Natural Capital in the Second National Infrastructure Assessment

Economic infrastructure can contribute positively to natural capital, accelerating background trends where these are improving, and slowing or in some cases reversing trends that are worsening. The *Second National Infrastructure Assessment* includes a range of recommendations to ensure this happens, based on a systematic assessment of the impacts of economic infrastructure on natural capital.

Introduction

Natural capital has declined in recent decades. Infrastructure both contributes to and is impacted by this decline but can also help reverse it. These interactions between infrastructure and natural capital are set out in the Commission's discussion paper *Natural Capital and environmental net gain*,[1] which highlights the importance of natural capital to its work. Since that paper was published, government has given the Commission a new requirement 'to consider potential interactions between its infrastructure recommendations, the government's legal target to halt biodiversity loss by 2030 and implementing biodiversity net gain'. In the Second National Infrastructure Assessment, the Commission has set out to produce a systematic analysis of its recommendations' impacts on natural capital through quantitatively and qualitatively exploring changes to air quality, biodiversity and water quality both due to background trends and its own recommendations. The conclusions of that work are presented here, both in a graphic showing the natural capital impacts of the Commission's recommendations *before mitigations are applied*, and then in a more detailed discussion of the evidence behind the natural capital assessment. The discussion (but not the graphic) also highlights additional actions the Commission recommends in the *Second National Infrastructure Assessment*, which it believes are necessary to ensure infrastructure makes a positive contribution to natural capital in future.

Natural capital refers to a range of natural assets and services that society and the economy depend on, including the water we drink, the air we breathe, the food we eat, and the wild places many of us visit to relax. Infrastructure can deliver benefits for natural capital, for example through the provision of protected natural habitats and connecting corridors for species along linear infrastructure, and sustainable drainage systems for mitigating flood risk. Changes in the environment can increase the costs of infrastructure, for example if roads and railways need to withstand higher temperatures. Natural capital approaches can reduce the demand for infrastructure, for example natural water catchment management for flood protection.[2]

UK and global trends show that natural capital has declined in recent decades, particularly due to declines in biodiversity. The latest UK biodiversity indicators show declines in the status of threatened habitats and species, as well as increased pressure from invasive species. Infrastructure is not the only cause of biodiversity loss, but if assets are badly designed and operated, they can exacerbate this problem by fragmenting habitats and polluting the environment. If infrastructure design and delivery is done well, it can contribute to the government's goal of improving the environment over 25 years as well as delivering a range of other benefits such as health, wellbeing and inclusion.[3]

The Commission carries out in-depth studies into the UK's major infrastructure needs and makes recommendations to government. The Commission's analysis is necessarily strategic, abstracting from the detailed designs and planning decisions that can significantly determine the impact of an infrastructure asset on natural capital. As such, many of the approaches and tools available for natural capital assessment cannot be directly applied to the Commission's work. This paper describes how the Commission has developed its approach to natural capital assessment in support of the *Second National Infrastructure Assessment*.

In the analysis for the *Second National Infrastructure Assessment*, the Commission focused on the potential impacts on air quality, biodiversity and water quality. These are not exhaustive but represent some of the most significant environmental impacts arising due to the footprint, location, construction and operation of infrastructure.

The *Second National Infrastructure Assessment* is the first time that the Commission has quantified the impact of its recommendations on natural capital in a systematic way. The Commission continues to develop the methodology to ensure opportunities are identified and adverse impacts addressed at the earliest stages, leading infrastructure to have a positive impact on natural capital through improvements to air quality, biodiversity and water quality. The approach taken is outlined in the following sections, and the Commission welcomes feedback on the approach and sources used.

Natural Capital Assessment

The natural capital assessment is built up from the analysis of potential natural capital impacts at various stages of the infrastructure lifecycle. The analysis looks at the footprint and to some extent the location of the infrastructure, the materials and processes used to build any new assets, and the way it is or will be operated and used, and considers how these will affect the natural environment.

To support the natural capital assessment, the Commission has developed an analytical tool which can be used to quantify the potential land use changes, along with the potential impacts of construction of any new assets. The impacts on natural capital during the operation/use phase have been assessed separately, taking into consideration historical trends and how these might change in future.

The Commission has also considered the impact of its recommendations on carbon, both embedded and operational, and this is presented separately in the publication *Impact and* costings for recommendations in the Second National Infrastructure Assessment.4

Figure 1: Summary of natural capital elements and pathways captured in the analysis

Element of natural capital	Footprint/location	Materials and processes of construction	Operation and use
Air quality (NO_x and particulates)	Proximity to receptors (qualitative)	Embedded impacts in extraction, processing and transportation of materials and construction and installation process (quantitative)	Combustion emissions, for example from gas-fired power stations and internal combustion engines (qualitative)
Biodiversity (terrestrial and freshwater habitats)	Direct land use change (quantitative) and scope for remediation (qualitative)	N/A	Implementation of Defra's Land Use Framework to encourage infrastructure sites to incorporate improved habitats (qualitative); indirect impacts via air and water pollutants are captured in assessment of air and water quality
Water quality	Changes in flow and groundwater levels (qualitative) and concentration of pollutants (quantitative)	Embedded impacts in extraction, processing and transportation of materials and construction and installation process (quantitative)	Abstraction for water supply, cooling for power generation and accumulation of pollutants due to, for example, wastewater discharge or road use that may be transported to water courses (qualitative)

Quantitative analysis

Methodology

The Commission appointed Atkins and Circular Ecology to develop a quantitative tool for assessing natural capital and lifecycle carbon. This quantitative tool captures the potential air quality, biodiversity and water quality impacts of new infrastructure associated with some aspects of its footprint and most aspects of construction.

