative for <£250k (LNMS)
Noise and Vibration	Modelled for projects >£250k, qualitative for <£250k (LNMS)
Material Resource and Waste	Qualitative Assessment of management of construction waste and approach to recycled content of works (Roads Renewals)
Soil and Geology	
Nature Conservation	Qualitative Assessment (LNMS/Roads Renewals)
Drainage and water quality	Qualitative Assessment (LNMS/Roads Renewals)
Landscape	Qualitative Assessment (LNMS/Roads Renewals)
Cultural Heritage	Qualitative Assessment (LNMS)
Accessibility	
Society and Community	Qualitative Assessment (LNMS)
Spatial Planning	Qualitative Assessment (LNMS)

Even by combining the methods used across the three scheme assessments, the environmental priorities are not fully addressed. Also, there is disparity between the assessments in their emphasis on use phase and construction phase impacts. Simply pulling the three assessments together into a single assessment criterion will not be sufficient to fully address the priorities, but it does provide a basis for including assessment mechanisms in a fully harmonised approach.

As identified in Table 2, there are targets and aims associated with the priorities. A more effective way of meeting targets would be to implement a more quantifiable

approach. Where there is only a general policy statement, a qualitative approach can be taken to ensure this aim is being addressed. New mechanisms should therefore be developed for those aspects that do not currently have this assessment Table 5 suggests what methods would be required to be implemented in the VM assessment.

Table 5 Potential Assessment Methods

Aspect	Value Management Assessment
Climate Change Mitigation	Modelled Assessment of carbon equivalent in build phase against carbon equivalent in use >£k. Qualitative for <£k[2]
Climate Change Adaptation	Qualitative Assessment
Air Quality	Modelled for projects >£k[2], qualitative for <£k[2]
Noise and Vibration	Modelled for projects >£k[2], qualitative for <£k[2]
Material Resource and Waste	Use of quantification tool for projects >£k[2] Qualitative assessment for <£k[2]
Soil and Geology	Qualitative Assessment
Nature Conservation	Qualitative Assessment
Drainage and water quality	Qualitative Assessment for effect on the local water environment. Use of quantification tool for use of water in construction projects >£k[2] Qualitative assessment for <£k[2]
Landscape	Qualitative Assessment
Cultural Heritage	Qualitative Assessment
Accessibility	Qualitative Assessment
Society and Community	Qualitative Assessment
Spatial Planning	Qualitative Assessment

By implementing the above methods the HA could demonstrate that the proposed programme addressed the current policy aims and targets. Where there is no current method available, a new method would need to be identified and introduced. It may be the case that methodology currently available such as the WRAP Designing out Waste principles could be used. Where new methods are required they should only be developed if needed to fulfil a HA commitment. It would also not be appropriate to prepare a quantitative assessment for projects that are of an insufficient size and as such the level at which certain assessments would be made would need to be identified.

In 2010/11 the approach to VM will be harmonised so that there is a single assessment for the schemes. The method proposed by Bradbury and Viner (2010) utilises benefit-cost-ratio. To address the aims and targets the above assessment should be included in this process. Section 5.1 sets out how this could be achieved.

5.1 Benefit-Cost-Ratio Approach

The NDDD has identified the need to rationalise the value management approach so that projects can be scored on the same basis and compared across schemes. They commissioned TRL to complete a roadmap to introducing a harmonised approach (Bradbury and Viner, 2010).

The conclusion of this report is to implement a benefit-cost-ratio (BCR) assessment, i.e.:

Net Benefits (benefits minus cost) to users, business, private sector providers

Divided by

Public Sector cost

This has the effect of identifying the benefits to the user, business and private sector providers against the cost to the public sector. This process provides the opportunity to identify environmental sustainability in the HA network as a benefit to users, businesses and private sector.

The BCR method has been proposed for future LNMS projects. It is being adapted from the DfT New Approach to Appraisal (NATA) Goals. The full list can be found in appendix A. Table 6 compares the HA priorities with the NATA goals.

Table 6 Comparison of HA priorities and NATA Challenges

HA Priorities	NATA Challenge
Climate Change Mitigation	Reduce greenhouse gases
Climate Change Adaptation	
Air Quality	Reduce air quality health costs
Noise and Vibration	Reduce exposure to noise
Material Resource and Waste	
Soil and Geology	
Nature Conservation	Biodiversity
Drainage and water quality	Water environment
Landscape	Landscape
Townscape	Improve the environment
Cultural Heritage	Heritage
Accessibility	Improve accessibility
Society and Community	
Spatial Planning	Support the delivery of housing

Whilst the terminology is different, the NATA (DfT) and HA priorities are similar. As such, many of the environmental priorities identified by the HA are addressed in the NATA goals. The NATA does not however address the HA priorities of climate change adaptation, material resource and waste, soil and geology and separately, society and community.

The NATA assessment is also scheme specific, which is true of the current VM mechanisms. It is therefore difficult to ensure that corporate targets for specific aspects, such as corporate targets relating to climate change or the Strategic Forum's halving waste to landfill, will be addressed through a VM score. The Treasury also requires the HA to report on CO_2 and waste. This reporting will enable targets to be set to reduce waste and CO_2 and at present there is no mechanism within the VM assessment to address these targets or future targets. Introducing a mechanism at this point will mean that the HA will be able to react to changes immediately and ensure that targets can be achieved.

Implicit in the NATA assessment is a focus on the use phase impacts; this does not provide a significant weighting to construction phase activities. The construction phase impacts should be considered in VM because the choice of whether a scheme goes ahead should include the consideration of how the construction phase impacts are mitigated. Construction phase impacts have an environmental cost and priority should be given to projects that minimise this cost. It is also the case that improving resource efficiency within a project can often reduce the overall cost of the project. It is understood that the current system does not allow the HA to identify those savings and they would be realised by the contractor.

