Wilts & Berks Canal Trust

TECHNICAL NOTE

Flood Protection of
New Eastern Villages

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Approvals

RWSewerniak — 24th January 2016

Richard Sewerniak – Originator — Date

Eddie Thomas – Engineering Manager — Date

1 INTRODUCTION

1.1 Summary

1.1.1 The objective of the Wilts & Berks Canal Trust (WBCT) is to reinstate the original Wilts & Berks and North Wilts canals and branches as constructed in 1810. The ultimate goal is to restore a continuous navigable waterway linking the Kennet & Avon Canal near Melksham, the River Thames near Abingdon and the Thames and Severn Canal near Cricklade.

1.1.2 The original route of the Wilts & Berks Canal passed through Swindon. However, due to the urban development, the canal cannot be easily reinstated through the town centre. Instead the proposed realignment is to be to the south and east of Swindon as shown on Figure 1.

1.1.3 The proposed canal route to the east of Swindon passes through the floodplain of the River Cole, intercepts the Liden Brook, a tributary of the River Cole and bisects the proposed New Eastern Villages housing development.

1.1.4 The New Eastern Villages (NEV) forms part of Swindon Local Plan 2026 promoted by Swindon Borough Council (SBC). The intention is to permit the development of 8,000 houses in the floodplain of the River Cole. The first two development areas are known as Lotmead and Redlands; these are indicated on Figure 2.

1.1.5 The development of housing in the floodplain will affect the natural drainage in two ways:

a) The impermeable area will increase thus the quantity of rainfall run-off will be much greater.

b) The areas developed will constrict the floodplain leading to an increase in fluvial flooding depths.

1.1.6 The floodplain has flooded in the past specifically affecting properties and the A420 trunk road in July 2007. As well as providing an amenity and adding value to the New Eastern Villages, the proposed Wilts & Berks Canal will provide flood control measures to counteract the increased fluvial flood risk resulting from the proposed development.

1.2 Details

1.2.1 The environmental impact assessment of the first two developments at Lotmead and Redlands acknowledges that there will be an increase in the rainfall run-off from house roofs, roads, pavements and other impermeable hard surfaces. It is proposed that this increased quantity of drainage flow is to be catered for by Sustainable Urban Drainage schemes (SUDs). However such schemes are to be designed in a piecemeal manner only considering each particular development in isolation. The aggregate effect of the overall increased drainage from all the planned developments has not been fully investigated. In addition SUDs require considerable maintenance to ensure that they perform properly and as yet the responsibility and associated costs for this maintenance is not defined.

1.2.2 In accordance with the SBC's planning policy, the proposed New Eastern Villages are to be constructed on artificially raised islands within the River Cole floodplain (shown on Figure 3) such as to be above the predicted flood levels. However the predicted flood levels are unknown. The effect of raising the ground for the NEV development will constrict the floodplain, removing flood storage volumes thus increasing the flood depths.

1.2.3 All the drainage of the River Cole and the tributaries feeding it from the downs is channelled towards one outlet, which is Acorn Bridge, a box culvert under the A420 trunk road and an arched brick culvert under the main railway linking London and the west. Acorn Bridge culvert is believed to be close to capacity and has previously been overwhelmed in July 2007 with flooding of the A420, properties near South Marston and surrounding farmland. With the predicted increase in peak drainage flows from the proposed developments the culvert will form a significant bottleneck, which will cause floodwaters to back-up potentially inundating the New Eastern Villages.

1.2.4 This increased flood risk due to the development in the floodplain can be averted with the construction of the Wilts & Berks Canal as described below.

2 FLOOD MITIGATION

2.1 Description

2.1.1 The proposed alignment of the Wilts & Berks Canal is along the floodplain of the Liden Brook a tributary of the River Cole. Apart from the development at Redlands, the canal embraces all the New Eastern Villages development areas to the North West, as shown on Figure 3, thereby shielding them from drainage flows and artesian groundwater emanating from the North Wiltshire Downs in the south east. In effect the canal embankment forms a flood protection barrier.

2.1.2 Under dry weather conditions cross drainage culverts beneath the canal permit low flows draining from the downs to pass into the River Cole floodplain. Under high rainfall conditions storm flows are prevented from rushing into the River Cole due to the throttling effect of the cross drainage culverts. Instead the canal embankment would act as a dam creating attenuation ponds. These ponds provide storage for the high peak flows, hence protecting the New Eastern Villages from excessive flood waters.

2.1.3 To further enhance the storage volume of the attenuation ponds, low lift pumps can be installed. These can extract water from the attenuation ponds and discharge it into the canal. Bypass weirs around each lock structure can convey this excess water to the lowest canal pound north of the main railway line.

2.1.4 Alternatively, in place of the low lift pumps, an open channel running alongside the toe of the canal embankment can convey water by gravity from the attenuation pond to the next lowest canal pound downstream of a lock structure. The flow in the channel can be controlled by a gated structures at both inlet and outlet end of the channel.

2.1.5 At the lowest pound excess water can be released from the canal via a side spill weir and returned to the River Cole north of the A420 and railway. The design of such release structures on the canal to return excess water to the river will be carefully considered to prevent any issues of cross-contamination in accordance with Environment Agency (EA) requirements.

2.1.6 The proposed Redlands development is relatively small and is already on naturally high ground. Even though this development is to the south east of the flood barrier formed by the canal, drainage from the development will flow into the Liden Brook and will accumulate in attenuation ponds where pumps or channels can discharge the water into the canal.

2.1.7 The Met Office provides a service which predicts the rainfall intensity throughout UK. This together with numerical fluvial models and ground saturation conditions can be used to predict the amount of rainfall run-off from the downs. When an extreme storm is predicted, the section of canal through the NEV can be closed to navigation and the water level lowered by an amount such as to provide the storage volume needed for conveying the excess drainage water into the canal thereby preventing extreme flows from entering into the River Cole floodplain.

2.1.8 The size of the attenuation ponds and the capacity of the low lift pumps or the channels conveying flood waters to the canal can be optimised so that functioning together they can cater for a storm with a 1 in 100 year return period. In the case of low lift pumps, the storage volume of the attenuation ponds can be maximised such that the capacity of the pumps need not be necessarily high. The storage volume is controlled by the size of the cross-drainage culvert under the canal and the canal embankment height. These are to be determined through hydrological studies.

