

Surcharging Technical Note February 2025

Project Name:	Lincolnshire Lakes (North)
Project No:	221638
Revision:	P02
Reference:	LIN-BWB-EGT-XX-RP-LE-0001_TN
Author:	James Farnsworth
Approver:	Ralph Sibley

Introduction

BWB Consulting Ltd (BWB) was instructed by Hargreaves Land Limited (the Client) to carry out an assessment of the feasibility of adopting a surcharging solution for the Proposed Development at the Lincolnshire Lakes Site.

This technical note is based on the ground investigation undertaken to date and provides an outline to the surcharging strategy. It is provided in support of Planning Application 1 at Lincolnshire Lakes (North), which comprises; a full planning application for the construction of a new vehicular access off the M181/A1077(M) roundabout, a pedestrian and cycle link to Scotter Road, a foul pumping station, earthworks and 'off-plot' drainage, ecological and associated landscaping and infrastructure works, and an Outline planning application, with all matters reserved, for the development of up to 550 residential dwellings (Use Class C3), a local centre (Use Class E) and associated 'on-plot' landscaping, drainage and other infrastructure works.

Site Setting

Lincolnshire Lakes (North) is recorded from BGS records to be underlain by Warp Deposits (anthropogenically placed 'alluvium') and natural Alluvium. BWB has recently undertaken a limited ground investigation across the wider area to the east of the A1077, the results of which concord with the geological records for the area.

The ground investigation, which consisted of trial pits and dynamic sampling, investigated Superficial soils to depths of between 3m and 5m below ground level (bgl). The exploratory holes revealed more granular deposits than were originally anticipated, typically described as silty sand with some gravel. Frequent peat bands were encountered which were typically of limited thickness, as well as some soft clay layers.

Historical borehole records from the wider area indicate that the bedrock geology is some 8m to 12m beneath existing ground levels, and so characteristics of the deeper Superficial soils at the subject site have not been confirmed. This means that the efficacy of any proposed ground improvement scheme will need to be verified by deeper ground investigation prior to detailed design.

Surcharging Principles

The principle behind surcharging of low strength/compressible soils is to subject them to an external stress, over the short term, to a load greater than that of the Proposed Development. The external stress is usually applied via the placement of a defined thickness of material over

the area to be surcharged. During the surcharging process the additional load promotes settlements as the low strength soils are 'pushed further along the stress path'. In turn, following removal of the surcharge, this process leads to a reduction in long-term settlement of the development following construction.

In general, imposing a higher surcharge load will result in a reduction in the timescale required to achieve the desired induced settlement. For low permeability soils, band drains (also known as prefabricated vertical drains or wick drains) can be installed to shorten drainage paths and accelerate the rate of settlement.

Surcharging details can be varied to take into account of:

- the construction programme / timescales;
- the amount of surcharging material available;
- the density of the surcharge material;
- the proposed finished ground levels;
- soil thickness, and
- soil permeability (vertical and lateral).

The design of a surcharging strategy requires detailed ground investigation, monitoring and testing, as the eventual induced settlement and the time taken to achieve that settlement are functions of the thickness of compressible soils and their permeabilities. The nature of Superficial geological deposits means that there is inherently variation (thickness and properties) in the soils encountered, both laterally and vertically. Comprehensive ground investigation is likely to raise confidence in the design of the surcharging strategy adopted, the efficacy of which then needs to be verified by monitoring during the surcharging exercise.

In this case, the importing of material to the site is unlikely to be economically viable, particularly as it should be possible to obtain site-won material from phased development and/or borrow pits. In addition, by not importing significant quantities of material to the site, associated vehicle movements would not take place and there would therefore be a benefit in terms of environmental impact.

Ground Investigation

Before a surcharging strategy can be fully designed, detailed information is required to be obtained from further ground investigation. The ground investigation is likely to include deep cable percussive boreholes advanced incompressible bedrock strata, which is anticipated to be approximately 10m to 15m bgl. A suit of laboratory geotechnical testing will be required on samples obtained from the boreholes from which relevant parameters can be determined and the surcharging solution designed in detail. The ground investigation and representative parameters will need to be reported upon together with the assessment and detailed ground improvement design.

