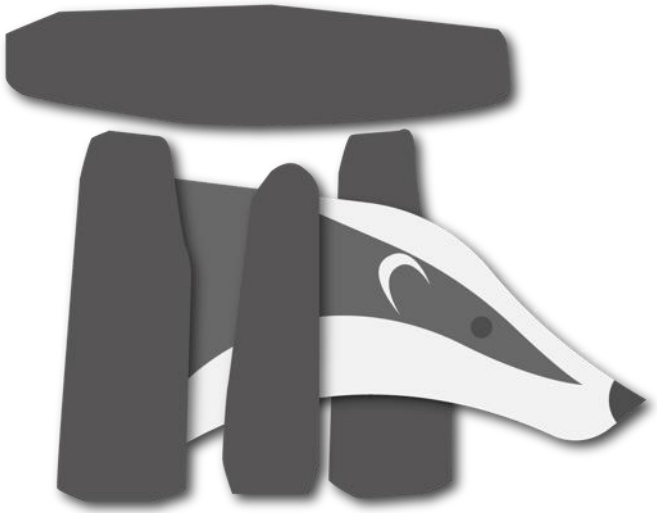


highways england

Earthworks and Landscaping | QS-11B | Delivery Methodology | Earthworks Strategy for the whole of the Scheme

4. Your earthworks strategy for the Scheme shall include:
    - 4.1. your strategy for the excavation, transport, treatment, storage and placement of all earthworks material types expected to be encountered during the works;
    - 4.2. your strategy for the protection of on-site heritage features and archaeological assets during all earthworks activities;
    - 4.3. the identification and proposed mitigation for key risks associated with the earthworks, including the phosphatic chalk;
    - 4.4. the management of surface and groundwater during construction.
5. Your earthworks strategy shall provide the following information as a minimum:
    - 5.1. your strategy for the excavation, processing and storage of earthworks materials (other than tunnel arisings) including:
        - 5.1.1 the expected sources, quantities and geotechnical classification of the excavated materials;
        - 5.1.2 the methods of excavation, transport, treatment (where required), placement and compaction, in order to meet the engineering and landscaping requirements of the Scheme;
        - 5.1.3 the locations and methods of storage;
        - 5.1.4 methods and routes of transportation of material to the storage locations and final placement locations;
    - 5.2. your strategy for the treatment of the tunnel arisings, including details of:
        - 5.2.1 processing plant, layouts and locations;
        - 5.2.2 the processes to be employed to produce a product suitable for landscape fill;
        - 5.2.4 the storage of arisings pre- and post-treatment;
        - 5.2.5 the methodology to minimise and dispose of unsuitable materials;
    - 5.3. your strategy for the placement and compaction of engineering and landscape fills in the earthworks, including:
        - 5.3.1 the locations and methods of storage;
        - 5.3.2 the transport routes and methodology for compaction;
        - 5.3.3 methods for the protection of stored and placed fill to prevent, or minimise, deterioration in the event of adverse weather conditions;
        - 5.3.4 earthworks classification and control measures which will be operated to demonstrate compliance with the approved earthworks specification;
        - 5.3.5 earthworks laboratory and resources deemed necessary to control the earthworks;
    - 5.4. your strategy for the placement and compaction of landscape fill on Parsonage Down, including:
        - 5.4.2 the methodology for the placement and compaction of treated tunnel arisings;
        - 5.4.3 the methodology for placement, compaction and surface treatment of landscape, or other, fill.

4. BADGER's earthworks strategy for the Scheme

The BADGER earthworks strategy guideline has been developed using the following documents as mandated by *the Client's* requirements:

- Volume 2 Part 2 Section 2 (Environmental)
- Volume 2. Part 2 Section 3 (Archaeology)
- Volume 2. Part 2 Section 9 (Earth Works)
- Volume 2. Part 2 Section 22 (Future Proofing Requirements)
- Outline Environmental Management Plan: Chapter 3, Annex A.3 and Annex A.4 Outline Soils Management Strategy A.4 Illustrated Examples of Key Design Elements
- Detailed Archaeological Mitigation Strategy
- Environmental Statement

The Earthworks' solution, is provided based on the requirements shown in the Environmental Masterplan included in the Environmental Statement, in accordance with the DAMS51; these requirements include:

- A natural appearance which reflects the surrounding topography and landscape character
- Avoiding any sudden or visually apparent change in landform
- A blend into the natural contours around the edge of the works
- The height of the regraded earthworks not exceeding the natural adjacent landform
- Result in no increased risk of localised flooding.

For the preparation of this document, the **Tunnel excavation and Road excavation have a completely different approach**. The Tunnel excavation will be done by Tunnel Boring Machine, and the arising material will be transported from the tunnel to the Treatment Area (Longbarrow Facilities) by a slurry pipe.

The arising material will be treated to reduce the moisture content, screened, and then transported to Parsonage Down by trucks. The cut and fill sections along the road scheme will be done by traditional methods. This Method Statement (MS) strategy is focused on the earthworks outside the tunnel.

4.1 Our Strategy for the Excavation, Transport, Treatment, Storage and Placement of all earthworks material types expected to be encountered during the works

BADGER has developed a strategy for earthworks based on the following considerations:

General Assumptions

1. **The estimated quantities of earthworks materials (included tunnel arising) are expected to be balanced inside the Project area**. The quantities of excavated material would be enough for the class 3 and class 4 fill required, and hence there would be no requirement for off-site (outside the boundary of the Scheme) transport, source, reuse, recycling or landscaping of surplus excavated soil.
2. **The tunnel spoil** will be processed and placed in the landscaping area east of Parsonage Down provided for that purpose.
3. **A "zero balance" strategy** can be implemented using the landscape needed for the excavation surplus not used in structural embankments. All surplus from the topsoil and excavation (road excavation and tunnel) is less than the capacity of the suitable areas for surplus material (landscape/agricultural use). The majority of the chalk excavated will be classified as Class 3 fill suitable for embankment fill. As there is a surplus of site obtained material, the volume of Class 3 exceeds that required for embankment construction and therefore much of the material classifying as Class 3 will be used as Class 4 landscape fill. The better material will be selected for Class 3.
4. **The only site obtained material exported** from site will be any Class U1 or U2 contaminated material identified during construction. Based on the ground investigation information this is likely to be limited. Currently we have quantified a volume of around 20k m3. We will undertake a further assessment to confirm the volume, classification and whether it can be retained onsite.
5. **There is a surplus of 68k m3 east of the tunnel**. It is intended to haul this surplus west of the tunnel, during off-peak hours, for placement in the suitable areas west of Longbarrow.

6. We will to **process the site obtained chalk** with lime and cement as Class 9A or 9E for Capping. By achieving this, we will remove approx. 2,500 trucks from the public roads **(TQ2B3.1)**.
7. We will **use the chalk for Class 6I / 6J backfill** to the proposed reinforced earth walls at Countess Junction. The Series 600 specification requires a maximum SMC of 20% for this material. The ground investigation data indicated that whilst some of the site obtained material has an SMC of <20% it is not likely to be possible to win sufficient material to meet this criteria. In addition, the test results of the material east of the tunnel all exceed 20%. To prevent the need to import Class 6I/6J material, processing the chalk with lime / cement will be considered during detailed design. The mixing would be carried out adjacent to the wall section being constructed or in a mixing plant prior to the material being placed and compacted behind the wall. BADGER will carry out a series of laboratory and site trials to demonstrate that cement-modified Chalk will be capable of meeting the specification requirements for 6I/6J. **(Ref. DQ 273).** By achieving this, we will remove approx. 1,500 trucks from the public roads (**TQ2B3.1** – led by our Construction Manager).
8. **Ground Improvement** will be required beneath the Reinforced Earth Wall and embankments at Countess Junction.
9. It is intended **to use the chalk for Class 6P / 6Q backfilling around** the bridges. The addition of lime / cement may be needed to achieve this class of material. By achieving this, we will remove approx. 3,200 trucks from the public roads **(TQ2B3.1)**.

For the transport of the excavated material the Haul roads will be used, always within the footprint of the permanent works as per requirement, with temporary bridges to cross the A303 and A360 at different levels. The River Till will be crossed by the haul road with a temporary bridge in compliance with the requirements.

Please refer to **QS-11C** for the whole earthworks strategy. In order to achieve this Earthworks Strategy, BADGER will develop a **soils management strategy** (SMS) that will be applied to all soil resources that are disturbed either permanently or temporarily.

BADGER will follow the guidance in the Construction Code of Practice for the Sustainable Use of Soils on Construction Sites when handling agricultural soils and, in particular, the land to be reprofiled for use as permanent chalk grassland. In the **SMS** we will identify:

- The nature and types of soil that will be affected; and
- The methods that will be employed for stripping soil and the restoration of agricultural land.

