Hatton Roads Ponds – Operational Characteristics

As noted previously whilst none of the new drainage infrastructure serving the Phase 1 development will discharge to the existing sewers in Longstanton, or the Longstanton Brook, consistent with the requirements of the Northstowe Area Action Plan and in recognition of the problems faced by local residents, Gallagher Longstanton Ltd have incorporated the creation of two new storage ponds upstream of the village alongside Hatton's Road into the wider development proposals.

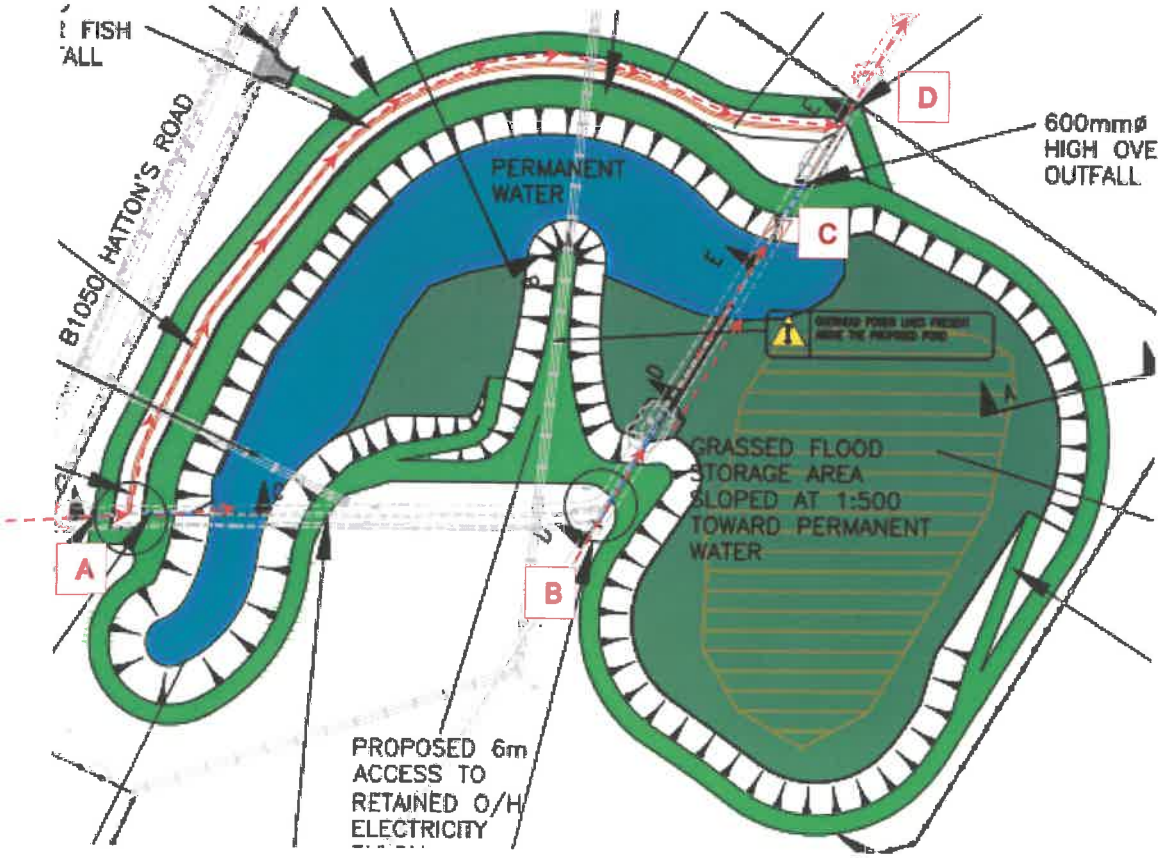
The flooding mechanisms within Longstanton are primarily caused by a lack of hydraulic capacity within the culverted sections of the Longstanton Brook as it flows through Longstanton village, with this lack of capacity having been exacerbated historically by a lack of maintenance. Work undertaken as part of the Flood Risk Assessment that accompanied the Outline Planning application identified that the culverts throughout the village are not large enough to pass the flood flows for extreme events over a 1 in 25 year event, which is a common situation for watercourses in the country.

The proposed Hatton's Road ponds (the "Off Site Flood Mitigation Works") will consist of two attenuation areas which will store a large amount of water and gradually release it into the Longstanton Brook, attenuating the existing flows in the Brook in times of storm. This will allow a better control of the flow and reduce the chance of flooding, providing an improved level of protection against existing flooding to the village of Longstanton.