The quantitative tool takes as an input the change in size of each type of infrastructure and applies a series of intensity factors to that increase or decrease. The intensity factors effectively transform the scale data (for instance, the footprint of new roads or the operating capacity of new plants) into estimates of the change in biodiversity or emissions of key pollutants.

The intensity factors are 'per unit' measures (for example, per MW, km, m3) which can be multiplied by the size of the asset to provide an estimate of the potential environmental impact. The quantitative tool covers a wide range of ecosystem services, and also includes broader categories of aggregate/bundled services, and externalities/pressures, which capture the wider consequences of changes in air quality, biodiversity and water quality.

The Commission typically makes geographically non-specific recommendations; for example, on hydrogen storage in the *Second National Infrastructure Assessment* the recommendation states that the government should target establishing a minimum of eight terawatt-hours of large scale hydrogen storage to be in operation by 2035, without specifying where this storage should be located across the country. This focus on geographically non-specific recommendations requires a different approach to natural capital assessment than other frameworks given the specific habitats that are associated with different locations across the country. While there is uncertainty across all the natural capital analysis, for biodiversity the lack of specific locational information is an additional source of uncertainty and the quantitative tool seeks to capture this additional uncertainty by producing a range of statistics. The quantitative tool uses representative hectares for GB, England, and England and Wales, to allow impacts to be quantified across sectors in line with devolved responsibilities for economic infrastructure. These national level values were presented for a range of statistics (average, worst case, best case, median, 25th percentile and 75th percentile) reflecting the range of possible habitat types that could be affected by the infrastructure.

The nationally representative hectares are based on regional scale values from the National Environment Valuation Online tool (NEVO) for Wales, South West, South East, London, East, East Midlands, North West, Yorkshire and Humber, North East and West Midlands. Land cover mapping is not provided by NEVO for Scotland, so Wales is used as a proxy as it has the most similar land cover by habitat type.

Data sources

Figure 2 summarises the data sources used in the quantitative analysis both for quantification and, where relevant, for monetisation.

The quantification data for impacts on air quality and water quality is taken from the Ecoinvent database version 3.9.1, using lifecycle assessment data.[5] The lifecycle assessment data covers the product stage and the construction process stage (Modules A1-5 – cradle to completed asset).

Air quality

For the impact on air quality, the data captures the changes in fine particulate matter (PM2.5) and in nitrogen oxides (NOx). This is measured in tonnes PM2.5 equivalent and tonnes NOx equivalent and is calculated on a per unit basis (for example, per megawatt of power generation or per kilometre of new road).

Biodiversity

Impacts on biodiversity are quantified in terms of habitat units from Natural England's biodiversity metric. To assess the quality of a habitat, the biodiversity metric incorporates information on the type of habitat, the condition of the habitat and its strategic significance.

For the quantitative tool, the habitat units are calculated for each of the five NEVO land cover classifications; agriculture, semi-natural grassland, urban, water reservoirs/ponds and woodland. Where the Commission recommends new infrastructure but is not prescriptive over its location, the habitat condition is assumed to be moderate, and the habitat is assumed not to be strategically significant (the affected areas are not in an existing local strategy). The resulting calculations provide an average number of habitat units per hectare for each of the five land types.

Water quality

For the impact on water quality, the data captures the changes in eutrophication potential. This is measured in kilograms phosphate equivalent and is calculated on a per unit basis (per megawatt, per kilometre, for example).

Figure 2: Summary of data sources for the quantitative assessment

Element of natural capital	Quantification Metric	Quantification Source	Monetisation Metric	Monetisation Source
Air quality	Tonnes PM2.5-eq Tonnes NOx-eq	Ecoinvent 3.9.1 data for air quality	£/tonne emitted	Defra Damage Cost Guidance
Biodiversity	Habitat units	Biodiversity Metric 3.1, Natural England	N/A	N/A
Water quality	Kg phosphate equivalent	Ecoinvent 3.9.1 data for water quality	£/kg emitted	Defra Farmscoper

Quantitative outputs

Biodiversity impacts are presented in terms of habitat units, from Natural England's biodiversity metric, and presented in habitat units.

Air quality and water quality impacts are quantified, monetised, and presented in both tonnes and net present values.

Construction is assumed to last one year and the potential construction impacts on air quality and water quality will be experienced for one year, as these impacts are directly linked to the construction process and therefore will cease once construction has finished. Impacts on air quality and water quality of operating the infrastructure is considered elsewhere. The potential impacts on biodiversity are assumed to be ongoing as they result from land take for the new infrastructure.