2.1.9 Pump stations may be in the form of submersible duty-standby pumps with variable frequency drive and level control although this needs careful design. The pumping stations would require a power supply and would need frequent maintenance and exercising. In addition a secure housing would need to be provided against theft or damage. Therefore, where ground and canal water levels permit, the preference would be to construct a gravity channel with inlet and outlet structures to convey flood water from the attenuation pond to the next lowest canal pound. Such a channel would require considerably less maintenance than a pumping station. The local land owner may have an incentive to maintain the channel as explained in 2.1.12.

2.1.10 Once diverted into the canal, flood flows can be conveyed northwards via the canal around each lock from pound to pound and through the proposed new culvert taking the canal under the railway where excess flow can be released into the River Cole. In effect the canal culvert acts as a by-pass to the Acorn Bridge box culvert under the A420 and protects it from overtopping under high flow conditions. Since the canal needs to pass under the railway only, unlike the River Cole which passes under both the road and railway and therefore is at a lower level, there will be adequate head to discharge excess flow from the canal to the river.

2.1.11 Figures 4, 5, 6 and 7 show schematic views of attenuation ponds, a typical low lift pumping station and a gravity conveyance channel.

2.1.12 The formation of attenuation ponds by the inundation of farmers' fields may be advantageous to farmers. The Environment Secretary announced this month (January 2016) that EU grants are to be provided to farmers who designate land to be inundated in heavy rain to prevent fluvial flooding of urban areas downstream. The National Union of Farmers (NUF) supports this proposal. With the canal forming the flood barrier, farmers will not need to build any earth bunds to form the attenuation ponds but may still be entitled to reward for allowing their land to flood. Where gravity channels are to be provided instead of low lift pumps, farmers may be required to maintain these channel in the same way as clearing drainage ditches at present.

2.1.13 The developers propose to construct the housing developments on raised islands so that the properties, roads and footpaths are set above predicted flood levels. In order to locally raise the ground levels significant volumes of material will be required. A source of suitable fill material can be obtained from the excavation of the proposed canal. Preliminary calculations indicate that there will be a surplus spoil of over 100,000m^3 originating from this section of the canal. The developers should include the excavation of the canal as part of the development work to utilise the excess spoil for the formation of the raised islands.

2.1.14 There may be opportunities to utilise the canal for ground source heat pumps to provide geothermal heating and cooling for nearby properties. This can be in the form of closed or open loop systems. The canal provides a ready excavation for such sustainable systems and requires only the installation of coils of pipes in the canal.

2.2 Summary

2.2.1 The benefits provided by the construction of the Wilts & Berks Canal around the proposed the New Eastern Villages is summarised as follows:

a) The canal forms a flood barrier protecting the NEV and prevents excess water from the North Wiltshire Downs flooding the NEV.

b) Cross drainage culverts under the canal can be sized so as to throttle flood waters and form attenuation ponds adjacent to the canal embankment.

c) Low lift pumps or gravity channels can convey excess water from the attenuation ponds into the canal. This can be used as replenishing water for the canal and as a further measure to prevent inundation of the NEV.

d) Farmers who permit their land to flood in the form of attenuation ponds in order to protect urban areas can receive financial reward.

e) Met Office predictions of rainfall intensity can be used to temporarily lower the canal water levels before a storm to provide the required storage capacity.

f) The canal is a route for conveying excess flood water through the proposed canal culvert under the railway thereby providing a relief to the existing culvert for the River Cole under the A420, hence reducing flood risk.

g) The excess suitable spoil from the excavation of the canal can be used to form the raised islands for the New Eastern Villages.

h) The canal can be used as a source for geothermal heating and cooling of houses in the New Eastern Villages.

2.2.2 Figures 8, 9, 10, 11, 11 and 12 give the detailed plan alignment and profiles of the Wilts & Berks Canal.

3 CONCLUSIONS

3.1.1 The construction of the Wilts & Berks Canal through the NEV development is advantageous to all parties; SBC, the developers, EA, residents, landowners, farmers and the WBCT. The Wilts & Berks Canal Trust recommends the participation of developers and other interested parties to form the canal as part of the construction of the New Eastern Villages.