I am writing to you on the Gallagher Longstanton Ltd's behalf to outline the basic principles of the pond design in various flow events to assist in understanding the intended performance of the proposed ponds.

There are three main scenarios to consider which are the; low flow, medium flow, and high flow events. I will outline the principals of each scenario for both ponds and hopefully this will assist with the clarifying how the ponds are intended to operate. I have included annotated extracts of drawings to assist with clarifying the text.

SOUTHERN POND



Low Flow Event

During the low flow event the water upstream of the attenuation pond travels into the pond along the existing brook (which is downstream of Noon Folly Farm) and it arrives at point 'A' and a second watercourse arrives at the pond from the Longstanton Brook at point 'B'. Refer to the annotated plan above for locations of the incoming watercourses.

The brook downstream of Noon Folly Farm travels through an existing culvert which is under the B1050 Hatton's Road to arrive at point 'A'. The water can enter the attenuation pond via a low level 225mm diameter pipe to maintain the permanent water area.

The existing Longstanton Brook watercourse intercepted from the south (point 'B') is culverted with a 900mm pipe and flows into the permanent area via a low flow channel.

Maintaining the permanent wetted area within the pond is termed the 'low flow' event.

Medium Flow Event

For flows entering the pond at point 'A' the flow through to the pond is restricted by the capacity of the 225mm low level pipe leading into the permanent wetted area. When the capacity of the 225mm pipe limits the flow into the pond the pipe becomes surcharged (full). Following surcharge of the 225mm diameter pipe the flow of water is diverted along the bypass channel. This is termed the medium flow event.

Water will continue to fill the pond through the 225mm low level pipe but the dashed red arrows in the annotated plan above displays the flow of water which is greater than the capacity of the 225mm pipe and it travels from point 'A' to point 'D'.

Flow is promoted along the bypass channel in the medium flow event to ensure that the water moves quickly through to the downstream network in order to maintain flow and storage capacity for larger higher flow storm events.

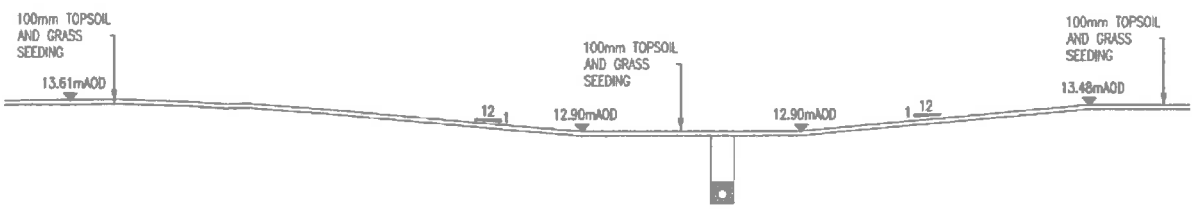
Water flow along the bypass channel also assists water vole migration and enhances their habitats. Specific provisions have been incorporated within the design of the bypass channel embankments to make the areas favourable to water vole occupancy.

Water approaching from the southern watercourse (point 'B') continue to be stored in the pond in the medium flow event.

High Flow Event

During high flow events water surcharges in the ditches and bypass channels due to the downstream catchment restrictions. Water is stored within the channels owing to the hydraulic gradient of flow. The depth of water which can be stored in the bypass channels is limited by the localised upstream lowering of the top of bank levels at point 'A'. Once the depth of water is surpassed (approximately 1.2m deep) the water overtops the upstream locally lowered bank between the bypass channel and pond. Water overtops the locally lowered section of bank and spills into the pond. The pond fills because the downstream outfall will be surcharged as a consequence of the backing up of the water in the ditches and bypass channels.

The cross section below displays the typical localised lowered bank levels at point 'A'.



When the high flow event subsides the water levels in the ditches/channels will reduce and the stored water in the pond will gradually discharge through the 600mm pipe from point 'C' to 'D'. Water levels in the pond will gradually reduce to the permanent wetted area.

The discharged water out of the southern pond flows downstream to the northern pond via a ditch which is approximately 1.6m deep to point 'E' which is annotated on the extract below.

NORTHERN POND

The design philosophy is the same for the northern pond as that detailed above for the low, medium and high flow rainfall events because the ponds both act as an upstream attenuation of water for the high flow events to reduce the peak flow volume of water travelling to Longstanton.