Additionally, as part of the SMS, we will develop a:

- Soils Handling Strategy, where we will incorporate the soils handling measures outlined within the DAMS, identify locations where archaeological in situ preservation is required and consider areas to be returned to agricultural use.
- Soils Resources Plan, which will confirm the soils type, the most appropriate re-use of the different types of soil and proposed methods for handling, storing and replacing soils on site.

The re-use of excavated materials, including tunnel arisings and material excavated for highway cuttings will be governed by the **Materials Management Plan**.

Strategy and methodology for the excavation, transport, treatment, storage and placement of all earthworks material is described in section **5** of this document.

4.2 Our Strategy for the Protection of on-site Heritage Features and Archaeological Assets during all Earthworks Activities

BADGER will prepare, for the delivery stage, the Heritage Management Plan (HMP) and a Construction Environmental Management Plan (CEMP); the HMP will include the procedure for dealing properly with any unexpected finds during the construction process and with the sites of archaeological interest that are to be protected in compliance with the Detailed Archaeological Mitigation Strategy in accordance with the DCO.

Specific Method Statements (MSs) will be released in consultation with Wiltshire Council and Historic England at the start of the

construction works to describe specific construction measures to be developed to the site works and areas of interest, such as archaeology or heritage assets, in compliance with the OEMP and HMP. To prevent unintended incursion/damage by plant or other vehicles, protective fencing and/or burying/sealing, sites beneath fill material will be built.

The MSs will also cover the temporary haul roads and temporary traffic management diversions where archaeological remains will be retained in situ.

BADGER will have close coordination with the Archaeological Clerk of Works (ACoW) (The Authority). ACoW will monitor BADGER's compliance with its obligations to ensure that protection measures are in place and maintained appropriately throughout the construction period in compliance with the contractor's HMPs and the DAMS.

The indicative areas of these sites are shown in DAMS document, Figure 12.1 and in **Appendix D**. The exact areas will be defined in the MSs to be prepared in consultation with Wiltshire Council and Historic England. In some sites, archaeological photographic recording will also be required prior to protection measures.

During the Preliminary works stage, protective fencing will be erected around the archaeological sites to prevent accidental damage during the works. The sensitivity of the site will be taken into account in selecting the type of fencing and the type of archaeological mitigation to be employed. Different types of fencing are foreseen:

- Freestanding metal site fencing systems
- Post and wire fencing or post and rail fencing may be suitable

Provision of temporary and permanent fencing in the WHS and within the WHS setting will be developed in consultation with the Stakeholder Design Consultation Group (SDCG) as defined in V2P2 4.1.1).The Notices prohibiting works will be attached to the fencing.

From the start of works all the assets and archaeological features potentially affected or disturbed by the earthworks along the corridor inside the contract boundaries and in all the identified areas will be taken over by BADGER.

Sites within protective fencing shall be maintained by BADGER and replaced if necessary. The proposed means of maintenance will be described in the MS for the site, in consultation with Wiltshire Council and Historic England.

All the risk associated to these works will be identified and any mitigation measures will be implemented during the works to avoid any damages (vibration, noise, dust, ground movement visual impact, contamination etc.)

All the operators and drivers will receive specific training and induction to identify and preserve the archaeological assets and to prevent any risk of damages to existing archaeological assets. BADGER will be responsible for managing, monitoring and maintaining all the protective measures installed along the site works throughout the main works construction period.

Following construction, the protective fencing will be removed by BADGER under the supervision of the Archaeological Contractor. All the areas identified in the DAMS affected by the earthworks during the delivery stage are highlighted in **QS-11C**; BADGER will implement all the mitigation measures indicated within the DAMS before starting the works on these areas.

4.3 The Identification and Proposed Mitigation for Key Risks associated with the Earthworks, including the Phosphatic Chalk

BADGER will apply a strategy to proactively manage risk from the outset, which will enable us to safeguard the integrity of HE´s goals and objectives for the project. The key risks associated with earthworks and the proposed mitigation measures are shown in the table below:

KEY RISK	PROPOSED MITIGATION MEASURE
Management of Phosphatic Chalk	A complete disaggregation, screening and mix with normal chalk in the excavation and treatment of the tunnel arising will be produced, so the percentage of phosphatic chalk inside each m3 of material for landscape in Parsonage Down will be minimal.
Management of excavated material outside of earthworks season (April to September). The Earthworks for Completion of sections 1 and 2 in 30 months and for traffic diversions likely during the winter periods.	Additional treatments such as adding lime or stabilisation will be done to manage chalk and dry it in periods of wet weather. Additional measures to control the surface water, slopes in the construction of the embankments and sealing the last layer with a compactor after every working day will be done to maintain drier the chalk.
Badger will use selected chalk stabilised with lime and/or cement for backfilling the proposed reinforced earth walls at Countess Junction. Risk: Stabilisation of the chalk does not achieve the required performance for reinforced earth fill.	In the event that we are not able to obtain the performance of reinforced earth fill by stabilising the site won chalk, Imported granular material (class 6I/6J) will be required.
Non-compliance with the DAMS and related mitigation measures during the construction works	We will ensure that key objectives and procedures outlined in the DAMS are communicated to all site personnel initially via the Site Induction and then by regular toolbox talks. Only trained personnel will manage particular tasks in terms of preservation of archaeological remains. Our trained people will ensure that all site personnel are aware of the importance of respecting these measures before the start of any type of activity and earthworks.
Groundwater findings resulting in an instability of the cuttings	Installation and monitoring of a groundwater management system to lower the groundwater table to allow the cut works to be performed in dry, safe and stable conditions.
After the treatment of the chalk material coming from the tunnel excavation, moisture content of the material is still too high to place in land east of Parsonage Down.	Trial and test will be developed to confirm the MC in tunnel chalk material after treatment. If MC is more than the necessary to fill the landscape areas, additional treatment to dry will be needed adding lime/cement.
Fill to structures with 6P or 6Q	To avoid the import of 6P or 6Q material from external quarries, trial test with different treatments will be developed to achieve this class using local chalk.

4.4 The Management of Surface and Groundwater during Construction

Our first intention will be to avoid the requirement for dewatering and/or groundwater abstraction. If dewatering and/or groundwater abstraction is determined as required, the duration of this will be minimised. Dewatering or groundwater abstraction will not:

- Be undertaken from existing ground level within the WHS
- Discharge groundwater on the ground surface of the WHS.

BADGER will execute the works in accordance with the protection measures required by the Groundwater Management Plan (Outlined in the OEMP).

The surfaces of the site works along the footprint of the roadway scheme and also all the area dedicated to active site works

(stockpiles areas, haul roads, working areas in the compounds) will intercept the rainwater flowing and groundwater table, where this will have an impact. These will be managed during construction activities and operations of the sites.

Surface water and groundwater will be managed where the flows could be detrimental to the stability and integrity of the earthworks. For the precipitation and water run-off, our approach will be to direct water out of active construction areas, and to minimise erosion of exposed surfaces. The surface water controls will include:

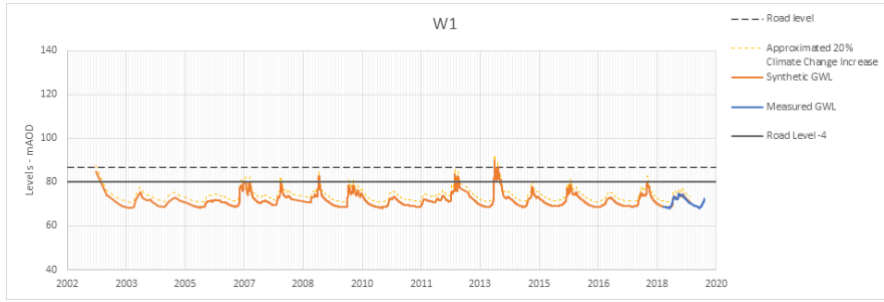
- Collection Ditches that intercept surface water runoff from disturbed areas and divert it to a stabilised area where it can be effectively managed. We will use excavators and wheel loaders with coarse aggregates to build ditches which will require little further maintenance, making them effective improvements
- Diversion Ditches will be constructed up-gradient of disturbed areas to intercept clean surface water runoff and discharge it through collection ditches designed to handle the expected runoff velocities without scouring
- These collection and diversion ditches intended to manage water run off during construction will only be temporary and will be removed where they do not form part of the permanent works
- Permanent infiltration trench on top of cut section along west and east cut section constructed at the commencement of the earthworks, please refer to QS 4B, 5B
- Culverts (Precast elements) will be used in tandem with collection or diversion ditches to pass water flow beneath disturbed areas, typically roadways, to prevent the erosion of these constructed structures. The installation of the culverts, if any, will be done in compliance with the DAMS
- Water stops will serve to reduce sheet flow and surface erosion of areas of exposed soil and/or haul and site roads by diverting runoff towards a stable vegetated area or collection ditch.
- Sedimentation Basins will be built as a temporary structure on the footprint of the permanent infiltration basin and used to detain runoff from drainage areas to allow sediment to settle out. Along the footprint of the new highway BADGER, based on the hydrology and morphology of the site works and considering the final watercourse destination, we will build the basin with a designated capacity;
- Sumps will be excavated placed at topographically low areas that will collect water runoff. Submersible pumps will be placed into the sumps so that water can be pumped out of the construction site towards a sedimentation basin.