The BCR would be a new system of assessment that would supersede the current VM approach. All of the schemes would then need to be assessed using this new method. BCR as a way of harmonising the VM therefore offers the opportunity to ensure that the Environmental Sustainability priorities are addressed. However to implement the BCR approach it is recommended that the following is considered for inclusion:

1. Rationalise the terminology and include criteria for climate change adaptation, material resource and waste and soil and geology.
2. Include construction phase impacts.
3. Include a mechanism to ensure targets for a specific aspect can be met across the whole programme of work.

5.1.1 Include additional criteria

When harmonising the VM the additional criteria for climate change adaptation, material resource and waste and soil and geology should be included. These impacts are key priorities and including them in the VM process will ensure they are taken into account on the project. The Environmental Information System (EnvIS) enables environmental sustainability to be accounted for in the project delivery. However, including the full range of environmental sustainability priorities as an integral part of the decision on whether a project goes forward through the VM process, will enable HA to determine whether targets based on these priorities will be met.

The Strategy for Sustainable Construction identifies the need to ensure infrastructure will be able to function with a change in climate. Ensuring that the network is resilient is part of the NATA score; including whether the network is prepared for the effects of climate change as part of that score would ensure that it is considered.

The Treasury has issued a requirement for the HA to report on waste and as such will be able to set a target for waste reduction. Without a mechanism to achieve this, the HA will be unable to respond. Material resource and waste have an impact on the project cost to the environment. As such, a project which will produce a large amount of waste should be considered, on an appropriate scale, less favourably than one that produces less waste. WRAP (2009) has also shown that good practice waste minimisation and management reduces project costs. The savings associated with resource efficiency can be better understood if they are considered by the HA earlier in the process.

The HA is committed to protecting soil and geology in line with Defra and EU soil strategies. As such there should be a mechanism to include this as part of the NATA score. The level to which this will apply to maintenance projects will need to be considered and the assessment should be appropriate to the effect maintenance projects will have on soil and geology.

The aspects could be included as such:

Climate Change Adaptation: As part of the score for resilience.

Material Resource and Waste: As an additional challenge in “improve quality of life” with two NATA sub challenges:

- material resource use, and;
- construction waste.

Soil and Geology: Additional sub challenge to minimise impact on the natural environment, heritage and landscape.

5.1.2 Include construction phase impacts

The environmental sustainability assessment in NATA focuses on the impacts of the project on the network during the use phase. However all of the aspects can be broken down into 'use phase' impacts and 'construction phase' impacts. A scheme may score well in terms of its impact on the environment in the 'use phase' but it could have significant impacts in the construction phase that are not considered. Figure 3 outlines the aspects and their impacts:

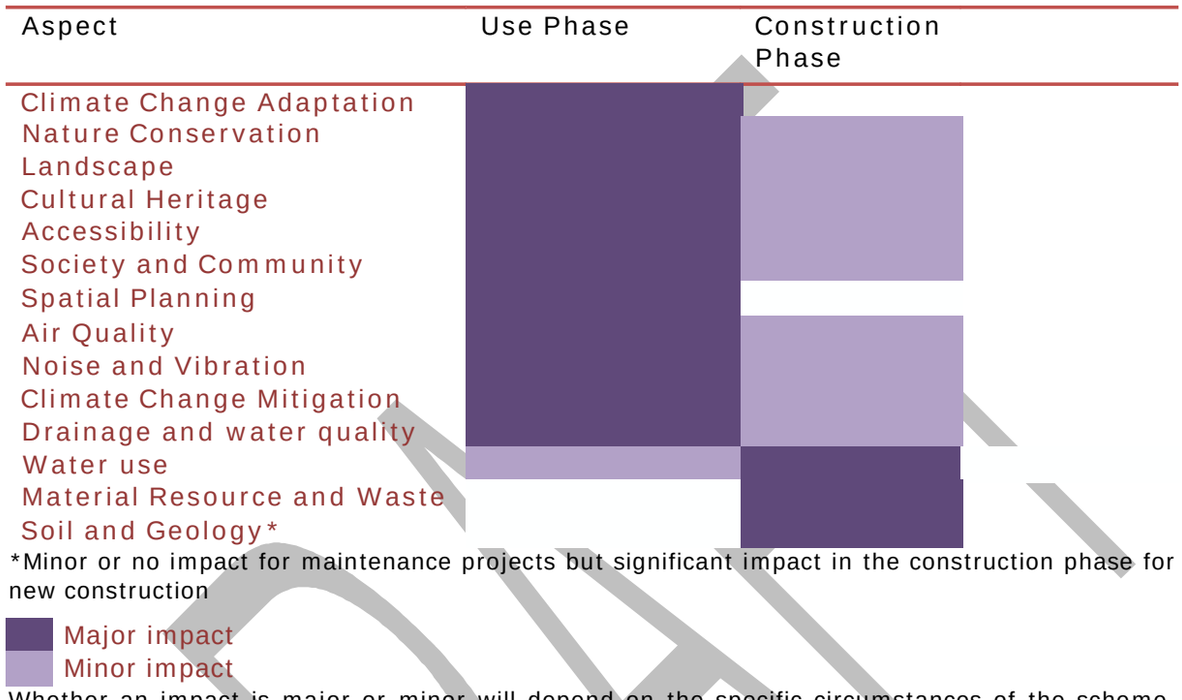


Figure 3 Generic suggestion for the phase the aspect will impact

There are not only use phase impacts that need to be considered. The construction phase impacts are important, particularly to meet targets set out in the procurement strategy for emissions during construction, reductions in waste to landfill and reductions in water use. These are not considered in the NATA.

The benefits of a project to the environment will be in the use phase. The construction phase has no benefit to the environment and the activities will have a net cost to society. These impacts could therefore be considered as net costs in the BCR score. Reducing this cost is significant in reducing the cost of the project to the environment and value of the project to society.

In the review of environmental sustainability indicators for the VM process for roads and renewals, TRL identified how energy used in construction can be evaluated using a qualitative method. The method identified good practice as providing a positive VM score and bad practice as a negative score. In the BCR the construction phase impacts would be considered as net costs to the project but good practice will reduce the impact of the construction phase and improve the value of the project. The scoring methods suggested could be adapted and added to the NATA score to express the impacts of the construction phase within the BCR.