Low Flow Event

Water arrives at the northern pond from the southern pond via the existing Longstanton Brook watercourse at point 'E' and water enters the attenuation pond via a low level 225mm diameter pipe to maintain the permanent water area detailed on the plan above. Another existing watercourse contributes to the permanent water area. The watercourse travels through an existing culvert from the land adjacent to Bar Farm under the B1050 Hatton's Road to arrive at point 'F'. This watercourse is again used to maintain the permanent water area in the northern pond.

Medium Flow Event

Water flow into the pond is maintained through the 225mm low level pipe located at point 'G' but when the pipe is surcharged the flow of water is diverted along the bypass channel. The dashed red arrows in the extract above displays the flow of water over and above the capacity of the 225mm pipe from point 'G' to point 'J'. This is termed the medium flow event.

Flow is promoted along the bypass channel in the medium flow event to ensure that the water moves quickly through to the downstream network in order to maintain flow and storage capacity for larger higher flow storm events.

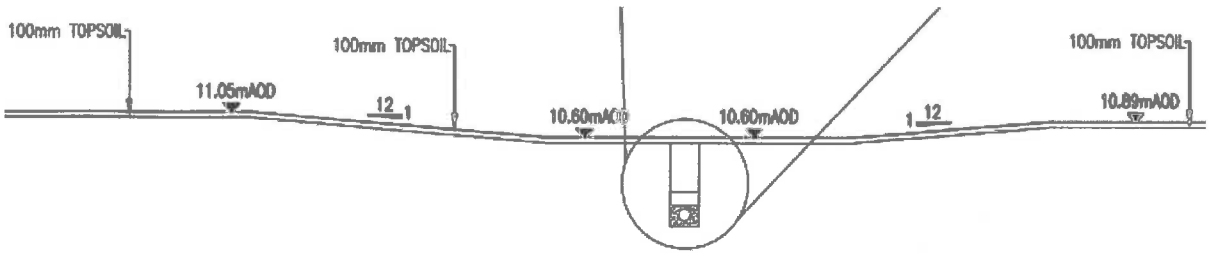
Water flow along the bypass channel also assists water vole migration and enhances their habitats with specific provisions incorporated within the design of the bypass channel embankments to make the areas favourable to water vole occupancy.

Water approaching the pond from the existing culverted watercourse referenced at point 'F' will continue to be stored in the pond and outfall through the downstream 900mm pipe located at point 'H' in the event that the water stored exceeds the permanent water level.

High Flow Event

During high flow events water surcharges in the ditches and bypass channels due to the downstream catchment restrictions. Water is stored within the channels owing to the hydraulic gradient of flow. The depth of water which can be stored in the bypass channels is limited by the localised upstream lowering of the top of bank levels at point 'G'. Once the depth of water is surpassed (approximately 1.2m deep) the water overtops the upstream locally lowered bank between the bypass channel and pond. Water will then spill across the locally lowered section of bank and fill the pond. The pond fills because the downstream outfall will be surcharged as a consequence of the backing up of the water in the ditches and bypass channels.

The cross section below displays the typical localised lowered bank levels at point 'G'.



When the high flow event subsides the water levels in the ditches/channels will reduce and the stored water in the pond will eventually discharging through the 900mm pipe from point 'H' to 'J' and water levels in the pond will reduce to the permanent wetted area.

The discharged water out of the northern pond will flow downstream to Longstanton via a ditch which is approximately 1.6m deep.

The attenuation features will reduce the 1 in 100 year flow through Longstanton village to less than the existing 1 in 20 year event peak flows, therefore reducing both the frequency and severity of flood events. The ponds provide a significant betterment to high flow storage when compared to what is was previously provided prior to the implementation of the Northstowe development.

HATTON'S ROAD PONDS - FLOOD MITIGATION

The flooding mechanisms within Longstanton are primarily caused by a lack of hydraulic capacity within the culverted sections of the Longstanton Brook as it flows through Longstanton village. This problem was recognised early in the evolution of the drainage strategy for the Northstowe development and a design which directed Phase 1 flows to the east via on-site attenuation ponds before discharging to Reynolds drain was thus promoted in order to ensure that the situation in Longstanton Brook was not exacerbated.