Figure 3, Figure 4 and Figure 5 summarise the impacts on air quality, biodiversity and water quality, in both tonnes and net present values. While these tables present point estimates, there is significant uncertainty around each of them.

Figure 3: Summary of the impacts on air quality by sector

	£m, 2022 prices	Tonnes PM2.5-eq	Tonnes NOx-eq
Energy	-35,300	681,000	322,000
Transport	-60	910	3,100
Waste	-156	2,500	3,500

Figure 4: Summary of the biodiversity impacts by sector

	Change in habitat units
Energy	-11,600
Transport	-8,400
Waste	-2,600

Figure 5: Summary of the impacts on water quality by sector

	£m, 2022 prices	Tonnes P-eq
Energy	-4,600	192,500
Transport	-2	80
Waste	-12	500

To put the biodiversity impacts into context, one 'average' hectare of agriculture land is considered to be worth 2.9 habitat units, whilst one hectare of semi-natural grassland is worth 12 habitat units on average. One hectare of urban land is worth 3.6 habitat units, while water reservoirs/ponds are worth 10.9 units and woodlands 11.2 units on average.

The change in habitat units for the energy sector shown in Figure 4 exclude impacts from solar PV and onshore and offshore wind. Where solar PV and onshore wind facilities take land out of agricultural or other land uses with low biodiversity value, there is evidence that improvements in biodiversity may follow.[6] The Commission's quantitative tool cannot currently capture this, nor biodiversity impacts in marine habitats, so these are reflected instead in the qualitative assessment below.

Natural capital assessment

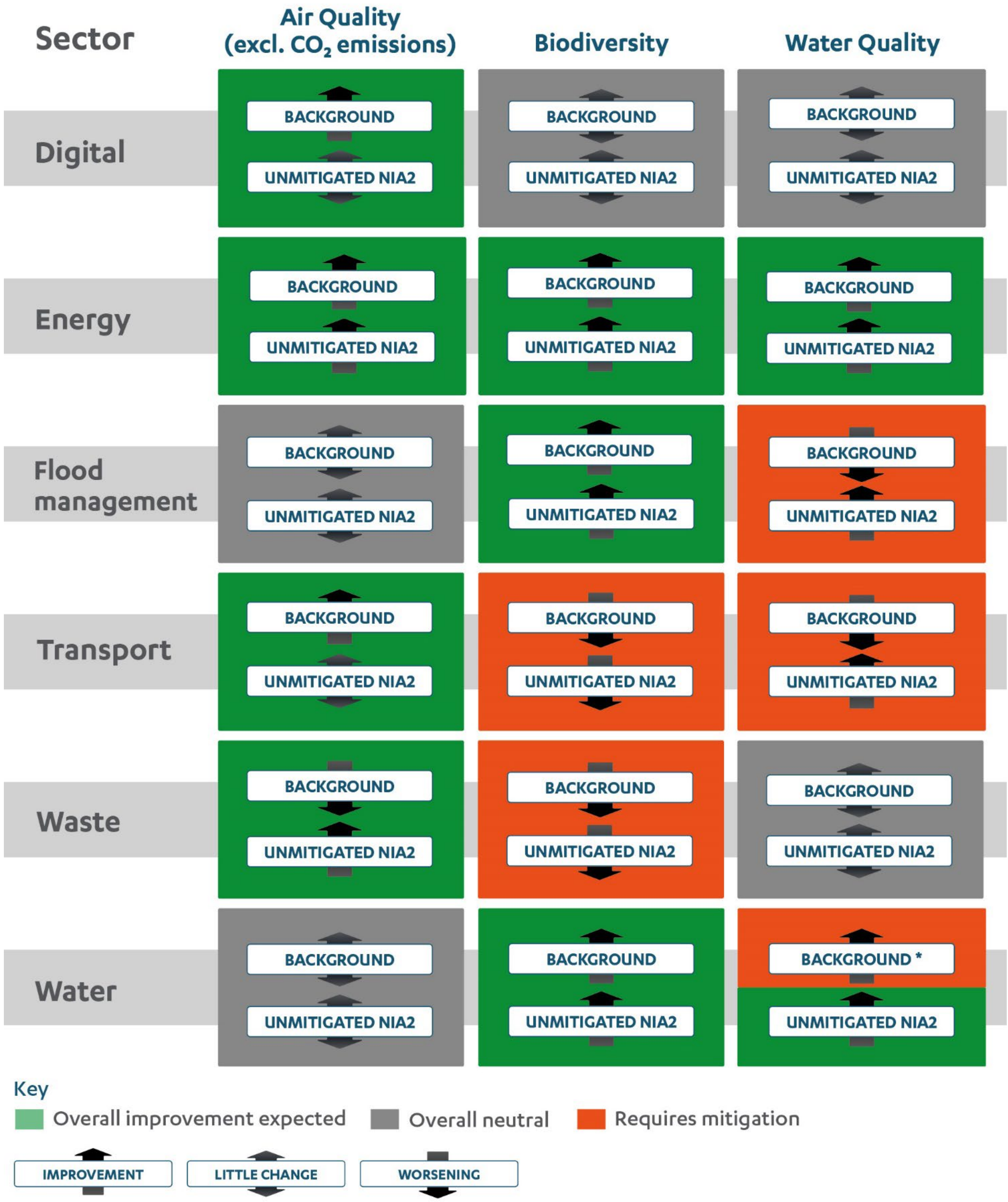
The outputs from the quantitative tool were combined with data describing background trends, expert judgement on how those trends might change in future, and stakeholder consultation on the likely impacts of recommendations, to produce the assessment of natural capital in the *Second National Infrastructure Assessment*.

