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# Brownfield Sites

## Achieving net gain through the biodiversity potential of brownfield sites

### Key Messages

- Brownfield sites can be important for biodiversity, potentially supporting unique assemblages of plant and animal species. However, identifying high value brownfield sites is difficult (in part due to a lack of data) and often overlooked, as brownfield sites are not explicitly referenced in policies and standards for biodiversity conservation.
- The use and management of brownfield sites should be informed by an assessment of biodiversity value and evaluated on a case-by-case basis during a project life cycle.
- Brownfield sites can be 1) restored to their pre-development (higher) biodiversity value, with potential co-benefits for climate adaptation and mitigation, and ecosystem services delivery; 2) rehabilitated for development of new economic activities, thus avoiding impacts on other greenfield sites of higher biodiversity value; or 3) conserved due to their high biodiversity value, in particular where unique habitats or species assemblages have established through natural succession on the sites and their disused infrastructure.
- With careful and informed management, brownfield sites present a potentially untapped opportunity for businesses to achieve net gain and contribute to global goals on biodiversity, ecosystem restoration, climate change and sustainable development.

# Introduction

Brownfield sites (broadly defined as areas that are, or have previously been, developed; see Box 1) are complex assets, with their potential biodiversity value often under recorded. Consequently, they are not always considered in corporate or government decision making for biodiversity conservation.

Brownfield sites are commonly targeted for redevelopment or rehabilitation due to:

- the actual or perceived public health risk posed by un-remediated former industrial sites;
- public opinion that brownfield sites are unattractive; and/or
- the assumption that they will be less important for biodiversity than other land use types (even in comparison to heavily managed formal parks or areas used for intensive agriculture).

As a result, brownfield sites may not be considered for the same restoration activities as areas that have not been previously developed (referred to as greenfield sites).

While brownfield sites may have limited biodiversity value, they can also provide ecosystem services and support important or unusual populations or assemblages of species (see Box 2). Brownfield sites can have significant cultural value as well and become important official or unofficial recreation areas for local communities[1].

Data on the location of brownfield sites, how they are used, and the biodiversity they support, remain limited compared to other land use types.

With interest in restoration growing in response to government and corporate commitments on carbon and biodiversity, and as part of the UN Decade on Ecosystem Restoration (2021 to 2030), the lack of information on brownfield sites could prevent their consideration for conservation and restoration activities.

This briefing:

- highlights the potential **biodiversity value** of brownfield sites;
- outlines the **policy context** for conserving brownfield sites, including global policy frameworks and standards on restoration; and
- summarises the **opportunities** for businesses to contribute to biodiversity goals through management of brownfield sites.

The briefing draws on a number of examples, particularly from Europe[2–6]. Over 23% of global modified areas within protected areas are in Europe (including Russia), with many examples of high biodiversity value brownfield sites associated with disused infrastructure found in this region.

**Box 1: What are brownfield sites?**

Brownfield sites can exist for a number of reasons, such as when:

- It is quicker and cheaper for companies to move to new sites, rather than renovating or retrofitting old sites when they become outdated;
- Structures or infrastructure are difficult or costly to remove at the end of a project lifecycle;
- Sites are difficult to remediate following pollution or contamination from historic industrial uses and therefore have low market value; and/or
- Changes to the economic system of a country lead to rapid closure or failure of certain industries, leaving behind a legacy of abandoned sites.

For example, in Central and Eastern Europe, many existing brownfield sites are a result of the transition from a planned to a market economy, where industrial and agricultural areas were abandoned.

Unless rehabilitation, restoration or management of a site is required (e.g. by law), sites may simply be left once production, processing or other activities have stopped, allowing the surrounding habitats to encroach, or new habitats to develop.

Definitions of brownfield sites vary – for example, some include all land that contains a permanent structure (even while it is still in use) but exclude urban parks and gardens (even when extensive infrastructure such as footpaths exist). Brownfield sites can also be known as wastelands (abandoned vacant sites where vegetation develops) and are often associated with derelict structures.