Although the Northstowe Phase 1 development will not in itself provide any additional contributing flows to the Longstanton Brook, the proposed creation of two interlinked attenuation ponds located between Bar Hill and Longstanton villages adjacent to the Longstanton Brook, south of the B1050 (Hatton's Road) will provide a degree of flood mitigation to the area. These attenuation ponds cover an area of 4.0ha and 5.5ha and will provide a storage volume of approximately 47,000m^3 and 58,000m^3 respectively. To put this in context these together would equate to the size of 10 football pitches and can hold the same volume of water as 40 Olympic size swimming pools.

The design of the Hatton Road ponds sought to -

- Provide as much mitigation of the existing flooding problems in the village of Longstanton as possible within the context of the existing utility constraints and land available.
- Allow as much water as possible to flow through Longstanton to Webbs Hole Sluice before the sluice becomes closed due to the flood levels in the River Ouse.

The scheme as proposed on drawings 0481-LA-101D and 0481-LA-102D were approved on 4 March 2015, (SCDC ref: S/0038/15/RM). However due to the need to retain and provide maintenance access to an existing overhead electricity powerline to meet the requirements of UK Power Networks it has been necessary to modify the design as shown on revised drawing 0481-LA-102G.

The design modification has maintained the same design ethos and has retained the same storage volume thus not compromising the attenuation capacity and performance characteristics of the previously approved scheme as outlined below.

The Hatton's Road attenuation ponds are to have off-line connections to the Longstanton Brook, and have been designed to reduce peak flow in the brook. The scheme will utilise adjustable side inlet weirs to channel some of the existing flood flow into the Hatton's Road attenuation ponds, with culverts to allow the water to drain out once flood flows have passed, this means that normal flows will by-pass the attenuation areas but will divert flood flows in extreme events thus reducing flood flows through Longstanton. The brook will be locally diverted around these areas so they can to be integrated into the landscape whilst reducing the extent of earthworks required.

Whilst it is not possible to specifically translate the mitigation impacts of the Hatton Road Ponds into a mapped on the ground flood outline for the villages of Oakington and Longstanton without building an extensive and particularly complicated hydraulic model, it is possible to consider the relative benefits provided by considering a more localised hydraulic model.

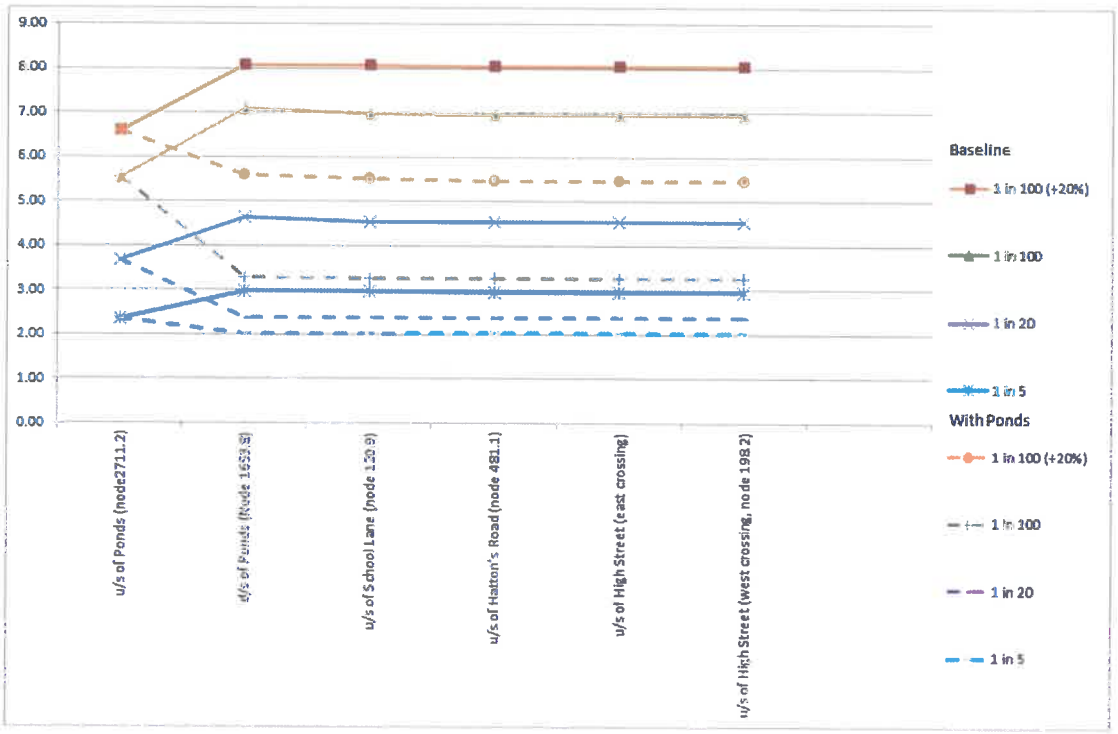
Table 1 and Fig 1 below show the peak pass-thru flow for a range of events comparing the existing situation to that with the attenuation ponds in place:-