As an example the scoring mechanism suggested is outlined below:

Score	Energy Use in Construction
- 1	Durable or low energy materials and low energy transport solutions sought • Low energy materials: warm or cold mix asphalt indicated for use, in-situ recycled of materials (with no off site processing/transport required) • Low energy transport: alternatives to road transport, backhauling or particularly local material solutions (e.g. use of borrow pits)
- 2	Durable or low energy materials or low energy transport solutions sought
- 3	No consideration of particularly durable or low energy materials or transport and no excessively high energy materials used
- 4	Excessive use of materials with a relatively high cement or steel content (durable)
- 5	Excessive use of materials with a relatively high cement or steel content (non-durable)

The method suggested would need to be evaluated so that it is suitable for inclusion within the NATA but provides a starting point from which to include the construction phase environmental costs into the score.

Scoring mechanisms were also identified for material resources and construction waste and could provide a similar score. Again the scoring system identified by TRL for these two aspects has been adapted to provide a negative score:

Score	Material Resource	Construction Waste
- 1	Materials on site recycled at as high a level as possible (e.g. reclaimed asphalt used in new asphalt) and recycled/secondary materials used wherever possible	Design of works optimised to minimise production of waste and maximise recycling of materials on site. Waste that is produced sent for recycling at as high a level as possible
- 2	Use of established recycling techniques (e.g. cold recycling of pavements) and use of recycled materials for unbound applications	Established recycling techniques used to reduce waste. Waste that is produced sent for recycling as unbound materials
- 3	Recycled materials used for unbound applications only	No efforts to reduce waste during design or construction and waste sent to recycling centre
- 4	Project will only use imported primary materials, no opportunities for recycling or use of recycled/secondary materials	No efforts to reduce waste during design or construction and waste sent to exempt sites
- 5	Project will only use imported primary materials although there are opportunities for recycling or use of recycled/secondary materials	No efforts to reduce waste during design or construction and all waste sent to landfill

These scoring systems may need to be adapted to fit in with the NATA but are provided as examples. A qualitative method such as this will enable projects to be identified that will commit to reducing waste, improving resource efficiency and reducing energy use during construction. As the full details of the final work up are not available at this point and the construction materials have not been decided it is difficult to determine a monetised or more quantified method. The above method would however set the intention to reduce waste and a score can be determined. A further mechanism is

suggested in section 5.1.4 to extend the VM process to ensure that these actions are implemented. A worked example can be found in appendix B.

5.1.3 Ensuring strategic targets are met

The NATA scoring system concentrates on the individual project to balance the benefits against the cost of the project. It does not however allow for the whole programme of work to be assessed and ensure that strategic targets are met. The basis behind the BCR is to enable the user to assess the benefits and costs (in terms of negative impacts, i.e. emissions of GHG in the construction phase) of each of the sub-objectives and create a net benefit score, which can then be used to determine the ratio of the net benefits of the scheme against the cost (cost to public sector).

This means that to gain a high score in the VM process then the scheme only requires a net benefit for the project as a whole. If we want to asses aspects across the whole programme another mechanism is required. This is illustrated in figure 4.

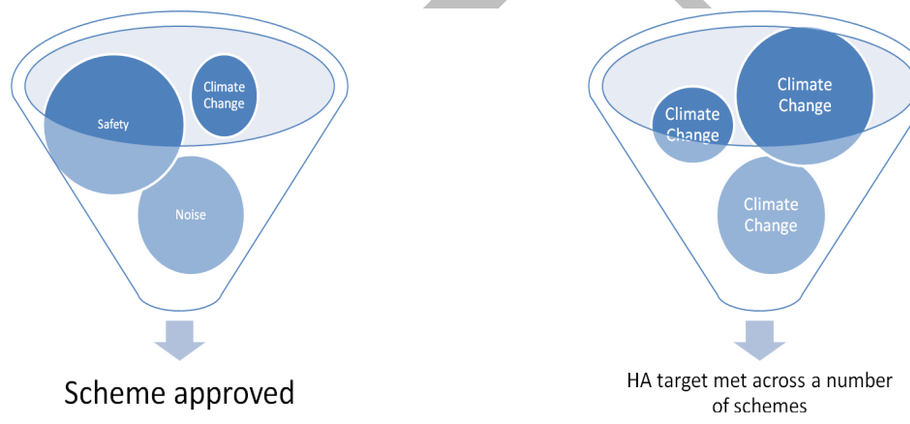


Figure 4 Illustration of how aspects contribute to scheme appraisals and strategic target

As schemes are approved on the selective benefits of a number of different options one particular aspect can receive a low score for all projects in the programme of work but the scheme can still go ahead. This is illustrated in figure 4; the left diagram shows a project with significant benefits for safety and noise but a small benefit for climate change. If all of the projects had a similar score then targets for climate change would not be achieved. This suggests that a second assessment is required where calculations can be made across the whole programme on the overall impact of that aspect to achieve HA strategic targets. This is illustrated in the right diagram; while there are some projects that have little benefit with regard to climate change, others with a larger benefit make up the difference and the overall target can be met. Identifying whether the target will be met at this stage ensures that this mix of projects can be adjusted to ensure the targets are met.

Table 7 below is an illustration of how this process could be scored.

Table 7 Illustrative example of the strategic mechanism to review targets

Aspect	Project A	Project B	Project C	Project D	Overall Score for Aspect	Strategic Target
Climate change mitigation	1	-4	2	2	1	1
Climate Change Adaptation	1	4	-1	1		
Nature Conservation	-2	-2	-4	-4		
Landscape	-3	-2	-4	-3		
Cultural Heritage	-1	-3	-2	-2		
Accessibility	-5	-2	-2	-2		
Society and Community	-3	-3	-2	-3		
Overall Score for Project	-12	-12	-13	-11		-15
Accepted/ rejected	ü	û	ü	ü		

Table 7 is included for illustrative purposes only. It shows how a project could be selected based on a combination of its overall score and its contribution to a strategic target. Project B has an overall score of -12 which is lower than Project C. All of the projects scored within the strategic target and can therefore be chosen based on strategic targets. The climate change target would not be met if Project B was selected and as such stopping it at this point will enable that target to be achieved.