Figure 1 – Plan alignment of Wilts & Berks Canal and branches

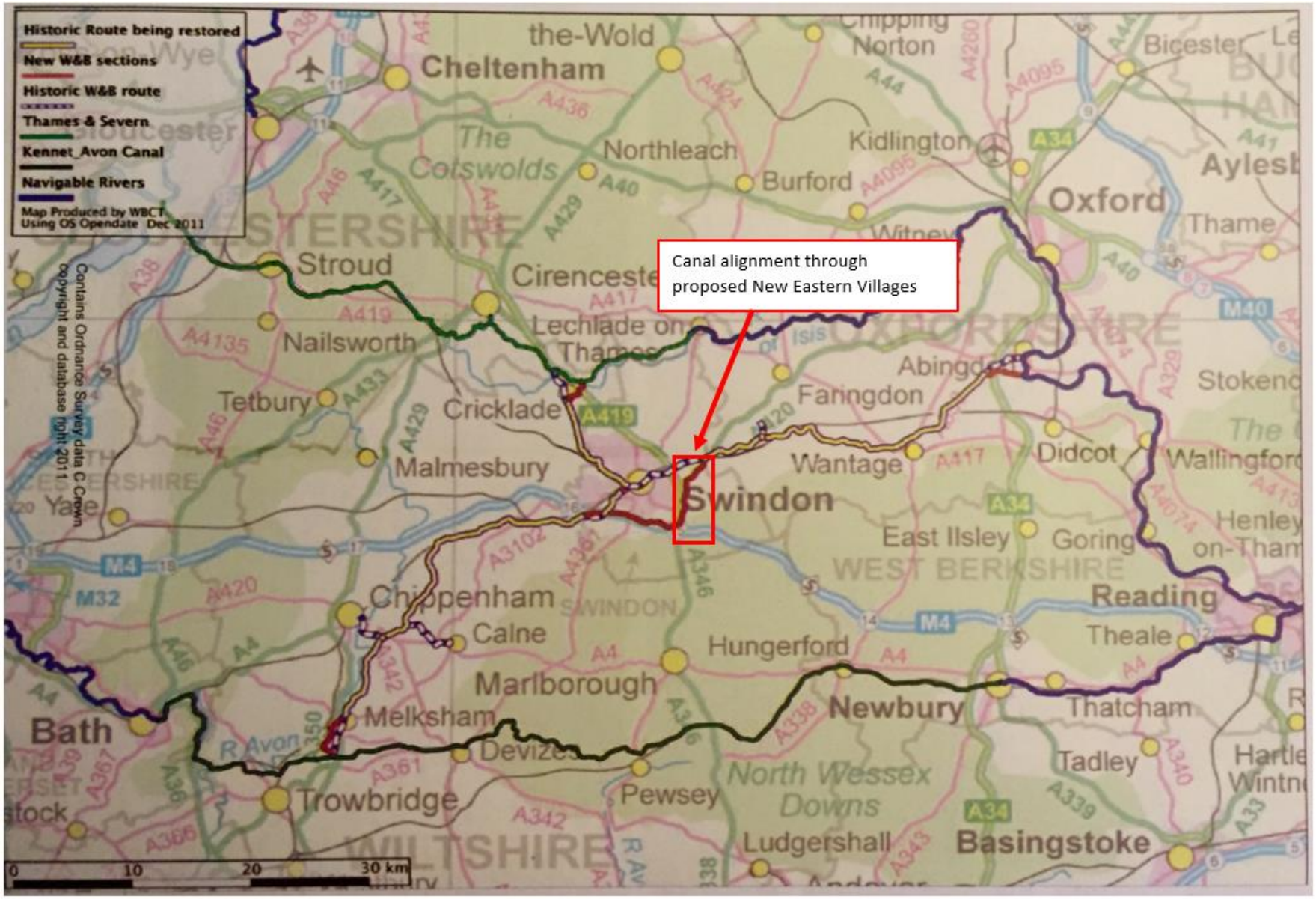


Figure 2 – Plan of proposed canal East of Swindon