The summary graphic below brings this 'mixed methods' approach to assessment together and appraises the impact of unmitigated Commission recommendations on natural capital. It shows that there are a handful of areas where the *Second National Infrastructure Assessment* needed to go further to ensure it sets infrastructure on a path towards enhanced natural capital.

The summary graphic shows that further mitigations were required within the *Second National Infrastructure assessment* for the impact of transport and waste on biodiversity and for the flood, transport and water sectors in relation to water quality. For example, without mitigation the government's current plans for road and rail infrastructure will require land take that is likely to have some negative impact on biodiversity so the background trend for transport on biodiversity is worsening, as indicated by an arrow pointing downwards; the Commission recommends further expansion of these transport assets, with a similar effect and a downward-pointing arrow associated with 'unmitigated NIA2'; the overall impact therefore requires mitigation, reflected in the orange colour of the tile.

The subsequent sections describe the underlying trends for each environmental impact and sector along with the data sources used. Where relevant these sections also discuss additional recommendations the Commission has made in the *Second National Infrastructure Assessment* to ensure that future infrastructure leaves air quality, biodiversity and water quality in a better condition than today.

Figure 6: Natural capital impacts of the Second National Infrastructure Assessment before mitigating recommendations are included



* While the background trend on water quality has historically improved, this improvement has stalled and mitigations are required to pick up the pace.

Source: Commission analysis

Air quality

Digital

Air quality impacts from the construction of 5G masts and the wider digital telecoms infrastructure contribute negligible amounts to air quality emissions. The sector's use of energy, for example by cellular networks, can contribute to air quality issues indirectly, but the ongoing switch to clean energy and the associated improvements in air quality will contribute to an overall improvement in background trends.

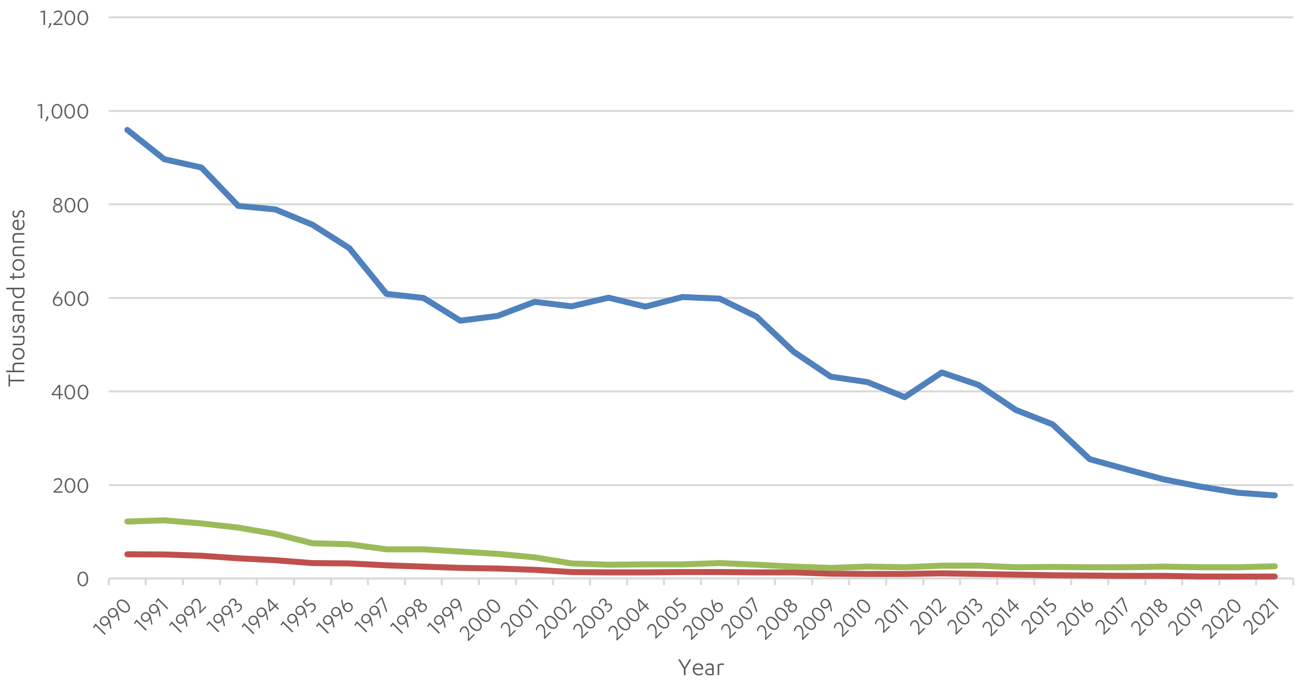
Energy

The background trend on air quality is expected to be positive. Historically, tougher emissions standards and the shift away from both coal to gas and from gas to renewables have reduced emissions significantly (see Figure *7*).