In those cases where according to the DAMS we are in preservation in situ areas, where a 'no dig' approach is required, collection ditches and diversion ditches to catch surface water in and around stockpiles will not be allowed.
Badger will provide a technical solution to preserve the in situ area if affected by temporary and permanent works using specific geotextile/membrane and aggregates layers to protect these areas. No dig of ditches to catch surface water will be done in these areas.

Groundwater management

As per provided wells logs and pumping tests, it is expected that the excavation of west cut section might be affected by high groundwater levels. Groundwater has seasonal variation; most of the times it is expected being below the invert elevation (80m) but some years for short periods the elevation has been exceeded.

The figure below shows the recorded groundwater levels in W1 from 2002 to 2020 and minimum invert level at west (80m):

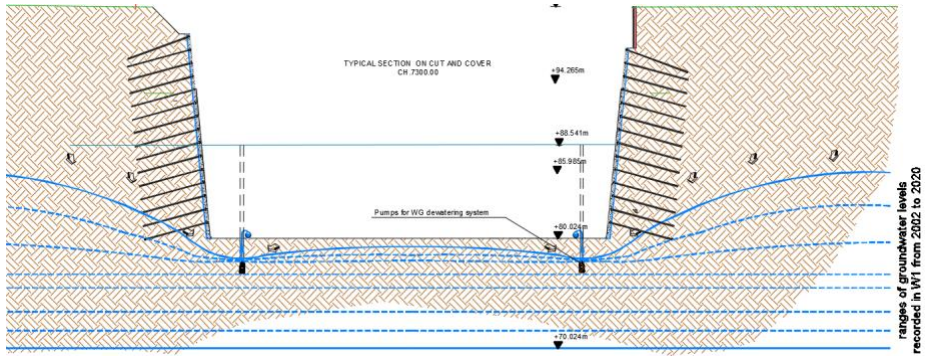


BADGER intend to install a drawdown groundwater system made by submergible pumps installed from elevation 88m capable to lower the GWL on cut section during the excavation from elevation 88,5 to 80.

This will allow the cut to be formed in workably dry and stable conditions. There are two objectives for this:

- To prevent the excavation from flooding
- To ensure that the seepage gradients (and associated high groundwater pressures) do not result in instability, which can be a problem in weaker grades of chalk, including structureless chalk.

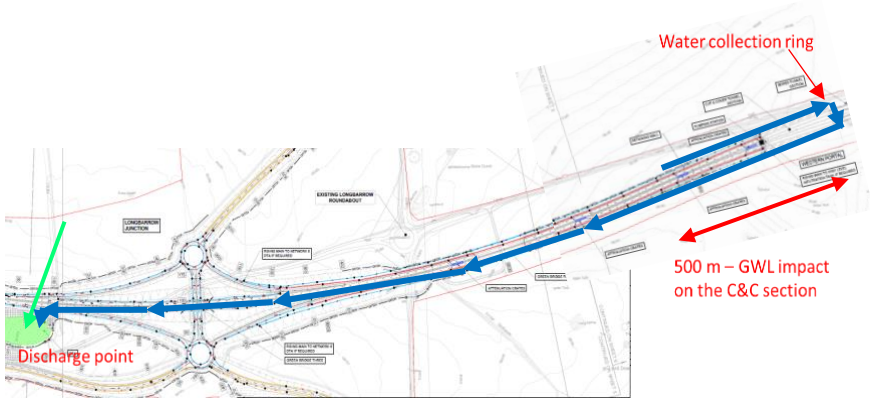
Our system will be based on the use of electrical submersible pumps to temporarily lower piezometric levels (Figure below). This will be achieved by pumping from an array of wells or sumps located in or around the excavation.



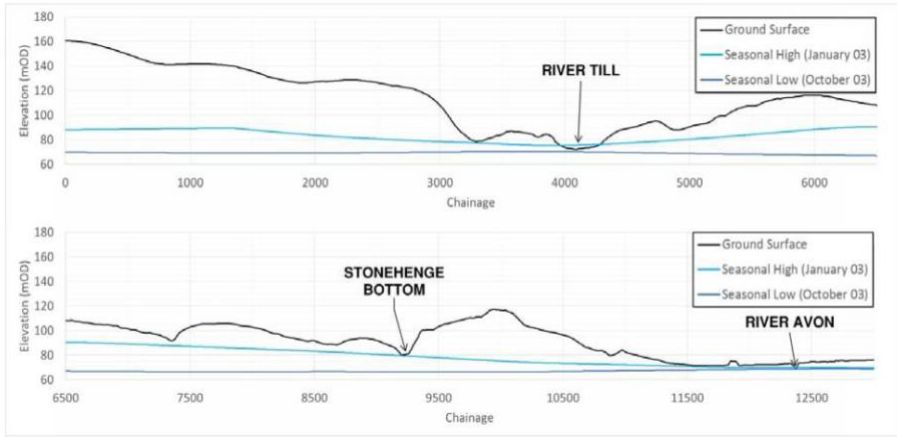
Lowering the groundwater level will not impact pre-existences because the wells will lower the groundwater to elevations already in place a few months earlier what it happens every year, this will comply with the requirement to minimise impact on the aquifer. In any case piezometers will be installed as part of the monitoring system.

BADGER will cast the invert slab and vertical wall up to max recorded groundwater level plus 20% climate change, this means 88,5 m. It will be casted just after the excavation, allowing to switch off the dewatering systems and proceed the works without any groundwater issues.

The runoff water and groundwater collected during the excavation phase will be pumped out from the cutting area, outside the WHS, up to the location of the sedimentation basin placed on the position of the permanent infiltration basin considered in our drainage strategy, in compliance with the requirements.



The main concern for groundwater seepage is related to the cut section between Green Bridge 4 and the western approach where for a stretch of approximately 500 meters the groundwater level plus the periodic effect of a climate change can have a huge impact on the excavation works.



As the excavations progress, the water control will be executed by means of open channels that will divert the water to sumps from which the water will be pumped out of the excavation to a dedicated

pond outside the WHS as per requirement along the road scheme; from this pond the collected water will be directly pumped out to the final destination/watercourse or a recharging well.

The proposed final discharge of the water will be subject to the approval of the Environmental Agency and Wiltshire Council; BADGER will take care of the quality of the water, in order to comply with the environmental requirements.

The procedures and methods statement considered by BADGER during delivery will be part of the Groundwater Management Plan. During the mobilisation period BADGER will undertake additional site investigations and related piezometer installation; in this way the water levels at selected observation piezometers will be monitored before, during and after any dewatering associated with the construction of the cut section and tunnel.

BADGER will undertake the works and implement working methods to protect surface water and groundwater from pollution and other adverse impacts, including change to flow, flood storage volume, water levels and quality. Impacts arising from dewatering will be included in the HMP. **(OEMP-MW-CH-1 b).**

Additionally, BADGER will be responsible for obtaining the necessary approvals and permits to enable any abstraction and discharge of pumped water in an approved manner.

5 Our Earthworks Strategy

5.1 Our Strategy for the Excavation, Processing and Storage of Earthworks Materials (other than tunnel arisings)

5.1.1 Expected sources, quantities and geotechnical classification of the excavated materials

The summary of the expected sources and the classification of the material, based on a preliminary geotechnical interpretation of the tender documents, will be the following:

- The material encountered in cuttings and used for fill will predominantly comprise chalk. Chalk is one of the major sources of earthworks materials in the UK and has been successfully used in the construction of many infrastructure projects. Despite its widespread use, due to its nature as a variably weathered soft rock and susceptibility to disturbance and changes in moisture content, problems have been encountered on projects where chalk has not been well managed. Good earthworks practice is therefore essential to maximising the acceptability of the chalk and the efficiency of the project. Much of this good practice is described in CIRIA C574.
- At tender stage the available ground investigation information has been used to determine the likely classification of the chalk and estimate the acceptability for reuse. The starting point has been to use the descriptions of the chalk including the CIRIA classification grades to determine the geological profile, summarised at a high level into three zones / layers:
    - Unstructured (soil-like) chalk
    - Weathered structured chalk
    - Competent structured chalk
- In general terms the thickness of unstructured chalk is limited, generally to approximately 1 to 3m thickness. Therefore, a high proportion of the material encountered in deeper cuttings will be the weathered and competent chalk which is likely to have a high degree of acceptability for reuse as fill material. The key control on the acceptability for reuse and the earthworks will be the natural moisture content of the chalk. An assessment has been undertaken of the moisture content data which has confirmed the likely high acceptability for reuse as fill material. Overall, excluding the tunnel spoil, the data indicates that over 80% of the chalk excavated will be acceptable for Class 3 fill which is substantially more than that required for embankment construction.
- Achieving a high degree of suitability for reuse as embankment fill during construction will depend on good earthworks practice for chalk being used such as limiting earthworks to drier months (the UK earthworks season is typically April to September),

avoiding earthworks in wetter periods, avoiding excessive handling of materials, good pre-earthworks drainage, sealing earthworks fill and providing a fall during construction to allow run off etc. If necessary, lime modification will be utilised to render additional material acceptable; this is most likely to help manage the weather risk and avoid excessive haul distances.