How brownfield sites are defined is important, as it can influence how national and global policies are applied. For this technical briefing, brownfield sites are taken to be those that evolve over time, once commercial or industrial activities on a site have ceased and the area has been left largely unmanaged.

While the term brownfield site is commonly used for terrestrial areas, this briefing considers marine brownfield sites as well.

# Biodiversity value of brownfield sites

## Terrestrial sites

Terrestrial brownfield sites can exist on land previously used for a range of different activities, including manufacturing, oil exploration and infrastructure development. Their biodiversity will have changed over time, with new species potentially colonising once active site management and maintenance has stopped[7, 8]. This process can create areas of high species richness (see Box 2). For example, a greater richness (determined by species richness, rarity and indigeneity) of flowering plant species was found within the wastelands/brownfields of Hauts-de-Seine, France, compared to other terrestrial habitats considered in a 2007 study[9].

Brownfield sites can also support important or unusual species. In the United Kingdom, between 12-15% of nationally scarce and rare invertebrate species are estimated to be found on terrestrial brownfield sites[10].

Where there is no or limited public access to brownfield sites, they can provide havens for species sensitive to disturbance. For example, in Berlin, Germany, brownfield sites provide suitable habitats for the declining Northern wheatear *(Oenanthe Oenanthe)*[2], while nest survival and productivity of the Northern Lapwing *(Vanellus vanellus)* population in Munster, Germany, was sometimes found to be higher on brownfield sites than in arable habitats and pastures[3].

Abandoned infrastructure on terrestrial brownfield sites can itself support rare wildlife. In Romania, old and flooded railway tunnels provide refuges for amphibian, spider and other species, including nationally protected amphibian species such as the Yellow-bellied toad *(Bombina variegate)*, Northern crested newt *(Triturus cristatus)* and the globally Near Threatened European pond turtle (*Lacerta viridis)*[4]. In the United States, a railway tunnel in the Chesapeake and Ohio Canal National Historical Park, which was disused in 1975, now acts as a roosting site for bat species, including the globally Endangered Eastern small-footed myotis (*Myotis leibii*). The tunnel may be the largest known hibernating population of the species in the state[11]. If properly decommissioned, abandoned mining pits on brownfield sites can also provide a water source and serve as important habitat for endangered bird species such as the Little bittern (*Ixobrychus minutus*) and the Great reed warbler (*Acrocephalus arundinaceus)* in the Trebon Basin Biosphere Reserve, Czech Republic[5].

In addition to being valuable areas for biodiversity now, brownfield sites can have the potential to act as climate refugia (climate refuges) for vulnerable species groups, such as amphibians[12], in the future.

### Box 2: Canvey Wick Site of Special Scientific Interest (SSSI), United Kingdom

In the 1970s, a 93ha oil refinery, owned by the Occidental Petroleum Corporation, was established on the coastal grazing marsh of Canvey Island, United Kingdom. The Canvey Wick site was first covered in several metres of dredged material from the river Thames, which created vast areas dominated by silt, sand and gravel. The site was then decommissioned in 1973, without ever becoming active.

The resulting altered hydrology and low nutrient conditions of the site led to the development of a complex lattice of habitats, with wetland features (reedbeds, damp grassland, ditches, and ponds) found alongside herb-rich dry grassland, sparsely vegetated gravels, sandy banks, and bare concrete.

Canvey Wick was found to support an extraordinary invertebrate assemblage with over 1,400 species recorded, including three species previously thought extinct in the UK (Canvey Island ground beetle, *Scybalicus oblongiusculus*, Morley weevil, *Sitona cinerascens*, and Small ranunculus, *Hecatera dysodea*).