To ensure that those projects with a high priority are implemented and those projects where the scores are low are not implemented purely on the basis of their contribution to a corporate target, then the projects should be separated into three bands. It is suggested that the projects would be separated into high (those that will be implemented because of high scores), low (those with scores too low and should not be implemented) and medium. The medium scores would be used to address the strategic targets with some of them being rejected for future years. It is likely that medium projects would be in a band that it would be of reasonable value to implement them all if funding was available.

This assessment is particularly required for those aspects where there is an associated strategic target and the VM process is the only opportunity to make this assessment. The example given is the ability of the HA to contribute to mitigating climate change. If this is to be achieved then schemes must be chosen that provide a beneficial reduction in GHG. The scores from the NATA may not be sufficient on their own to ensure that this strategic target is met and as such an overview should be taken to ensure a strategic contribution.

The Network Delivery and Development Directorate Management Plan 2010/11 identifies:

- a 3% reduction in the carbon dioxide equivalent emissions of network energy compared with 2008-09;
- delivery of six effective interventions at priority outfalls, priority soakaways and flooding hotspots and culverts, and;
- delivering ten interventions to support protected species and enhance habitats in accordance with the Agency Biodiversity Plan.

The Procurement Strategy highlights:

- a 50% reduction of waste to landfill from construction and demolition activities by 2012 (compared with 2008);
- by 2020, the recovery of non-hazardous construction and demolition waste shall be increase to a minimum of 70% by weight;
- 15% reduction in carbon emissions from construction and maintenance processes and associated transportation by 2012 (compared with 2008 levels);
- 25% (minimum) of products used in construction projects to be from schemes recognised for responsible (sustainable) sourcing by 2012, and;
- 20% reduction in water usage in construction and manufacturing phases (compared with 2008 usage).

By implementing a secondary mechanism as described above at the VM stage, priority can be given to projects that will ensure these and future targets are met.

For climate change mitigation it is suggested that, using the same data used for the initial VM assessment, the Scheme Managers can make an alternative assessment in relation to a strategic target. This means that priority can be given to projects that have a large climate change mitigation impact to ensure this overall target is met.

The added advantage of setting up a second strategic assessment is that additional guidance on objectives from the HA can be incorporated into the VM process without a major restructuring of the mechanism. Bodies such as the Environment Strategy and Action Plan Management Group could use this mechanism to ensure that environmental objectives can be met.

5.2 Extending the VM process

The VM process as described above provides a single point at which the projects can be assessed and selected for approval. The VM provides a significant opportunity to select projects based on their overall objectives and to agree spend based on their benefit to England. The process is however restricted by this single assessment in two ways:

- It is difficult to fully assess construction stage impacts because of the need for a more detailed design to understand the proposed methods and materials that will be used in construction.
- There is no significant way of ensuring that priorities outlined in the VM follow through into the work.

The materials and the specific methods that are used in construction are not decided until after the VM process. The full extent of the construction phase can therefore not be quantified until these decisions have been made. Specifically the quantification of

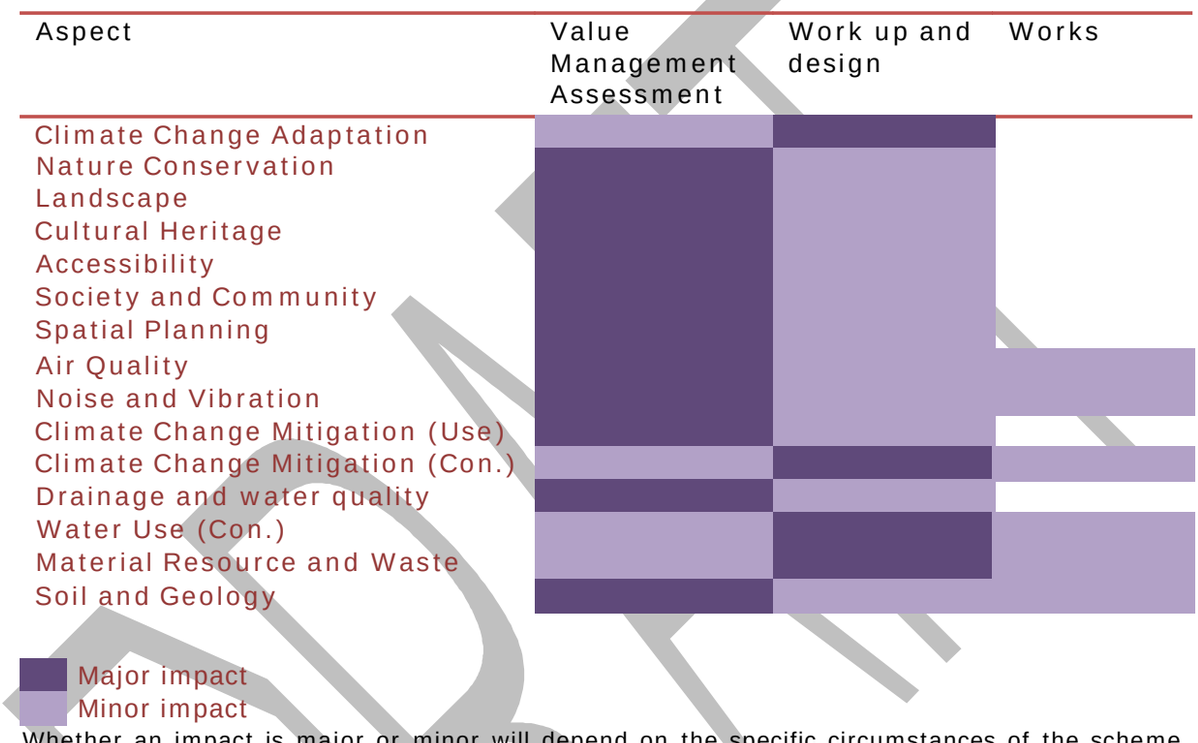
- materials with a high recycled content are used (the amount of recycled material used in construction materials that is recycled);
- reducing the amount of waste through the design;
- identifying the amount of waste that can be reused, recycled or otherwise recovered;
- identifying the carbon emissions associated with construction;
- water use during construction, and;
- resilience of the product to climate change.