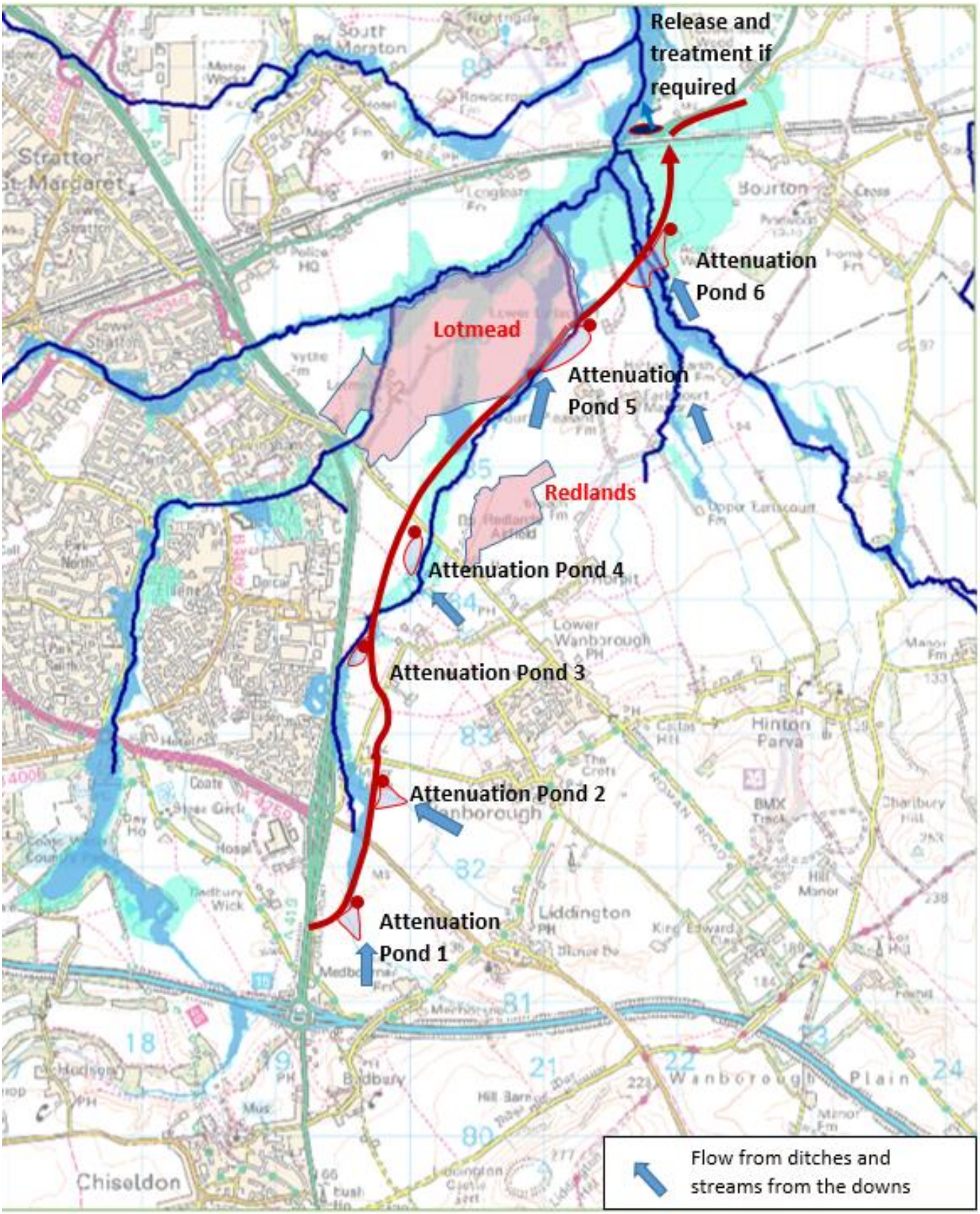


Figure 3 – Proposed canal through New Eastern Villages

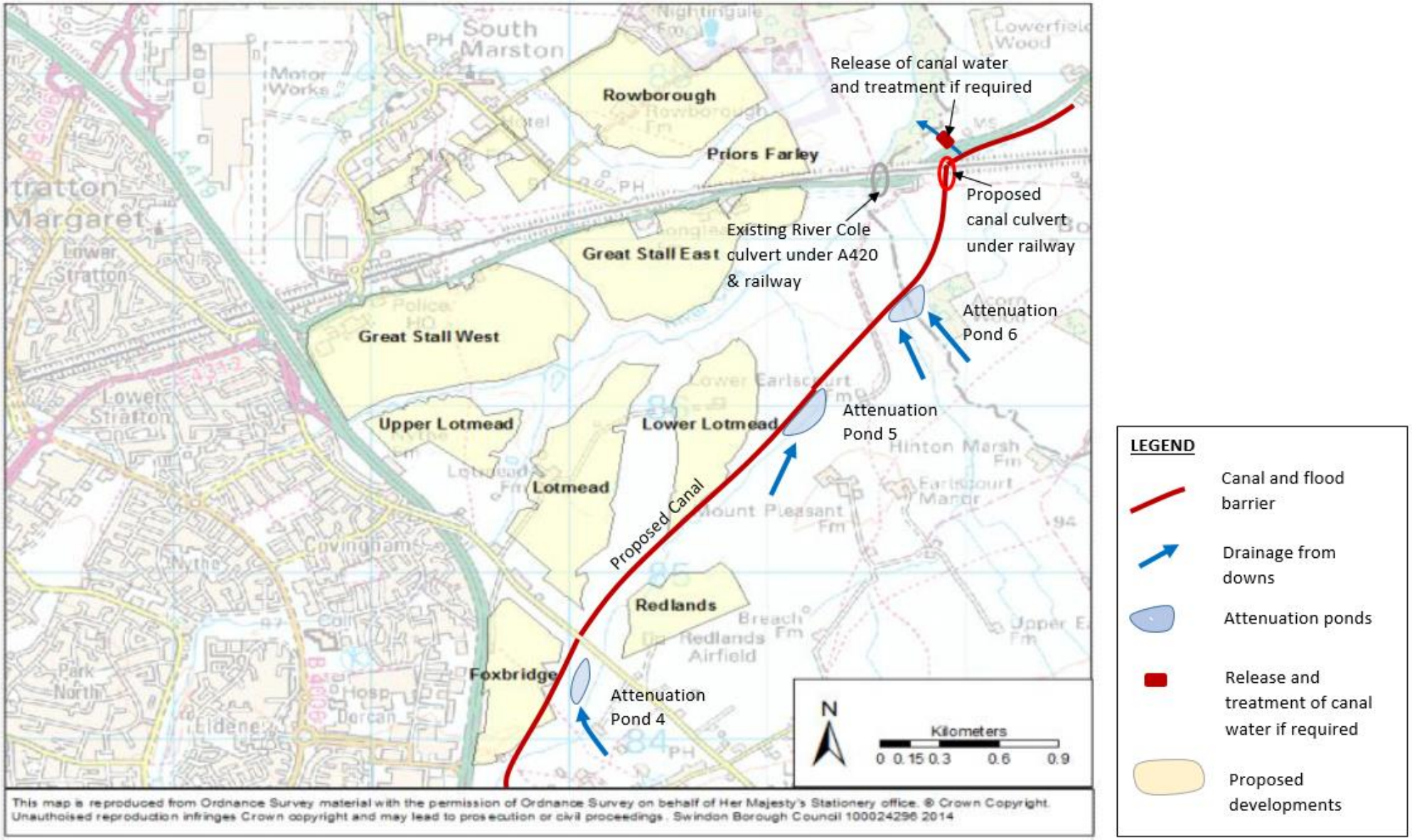


Figure 4 – View of canal through Liden Brook floodplain