As a result, Canvey Wick was designated in 2005 as the first brownfield Site of Special Scientific Interest (SSSI), and as a Habitat/Species Management area (IV) under IUCN Management categories. Part of the site (20ha) is now owned and managed by the Land Trust and Buglife, in partnership with the Royal Society for Protection of Birds (RSPB), ensuring that the mosaic of habitats and the high biodiversity they support is preserved.

Figure 1: Canvey Wick Pier, United Kingdom. *Source: Ian Tokelove (2019)*

## Marine sites

Much like terrestrial brownfield sites, abandoned infrastructure (e.g. pipelines or rigs) in the marine environment has the potential to be colonised by, and support, marine species over time. For example, decommissioned oil and gas infrastructure in the North East Atlantic has provided habitat for invertebrates that use or attach themselves to hard surfaces (epifaunal invertebrates)[13]. In turn, these invertebrates act as a food source for larger invertebrates and commercially important fish species such as Atlantic cod *(Gadus morhua)*, Saithe *(Pollachius virens)* and Monkfish *(Lophius piscatorius)*. Similarly, the Echo Yodel pipeline in Western

Australia has enabled a community of invertebrates to grow and re-establish ecosystem functions in the area, lost through historical trawling of the seabed. Commercially important fish species such as pearl perches ((*Glaucosoma buergeri*), Russell's snapper *(Lutjanus russellii),* Blue-striped snapper *(Lutjanus quinquelineatus)* and Australian striped velvetchin *(Hapalogenys dampieriensis)* have been found on this pipeline.

The presence of marine brownfield sites can provide other types of habitats, for threatened and declining species. For example, the Endangered white coral *(Lophelia pertusa)*, normally found within the Atlantic Ocean, was first recorded within the North Sea on oil infrastructure and on the Brent-Spar oil storage buoy, which provided an important source of artificial hard substratum for the coral to grow on[14]. Artificial reef structures provided by abandoned marine infrastructure can support populations of specific overfished species, increase connectivity between habitats, produce large fish biomass, and provide large foraging areas for predators higher up the trophic levels[15]. In certain locations, artificial reefs can even be used as scuba diving sites, providing opportunities for recreation and tourism (see Box 3).

Box 3: Rigs to reefs, Gulf of Mexico

In the Gulf of Mexico, United States (US), 532 platforms have been left to provide artificial reef systems for marine biodiversity.

The US Bureau of Safety and Environmental Enforcement began Rigs to Reef to develop a national policy that recognised the artificial reef benefits of oil and gas platforms. Under this policy, environmental and engineering standards must be reached for converting a platform to a permanent artificial reef. All five Gulf of Mexico coastal states (Alabama, Florida, Louisiana, Mississippi, and Texas) have approved artificial reef plans to allow the remaining infrastructure to stay in place.

The benefits of this approach include:

- Reducing energy use and air emissions that would have been released from transporting and disposing of the concrete structure and drill cuttings, resulting in a reduced cost;
- Reduced negative impacts on the marine environment from the total removal of the infrastructure;
- Reduced landfill waste, which benefits the environment and society;
- Attracting marine life, which enhances fisheries; and
- Contributing to the economy by providing sites for recreational fishing and diving.

Liberty ships and partially removed or fallen structures along the Texan continental shelf were sampled over a two-year period. A total of 59 species from 19 families of fish were recorded, including sharks (Sandbar shark, *Carcharhinus plumbeus*, and Silky shark, *Carcharhinus falcliformis*), and damselfishes. Additionally, commercially important fish such as the Red Snapper (*Lutjanus spp.*) were present in all 15 sites and at 50-60m from the seabed. This provides an ideal location for diving experiences and potential fishing activities, highlighting the socio-economic importance of artificial reefs as well as their biodiversity value.

## Site management and biodiversity values

As outlined above, many brownfield sites evolve through a process of natural succession after management actions associated with the original development cease. This can lead to unusual, rich and/or important species assemblages.