During the VM process the intention of the project to include these actions in the design can be assessed but the quantification of how they are implemented cannot be achieved without an assessment of the detailed design. The design can also change

between the initial design and the detailed design without a reassessment of the commitment of funds. As such the risk assessment is the only process that confirms actions have been taken.

To include a quantification of the construction stage impacts fully it is proposed that the mechanism for assessing whether a project is successful should be extended to include the work up to delivery stage. There are significant cost savings that could be achieved through this process that would cover any additional costs, as well as a better priority of work based on not only use phase costs but also construction phase costs.

Figure 5 suggests where the greatest impact on the environmental aspects can be had on a project.



Whether an impact is major or minor will depend on the specific circumstances of the scheme. The shadings are for illustrative purposes only.

Figure 5 Generic impact of intervention at stage of project

Figure 5 illustrates the stage at which an intervention can be taken on a project and the potential impact. The figure suggests that, for some of the aspects, an intervention at the work up and design stage will have a greater impact because it will have a greater influence over the final output as many projects will be selected regardless of their impact on the construction phase. This needs to be taken into account at the VM stage but it needs to be followed up in the work up and design and the final construction stage. Where a commitment is made in the outline design stage then it will need to be followed up in the work up and delivery. If the score changes significantly then the mechanism should be there to put that project on hold so that it can be reassessed as part of a pool of projects available at this stage.

At the stage at which the VM is carried out at the moment, it is difficult to assess all of the construction phase impacts. Any score will be based on an estimation of the potential project and the potential to influence the construction. If the VM is extended into work up and delivery then this gives the opportunity to spread this assessment and implement a more appropriate mechanism.

Therefore the outline design stage (Current VM stage) assessment would primarily be used to select between two projects based on use phase impacts and the intention to mitigate construction phase impacts. Essentially a score would be given based on what

mitigating measures have been identified. These can follow the outline provided in section 5.1.

A second stage of VM would follow after the detailed design has been confirmed that will include a quantification of the construction stage impacts. At this point a project should be rejected and put back for reassessment in future years if the actions identified to reduce construction phase impacts are not implemented, or the quantification of those actions shows a low mitigation of construction impacts. The allocation of projects that go through to work up should allow for some to be rejected at this stage. If a project is rejected it does not mean that it would not be implemented but it does mean that thought will have to go into reducing the construction phase impacts if the project is going to succeed at a later date.

The assessment will involved the quantification of construction phase impacts. This will require the use of quantification tools for each of the impacts identified. A score will be given to the project based on its design and how it mitigates use phase impacts. This assessment can also be applied to other priorities such as journey time reliability in the use phase.

As well as meeting the targets for resource efficiency within the HA there is also the opportunity to identify cost savings. WRAP has shown that improved resource efficiency on a project can produce significant real savings and these should be realised at this stage. When the re-assessment of costs are conducted the effect that the design has had on the materials resources and waste and water use on the cost of the project and the environmental impact can be judged. The HA will be able to identify those savings in the design and ensure ownership of those savings.

6 Conclusion

It can be concluded from this review of the VM process that currently the system for evaluating environmental sustainability is not sufficient to take into account the full range of HA priorities and evaluate current and future strategic goals.

There is a need to harmonise the approach and this can be achieved by following the Bradbury and Viner (2010) suggestion to implement the NATA system across projects. This system can be supplemented by additional assessment aspects outlined in this roadmap to address the key criteria set out in the HA Procurement Strategy, Sustainable Development Vision and Action Plan and the Environment Strategy.

There is a difference between the use phase impacts and the construction phase impacts and they need to be treated differently as part of VM. The construction phase impacts can be best assessed at the work up and design stage as only then is the design at a point where construction activity can be calculated and a value given to the impact on the environment. At the moment, however, the budget will be committed without the need for this full consideration.

At the stage at which the current VM process is conducted, only the outline design can be assessed. The use phase impacts can be calculated and included as part of a benefit-cost-ratio. An intention of the project to implement construction phase mitigation actions can also be included as part of the assessment and the additional priorities can be addressed by adding in the aspects at this point.

The current system is also insufficient in the way it deals with strategic targets and a cross cutting management approach is required to achieve national targets for the whole programme. This can be achieved by using the same scores to evaluate the schemes a second time to ensure that the programme as a whole meets strategic HA targets.

Cost saving and mitigating actions are not identified at the work up and design stage where they can have the greatest impact on the project. A process by which projects can be evaluated to ensure that they achieve the targets identified in their initial evaluation and rescored based on actual impacts calculated from detailed design will

enable scheme and programme managers to have greater visualisation of the impacts involved. Because projects can change between the VM and the work up and delivery, an assessment must be made of the final design to ensure that strategic targets can be achieved and the network is maintained to a standard that will enable the HA 'to lead the world in the environmental performance of roads'.

This introduces a process prior to construction that provides a more accurate picture of the final product. This score should closely relate to the Post Opening Project Evaluation (POPE) which would be used to evaluate the effectiveness of the scheme. Key activities such as the forecast of waste, the reuse of materials, the use of materials with high recycled content and the use of low carbon materials can then be evaluated through POPE against the forecast from the VM.

7 Recommendations

This report has highlighted the following key aims:

- Sustainability should be at least 20% of the VM score for it to affect the scheme programme
- The VM process should address the key priorities outlined in the Highways Agency Business Plan, Sustainable Development Action Plan and the Environmental Strategy.
- There should be a way of assessing the procurement strategy targets through the VM process.
- The VM process should enable strategic targets relating to sustainability to be met within the programme
- Aspects that relate to the construction phase should be mitigated and monitored throughout the project development.
- The requirements of the VM assessment should relate to the targets and the value of the job.