- A final assessment is done with updated quantities shown below based on BADGER design. The **QS-11C** is updated and it is consistent with these quantities. The Figure is slightly different from the **QS-11C** because the balance in the drawing is cut (unbulked)-fill and here, in this table, topsoil quantities are included and for the landscape areas we have included the bulked factor.

***Table Summary:** All the excavated material along the project will be used and relocated within the limits of the scheme, except those ones that cannot be placed in landscape areas, as U1/U2.*

The material coming from the tunnel excavation will be all treated in Longbarrow compound and all relocated in the Parsonage Down area.

The surplus material, identified as class 3 and class 4, will be relocated in the available landscape areas identified in the project. The volume capacity of these landscaping areas can vary as per the bulking factor of the excavated material obtained during the works.

EARTH WORKS QTY SUMMARY

	Cutting (Unbulked Quantities) (Km3)					Cutting (Bulked Quantities) (Km3)				Fill (Km3)										Balance (Km3) - incluiding class 5A		
Area of work	Total (unbulked) excl. 5A	Class 5A	Class 3	Class 4	Class U1B / U2	Total (bulked) excl. 5A	Class 3	Class 4	Class U1 B/ U2	Total excl. Topsoil and Capping	Total excl. Topsoil	Class 5A	Class 3	Class 6P/6Q	Class 4	Class 6C	Class 6 I/J	Class 6F	Class 9A/E	Surplus: Exc (bulked)-Fill	Areas Landscape (incluide PD)	Blance: Area Landscape-Surplus
West of Tunnel + W Portal	1.612	376	1.362	229	20	1.646	1.362	264	20	974	1.030	276	800	158	16	0	0	0	56	741	1.999	1.259
Tunnel TBM	833	0	0	0	0	1.041	0	0	0	0	0	0	0	0	0	0	0	0	0	1.041	0	-1.041
East of Tunnel + E Portal	213	28	168	46	0	220	168	52	0	141	153	8	53	32	0	12	40	4	12	92	0	-92
Scheme-wide	2.658	403	1.530	275	20	2.908	1.530	316	20	1.115	1.183	284	853	190	16	12	40	4	68	1.874	1.999	126

NOTE: there are 126 (k)m3 of deficit to fill all landscape Areas modeled. This assumption can vary with the real bulk factors.

5.1.2 Methods of Excavation, Transport, Treatment (where required), Placement and Compaction

Methods of Excavation

TOPSOIL STRATEGY

The topsoil will be removed during construction in order to prevent permanent burial beneath other earthworks. Such soils will be stockpiled and re-used, subject to acceptability, in the general earthworks for the Scheme such as landscaping and noise bunds. In particular, topsoil excavated from areas of known high quality agricultural land will be stored separately and, where possible, will be reused on-site in areas that will be returned to agricultural use.

The effects on soil resources will be mitigated by employing high standards of soil handling and management during construction, and by avoiding the creation of bare areas of exposed soil that could be vulnerable to erosion processes. BADGER will endeavour to return

topsoil stripped during the construction of the scheme as close to its source of origin as possible during restoration.

The topsoil stripped during the construction of the Scheme will be re-used as soon as is practicable and stored in such a way as to minimise structural damage from weathering, construction traffic movements, and multiple handling. This will also minimise the potential for leaching of nutrients from soils. Additionally, the creation of bare areas of permanently exposed soil that could be vulnerable to erosion processes will be avoided.

To form part of the SMS, we will develop a Soils Handling Strategy, with reference to BS3882: 2015 Specification for Topsoil and the Defra Construction Code of Practice for the Sustainable Use of Soils on Construction Site. This will incorporate the soils handling measures outlined within the DAMS, identifying locations where archaeological in-situ preservation is required and consider areas to be returned to agricultural use.

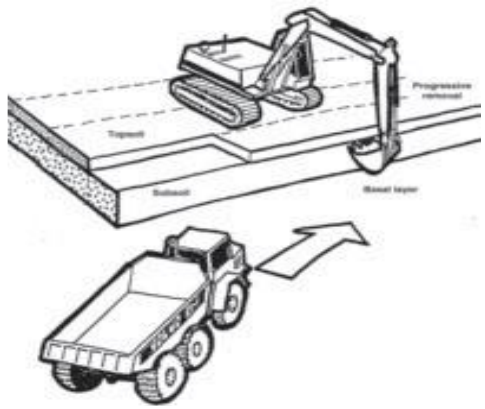
BADGER will prepare, in accordance with item MW-CH5 of the OEMP, an Archaeological MS setting out how we will preserve sensitive archaeological remains and prevent deformation of topsoil/ subsoil horizons (including no-dig solutions). The Archaeological MSs will be developed in compliance with the provisions of the DAMS and the approved HMP. Where the fill depth is >1m, topsoil will be removed prior to deposition of fill material. Archaeological mitigation will include archaeological excavation and recording, ploughzone artefact collection, trial trench evaluation, archaeological topographic survey. Preservation of archaeological remains is proposed where the fill depth is <1m and topsoil is to be retained in situ.

TOPSOIL STRIPPING

Topsoil will be stripped and placed into stockpiles, either by using dozers (outside the WHS) as per the methodology set out in Sheet 13 of the Good Practice Guide for Handling Soils (MAFF, 2000), or by tracked excavators with dump trucks used for transport to the storage areas.

The method illustrated in the right column is the preferred method for minimising damage to topsoil:

The transport vehicle is running on the basal layer under subsoil as subsoil is also to be stripped.



Stripping will be undertaken by the excavator standing on the surface of the topsoil, digging the topsoil to its maximum depth and loading into the designated transport vehicles.

Alternative stripping methods that can be shown to afford the same degree of soil protection will be also considered and acceptable.

Do

- ✓ Strip topsoil in the driest condition possible.
- ✓ Use tracked equipment wherever possible to reduce compaction.
- ✓ Confine movement of trucks or dumpers to designated temporary haul routes.

Don't

- ✗ Incorporate vegetation into topsoil to be stored.
- ✗ Strip soils during or after heavy rainfall or when there are pools if water on the surface.
- ✗ Strip topsoil too deeply so that subsoil becomes incorporated, thereby reducing fertility.
- ✗ Remove topsoil from below the spread of trees to be retained.

STRATEGY OF EXCAVATION CLASS 3

The classification of the material is in most of the project class 3, so in the cut sections the excavation will be mainly in chalk. Excavators from 45 tons to 65 tons will be used to excavate the material. The final slopes will be compliant with the Design and Technical requirements and based on BADGER's design. Temporary ditches will be constructed to manage the water to provisional or permanent ponds and not entering the scheme. If it is mandatory to revert to sources of water, a treatment and decantation will be done before pouring out to the natural courses.

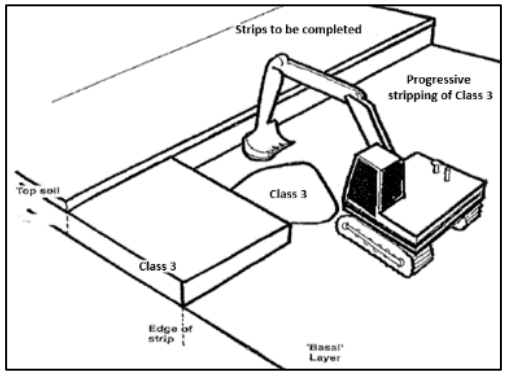
The earthwork cuttings intended to be used for the embankments will follow the earthwork section **series 600** drawings together with special requirements; additional test and geotechnical features from

the chalk will be investigated to understand the type of chalk and the procedures to manage this material.

In advance to the cutting works, the in situ soil will be tested for its suitability as fill material. If the material is suitable, it will be transported to the fill area and placed and compacted as defined by the method of compaction procedure (depth of layer, size of compactor and number of passes) according to table 6/1 and 6/4 of the Specification for the classification of the material. Trial pits and test will be developed to define the specific procedure to apply.

METHOD OF EXCAVATION OF CLASS 3

The preferred excavation method for Class 3 material is below:



Topsoil has been firstly stripped from all areas from which class 3 is to be removed for reuse.

Stripping will be undertaken by the excavator standing on the surface of the base/ formation layer.