Any proposed management, restoration or redevelopment of a brownfield site will have an impact on its biodiversity value. This impact can be positive, or negative, if the site management is not carefully assessed and considered before being implemented.

For example, a study in the Czech Republic found mining sites that had been left to undergo natural succession supported both a greater bird species richness and conservation value than those that had been actively reclaimed (through enrichment of substrates)[6]. This was attributed to the presence of early specialist plant and invertebrate species on the brownfield sites, that were otherwise scarce in the surrounding landscape.

However, the unusual conditions on brownfield sites (e.g. low soil fertility) can themselves be created by the land management activities associated with previous commercial or industrial use. In some cases, these conditions may need to be maintained for particular habitats to persist[16]. For example, intensive public use of a brownfield site may maintain soil fertility at low levels, allowing specific rare plant species to thrive[17].

In the marine environment, the removal of oil and gas infrastructure, which may have become a substrate for flora and fauna, could deplete the area's biodiversity value (see Box 3). This biodiversity value needs to be considered to understand the potential impacts of proposed management, decommissioning, restoration or redevelopment of marine brownfield sites. Given the complexities of decommissioning in the marine realm, the potential benefits of leaving marine infrastructure in place need to be assessed carefully on a case-by-case basis against the risks of incomplete cleaning and inadequate decommissioning which could result in a net negative impact on biodiversity compared to full removal.

# Brownfield sites in policy

## Regional, national and local policies

The consideration of brownfield sites in policy varies between local, national and regional contexts. However, a lot of national and regional policy focus is placed on how terrestrial brownfield sites can be used to help meet demand for housing. For example, in Quebec, Canada, the government has established a Revi-Sols (Revitalize Soils) programme to promote and prioritise the redevelopment of 1,000 brownfield sites[18]. The programme includes CAD 40 million to help finance studies and rehabilitation of brownfield sites in Quebec City and Montreal (Phase I) and a further CAD 50 million for the same activities in other municipalities (Phase II). In the European Union (EU), the main focus has been on how brownfield sites can be used to help address housing shortages while achieving no net land take targets (e.g. the Roadmap to a Resource Efficient Europe). EU investments in projects such as Tailored Improvement of Brownfield Regeneration in Europe (TIMBRE) aim to increase uptake of innovative and existing methods, technologies and decision-support tools on using, reusing and developing on brownfield sites. The use of terrestrial brownfield sites for redevelopment is also gaining attention in academic literature relating to Brazil[19], Bolivia[17], Ethiopia[20] and Pakistan[21].

International marine conventions aim to limit sources of marine pollution and the impacts of offshore industrial infrastructure in the ocean. The International Maritime Organization (IMO), the global standard-setting authority for the security, safety and environment of international shipping, regulates the decommissioning or relocation of offshore oil and gas infrastructure. Under this convention, marine brownfield sites should be fully decommissioned, and the associated infrastructure removed from the marine environment (see Box 4). Similarly, the OSPAR Convention (Convention for the Protection of the Marine Environment of the North-East Atlantic) states that all oil and gas installations and wind turbines must be decommissioned under the 'clean seabed' policies, to ensure safe access to and use of the seabed, and limit the risks of pollutants.

In contrast to those marine conventions, certain national governments in areas with significant offshore infrastructure are exploring how to use it to create artificial reefs, rather than removing it (see Box 3).

**Box 4: IMO Guidelines**

The IMO's Guidelines and Standards for the Removal of Offshore Installations and Structures on the Continental Shelf and in the Exclusive Economic Zone states that all abandoned and disused offshore installations should be removed with only limited exceptions, granted on a case-by-case basis by the costal State with jurisdiction over the installation.

The presence of an artificial reef can be considered as an exception that would allow for only the partial removal of offshore infrastructure, if scientific evidence is provided to demonstrate its biodiversity value.

For example, under Standard 3, information on the presence of Endangered or threatened species and/or existing habitat types should be collected to inform the decision on whether partial removal is appropriate and permissible.