Surcharging Proposals

BWB has based their proposals on the presumption that the final development levels have been agreed with respect to flood levels but, it is noted that the Environment Agency has suggested that they are undertaking a catchment wide review of the River Trent which may require further review once complete.

The design of the surcharging approach has used information obtained from the ground investigation to determine the anticipated rate and magnitude of settlement that is likely to occur. A sensitivity analysis may be performed, whereby the height/load of the surcharge are varied to determine what may be optimal in terms of balancing timescale with material

volumes and material movements (potentially with and without the addition of band drains). The surcharging works will need to be subject to ongoing monitoring to validate the efficacy of the design; ideally the settlements will be monitored until all primary consolidation is complete and the creep settlement stage can be demonstrated to have been attained.

From the soils data available, a surcharge thickness of up to 5m is expected to be required provide the loading needed to expedite settlement sufficiently to attain suitable ground conditions for the nature of the development proposed. The surcharge mound is proposed to comprise a mix of site-won topsoil and subsoil materials.

From the site investigation undertaken, there is an average topsoil depth of 390mm on the development areas to the north of Brumby Common Lane. To the south the depth is slightly greater with an average of 430mm.

A site strip drawing relating to the initial removal of topsoil has been prepared (LIN-BWB-CIV-XX-D-C-0650_Site Strip Coordination Plan_S1-P02) and this reflects the expectation to minimise the total area which is to be subject to this engineering operation. Areas HA4 and BG3 to the east of the first phase development will be left untouched given the need to manage the ecological considerations for this part of the overall site.

In order to ensure the availability of an adequate volume of material, it is proposed to remove the topsoil from HA6, HA7, BG4 and AB3 to the south of Brumby Common Lane. This will allow access to the subsoil beneath those areas and the proposal is to excavate a 1m depth of subsoil on BG4, HA6 and HA7. The subsoil material will be utilised for purposes of surcharging and bulk earthworks upfill where required.

The level of the prevailing groundwater has been determined as part of the ground investigation works. The indicated depth of 1.5m below the existing ground surface means that the maximum proposed excavation depths across BG4, HA6 and HA7 will not intercept groundwater.

The future use of BG4 for attenuation of surface water flows from the proposed development of the site to the south of Brumby Common Lane means a large element of the excavation works will be permanent, albeit that it is recognised that adjustments will be introduced for permanent placement of topsoil where necessary and subsequent enhancements to the proposed lake's amenity value as necessary. A section through the borrow pit area to the south of Brumby Common Lane is depicted on drawing LIN-BWB-CIV-XX-D-C-0660_BG4-AB3 Borrowpit Section and Plan_S1-P02.

In order to restrict colonisation of the borrow pit areas by wildlife and access by the public, an appropriate secure fence will be installed around the perimeter of the excavated areas. This fence will be managed and maintained until the development of the land to the south of Brumby Common Lane proceeds.

Monitoring

Comprehensive monitoring of the surcharging will be required to validate the design and provide confidence that primary settlements are complete.

The monitoring is likely to consist of a range of measures to record settlements and pore pressures within the loaded soils, which are likely to include extensometers, settlement plates, vibrating wire piezometers and high accuracy surveys.

The monitoring data will be subject to ongoing analysis, including plotting on log/ root square graphs, so as to assess when primary consolidation is considered to be complete.

Completion and Validation

When primary settlement is determined to be complete beneath the surcharged area, the treated area can be unloaded, and the soils utilised in further surcharging zones and ultimately elsewhere on site. It may be possible to use these to attain the required flood levels, or off-set volume reductions resulting from to compression from the surcharging exercise.

Summary

BWB trusts that this technical note provides an appropriate explanation of the surcharging process for planning purposes. It should be noted that the scope of the later elements may be subject to amendment once further assessments and investigations have been completed.