It is recommended that the aims can be achieved through:

- Stage One: Incorporate the Environmental Sustainability into the process of harmonising the VM
    - Include material resources and waste, climate change adaptation, soil and geology and water use in the NATA mechanism
    - Include construction phase in the score
- Stage two: Introduce a mechanism to achieve strategic targets
    - Identify those aspects where assessing the impact on an individual project will not be sufficient to meet strategic targets, e.g. climate change mitigation
    - Implement a second process that assesses the aspect across the whole programme of works and ensures strategic goals are met
- Stage Three: Extend the VM process to include work up and design
    - Increase the number of projects that make it through the initial scoring round so that projects can be assessed at a later stage when the detailed design is available.
    - Rescore the shortlist of projects based on the final design to fully assess the construction phase impacts. This method will quantify the impact that the proposed project will have on the environment to a greater level of accuracy.

- Rank the projects again. The projects with the lowest scores will be carried forward for reassessment in future years.
- Provide suggestions for improving the score for environmental sustainability, i.e. suggest the use of the WRAP Designing out Waste Guide for Civil Engineering.
- Acceptance of projects in future years will be on the basis that they either improve their score or they now represent a greater value for money in comparison to projects in later years.
- This will drive resource efficiency.
- Include within the revision of the projects a cost comparison to identify cost savings; this could be through waste reduction and management, on site logistics, effective procurement or reuse of materials. This final step ensures that the savings that are generated through improved resource efficiency are passed on to the HA and offset any cost.

The process is illustrated as a flowchart in figure 8.

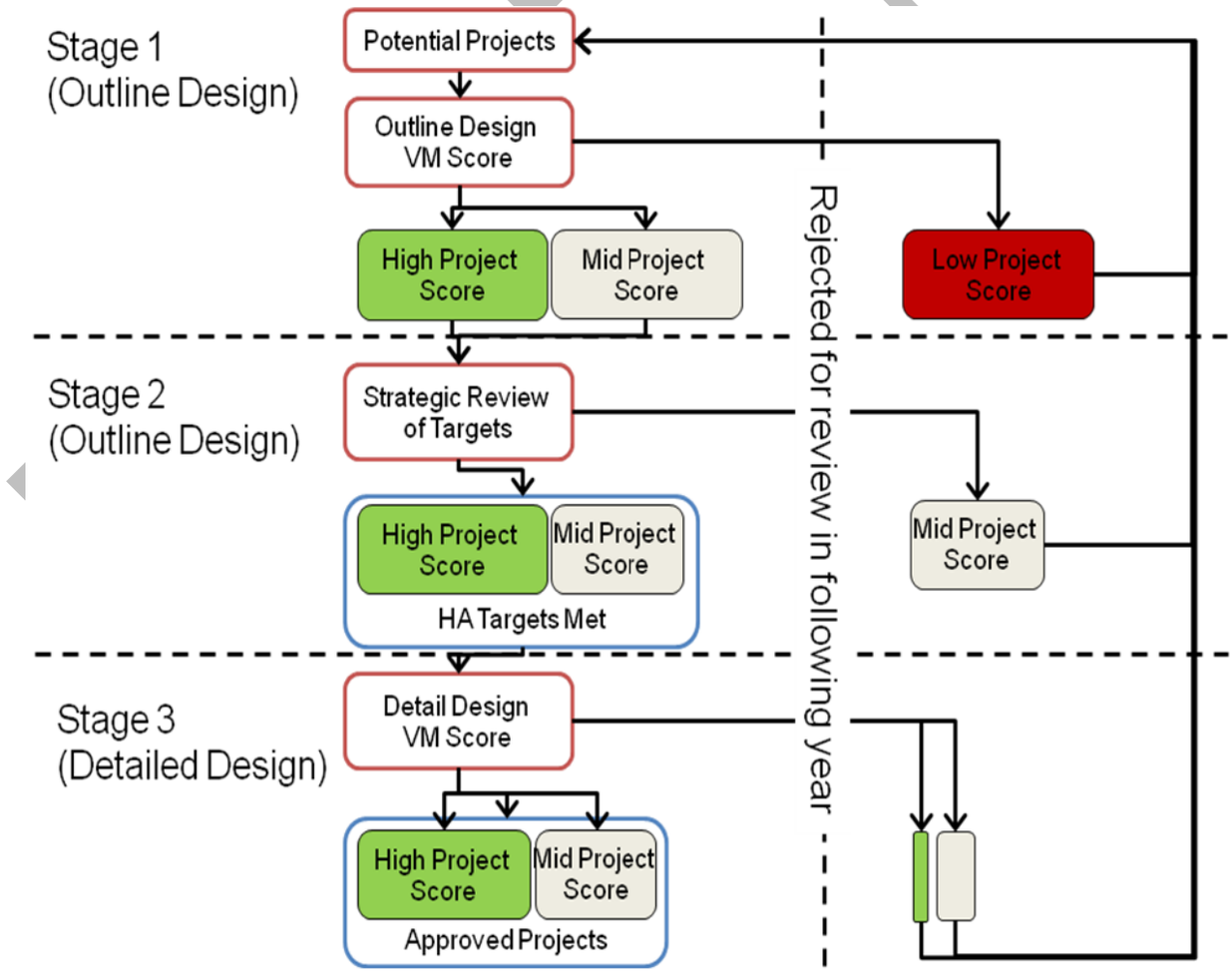


Figure 6 Recommended VM Process

The flow diagram outlined in figure 6 shows how all three stages recommended in this report could be implemented. Stage one represents a harmonised approach to the current system. This assessment would therefore take place at the same time in the project lifecycle as the current VM process. The projects would be scored and separated

into three groups, high, medium and low. The low scores would be immediately rejected and the high and medium scores would go forward to be chosen based on their overall contribution to strategic targets. Only medium scores would be rejected at this point based on their contribution to strategic targets. Stage two would be conducted at the same workshop as stage one.

Stage three is carried out after the detailed design and specification of materials has been made. A new score for the project is determined based on a more detailed quantification of the projects. A small number will be rejected at this stage based on this score. The rejected projects will carry through to the following year for improvements to be made.