Table 1. Hydraulic Modelling Results for existing and post implementation of the flood mitigation proposals at Hattons Road.

Location Peak flow in m3/s	Without Ponds (Baseline)				With Ponds			
	1 in 100 (+20%)	1 in 100	1 in 20	1 in 5	1 in 100 (+20%)	1 in 100	1 in 20	1 in 5
u/s of Ponds (node 2711.2)	6.596	5.542	3.694	2.353	6.600	5.542	3.694	2.358
d/s of Ponds (node 1653.8)	8.076	7.088	4.652	2.977	5.598	3.289	2.395	2.017
u/s of School Lane (node 920.9)	8.069	6.991	4.549	2.971	5.53	3.278	2.394	2.016
u/s of Hatton's Road (node 481.1)	8.056	6.947	4.548	2.963	5.463	3.259	2.393	2.016
u/s of High Street (east crossing) (node 258.6)	8.055	6.943	4.545	2.962	5.463	3.258	2.393	2.016
u/s of High Street (west crossing) (node 198.2)	8.055	6.962	4.545	2.962	5.467	3.258	2.393	2.016

As noted above, the design modification to accommodate the retention of the support to the existing overhead electricity powerline has no impact on the attenuation capacity of the ponds. The figures referred to within Table 1 therefore remain unaffected by the minor change in the shape of the southern pond.

Fig 1. Comparison of Peak Flows, with and without ponds.



Further details can be found in Technical Appendix H: Flood Risk Assessment, Feb 2012 submitted in support of the 2012 Phase 1 Planning Application.

From the above it is evident that all comparable flows are significantly reduced compared to the baseline flows. For example hydraulic modelling of the proposed Longstanton Brook attenuation areas show that the existing peak flood flow of approximately 6.962m^3/s for the 1 in 100 year event upstream of the High Street (Node 198.2), is reduced significantly into two smaller peak flows of approximately 3.258m^3/s, representing the attenuation provided by both the proposed areas.

The benefit of these attenuation features will be to reduce the 1 in 100 year flow through Longstanton village to less than the existing 1 in 20 year event peak flows, therefore reducing both the frequency and severity of flood events.

Furthermore, with reference to Table 2 below, whilst we cannot definitively define the flood regime it can be seen that the peak flow for the extreme 1:100 (+20%) shows a reduction of thru flow of over 30%, and at the 1:100 year event the reduction of flow is proportionately even greater at over 50%.

Table 2: % Flow Reduction

	Original	With Ponds	% Reduction
	1 in 100 (+20%) Peak Flow m3/hr		
u/s of Ponds (node2711.2)	6.60	6.60	0%
d/s of Ponds (Node 1653.8)	8.08	5.60	31%
u/s of School Lane (node 120.9)	8.07	5.53	31%
u/s of Hatton's Road (node 481.1)	8.06	5.46	32%
u/s of High Street (east crossing)	8.06	5.46	32%
u/s of High Street (west crossing, node 198.2)	8.06	5.47	32%

A degree of flexibility in the day to day management of the ponds will be facilitated by the construction of weir controls, located downstream of the bypass channels and upstream of

the attenuation area. These will be manually adjustable in order to flexibly manage the high level overflow into the ponds. As per the details proposed on drawing 0481-SK-016 rev A adjustable timber weir details, the adjustable weir will be set between two pairs of driven piles and notched into the embankment for further support. In order to adjust the weir height, horizontal timbers (weighing circa 250kg) can be removed or added. Rip-rap scour protection is proposed downstream of the weir in order to prevent erosion of the base whilst the weir is in full operation.

From the above it is evident that the creation of the Hatton Road Ponds are not detrimental to the upstream situation at Longstanton and will provide a real and material reduction in flood risk for the Village of Longstanton.