The soil layers above the base/formation layer will be removed in sequential strips that can be up to the reach of a 360° excavator. A toothless bucket will be used for this stripping. The soil transport vehicle runs on the level where the base/formation layer will be placed.

Alternative stripping methods that can be shown to afford the same degree of soil protection will be also considered and acceptable. Prior to embankment construction, the formation will be inspected and all uncharacteristic areas or "soft spots" identified and soft ground removed to an agreed location. Suitable materials in cut areas will be excavated above formation level and placed in the embankment. The final 300mm of cut will be trimmed to final formation level with the GPS Bulldozer or other suitable survey instrument. The formation level will be proof rolled using a smooth drum roller. The formation of the cutting will be tested as per **Appendix 1/5**. These tests will confirm approval to continue to the next layer of construction (Capping Layer).

Do

- ✓ Strip the class 3 material in the driest condition possible.
- ✓ Use tracked equipment wherever possible to reduce compaction.
- ✓ Confine movement of trucks or dumpers to designated temporary haul routes.

Don't

- ✗ Strip soils during or after heavy rainfall or when there are pools if water on the surface.
- ✗ Mix soils of different quality and composition.

Strategy and Methods of treatment

Topsoil and subsoils within the permanent works are of good quality and in principle there is no requirement to import any topsoil or subsoil to the scheme for these uses.

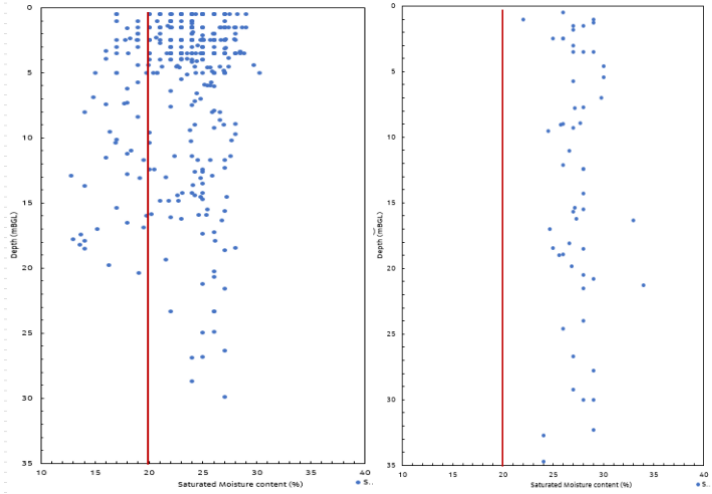
Achieving a high degree of suitability for reuse as embankment fill during construction will depend on good earthworks practice for chalk being used, such as:

- Limiting earthworks to drier months (the UK earthworks season is typically April to September)
- Avoiding earthworks in wetter periods
- Avoiding excessive handling of materials
- Good pre-earthworks drainage
- Sealing earthworks fill
- Providing a fall during construction to allow run off etc.

Due to the tight programme of works and specific requirements, earth works will be programmed in dry seasons, however works in winter season will be needed for some special works. In this cases, special methodology of working will be done to dry the material, **lime modification** will be utilised to render additional material acceptable; this is most likely to help manage the weather risk and avoid excessive haul distances. For the Landscape fill, no treatment of the material will be expected.

From our experience on other projects, the typical upper limit of moisture content to render chalk material into suitable for Class 3 is around 28%. Moisture content is under 28% in most of the locations, so BADGER consider that, minimising the disturbance of the surface water on the material, that most of the chalk will be available for embankments.

For the execution of the capping layer, to avoid the importation of a well graded material, BADGER will stabilise with cement the class 3 material increasing the strength and reducing the moisture. Additionally, the use of Lime will be considered too if it is needed.



West of Tunnel SMC vs Depth East of Tunnel SMC vs Depth

The above data shows that there is no material east of the tunnel with SMC < 20%. There is some material west of the tunnel with SMC < 20% but the majority has a higher SMC. Whether there is sufficient quantity (SMC<20%) depends on its location and whether it can be practically separated from the other material (SMC>20%).

Our approach east of the tunnel is defined below:

- We need approximately 40k m3 of Class 6I / 6J material to construct the reinforced earth walls at Countess
- At the eastern approach to the tunnel the volume of chalk to be excavated will be around 220k m3 of which around 50% is structured (weathered & competent) chalk.
- There is larger proportion of better quality structured chalk in the deeper cuttings west of the tunnel.
- Irrespective of where we get the chalk, we are unlikely to get a sufficient quantity of chalk with an SMC <20%.

The Highways England specifications require the use of good quality 'harder' chalk; however, it is possible to use softer chalk for reinforced earthwork .considering a ground improvement method

NOTE:
Methods and routes of transport are explained in point 5.1.4 of this document.
Placement and compaction are explained in point 5.3 of this document.

5.1.3 Locations and Methods of Storage

The topsoil to be stripped from the earthworks trace during the Main Works stage will be temporarily stockpiled until it is required for re-using on the various batters, verges and landscape areas as per Environmental Masterplan requirements. These temporary topsoil stockpiles are all located within the DCO boundary. The areas identified as suitable areas for surplus material (landscape/agricultural use), both topsoil and excavated material are well identified on the **QS-11C**.

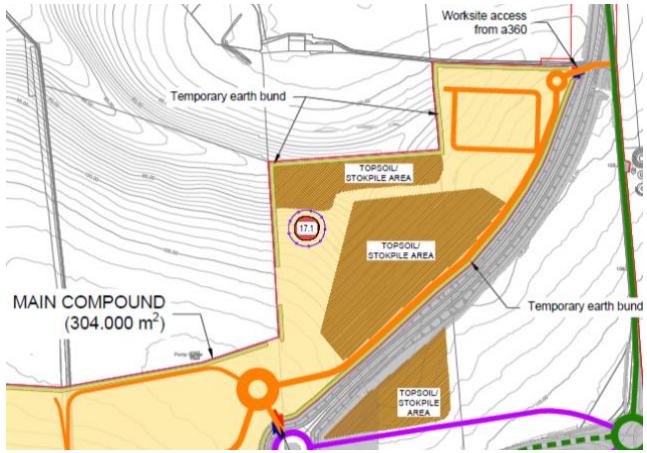
As per our calculation, there will be space enough within the site boundaries to accommodate all the stockpile and surplus material.

BADGER will include in the MSs before stockpiling the material, the mitigation measures to be adopted in compliance with the DAMS. These will include:

- No digging specific areas
- Protecting areas by temporary perimeter fencing or keeping in place the fence installed by the PW Contractor
- Installing the geotextile on the topsoil before to backfill in others defined areas.

The stockpiles will also be used to screen some working areas of the site, such as parts of compounds, from the public and to lessen the impact on views from the WHS. They will be sown with chalk grassland seed to reduce their visual impact. The Stockpiles will be no more than 2m high **(Ref. DAMS paragraph 5.2.62.).**

No topsoil will be stockpiled within the WHS during construction works. An area within the Longbarrow Interchange has been allocated for the topsoil removed from the western tunnel portal approach cutting within the WHS; this topsoil will be used during works to downgrade the redundant section of the A303 within the WHS to a restricted byway.



For the class 3 cutting, no store for fill will be considered. The material for the Landscape reprofiling areas will be place in the final position. Double handing for chalk material is not recommended in other to avoid the degradation of the material.

Methods of storage

The existing topsoil under and around the stockpiles will be retained in situ. A layer of High-Viz Orange Geotextile would be laid over the topsoil after light compaction by a smooth drum roller, and the topsoil stockpile placed over this.

We will follow the Defra code of practice for sustainable use of soils in construction for the stockpiling method. The methods for stockpiling will be chosen depending on the season in which we are working and the properties and conditions of the soil to be stockpiled.

Where possible, soil will be directly placed into stockpiles by excavators for small stockpiles.

We will prepare a MS describing the stockpile requirements, in consultation with Wiltshire Council and Historic England. The Method Statement will be prepared with reference to the guidance on preserving archaeological remains published by Historic England (Historic England, 2016c) and based on a specific own study developed in consultation with the design consultant considering:

- The development of a geotechnical engineering model of compression effects
- The development of a project design for the preservation of archaeological remains.

Temporary drainage measures will be adopted to avoid soil contamination in stockpiles and landscaping areas. Special attention to invasive species will be taken.

Soils will be protected from accidental contamination during storage and transit. We will detail in the relevant Method Statements the proper methods of soil handling and storage, including measures to prevent erosion by wind or surface water. This will be prepared prior to the commencement of the construction activities.

Additional protection measures for stockpiled soil are described in **5.3.3** of this document, according to the Specification For Highway Works Series 600.

Do

- ✓ Remove vegetation and waste materials from storage areas before forming stockpiles.
- ✓ Manage the site so that soil storage periods are kept as short as possible.
- ✓ Stockpile soils in the driest condition possible.
- ✓ Use tracked equipment wherever possible to reduce compaction.
- ✓ Protect stockpiles from erosion by seeding or covering them.
- ✓ Use clear signage to identify the content of stockpiles.