The quantification for material resource efficiency would likely be carried out by contractors for SWMPs, and to meet HA targets, forecasts of other priorities should be expected on projects. The process of specifying materials will provide a lot of the information required to complete such an assessment. The additional time could therefore be kept to a minimum with the most significant in year loss for those projects rejected at the detailed design stage. However, these projects would go forward to the following year where their impact can be adjusted or the mix of projects could be developed to accommodate them. The result of improving resource efficiency is to reduce costs at the project level. As such, if the detailed design and specifications have identified these savings at this stage, they should be reflected in the overall cost of the project. It is envisaged that the minimal outlay of costs during the VM process will be more than compensated by the savings that are identified and passed on to the HA.

The roadmap is presented as a table in Section 8, with indicative timescales and costs for each stage.

8 Roadmap

	Action	Additional Scoring methods	Testing	Monitoring	Consultation	Time	Indicative Cost
Stage 1.1	Include energy use in construction, material resource use, construction waste, soil and geology and climate change adaptation into the NATA score. Create guidelines to show that the terminology is comparable between the HA and NATA.	Develop and calibrate outline design scoring methods for energy use in construction, material resource use, construction waste, soil and geology, climate change adaptation and water use in construction. These would be based on the method outlined in this report.	Test the BCR method on projects that have already been approved. Test BCR method on test case studies to gauge the level of assessment required for different project sizes.	Identify existing feedback loops such as Site Waste Management Plans, EnvIS and POPE that the VM score can be assessed against.	Present the results to NDDC, and scheme mangers. Present results to MAC's. Revise and implement.	3-6 Mths	£20-30k
Stage 1.2	Identify the potential to use quantification tools at the outline design stage. (Option presented as alternative to stage 3)	Fulfil requirement for modelled results for energy use in construction, material resource use, construction waste and water use in construction. Use existing tools where available such as the WRAP outline design tool for Civil Engineering Projects.	Test the quantification methods on test case studies.		Present the results to NDDC, and scheme mangers. Present results to MAC's. Revise and implement.	6-12 Mths	£30-100k
Stage 2	Develop a strategic mechanism to review projects based on strategic targets.	Develop a conversion factor for the scoring method that relates to targets from stage 1.	Test the quantification methods on test case studies.	Identify existing mechanisms that could be used to provide	Present the results to NDDC, and scheme	6 Mths	£30-50k

				information on whether strategic targets will be met.	mangers. Present results to MAC's. Revise and implement.		
Stage 3	Develop an extended VM process that evaluates projects at the construction phase. Implement quantification tool for energy use in construction, material resource use, construction waste and water.	Identify/ develop quantification tools for energy use in construction, material resource use, construction waste and water using existing tools where possible. For example waste can be quantified using the WRAP Designing out Waste Tool for Civil Engineering and a forecast of waste will be required for Site Waste Management Plans.	Test the quantification methods on test case studies. Test outputs on live projects. Develop case studies.	Introduce additional quantification methods for water and waste in the construction phase and add them as a cost to the BCR.	Present the results to NDDC, and scheme mangers. Present results to MAC's. Test methods on existing projects. Revise and implement.	6-12 Mths	£30-50k +£30-100K to Develop additional tool.

Acknowledgements

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Glossary of terms and abbreviations

BCR	Benefit-Cost-Ratio
GHG	Green House Gas
HA	Highways Agency
LNMS	Local Network Management Scheme
NATA	New Approach to Appraisal
NDDD	Network Delivery and Development Directorate
SWMP	Site Waste Management Plan
VM	Value Management

Appendix A NATA Goals and Challenges

Goal	Challenge	
Tackle climate change	Reduce greenhouse gases	
Support economic growth	Improve reliability	
	Improve connectivity	
	Support the delivery of housing	
	Enhance resilience	
	Wider (economic) impacts	
Promote equality of opportunity	Improve accessibility	
	Improve affordability	
	Reduce severance	
	Enhance regeneration	
	Reduce regional imbalance	
Improve quality of life	Reduce exposure to noise	
	Minimise impact on the natural environment, heritage and landscape	Biodiversity
		Water environment
		Heritage
		Landscape
	Improve experience of travel	
	Improve the environment	
	Improve access to leisure	
Better safety, security and health	Reduce the risk of death or injury	
	Improve health through physical activity	
	Reduce air quality health costs	
	Reduce vulnerability to terrorism	
	Reduce crime	

Appendix B Example of using scoring system

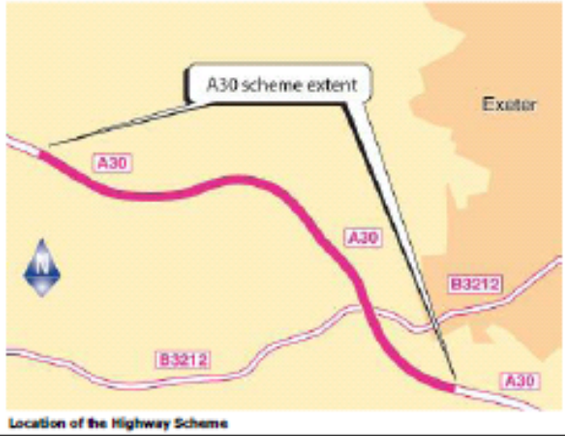
WRAP has published a series of case studies highlight good practice Site Waste Management Planning. The below case study was developed from a Highways Agency project.

wrap Material change for a better environment

Site Waste Management Plan good practice – Hanson Contracting

A30 Pocombe Bridge to Fingle Glen

Hanson Contracting for Enterprise/Mouchel (Area 1 MAC) and the Highways Agency



Location of the Highway Scheme

Key facts

- Highway reconstruction and drainage improvement on a 4.8km section of the A30, near Exeter.
- Waste reduction actions recorded in the SWMP included the reuse of bituminous materials and use of recycled aggregates.
- An estimated 4,100 tonnes of waste was diverted from landfill by carrying out the actions in the SWMP.
- The project's carbon footprint was reduced by 328 tonnes of CO_2.
- An estimated £50,000 in savings were generated by a reduction in waste disposal and material costs quantified by the SWMP.