Figure 5 – View of canal and attenuation pond

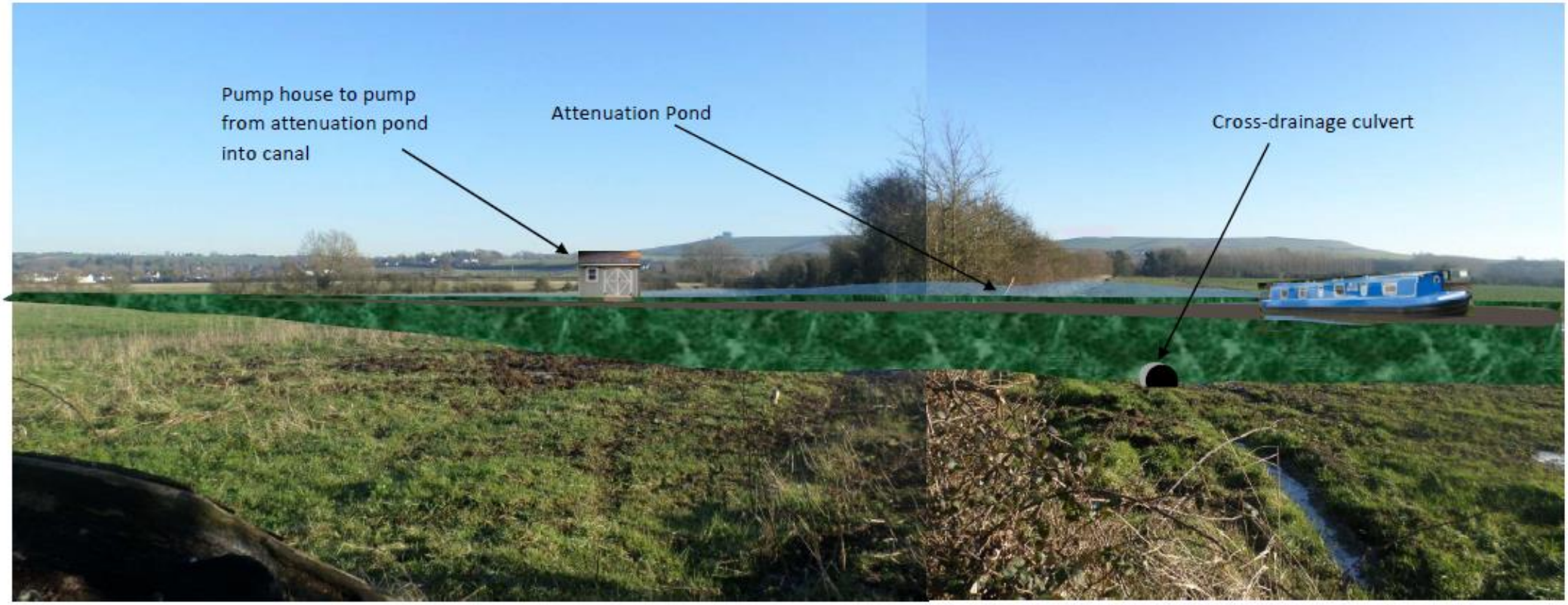


Figure 6 – View of low lift pump arrangement