Reductions in emissions of nitrogen oxides and particulate matter are expected from a significant reduction in the use of unabated gas for electricity generation, heating buildings and in powering industry. Hydrogen combustion will still generate certain emissions (nitrogen oxides in particular) but will not generate any particulate matter emissions.[7] Combustion of hydrogen (for electricity generation and industrial uses) will be on a smaller scale than today's combustion of natural gas (for generation, heating and industry) so an overall reduction in air pollution is very likely. [8]

Figure 7: Air quality emissions from the energy sector have reduced significantly since 1990

Air quality emissions from the energy sector (including domestic combustion)



Source: Defra

Flood management

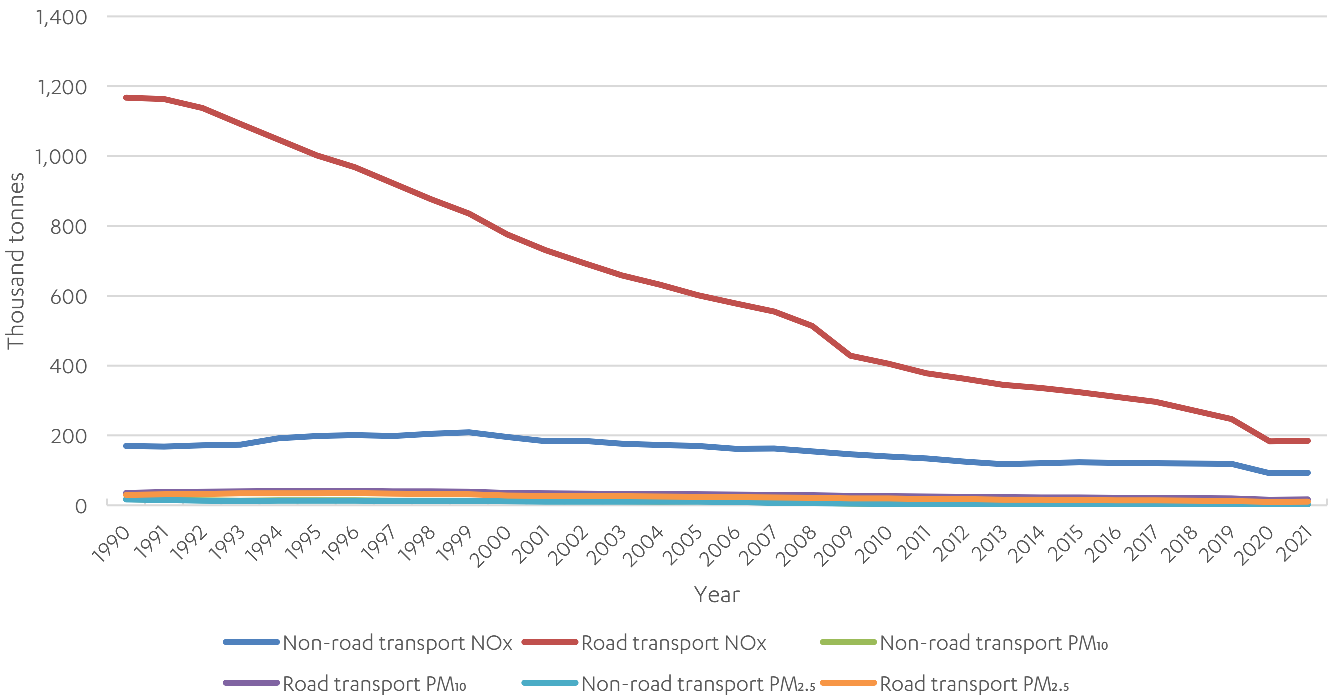
The background trend for air quality is expected to be static, although there may be a modest positive contribution resulting from the decarbonisation of the transport and energy used to construct, install, and operate flood management infrastructure. The Commission's recommendations on wider transport and energy decarbonisation (as an input to the construction and operation of flood risk management assets) should equally contribute to improving air quality.

Transport

For air quality, there has been a trend towards improvements in the 21st century, with newer vehicles and emissions standards driving dramatic declines in nitrogen oxides emissions from road and non-road transport, and particulate matter emissions have more than halved since 1990 (see Figure 8).[9] The background trend is set to continue improving as the transition to electric vehicles gains pace. The Commission's recommendations provide greater certainty that vehicles will decarbonise at the pace required to meet government targets.

Figure 8: Particulate matter emissions from transport have more than halved since 1990

Air quality emissions from the transport sector



Source: Defra

Waste

Although the waste sector's impact on air quality is small compared to larger industries, energy from waste facilities emit nitrogen oxides and particulate matter emissions which contribute to air pollution.

Air pollution from waste followed a generally improving/declining trend from 1990, but recent increases in energy from waste have started to reverse that trend. Commission analysis shows that energy from waste capacity is expected to increase over the next decade, suggesting that air pollution from waste may continue to increase without intervention.