Don't

- ✗ Stockpile soils when wet or plastic.
- ✗ Stockpile soils of different quality and composition together, especially topsoil and subsoil.
- ✗ Stockpile subsoil or waste materials on top of topsoil.
- ✗ Locate stockpiles close to retained trees, drains, watercourses or excavations.
- ✗ Steepen stockpile sides beyond a slope of 1 in 1.75 (30°) in order to reduce the risk of erosion.
- ✗ Allow vehicles to run over stockpiles except during their construction.

5.1.4 Methods and Routes of Transportation of Material to the Storage Locations and Final Placement Locations

BADGER will transport the soil material from the excavation area to the deposition area or stockpiles (topsoil, engineering fill or landscape fill) through internal haul roads and by the existing A303 between Countess and Longbarrow Junction. The surplus material extracted from the Eastern Portal will be moved to the West section area through the A303 by commercial lorries during the peak off hours.
Haul Roads description is detailed in **QS-13A** according to DAMS Paragraphs **5.2.35** to **5.2.44**.
Layout drawing of the proposed haul roads during the different phases of the project is shown in **QS-13C** and **QS-11C**.

Wherever possible, construction plant will travel along the alignment of the Scheme using the footprint of the proposed embankments and cuttings, for example from the main site compound to the western tunnel portal. No haul roads are proposed within the WHS, other than those within the footprint of the proposed road alignment. Haul road maintenance and dust control measures will be adopted as defined in OEMP (**Appendix 2.2**). All haul routes will be removed upon completion of the earthworks and the land reinstated. The haul roads will be used predominantly by site traffic such as dump trucks engaged in earthworks activities, hauling material from cut areas to stockpiles and fill areas.

As the work proceeds, the routes of these temporary roads will be changed as required and will often travel through cuttings, across embankments and over the suitable areas for surplus material (landscape/agricultural use). No surface stone will be placed over these transient roads, unless required to maintain passage. The haul roads will be used all year including the winter months and will be maintained in accordance with item MW-TRA9 of the OEMP, however work will often cease if the weather is inclement.
A complete haul road, on the new A303 East Bound will be provided in order to communicate the west end of the scheme with the western tunnel approach. This haul road will be also used to transport the tunnel treated material to the Parsonage Down area.

At the River Till location, a temporary Bridge will need to be constructed to connect East and West sides. All the constraints regarding Environmental Issues and requirements will be achieved.

Although the proposed haul routes and the alignment of the Scheme will be used for the majority of on-site vehicle movements, it will be necessary to use the existing A303 for some operations. For example, while much of the material excavated at the eastern end will be used to construct the embankments for the Countess Roundabout flyover, there will be some surplus chalk material that will need to be transported during off-peak periods along the A303 from the eastern section of the works towards the allocated landscaping area.

Topsoil Removal from Stockpile to Final Placement Location

The inspection of the topsoil will be undertaken regularly to ensure that topsoil remains in a suitable condition. The stability of the stockpiles will be inspected on 7-day intervals or after any event that may affect the stability of the stockpile.

The excavation process will commence on the side closest to the stockpile entrance, working away from the entrance. The maximum height for stockpiles will be no more than 2m high, thus excavating the material in layers. The excavator will not be permitted to be sitting higher than the tail board of the associated Articulated Dumper.

The topsoil will be removed in an intermittent manner depending on topsoil reinstatement requirements. The geotextile would be carefully exposed during removal of stockpiles, taking care not to penetrate the original topsoil. At the end of each shift, the exposed working face will be sealed to prevent water ingress and battered at an appropriate angle depending on usage requirements.

5.2 Our Strategy for the Treatment of the Tunnel Arisings

5.2.1 Processing plant, layouts and locations

The treatment of the tunnel arising material, before final transport to Parsonage Down, will be executed by a Slurry Treatment Plant (STP). As per **Environmental Statement** requirement **Chapter 7,**

Section 7.8, Table 7.4, the Slurry Treatment Plant will be located to the west of the WHS and main compound and below the ridgeline. Reference location can be found in **QS-13C** layout drawings and **QS-11C** Mass Haul Diagram. These facilities will be provided with all necessary utilities' connection (electricity, water, sewage etc.)

All plant and equipment within the production areas will be equipped with BPM to minimise noise and vibration effects, based on the requirements of the **ES Chapter 9, Section 9.8**. This will be led by our Construction Manager supported by relevant site managers (**TQ3A1.4, TQ3A2.4, TQ3A3.4, TQ3A4.4).**

The STP position is in compliance with the **ES-Figure_2.7_ Construction Layout** as per clarification received from Highways England during the Competitive Dialogue.

The picture below (taken from **QS-13C**) shows the area dedicated to the STP and the updated layout.

5.2.2 The Processes to be employed to produce a Product suitable for Landscape Fill

The slurry treatment plant has the objective to reduce the moisture content and separate the excavated chalk coming from the TBM by:

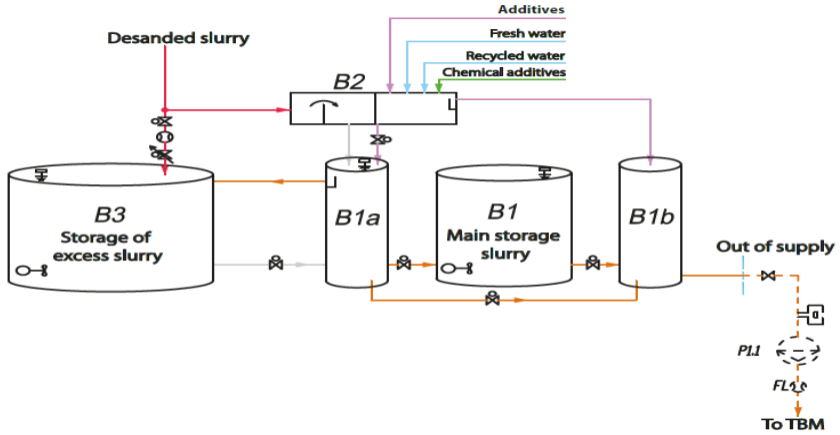
Prior to commencement of the tunnelling suitability testing will be undertaken on material representative of the chalk cakes together with the intended additives. The intention would be to correlate the moisture content of the processed tunnel spoil with density and CBR to determine a suitable upper limit of moisture content that will achieve a suitable level of compaction by dozers to produce a stable landform **in accordance with clause 620.** From our experience of other projects we expect this upper limit of moisture content to be around 30%. The testing will also consider the time between treatment and compaction as the material properties will improve over time. Moisture content will then be used to control the material suitability and required treatment with lime or biodegradable additives. Consideration will also be given to installing piezometers in the landscape fill to measure the dissipation of porewater pressure to ensure stability.

The chalk from the TBM will be pumped as a slurry to the treatment plant at Longbarrow compound, where it will be ultimately dried in filter presses after the separation of coarse materials. The main operations of the Slurry Treatment Plant consist in the following:

- Scalping / desanding / desilting
- Recycled slurry management
- Excess mud treatment
- Water treatment and management.

The trommel will be used for the material's separation at 6 mm; the desanding process is ensured by the passings of the revolving screen and is designed to produce approx. 70-80 µm in slurry; the overflow of each primary unit is directed pumped into the cyclones that are designed to reduce approx. 40-50 µm in slurry.

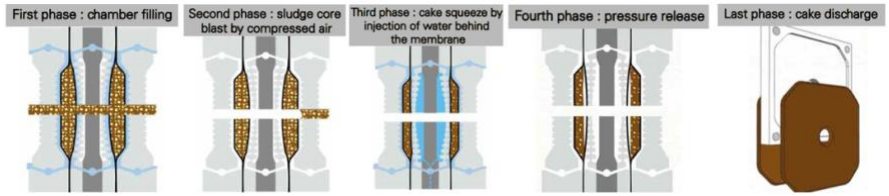
After desilting, the slurry is discharged from B2 tank into B1a tank via a monitored valve, after measuring the flow and the density. The excess volume is automatically directed into the "waste slurry" tank B3.



The mixing tank B2 receives the fresh and the additives mud from different sources.

These additions are controlled and monitored by the PLC according to pre-set criteria entered by the operator depending on the soil requirements and are readjusted automatically in quantities and qualities. The B1 buffer capacity stores a regenerated slurry with controlled density and characteristics, kept homogenised thanks to an immersed agitator. The slurry management and monitoring control section, measures and displays, in real time, the parameters.