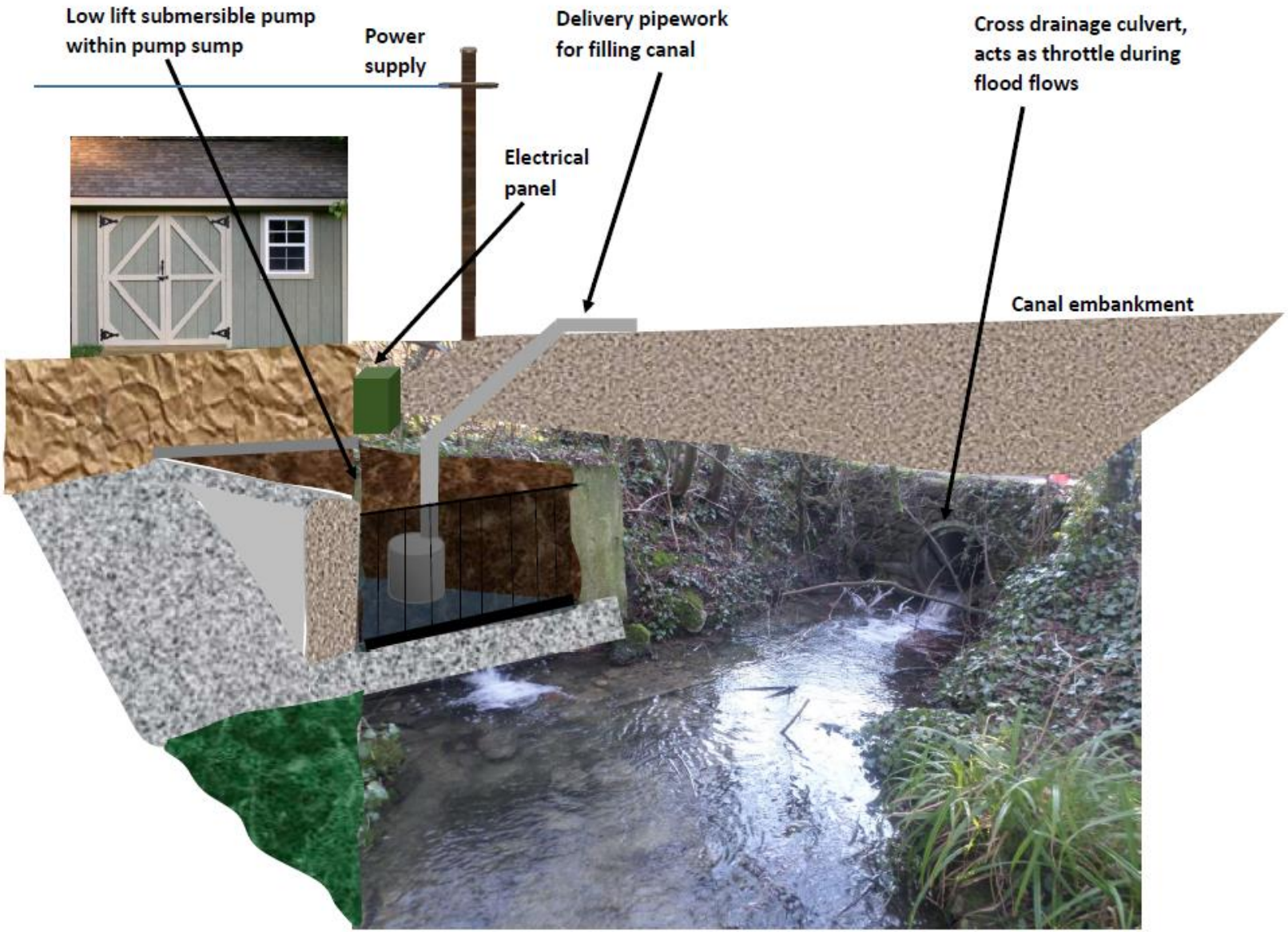


Figure 7 – View of channel from attenuation pond

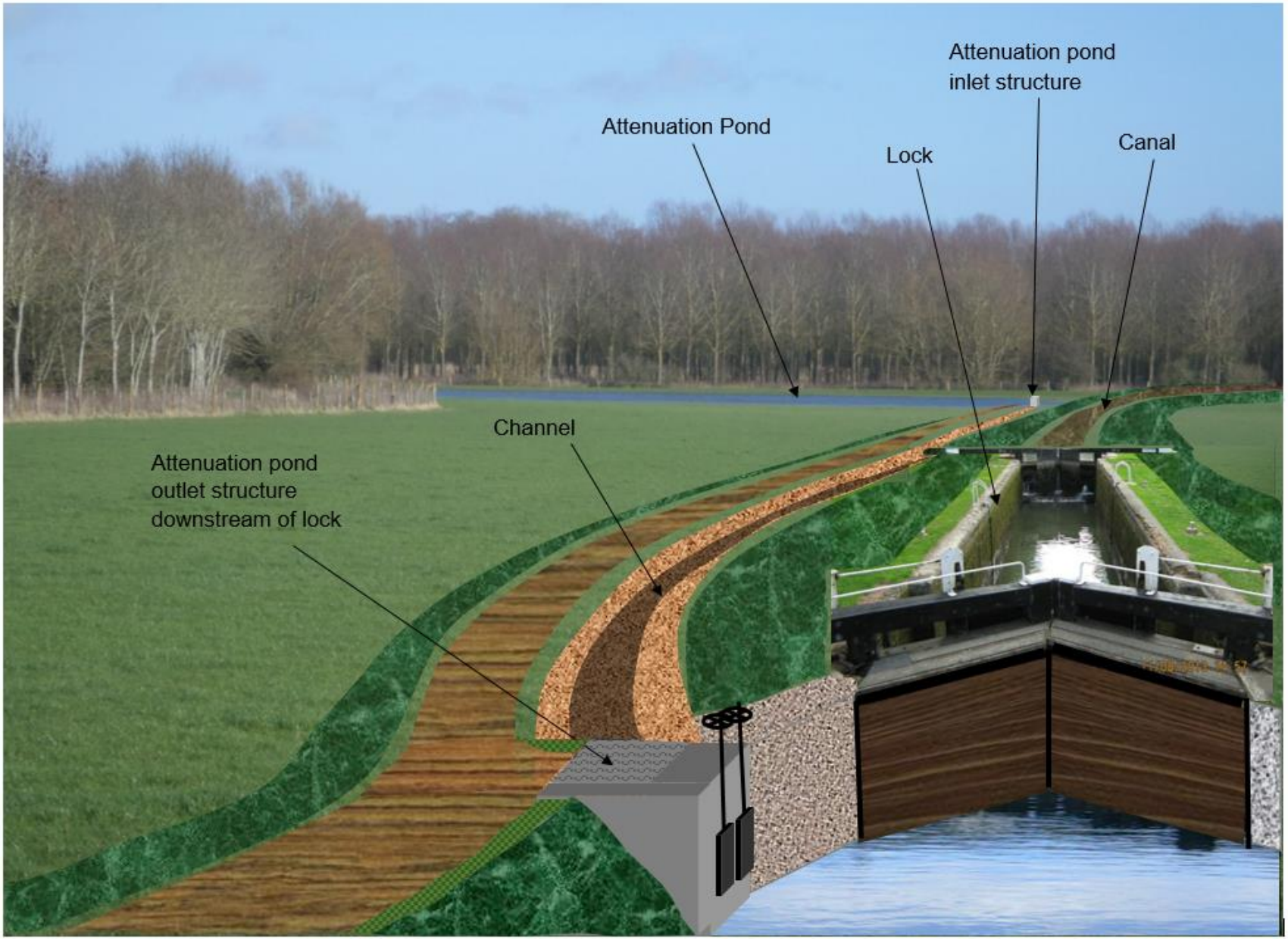
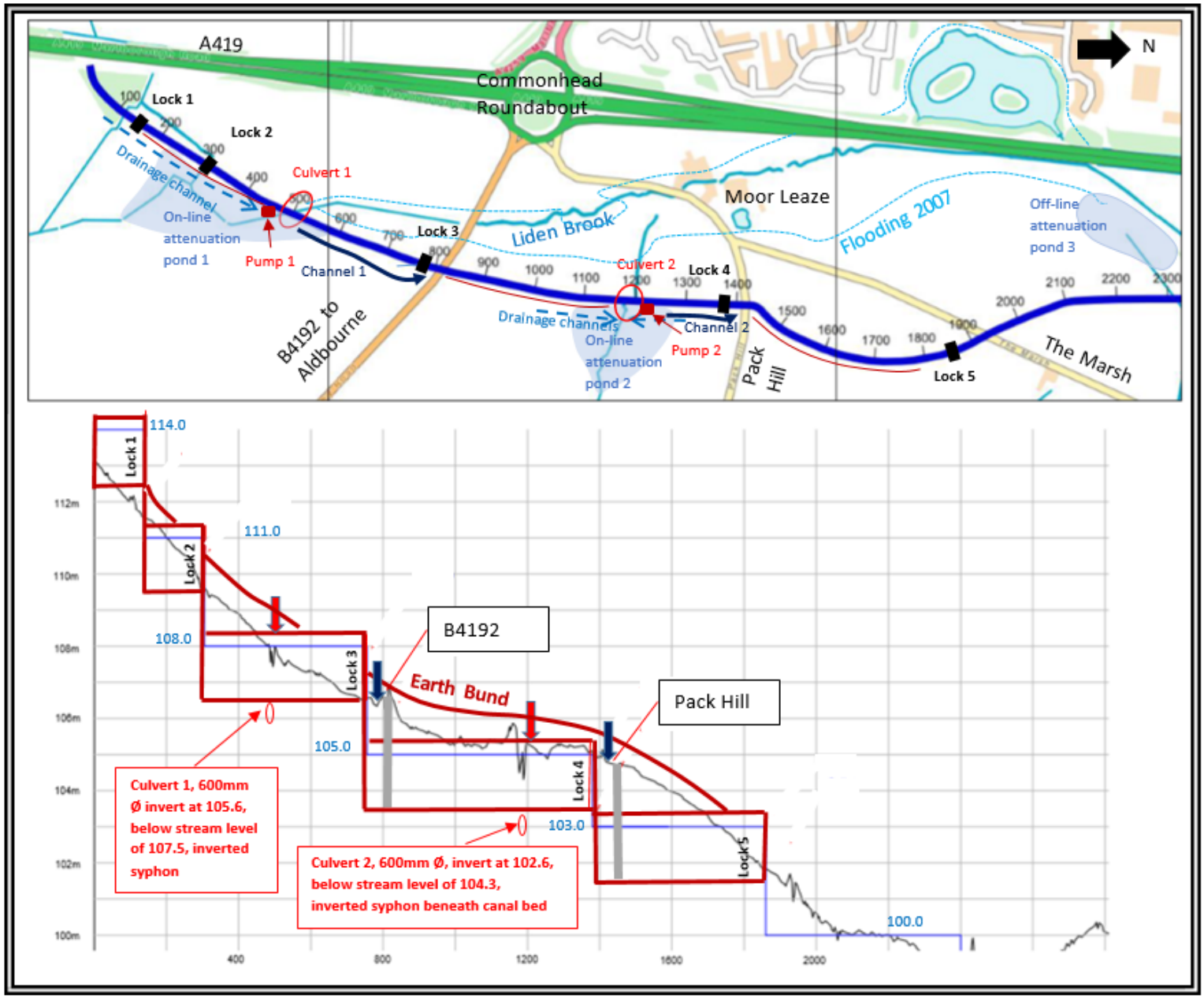