The Commission's recommendations to phase out energy from waste facilities that are not fitted with carbon capture and storage and reduce the overall capacity of energy from waste are expected to put the sector back onto an improving trend.

Water

The background trend on air quality is expected to be neutral, although operational emissions are expected to decline in line with the water industry's commitment to reach net zero on operational emissions by 2030.[10] The Commission's recommendations on wider transport and energy decarbonisation should contribute to improving air quality from electricity and transport used in the sector. Emissions including nitrogen oxides which arise during the water and sewerage treatment processes will be harder to reduce.

Biodiversity

Digital

The background trend for biodiversity is expected to display little change. The impact in biodiversity-rich areas from the construction of the 5G network is minimal. According to research by Analysys Mason, there are approximately 0.06 macrosites per square kilometre in rural areas.[11] This footprint is extremely unlikely to result in negative impacts at the habitat scale.

The evidence surrounding the impact of 5G technology on biodiversity is limited. There is the possibility of negative impacts of 5G technology on biodiversity, but most studies are inconclusive.[12]

Energy

The background trend for the impact of energy infrastructure on biodiversity is expected to improve. Defra's Land Use Framework will create an opportunity to consider how land use could be multifunctional, such as encouraging biodiversity between solar panels. [13] The decommissioning of the gas grid may also contribute to a positive trend as the sites are used in other ways, and from 2025 new nationally significant energy infrastructure will be legally required to achieve biodiversity net gain.[14]

Developing a spatial plan for the energy sector, as set out in the Electricity Networks Commissioner report,[15] links to the greater role for integrated spatial planning proposed in the Commission's planning recommendations, including mapping sites with irreplaceable habitats, which would support infrastructure developers delivering cobenefits for nature.

The Commission has undertaken analysis of possible mitigation measures including spatial planning, applying the mitigation hierarchy (avoid, mitigate, compensate), the statutory requirement for biodiversity net gain and good design incorporating cobenefits from the outset. If these are implemented and well designed, the Commission's recommendations should lead to an improvement in biodiversity.

Any new infrastructure will have a legal requirement to deliver biodiversity net gain and should apply the Commission's Design Principles. They could also benefit from the tools proposed in the Commission's planning study, which recommended that the development of strategic mitigations and environmental data should be prioritised for wind generation and transmission infrastructure. The tools proposed in the study promote the uptake of best practice, such as the following examples which promote biodiversity around solar panels:[16]

- **Hedgerows:** Design and maintain hedgerows surrounding solar modules to restore habitat niches for several species
- **Field margins and wildflower meadows:** Ensure field margins have high levels of structural complexity (rather than being homogeneous). Plant wildflowers around the panels.
- **Wetlands, drainage and on-site water management:** Incorporate wetland habitat areas and use open drainage structures
- **Conservation focused grazing:** mainly during the winter half of the year, to allow ground nesting birds to reproduce and vegetation to flower for pollinators.

Flood management

The background trend for biodiversity is judged to be positive, as flood defences can also protect habitats and the move towards nature-based solutions delivers multiple benefits, including biodiversity.[17]

As per the hierarchy set out in the Commission's surface water flooding study in 2022, and before that in the first National Infrastructure Assessment, natural flood management or sustainable drainage systems should be considered and deployed where possible.[18] In addition to preventing harmful flooding they can create new habitats and filter and clean water. As recommended by the Commission, the government recently announced its intent to make sustainable drainage solutions the default for almost all new developments in England.[19]

There may be additional opportunities to consider a natural capital approach to flood risk asset management, making traditional 'grey' infrastructure more 'green'. Renewals carried out by the Environment Agency or other flood asset managers could aim to replace life expired assets either completely or partially with rain gardens or ponds or look at reforestation and wetland restoration as a complementary measure. They could also design in options that mitigate impacts such as fish passage, when renewing a hard asset, as proposed for projects like the Tadcaster Flood Alleviation Scheme.[20]

Transport

Changes in biodiversity due to land transport will be driven by land take for new road and rail assets. Government's current programme of road and rail enhancements involve change of land use, so the unmitigated impact on biodiversity is assessed as negative. Network Rail has set out plans to achieve no net loss in biodiversity by 2024 and net gain by 2035, and National Highways aims to achieve no net loss by 2025 and net gain by 2040.[21] However, until these plans lead to demonstrable net improvements in road- and rail-side habitats across the transport estate in England, this is not recognised as a neutral or improving background trend.

The biodiversity net gain requirement in the Environment Act 2021 will require that any new transport developments make a positive contribution to biodiversity, and the Commission expects that any additional cost associated with this can be met within its recommendations for transport enhancement spending in the *Second National Infrastructure Assessment*.

The Commission has undertaken analysis of possible mitigation measures. These include spatial plans for road and rail which use optioneering to apply the mitigation hierarchy (avoid, mitigate, compensate), and are then linked in the National Networks National Policy Statement, the statutory requirement for biodiversity net gain and good design incorporating cobenefits from the outset. If these measures are implemented and well designed, the Commission's recommendations should lead to an improvement in biodiversity.