Project site

Part of the international company Heidelberg Cement Group, Hanson Contracting carries out infrastructure and road construction work. 90 per cent of their projects involve highway surfacing and they use recycled aggregates from the Group's production plants where possible. Before the SWMP Regulations came into force in England, Hanson Contracting had already prepared SWMPs for specific projects and found that they produced significant environmental and cost benefits. Because of this they sometimes use SWMPs on smaller projects not covered by the Regulations. All supervisory staff have been trained in the use and implementation of SWMPs.

This case study describes the successful implementation of a SWMP for a highway scheme on the A30 near Exeter.

A30 Pocombe Bridge to Fingle Glen
Hanson Contracting was the Principal Contractor for maintenance work carried out on the A30 for Enterprise/Mouchel, the Managing Agent Contractor for this area for the Highways Agency. The A30 is a trunk road located in the rural area to the west of Exeter. It takes a significant proportion of the tourist traffic travelling to the South West coast. The work involved the reconstruction of 4.8 km of two lane highway, hard verge and associated works from Pocombe Bridge to Fingle Glen. The project ran from January to April 2009 and cost £2.2 million.

A SWMP for the project was prepared by Hanson Contracting and the client using an in-house template. They identified the main waste streams as soil and stones, bituminous and concrete. The actions recorded in the SWMP included reuse of bituminous materials and the use of recycled aggregates.

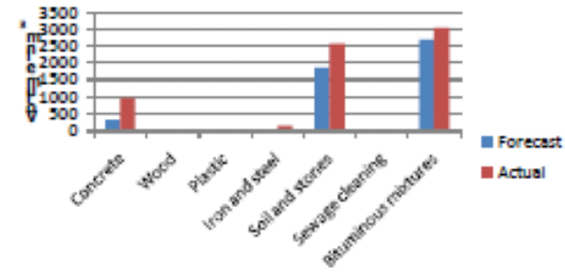
The SWMP was reviewed monthly throughout construction by the Hanson Contracting Site Manager and Environmental Manager. It was also inspected by the Highways Agency.

Economic benefits and costs
By implementing the actions identified in the SWMP Hanson Contracting estimate they have saved around £50,000 on disposal costs and material costs. These savings are largely achieved by using recycled aggregates and reusing bituminous products.

Hanson Contracting spent eight hours preparing the SWMP and a further six hours reviewing the SWMP during construction. After project completion Hanson Contracting spent eight hours reviewing the lessons learnt and feeding the information into the company KPIs. Commercial Mangers and the client were informed of the lessons learnt. They estimate that the SWMP cost around £1,000 in administration costs: very little compared to the savings obtained.

Environmental benefits
Waste was prevented through design, segregation of waste and reuse of material on site. The reconstruction involved planing the existing surface to an average depth of 100mm. The planings were reused in the new high modulus binder course which included 15% Recycled Asphalt Planings (RAP). This was overlaid with a Tuffgrip proprietary surface course. When the existing Frerch drain stone was removed and new concrete v-drain was installed, the recycled aggregates were used as the sub-base. All bituminous materials were supplied by in-house production plants from nearby quarries.

During the project the client changed the specification which increased the amount of reconstruction required. This in turn would increase the waste produced beyond the original forecast. The target on reusing waste set in the SWMP (5%) could now not be met. However, by using the SWMP to identify waste arisings and destinations, much of this material was sent for recycling. This meant that the project exceeded the less than 20% target for waste sent to landfill originally set in the SWMP. The graph below shows the forecast volume of waste for each category of waste compared to the actual figures.



Forecast and actual waste produced

An estimated 4,100 tonnes of waste was diverted from landfill as a result of the actions identified in the SWMP. This saved around 328 tonnes of carbon dioxide (calculated using an in-house and Environment Agency construction sector tool).

Other benefits
Hanson Contracting has found that cost savings are not the only benefits of SWMPs. The use of SWMPs increases the awareness of site management and has helped to introduce a culture of looking for opportunities to reduce waste or use recycled materials. SWMPs also help to reduce the carbon footprint of their projects contributing to the companies KPIs. They believe that by recycling material from different sites, provided the transport distances are small and by using contractors with recycling experience, the majority of inert waste can be reused or recycled.

Lessons learnt
Hanson Contracting has identified the following key actions in implementing a successful SWMP:

- Appointing a single person to champion the SWMP.
- Obtain buy-in to the SWMP by raising awareness of the cost reductions and environmental benefits of reducing landfill and recycling.
- Constant questioning and guidance of site staff to ensure the actions identified in the SWMP are implemented effectively.

Hanson Contracting believe it is important for designers, clients and producers to work with contractors to reduce waste and that all parties should input into the SWMP at the earliest possible stage.

Waste & Resources Action Programme
The Old Academy
21 Horse Fair
Banbury, Oxon
OX16 0AH
Tel: 01295 819 900
Fax: 01295 819 911
E-mail: info@wrap.org.uk
Helpline freephone
0808 100 2040

www.wrap.org.uk/swmp

recycle

The above case study is used as an example to illustrated how the suggested scoring system for Material resource use, waste and energy use during construction could be implemented. The following table provides an example of the results for this study.

Aspect	Score	Reason
Energy Use in Construction	-2	Low energy materials identified including the in situ reuse of bituminous material and use of recycled aggregate. Although sourcing of material is local there is no explicit use of low energy transport and there is no specific mention of low temperature asphalt mixtures. A combination of some positives and some 'could do better' leads to the -2 rating.
Material Resource	-1	Reuse of bituminous material and use of recycled aggregate. Identified a high level of recycled content for use in resurfacing.
Construction Waste	-1	Design of works optimised to minimise the production of waste and where possible options identified to reuse, and recycle material. Project target set for waste to landfill that exceeds commitment from HA.

At the outline design stage it is expected that the contractor would commit to the above actions. Whilst this example is retrospective the intention is that the actions above will be committed to in a similar way at the start of the project. By initiating this process early on the contractor can identify material resource efficiency and cost savings. The criteria are to be used indicatively and will require the assessor to make a judgement based on the evidence provided.