

Mousesweet Brook Improvement Scheme, Dudley

Client: Dudley MBC

Designer: Mott McDonald

Value: £1.55m

Start date: Oct 2016 - June 2017

This scheme was undertaken to replace an existing 'keyhole' shaped brick culvert carrying the Mousesweet Brook beneath the 10m high Mushroom Green Embankment in Cradley Heath. A combination of undersizing, poor condition and frequent blockage of the trash screen was resulting in regular flooding of the upstream catchment in storm conditions with the added risk of catastrophic embankment failure which would not only release impounded flood water but would also result in the loss of 2 critical Severn Trent foul sewers (675mm and 750mm dia) which, run across the embankment, and would cause extensive foul flooding. The contract was carried out for Dudley Metropolitan Borough Council who had obtained funding for the scheme from the Environment Agency (EA).

We were approached by Dudley MBC Engineers to assist in the development of a solution for the scheme which also had a number of constraints including;

- A design flow requirement of 25m³/sec at a gradient of 1:500
- Mushroom Green embankment is constructed from poor quality ash and clay made ground soils
- Severn Trent Water would not allow the 2 critical Severn Trent sewers to be diverted or interrupted
- The EA required a flat bottomed culvert solution to allow for habitat creation and species migration, based on the design flow requirement this necessitated a 4.2m x 3.0m ID pre-cast concrete culvert
- The work was in a nature reserve and had a number of ecological constraints including; nesting birds, bats and badgers as well as invasive species such as Himalayan Balsam and Japanese Knotweed

We were able to negotiate a 'target price with risk register' contract with Dudley on an open book basis.

A number of options were considered at ECI stage however given the constraints we proposed a culvert jacking solution. The final design incorporated a 45m-long section of pre-cast concrete culvert with gabion supported inlet and outlet structures as well as re-configuration of the upstream and downstream channels. The new alignment was constructed offline of the existing culvert and brook channel with flows diverted as a final activity.

Due to the potentially unstable embankment soils the jacked section was limited to 28m with the remainder of the culverts being installed in a sheet piled cofferdam in the longer downstream face of the embankment. Jacking was undertaken from a 10m x 8m x 9m deep sheet piled drive pit with a reinforced concrete base and thrust wall. Each 1.5m long culvert weighed 17.9 tonnes and the jacking system was designed for up to 880 tonnes jacking force (8 no 110 tonnes capacity rams), in case of high friction loadings building up during the jack.

A 3tonne mini-excavator and a Bobcat skid-steer loader were used in the culvert for excavation and removal of spoil into skips. A 100 tonne all terrain mobile crane was used to handle the culvert units and to service the drive pit.

The culvert jack was undertaken by specialist HB Tunnelling and the culverts were designed and manufactured by Shay Murtagh in Northern Ireland.



Mousesweet Brook Improvement Scheme (Cont'd)

In order to mitigate ground conditions and other risks we incorporated a number of special measures in the scheme;

- Pre-stabilising the mainly ash strata above the proposed culvert to improve its stability and strength by grout injection through an array of angled drill holes.
- Pre-installation of 2nr 450mm diameter steel cased auger bores to act as guide rails for the culverts in case of encountering soft ground.
- A purpose built heavy duty steel shield with face support and anti-drag system was used.
- Settlement calculations were carried out to ensure that projected settlements were within acceptable limits.
- Extensive monitoring was carried out during the jack.
- The above ground 750mm dia cast-iron sewer was provided with new support pads, temporarily strapped and jacks installed to ensure existing levels could be maintained should any settlement occur.
- The culvert jack was carried out on a 24/7 basis to ensure jacking loads were minimised.
- An emergency plan was agreed with Severn Trent Water to divert, tanker or overpump the sewer flows if necessary.

Access to the site was poor and a 140m long temporary site access road to the site was installed from Forge Lane which was designed to accommodate crane and culvert deliveries. A crane hardstand, working area and turning head was constructed adjacent to the jacking pit.

The retaining walls to the inlet and outlet structures were formed from gabions with grey PVC coated wire. Each of the stepped gabion walls was 3.5m wide at the base narrowing to 1m at the top with largest being 9.5 x 4.5m. The gabions were filled with 75/150mm graded Granite.

Other works included;

- RC headwalls constructed above the end culverts.
- Handrailing to both culvert headwalls.
- The culvert and the new brook channel profiled and filled with a 300mm layer of 150/300mm Granite.
- Following flow turning the existing brook channels were filled and landscaped with surplus soils.
- The new brook embankments were protected using layers of Salix Bio-Net and Coco-Net, the embankment toes lined with Salix Coir Rolls and Faggots to prevent embankment erosion.
- Extension of an existing surface water sewer outfall pipe with a new headwall.
- Reinstatements including installation of 175m of 2m wide pedestrian footpath and new fencing.

We worked closely with Dudley MBC engineers, designers, the park wardens, ecologists and other stakeholders in order to successfully deliver the scheme with minimum impact on the environment.

