SocEnv Soils and Stones project:
Case study demonstrating one or more of the ten principles of good soils and stones management in action

HS2 Colne Valley Western Slopes

Summary:

The Colne Valley Western Slopes (CVWS) is a large-scale and multi-faceted green infrastructure project, being delivered by the Align joint venture as part of the High Speed 2 (HS2) Phase One Scheme.

The design vision for the CVWS is to establish a biodiverse chalk downland mosaic with a high public amenity value at the 140ha site, which was previously used for arable farming and mineral extraction, and is currently occupied by a temporary works area for HS2. Inspired by its setting within the Colne Valley and the neighbouring Chiltern Hills, the aim is to deliver a dynamic landscape of tree-lined ridges, wood pasture and wetland, set within extensive areas of species-rich calcareous grassland, accessible from over 4km of new recreational routes.

The design strategy is to create this mosaic of semi-natural habitats via the sustainable reuse of site-won soils, concrete and limestone aggregate from decommissioned compounds/haul roads, and 2.6 million m^3 of 'chalk cake' (destructured chalk arisings from the HS2 Chiltern Tunnel, processed in on-site treatment plant). Whilst this is the most sustainable approach, creating the optimum ground conditions to establish a biodiverse calcareous grassland mosaic using these resources is also a key technical challenge due to uncertainty in the materials' properties and interactions between them.

Therefore, a research project was commissioned by HS2 and Align to help resolve uncertainties and limit risks for the habitat creation, led by Jacobs, in partnership with Cranfield University and Tim O'Hare Associates. This comprises a series of laboratory and field trials to identify the best configurations of materials for supporting the project aims.

In addition to this research, multidisciplinary collaboration, early consideration of soils within the design process, and sustainable soils management from inception through to verification are central to the success of the project.

The photographs above show early stage observations from the field trials in 2023, with target vegetation and invertebrate species beginning to emerge.

Meeting the ten principles:

Principle	How the principle was met in this project.
1. Implement soils and stones management practices to drive sustainable economic growth.	Early consideration of available soil and substrate properties and volumes within the design process identified a soil/substrates mass balance and habitat creation proposals that are achievable with site-won materials. This avoids the needs for costly material imports/exports.
2. Preserve, protect, and enhance the value of all soils and stones in situ.	A series of drawings were produced to specify the necessary soil stripping depths, taking into account the volumes required for proposed landscaping and the protection of soils from trafficking, compaction and sealing during construction. Soils were left in situ where appropriate.
3. Promote and enhance the inherent value of soils and stones as part of a wider integrated environmental system (e.g., for carbon sequestration, food security and biodiversity).	The natural capital of soils will be significantly enhanced through their role in supporting the creation of semi-natural habitats in place of arable land, as future carbon sequestration and biodiversity are dramatically increased (for instance, via a predicted 50 % gain in biodiversity units within the CVWS area).

4. Use a common standard for soil health in relation to land-use, taking underlying soil conditions and functions into account in the management of land.	A range of parameters are being measured and monitored within the research project to gain a holistic understanding of soil functioning and soil health. Soil health should be enhanced by the project through increased organic matter and soil biological activity/diversity, as well as continuous vegetative cover.
5. Use common quality standards for soil based on principle #4 for excavated soils, stones and dredgings to be used in specific end-uses.	A programme of testing for chalk cake, limestone aggregate and crushed concrete has been undertaken to ensure that all soil-forming materials are suitable for their intended purpose, with a similar suite of parameters used as for site-won soils as appropriate.
6. Understand and identify site specific soil conditions at the start of project planning or change of land-use. Define the status of any excavated soils and stones according to their value as an end-use resource and avoid the intention to discard them as surplus to the needs of the project. Protect undisturbed soils to enhance soil health.	The habitat creation designs were led by the inherent properties of soil and substrate materials on site, as characterised by baseline testing, which helped ensure that a soils mass balance was achievable in line with circular economy principles. In situ soils were also protected via sustainable soil management practices.
7. Develop and implement a resource hierarchy for the management of land, soils and stones.	A cover system was implemented for historical landfill materials on site using site-won chalk cake, avoiding potential waste generation; and soils have been retained in situ where practicable or reused on site.
8. Implement financial metrics for the life cycle of all projects based on the impact on soil value in order to drive the market for offsetting (e.g., metrics for biodiversity loss, carbon sequestration and loss of food security).	Financial analysis related to sustainable soils management has not been undertaken for this project, but significant cost savings will have been realised via the avoidance of waste generation and material imports. Biodiversity net gain has been quantified in accordance with HS2's metric, and carbon sequestration rates have also been estimated.
9. Implement a national policy progressively to harmonise legislation, regulation, best practice guidance and monitoring programmes to protect soils. Include the fields of planning, land contamination, forestry, agriculture, ecological restoration, and waste management. Aim to promote integrated markets for soils and stones, offset trading and policies	Current national legislation, policies and guidance have been followed with respect to soils and stones, for instance waste regulations, Defra soils guidance and the CL:AIRE DoWCoP. Experience gained from the CVWS and wider HS2 project in these matters will be used to help effect positive change.

thereby allowing land values to reflect optimum soil health based on metrics in principle #4.	
10. Periodically benchmark the natural and economic value of UK soils against both base-line UK and international metrics, taking into account global social, economic and environmental sustainability (e.g., the supply chain impacts of ensuring UK food security, and the valuation of soils and stones).	Soil health metrics have been compared with other UK/European soils, and the research conducted for this project will have a lasting learning legacy for HS2 and the wider construction industry. However, this principle is wider than the scope of one site; opportunities will be sought for wider collaboration as appropriate.

The figure above illustrates the trial phases conducted as part of the research project. The field trials are ongoing at the time of writing (due to finish in October 2024).

Lessons learned:

- Early consideration of available soil and substrate properties and volumes can help achieve a soil/substrates mass balance and ensure success for habitat creation/landscaping proposals.
- Multidisciplinary collaboration from the outset facilitates early risk identification, thereby allowing sufficient time for information gathering and mitigation implementation.
- Embedding circular economy principles into the design and collaboration with construction teams helps to maximise opportunities for the sustainable use of materials and avoid waste generation.
- Chalk cake and temporary works aggregates can be successfully used within soil profiles to support the creation of chalk downland habitats with careful consideration of their properties and configurations.
- Landscaping trials can provide valuable information to optimise processes, reduce risks and improve outcomes, with a combination of laboratory and field trials in this case adding value and contributing to a unique learning legacy.
- Accurate tracking of soil movements and stockpile contents is important for traceability and assurance that the properties of the as-placed soils are consistent with design intentions; innovative technology such as drone imagery can assist this.
- Good practice soil handling methods, reinforced by training, inspection and monitoring protocols, are crucial to limit soil degradation and maintain the suitability of soils for reuse.

About the authors:

Authors: Chris Cantle[1], Matt Hobbs[1], Jane Rickson[2], Christopher McCloskey[2], Silvia Arpano[2], Wilfred Otten[2], Rebecca Butler[2], Ceri Spears[3]

[1] Jacobs UK Limited (chris.cantle@jacobs.com)
[2] Cranfield University (j.rickson@cranfield.ac.uk)
[3] Tim O'Hare Associates LLP (ceri.spears@toha.co.uk)

Find out more:

Chilterns South Portal Chalk Grassland Project article:
https://www.hs2.org.uk/building-hs2/environmental-sustainability/green-corridor/chilterns-south-portal-chalk-grassland-project/