The data sharing platform and the best practice library proposed in the Commission's planning study can be used to identify the most effective mitigations and help developers meet their legal requirements. Key considerations in designing for biodiversity include the effects on animal migration and habitat connectivity, as well as the materials used in construction which may have an impact on local ecosystems. As linear infrastructure, the transport network offers opportunities to connect habitats using verges and green bridges. Biodiversity may also be improved in parallel with water quality and resilience as sustainable drainage solutions such as habitat restoration are deployed.

Most of these mitigations apply to new developments, but there may be additional opportunities to incorporate a natural capital approach in the operation, maintenance and renewal of transport assets. This is particularly important given the environmental impact of the existing network, in comparison to which the impact of the recommended enhancements will be minor. If the opportunity is taken to improve environmental performance on the existing infrastructure estate, through a better understanding of its role as part of ecological networks, there is potential to deliver natural capital benefits through operation, maintenance and renewal. This could include:

- reducing existing impacts by altering re-surfacing materials or changing the approach to vegetation management, collaborating with other landowners beyond the asset boundary
- achieving mitigation of new development through planting on and management of existing verges and embankments with greater strategic value than at an individual scheme site because of their type and link to wider nature recovery networks
- improving resilience through the retrofit of sustainable drainage networks, tree-based wind breaks, shading and other nature-based solutions.

Waste

The background trend on biodiversity is declining, due to the increase in the number of waste facilities required to keep pace with expected growth in the generation of waste. The way in which waste is processed is changing, as is the associated land footprint of the anticipated increase in the number of new facilities required. The Commission's recommendations require the introduction of carbon capture and storage technology, and rapid rise in material recovery facilities plants, will likely result in a net increase in land take for the waste sector which could negatively impact natural habitats and wildlife populations if greenfield sites are used.

Use of existing industrial sites and application of biodiversity net gain across local authorities should help to avoid or mitigate this. There are opportunities to produce positive outcomes for biodiversity, such as drawing on the tools proposed in the planning study. For example, some operators have restored former landfill sites for wildlife.[22]

Water

Biodiversity is expected to improve in the background trend, as the water industry shifts to catchment and nature-based solutions.[23] However, the benefits of nature-based solutions may be slower to materialise due to the growth rate of natural components.[24] The Commission's 2018 report on preparing for a drier future sets out how to ensure more efficient water supply, including reducing leakage and demand, which would in turn ensure that there is sufficient water in the environment to dilute water pollution and support ecosystems and biodiversity. The Commission's study on surface water flooding underlines the important role of the water industry in finding solutions which will have positive impacts on water quality in addition to reducing flood risk.

As with other sectors, in addition to building new assets there are also opportunities in the operation, maintenance and renewal of water assets as reflected for instance in catchment management plans. For example, water companies can change ground maintenance practices by reducing levels of mowing and removing grass cuttings to promote wildflower growth, while leaving organic matter in piles can create habitats for invertebrates. This approach was used by Severn Trent at the Halam Service Reservoir and led to an increase in plant species and invertebrates.[25] In addition, when renewing assets, water companies could change their approach to the management of land in their immediate surroundings, for example, land management on and near treatment works. Wessex Water have suggested that nature-based approaches could deliver biodiversity benefits through wetland provision and provide a natural alternative to chemical treatment of wastewater to remove phosphorus.[26] The Commission recommends infrastructure operators take such opportunities to improve biodiversity through their operation, maintenance, and renewal strategies.

Water quality

Digital

The background trend for water quality is expected to display little change. 5G masts and the wider digital telecoms infrastructure are not significant users of water and will have no adverse impact on water quality.

Energy

The move to increasingly renewable generation will reduce the amount of water required for steam-driven turbines and cooling.[27] There will still be water demand from hydropower and future thermal generation (hydrogen or gas with carbon capture and storage), but there will be a gradual decline from today's level of thermal generation.[28] The majority of this water is also returned to the environment.[29]

Hydrogen production uses water, with the demands of green hydrogen more significant[30] and the Commission expects this will become the dominant hydrogen production technology.

Water demand by households would increase if hydrogen were used to heat homes, although the Commission recommends that hydrogen for heating is not supported. [31] There is considerable uncertainty in the volume of hydrogen that will be used in electricity generation and by industry and therefore how much water will be needed. This uncertainty in industrial use makes the assessment of the energy sector's overall impact of water quality particularly uncertain: the Commission concludes there is likely to be an improvement overall, but a worsening due to increase demand for water as an input to hydrogen production remains a possibility.