Figure 8 – Plan and profile of canal length 1



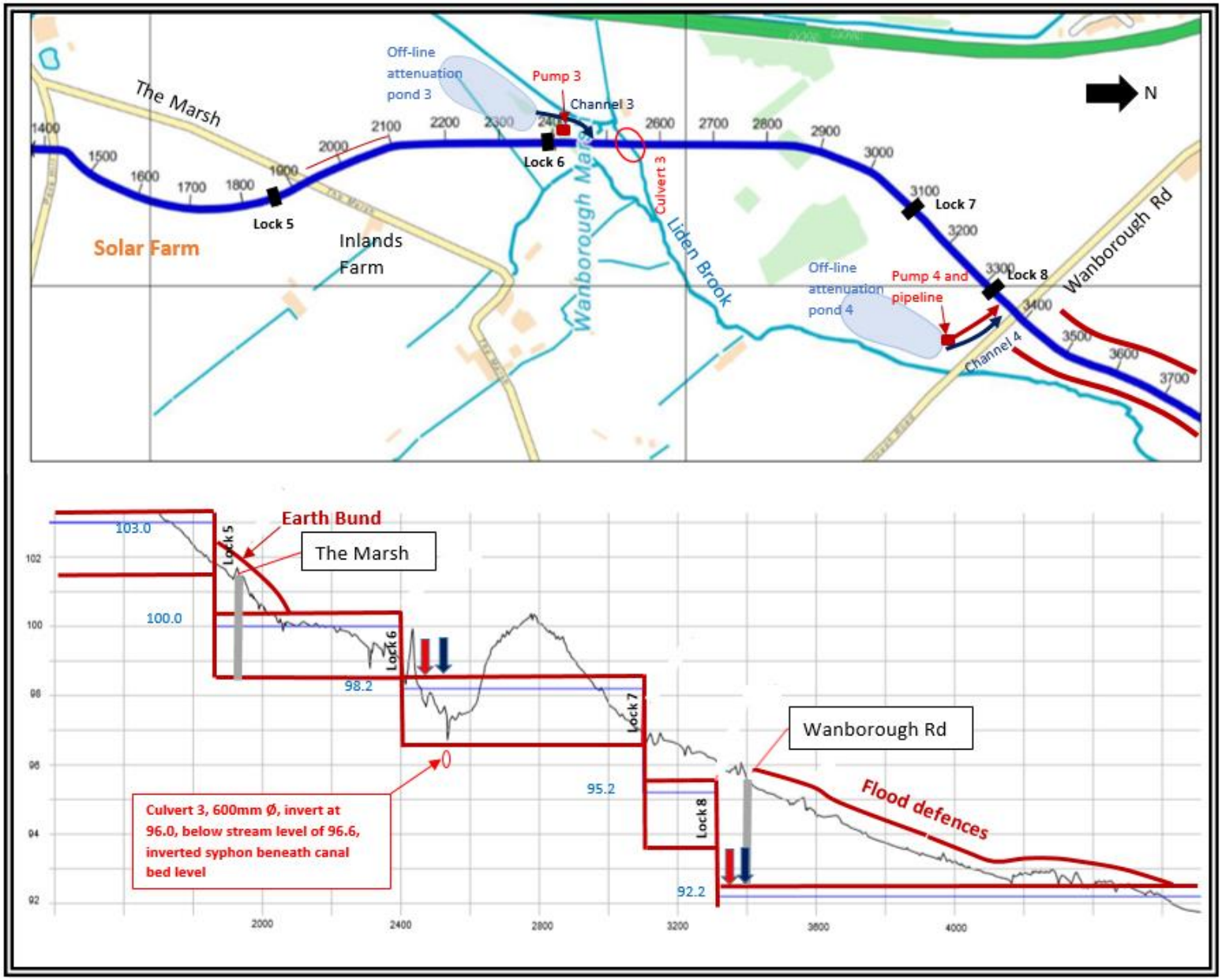
Notes

1) Levels are in metres above OS datum.
2) Distances are in metres.
3) Canal freeboard is 300mm.
4) Canal water depth is 1.5m.

Legend

- Pumped inflow
- Low lift pump
- Or channel inflow
- Cross drainage
- Lock
- 103.0 Water level

Figure 9 – Plan and profile of canal length 2



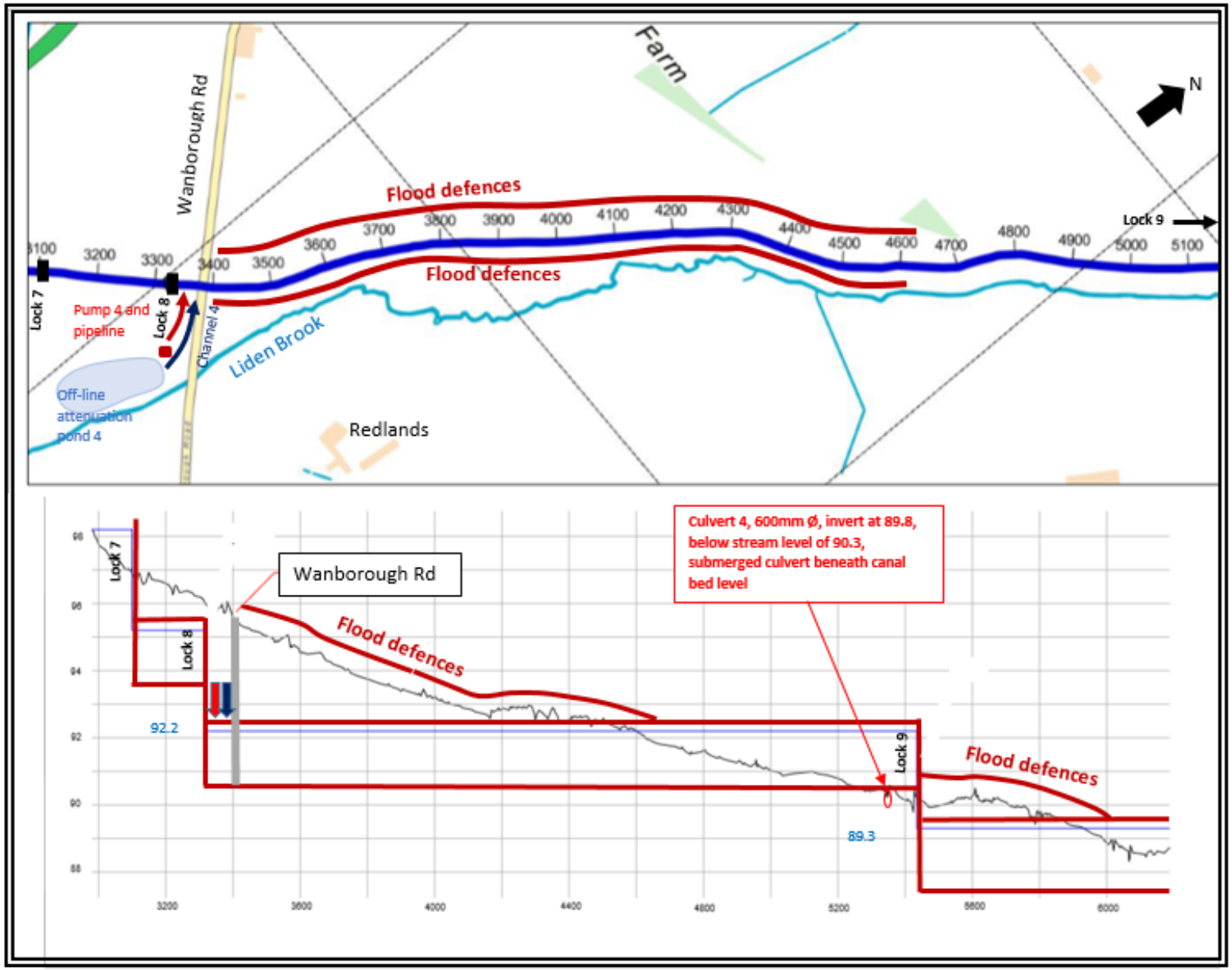
Notes

1) Levels are in metres above OS datum.
2) Distances are in metres.
3) Canal freeboard is 300mm.
4) Canal water depth is 1.5m.