Marine biodiversity surveys are therefore necessary as part of the decommissioning process, to ensure the solution most appropriate to the site's biodiversity value is adopted.

## Financial Performance Standards

Globally recognised financial performance standards adopted by businesses encompass brownfield sites, and can support the protection of their potential high biodiversity value. The International Finance Corporation (IFC) Performance Standard 6, which covers biodiversity, involves identifying habitats meeting at least one of the five Critical Habitat criteria within a project development. Brownfield sites can meet those Critical Habitat criteria, in particular: (i) habitat of significant importance to Critically Endangered and/or Endangered species, as listed on the IUCN Red List of Threatened species; (ii) habitat of significant importance to endemic and/or restricted species; (iv) highly threatened and/or unique ecosystems.

For project development to take place in areas of Critical Habitat, additional actions are required to avoid "measurable adverse impacts on biodiversity values", thereby protecting high biodiversity brownfield sites from development impact. Similar Critical Habitat criteria are outlined in other financial performance standards, such as the World Bank Environmental and Social Standard 6, the European Investment Bank (EIB) Standard 3, and the Asian Development Bank (ADB) Safeguard Policy Statement. As a result, businesses which comply with these standards must consider high value biodiversity brownfield sites within their projects. Despite being included where they meet the criteria of a performance standard, of the major financial performance standards, only EIB Standard 3 makes a specific reference to brownfield sites, in the context of its definition of Urban habitats.

## International conventions and agreements

The draft of the forthcoming Post-2020 Global Biodiversity Framework proposes to ensure no net loss in the area or integrity of freshwater, marine and terrestrial ecosystems by 2030[22]. The protection of high biodiversity value brownfield sites can potentially help maintain this integrity, as well as the re-use of low biodiversity brownfield sites to reduce the need to develop on greenfield sites. The re-use of those brownfield sites also contributes to the United Nations (UN) Sustainable Development Goal 11 on Sustainable Cities and Communities, which seeks to protect degradation of the planet through sustainable management of resources.

Under the Land Degradation Neutrality goal (UN Convention to Combat Desertification), focus on conserving, sustainably managing and restoring land can extend to brownfield sites. Where feasible, brownfield sites can be restored to their original, pre-development state if the restored site has a higher conservation value than in its brownfield state. This restoration and rehabilitation can support the UN Decade on Ecosystem Restoration (2021-2030), which aims to achieve transformational ecosystem restoration, with the inclusion of private initiatives.

Moreover, management of brownfield sites can contribute to the goals of the Paris Agreement under the UN Convention on Climate Change if their habitats are conserved or restored to maximise their potential to capture and sequester carbon.

Businesses managing marine brownfield sites can engage with the Business and Industry community of the UN Decade of Ocean Science for Sustainable Development to facilitate mutual learning and inform the development of mainstream policy frameworks through their lessons-learned.

Whether it is through their protection, re-use, or restoration and rehabilitation, brownfield sites represent key assets for businesses looking to contribute to international goals and targets for sustainable development.

# Using brownfield sites for net gain

Good management of brownfield sites can contribute towards corporate commitments, including for net gain (see Figure 2), as well as international efforts for the conservation and restoration of biodiversity. Collecting baseline data and assessing the biodiversity value of both a project site pre-development, and of the resultant brownfield site post-development is crucial to inform how to manage this site.

## Restoration of brownfield sites

If the brownfield site has been assessed to have high biodiversity potential, restoration efforts in line with the mitigation hierarchy should be prioritised to conserve and repair damaged ecosystems, including from the project's activity and impacts. As part of the restoration process, multiple co-benefits beyond biodiversity conservation can also be accounted for, such as climate resilience, carbon sequestration, the delivery of ecosystem services, recreation areas for local communities, etc.