Flood management

Climate change will increase flooding of all types, which contributes to a background trend of worsening water quality, as floodwater can carry contaminants and pollution,[32] but the Commission's recommendations can partially mitigate this. Many of the actions mentioned in the section on biodiversity above are also relevant to improving water quality. As per the hierarchy set out in the surface water flooding study, and as set out in the first National Infrastructure Assessment, natural flood management or sustainable drainage systems should be considered and deployed first where possible.[33] In addition to preventing harmful flooding they can filter and clean water. As recommended by the Commission, the government recently announced its intent to make sustainable drainage solutions the default for almost all new developments in England.[34] However, there may still be opportunities to consider a natural capital approach to flood risk asset management, for example making traditional 'grey' infrastructure more 'green'. Renewals carried out by the Environment Agency or other flood asset managers could aim to replace life expired assets either completely or partially with rain gardens or ponds or look at reforestation and wetland restoration as a complementary measure. Or they could design in options that mitigate impacts such as fish passage when renewing a hard asset such as at Holm Sluices on the River Trent.[35]

Transport

For the impact of transport on water quality, the background trend is judged to be worsening, although there are some mitigating factors. Road runoff carries pollutants from roads into the water environment. While it is unclear whether there will be more overall rainfall with climate change, heavy rainfall events are expected to become more common, in combination with longer dry spells.[36] Dry spells can cause contaminants to accumulate on roads, and heavy rain will wash pollutants into water bodies. Runoff caused by such cycles of dry spells and heavy rainfall will likely have a higher concentration of pollutants.[37]

Another key background trend is future demand for road transport, and all scenarios used in the NIA2 modelling show an increase. This also contributes to a worsening of water quality with more pollutant available to be carried to the water environment. However, the switch from petrol and diesel vehicles will reduce overall emissions and the regenerative breaking technology used for electric vehicles may release less particulate matter, although this will also depend on vehicle mass.[38] On balance, the overall background trend for water quality is judged to be worsening.

The transport sector is likely to require a concerted effort to avoid, mitigate or compensate for its impacts on natural capital particularly related to the potential for some induced car usage, and the direct impacts of new infrastructure. To mitigate impacts on water quality, and as per the Commission's Design Principles, any new roads should anticipate the need for environmental mitigation at the point of design and be developed with the objective to reduce runoff and water pollution. This could include using sustainable drainage solutions such as swales, tree planting, tree trenches or wetlands. Developers should also follow the solutions hierarchy set out in the surface water flooding report and use nature-based solutions where possible. Sustainable drainage solutions provide additional benefits such as air quality, biodiversity, and resilience improvements, which are not delivered by conventional piped drainage solutions.[39]

The Commission has recommended that government should require infrastructure network and asset plans for the transport sector to maximise the opportunity to improve natural capital by taking an integrated and strategic approach to maintenance and renewals.

The Commission believes that these strategies are sufficient to offset the declining background trend in the impact of transport on water quality, and to accommodate the Commission's recommendations for expanded transport networks.

Waste

There is expected to be little change in the background trend on water quality. Stringent regulations are already in place to ensure that potential water quality impacts from landfill sites are minimised. Landfill operators are required to design and build their sites to protect the environment, which includes managing the effectiveness of the leachate collection system and of any groundwater control systems.

The Commission's waste recommendations are likely to limit additional impacts on water quality by reducing the proportion of future waste arisings that go to landfill.

Water industry

Water quality has improved over the last few decades due to stronger regulation driving continued investment by the water industry in measures to control pollution. This has, for example, reduced pollutant loads discharged to rivers from sewage treatment works.[40] However, significant action is still required to reduce impacts further. The number of serious pollution incidents caused by water company assets remains unacceptably high. Moreover, in 2021 only 16 per cent of water bodies achieved good ecological status with wastewater discharges contributing to issues in 36 per cent of water bodies.[41] The Commission's overall judgement is therefore that despite historic improvements, mitigations are still required.

The Commission's recommendations on water resources and ensuring a more efficient water supply, including reducing leakage and demand, will improve water quality by increasing the volume of water available in the environment, diluting pollution impacts and supporting species. The Commission's study on surface water flooding underlines the important role of the water industry in finding solutions which will have positive impacts on water quality in addition to reducing flood risk. In the *Second National Infrastructure Assessment*, the Commission also recommends that the water industry considers opportunities to improve environmental water quality in the maintenance, renewal and operation of water and wastewater assets.

Next steps

The Commission believes its recommendations in the *Second National Infrastructure Assessment* will ensure that infrastructure contributes to improvements in air quality, biodiversity and water quality compared to today. The assessment of unmitigated impacts in Figure 6 demonstrates the importance of dedicated effort to ensure infrastructure improves natural capital, and the need for the Commission's environmentally focused recommendations. It also shows the critical role for government and other infrastructure providers to pay attention to air quality, biodiversity and water quality as infrastructure is designed, built and operated.

This is the first time the Commission has quantified the impact of its recommendations on natural capital in a systematic way. The Commission continues to develop its methodology, welcoming feedback on the approach and sources used.

The Commission is exploring what further developments to make to its approach. These could include greater conceptual consistency in its treatment of different elements of natural capital, where currently it relies on a mix of stock (of biodiversity) and flow (of air and water pollutant) measures to draw conclusions. There may be opportunities to improve the accuracy of the biodiversity assessment with better data on the location of new and existing infrastructure assets, by incorporating insights from geographic information systems. In the *Second National Infrastructure Assessment* the Commission chose to focus on air quality, biodiversity and water quality and recognises that this will miss other elements of natural capital. A more comprehensive assessment of changes in natural capital would necessarily expand this list. In the longer term, the Commission believes it will be important to complement the current assessment of changes with a quantitative description of the stock of natural capital within the boundary of (and affected by) existing infrastructure assets.

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