Legend

- Pumped inflow
- Low lift pump
- Or channel inflow
- Cross drainage
- Lock
- 103.0 Water level

Figure 10 – Plan and profile of canal length 3



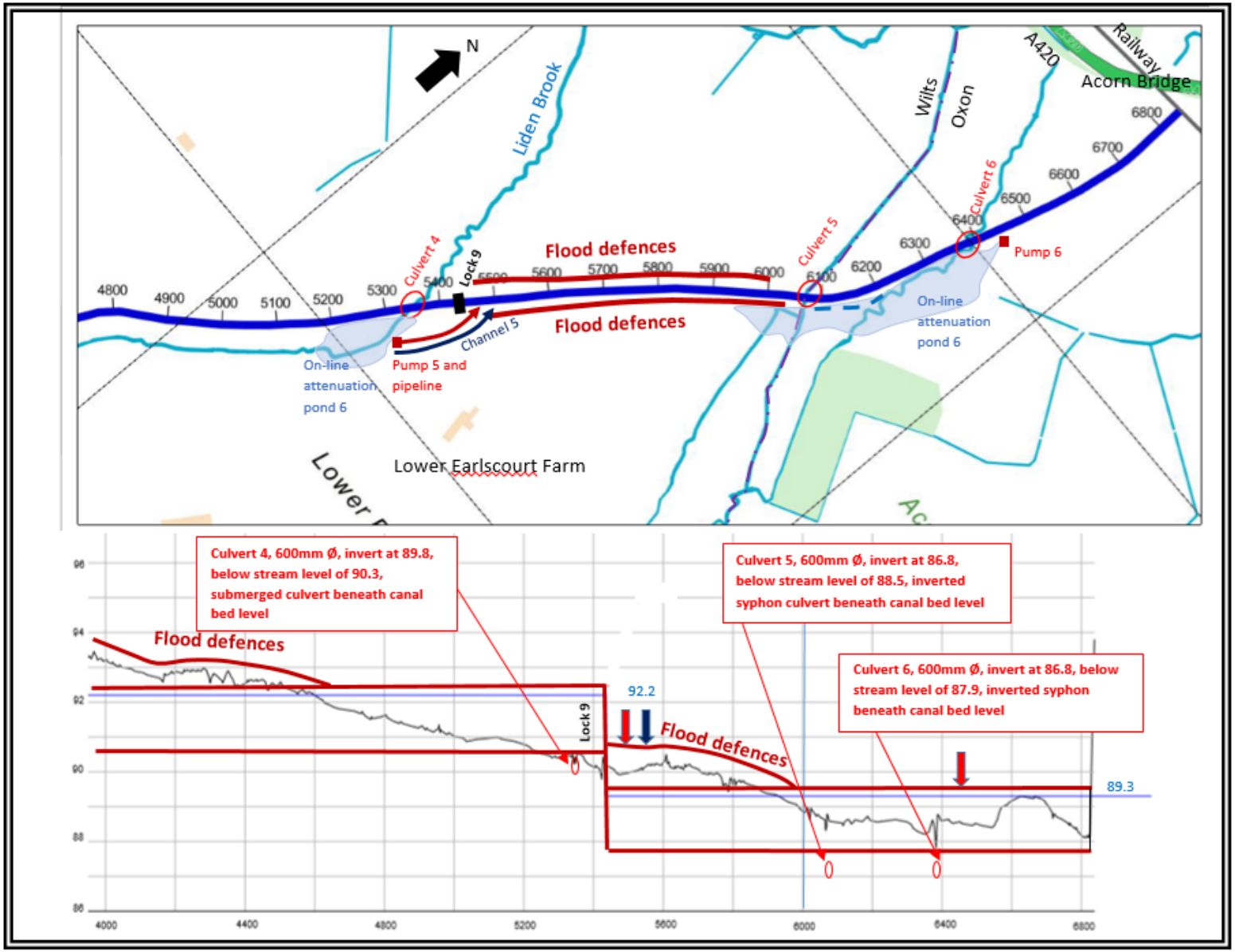
Notes

1) Levels are in metres above OS datum.
2) Distances are in metres.
3) Canal freeboard is 300mm.
4) Canal water depth is 1.5m.

Legend

- Pumped inflow
- Low lift pump
- Or channel inflow
- Cross drainage
- Lock
- 103.0 Water level

Figure 11 – Plan and profile of canal length 4



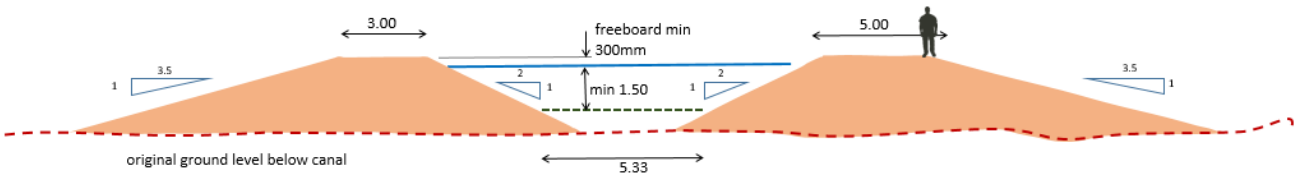
Notes

1) Levels are in metres above OS datum.
2) Distances are in metres.
3) Canal freeboard is 300mm.
4) Canal water depth is 1.5m.

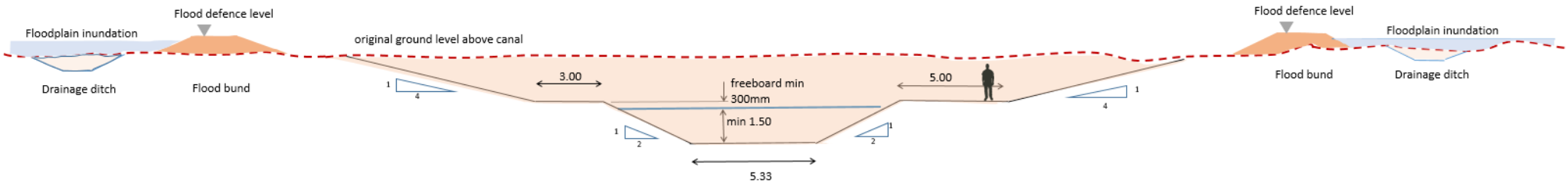
Legend

- Pumped inflow
- Low lift pump
- Or channel inflow
- Cross drainage
- Lock
- 103.0 Water level

Figure 12 – Typical cross-sections of canal



SECTION IN EMBANKMENT



SECTION IN CUTTING WITH FLOOD DEFENCES