## Redevelopment of brownfield sites

If the biodiversity value of a brownfield site has been assessed as low, rehabilitation to restore basic ecological functions and/or ecosystem services of the area is sufficient[23]. This will enable the redevelopment of the site for new economic activities, hence reducing the demand on greenfield sites for development. Impacts on other sites of higher biodiversity value are therefore avoided, contributing to international efforts for no net loss of biodiversity and sustainable development.

## Conservation of brownfield sites

On the other hand, if the resultant brownfield site has a higher biodiversity value than the original project site, conserving it should be prioritised to ensure net gain and with the aim to achieve the highest level of recovery possible for ecosystem health and human wellbeing (in alignment with the guiding principles for the UN Decade on Ecosystem Restoration).

Consideration of the potential biodiversity value of a brownfield site can be integrated early on into the planning process, for example by designing beneficial structures for biodiversity, and considering decommissioning options that will help retaining those structures after the project lifespan.

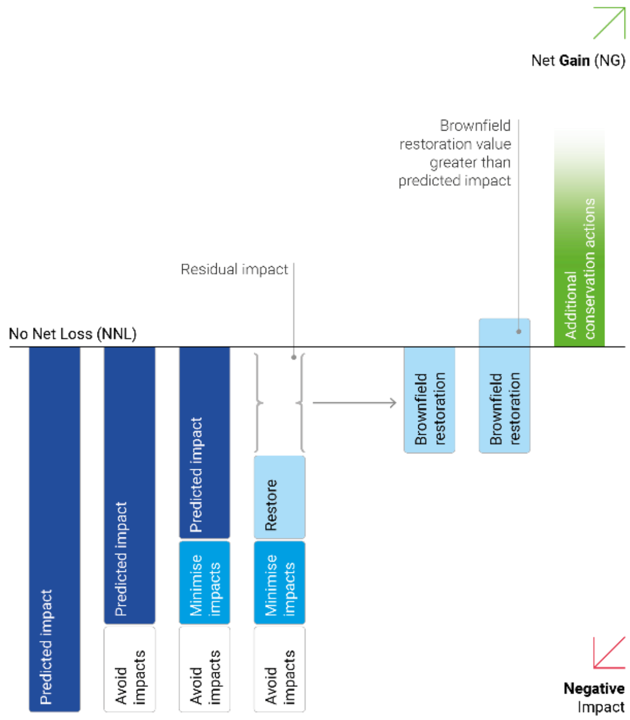


Figure 2. Integrating brownfield sites within the mitigation hierarchy can contribute to a business' efforts towards net gain of biodiversity by creating restoration value greater than the predicted or original impact.

# Summary and conclusion

Both marine and terrestrial brownfield sites can be of high biodiversity value, but this is not always explicitly acknowledged in development policies and standards. The potential role of brownfield sites in achieving national and international commitments relating to no net loss of biodiversity, net gain, restoration of ecosystems and mitigation of carbon emissions, should not be overlooked.

The challenge lies with differentiating between brownfield sites that provide a range of ecosystem services or support important biodiversity (and should therefore be conserved), those that present potential to become high biodiversity sites with multi-benefits (and should therefore be restored), and those that may be more suitable for redevelopment to minimise impacts on other previously undeveloped areas.

Businesses can incorporate management considerations for brownfield sites at various stages of their associated project development, from the onset of the impact assessment process to decommissioning; and for different intents, including risk mitigation and restoration.

Brownfield site conservation and restoration require coordinated efforts between the private and public sectors to mobilise resources, information, and societal buy-in, which will ensure the best options are considered. Data collection on brownfield sites is essential if businesses are to adequately incorporate those assets in their efforts towards sustainability commitments.

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Citation: UNEP-WCMC (2021) Brownfield Sites: Achieving net gain through their biodiversity potential. Cambridge, UK

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Acknowledgements: The authors would like to thank their reviewers, including Katie Dawkins, Jonty Knox, and Matt Jones.

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