The excess slurry (B3) is treated by a specific type of filter presses, equipped with a mixed pack type of plates, where filtration 0 to 7 bars is ensured by a volumetric pump and final squeeze is ensured by pressurized water injection behind the membranes at 16 bars. Filter-press is a stack of hollow plates creating chambers, maintained tight by a hydraulic cylinder between a fixed and a mobile steel plate. Plates covered by filtration cloths and protection under-cloths. The sludge feed at the centre fills first the chambers to initiate the filtration phase by retaining the solids and draining the filtrates through the cloth. Quickly, the cake build up inside the chambers acts as the real filtration media, and deliver "crystal clear" filtrates. These filtrates are recovered alongside the plates and collected in lateral channels.



Excess mud from the buffer tank B3 is directed to one storage silo with lime addition before pressing and without flocculation. In order to facilitate pressing, it is necessary to modify the internal structure of the mud before feeding the filter-press. Acid will be added as required to correct ph.

Additive options are currently being considered with two main alternatives:
1. Addition of lime with potential need to add acid to balance the pH.
2. Addition of biodegradable additives to minimise the impact on pH.

Trials, testing and further risk assessment will be implemented to determine the effect of altering pH and potentially changing the geochemistry of the chalk on mobility of contaminants such as phosphorous through the addition of lime and/or acid.

5.2.4 The Storage of Arisings pre- and post-treatment

The excavated materials by the TBM, will be pumped as a slurry to the treatment plant where it will be grain size separated, desilting and the excess slurry treated by a specific type of filter presses. After this treatment, the material will be stocked in a dedicate stockpile area right next to the STP. The available stockpile area will have capacity for 18.000 m3, considering an average production rate of circa 2000 m3/day (24 hours) this available stockpile area will be enough to accommodate the production of 9 days. As contingency and in case of needing, this available surface could be extended. The location of this stockpile is shown in **QS-13C**.

Some operations such as the adjustment of the granulometry by mixing coarse material for specific request of landfill, if necessary, will be make in the stockpile area before the material will be transported to its final destination.

5.2.5 Minimising and Disposing of unsuitable materials

The phosphatic chalk itself is considered unlikely to present a risk to human health or controlled waters in its natural form. This is based on the available geo-environmental data for phases of ground investigation, completed up to and including Phase 7A, the findings of the assessments completed in ES Chapter 10, the Groundwater Risk Assessment (Appendix 11.4) and additional submissions through the examination period in response to stakeholder relevant representations. Based on the current findings and conclusions, there is currently no indication from the perspective of environmental risk that the phosphatic chalk in its natural form requires segregation, management and dedicated disposal as unsuitable material.
The only site obtained material exported from site will be any Class U1 or U2 contaminated material identified during construction. Based on the ground investigation information this is likely to be limited. Currently we have quantified a volume of around 20k m3.

As defined in the **QS-13A,** the off-site disposal of excavated soil will be characterised to determine firstly whether it is Hazardous or Non-Hazardous waste in accordance with the Environment Agency's Technical Guidance WM3. The appropriate disposal facility will, where required, be determined through Waste Acceptance Criteria (WAC) analysis as required.

5.3 Our Strategy for the Placement and Compaction of Engineering and Landscape Fills in the Earthworks:

5.3.1 Locations and methods of storage

Please refer to section **5.1.3**

5.3.2 Transport routes and methodology for compaction

Please refer to section in **5.1.4**

Methodology for placing and compaction

TOPSOIL AND LANDSCAPING PLACING
The areas of landscape planting (chalk grassland and new tree/shrub/hedgerow planting) are required as part of the landscape mitigation design in order to integrate the Scheme back into the existing landscape. The Landscape filling will follow the earthwork section series 600 and the guidance in the Construction Code of Practice for the Sustainable Use of Soils on Construction Sites when handling agricultural soils and, in particular, the land to be reprofiled for use as permanent chalk grassland. Material to be used for landscape integration and habitat creation will be in accordance with:

- Soils management strategy
- Materials Management Plans

The topsoil and subsoils that are permanently displaced for the construction of the scheme will be reused within the scheme in landscape mitigation areas, highway verges and batters as close to their source as possible; these materials within the permanent works are of good quality and there is no requirement to import any topsoil or subsoil to the scheme for these uses. Additional information about the methodology for placement the Class 4 and Class 5A material can be found in section **5.4.2** of this document.

When placing the material, temporary ditches will be constructed to manage the water to provisional or permanent ponds and not entering in the scheme. Unstructured Chalk from cut areas will be deposited in the landscaping fill areas. The strategy for topsoil placement for the different habitats/ landscape types will take account of their various requirements, broadly as follows.

- For chalk grassland, thin soils will be targeted, with low nutrients (particularly phosphate) and high pH and calcium carbonate levels. Particular attention will be given to the guidance note prepared for calcareous grassland in MW_O1_7_1_15.
- For woodland, deeper soil profiles will be appropriate, with topsoil up to 400 mm thickness and uncompacted subsoils to provide rooting depth up to 1 meter below ground level.
- For agricultural restoration, soil profiles similar to the existing profiles will be reinstated to ensure that agricultural quality is maintained.

Further details of Calcareous grassland are shown in **QS-11A, Section 2**.

Consideration will be given to the mixing of topsoil with as-dug chalk and TBM arisings where appropriate to achieve suitable soil

conditions for the seeding of calcareous grassland. The topsoil will be placed to the thicknesses required in contract specifications and as shown on the BADGER design. This material will be placed by excavator to the required depths and graded to remove any stones and debris from the surface in accordance with the works specifications. It will be left smooth and even with a fine tilth prior to grass seeding.

Grass seed of the type required by the specification or other environmental measures will be spread or installed as soon as possible after the topsoil has been placed. Once seeding has been completed, the topsoil shall receive a light tamping and fertiliser as required per works specifications. Any areas which do not take adequately, will be re-soiled and seeded to landscape specification.

Within the landscape fill areas where the proposed fill depth is <1m, there are a number of known sites which will be separately fenced off and not covered over (according to **Appendix D** of the DAMS). At these locations, BADGER will also include in the MS (Preservation of sensitive archaeological remains) how we will grade out the fill and topsoil next to the protected sites to ensure that the sites remain visible in the landscape and that they are not left in relatively deep hollows.

The material to be used to protect and bury archaeological sites (in areas where the proposed fill depth is <1m) and to ensure the long-term preservation of archaeological remains will be selected in line with the Scheme requirements (including essential landscape mitigation), and following guidance provided by Historic England (Historic England, 2016c: Appendix 5, 'Materials for Use in the Reburial of Sites'). The guidance recommends that materials to rebury sites should be:

- Permanent and not subject to alteration or change over time;
- Cause no mechanical damage to the stratigraphy or to sensitive artefacts
- Release no new material into the stratigraphy;
- Have no significant effect on soil water chemistry of the stratigraphy; and
- Be visible to future archaeologists.

A geotextile barrier membrane or fabric sheeting will be used to provide a definitive boundary between the undisturbed stratigraphy and the fill material. This membrane will be of a geosynthetic composition (not an organic material due to danger of introducing microbial activity into the buried environment). It will also be permeable and will also provide a degree of load protection during fill operations.

BADGER will prepare the method for mapping and placement of topsoil, it will be set out in a Method Statement, in consultation with Wiltshire Council and Historic England and, for sites within or affecting the WHS, HMAG, and approved by Wiltshire Council.

PLACING CLASS 3

The earthwork filling to the embankments will follow the earthwork section series 600 drawings.

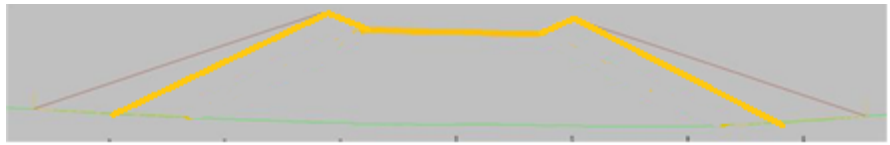
Suitable materials from cut areas will be deposited in the fill areas. The material will be spread and compacted as defined by the method compaction procedure (depth of layer, size of compactor and number of passes) according to table 6/1 and 6/4 of the Specification. The embankment will be filled and graded to allow water to shed off and the embankment will be sealed at the end of every working shift to prevent the ingress of water.

When the fill layer is completed it will be tested as per Appendix 1/5. These tests will confirm approval to continue to the next layer of construction. The process will be continued on each layer up to formation level.

Visual inspection and dynamic probes (Dynamic Cone Penetrometer) will be undertaken at sub formation before commencing pavement foundation construction to confirm the sub formation conditions and CBR design assumptions. These tests will confirm approval to continue to the first layer of construction. Structureless Chalk could be use in landscape fillings and Structured Chalk could be used in engineering embankments.

The protection methods to be applied for stored and placed fill (to prevent or minimise deterioration in the event of adverse weather conditions) are defined the section **5.3.3** of this document.

Structural fill: We have allowed for a 1v:3h "structural" embankment core of Class 3 with Landscape sides slopes and bunds of Class 4.



The figure above shows the structural fill (yellow line) from the top of false cut. Landscaped material (class 4) will be benched into the structural slopes to form the landscape shoulders. The embankment construction (yellow line) does not rely on the Class 4 material in any way for stability.

The slope angles are predominantly as shown in the 3D model provided by Highways England. Slopes are generally proposed at a maximum gradient of 1:3 aside from where particular constraints dictate the need for a steeper slope e.g. due to the proximity of DAMS areas, where this is the case slope angles vary between 1:2 and 1:3. So, generally:

For cutting slopes:

- Slopes are generally proposed at a maximum gradient of 1v:3h.
- Where particular constraints dictate the need for a steeper slope e.g., due to the proximity of DAMS areas, slope angles vary between 1:2 and 1:3.
- Retaining walls are required at the tunnel approaches
- Around Chainage 11000 where the existing A303 slope will be widened adjacent to a DAMs area, we will build a retaining structure like the solution we have proposed in the QS-5A Eastern tunnel approach aligned with the design vision of the project.

For embankment slopes:

- Most significant embankments have landscaping adjacent and have shallow slope angles
- At Countess the embankments are supported by retaining walls
- Environmental bund slope angles vary from 1v:3h to 1v:4h
- River Till approach embankments are at 1v in 3h

Landscape fill: Forming the shoulders to the highway model. As previously said, the embankment construction (yellow line) does not rely on the Class 4 material in any way for stability.

Compaction of Chalk fills

Table 6/4 of the Highways Agency Specification for Highway Works (2001) identifies different compaction plant appropriate for the compaction method specified for the different classes of chalk. This normally requires a smooth wheeled roller, a vibratory roller or a tamping roller whose weight dictates the layer thickness and number of passes necessary for adequate compaction. For Class 3, low and very-low-density chalk, there are severe restrictions on the maximum weight of vibratory roller that may be employed, typically 1800 kg/m width of roll.

The Specification for Highway Works does not permit use of heavy vibrating rollers (>1800 kg/m width) on chalk fill (Class 3) because of the excess porewater that these rollers release from the lower-density varieties of chalk. Typically, the landscape compaction will be applied after spreading and breaking down the larger lumps with a dozer.

BADGER will minimise noise and vibration from the construction of the Scheme by employing Best Practicable Means (BPM), as defined in OEMP MW-NOI1. Compaction activities will be carried out in accordance with Appendix 1/9 Control of Noise and Vibration.

5.3.3 Methods for the Protection of stored and placed fill to prevent, or minimise, deterioration in the event of adverse weather conditions

The methodology to protect the stored and placed fill will be executed according to the Specification For Highway Works Series 600.
The excavation of cuttings may be halted at any stage providing at least 300 mm of material as a weather protection is left in place above the formation or above the sub-formation.
The last 600 mm depth of fill up to sub-formation level, or formation level as appropriate, will, unless otherwise required in the Contract, be carried out for the full width of embankments, or between the outer extremities of the verges in other areas of fill, in a continuous

operation. We will then continue without delay to carry out either (i) or (ii) below:

(i) the construction of a lesser thickness of capping or sub-base as described therein laid as a weather protection layer;
(ii) place an additional 300 mm minimum compacted thickness of material above sub-formation level or formation level as appropriate for the full width of the filling to form a weather protection. This weather protection will be composed of the same material as the sub-formation or formation and compacted in compliance with Table 6/1. BADGER will provide the material from our own resources and the protection layer will be constructed in a continuous operation. For stabilised capping, the protective layer will consist of unstabilised material.

As explained in **5.1.3**, protection measures to the stockpiled material would be applied:

- To help shed rainwater and prevent ponding and infiltration a tracked machine compacts and re-grades the sides and top of the stockpile will form a smooth gradient.
- Temporary drainage measures will be adopted to avoid soil contamination in stockpiles and disposal area.
- Special attention to invasive species will be taken
- Soils will be protected from accidental contamination during storage and transit
- We will detail in the relevant MSs the proper methods of soils handling and storage, including measures to prevent erosion by wind or surface water. This will be prepared prior to the commencement of the construction activities.

5.3.4 Earthworks Classification and Control Measures which will be operated to demonstrate compliance with the approved earthworks specification;

Please refer to section **5.1.1** and **5.3.5**

5.3.5 Earthworks Laboratory and Resources deemed necessary to control the earthworks

The natural moisture content will be the principal method of control for chalk earthworks whether for method or end-product specification. The location at which moisture contents should be measured will usually be the point of excavation. The Chalk fill, however, can dry out rapidly on hot summer days and wet up on rainy days. If there is a delay of more than one hour between excavation and placement in the embankment or fill area, or if the material has altered its characterisation or become unacceptable for any other reason, additional moisture content samples will be taken at the point of deposition in the embankment or other fill area. These moisture contents will be used to determine the classification and thus the compaction requirements for the material.

The main site control tests for chalk fills are bulk density and moisture content (and by derivation, percentage air voids). These can be determined using sand replacement (BS 1377, 1990) and nuclear methods (also BS 1377, 1990). We will also use testing within the method specification during compaction of the fill. The introduction of nuclear methods for measuring chalk fill density and moisture content provides a quick means of checking suspect areas. If necessary, further tests, such as field inspection by trenching, may be required. Nuclear methods can be unreliable for measuring moisture content and where this is important (as for compliance testing of air voids), the principal procedure for moisture content determinations should be by standard ovens. We will adopt a high frequency of in-situ density testing to give reasonable confidence levels in the results.

Important considerations in interpreting the results of the in-situ density tests are the effects of the different particle sizes within the fill and in some situations, determination of the particle density.

The Testing methodology that we will apply will be done in accordance with **Appendix 1/5**.

5.4 Our Strategy for the Placement and Compaction of Landscape fill on Parsonage Down

5.4.2 Methodology for the placement and compaction of treated tunnel arisings

Parsonage Down, is an area of chalk grassland creation and it is subject to archaeological mitigation, according to the DAMS requirements prior to place any fill materials.

We will strip the existing topsoil in some specific area such as 44 and 45 of the DAMS before excavated material is dumped onto it (fill depth >2m). In some others areas such as 10.1, 10.2 10.3 and area 6 we will install a layer of geomembrane before to place the fill material (fill depth <= 1 m)

The dried chalk delivered to Parsonage Down will be distributed by dump trucks and spread and compacted by dozers or graders. The intention would be to avoid the need for further treatment of the spoil at Parsonage Down. Depending on the moisture content of the dried chalk and the time of year of filling, additional treatment with lime will be required to render the material suitable for tracking and compaction by dozers. Careful planning of the phasing of the works and haul road network in the landscape area will be undertaken to ensure the soil can be suitably distributed to provide the required contours and compaction to provide a stable landform. Accordingly consideration will be given to stabilising some of the chalk spoil with cement to provide a platform for the haul roads.

BADGER will carry out a 5,000m2 trial to develop the method of making Calcareous grassland in Parsonage Down. Filter pressed chalk will not be available for the trial and BADGER will make the material for the trial by rotovating chalk from the cuttings and adding a small amount of water until it has the consistency of filter pressed chalk. The manufactured chalk will be used in the base layer of the trial, circa 0.75m below finished level. A series of strips will be formed with different sub-soil, chalk/topsoil mixes (method and proportion), preparations and seeding (mixes and sowing/harrowing/rolling methods). The method for carrying out the re-instatement in Parsonage Down will be selected from the trail strips.

To restore the area as chalk grassland, consideration will be given to achieving sufficient permeability in the landscape fill underlying the topsoil. This will either be by suitable decompaction measures (e.g., ripping) of the placed tunnel spoil or via supplementary drainage measures (e.g., trenches or blanket). A thin layer of topsoil will then be placed suitable for a chalk grassland, although the thickness of the soil layers could also be increased to improve drainage.

5.4.3 Methodology for placement, compaction and surface treatment of landscape, or other fill

The Landscape filling will follow the earthwork section series 600. Slopes will be compliance with the BADGER Design. The soil will be handled only when dry or slightly moist and we will use suitable machinery in an appropriate way. Multiple handling of soil materials increases the risk of damage to soil structure, so this practise will be minimised.

The ‘loose tipping’ method, using dump trucks and hydraulic excavators or dozers to move and spread the topsoil and the landscape filling material, is the most appropriate method to use. The receiving ground will have been firstly loosened according the appropriate archaeological mitigation (Topsoil stripped and stockpiled in compliance with the DAMS).

The landscape fill will be placed with class 3, class 4 or slurry treated chalk. A dozer stands next to the newly dropped soil and spreads this to the required thickness. If there is more than one layer then the fill material will be laid in as many layers as needed and slightly compacted by using a low pressure dozer. The topsoil is lifted onto the subsoil and spread with an excavator or low pressure dozer.

Providing that soil conditions are suitably dry and dozer movements are minimised, this can gently consolidate the placed soil without causing over-compaction.