Milton Keynes City Council

Briefing note

Summary of the strategic surface water drainage network in Milton Keynes.

Prepared by	Flood and Water Management Team Lead Local Flood Authority
Date	26 June 2024
Purpose	To provide an interim written overview of the strategic drainage network including the lakes, watercourses, and primary surface water sewer network prior to commencement of wider modelling study.

0. Background

Milton Keynes City Council are delivering an Asset Performance and Capacity Assessment – Balancing Lakes Study (APCA – BLS) to gain a better understanding of the existing and future flood risk in Milton Keynes. By doing so it will further understand the existing interaction between the strategic surface water drainage and fluvial networks. The study will consider how flood risk within the city is impacted by climate change and growth, which includes the changes and new infrastructure associated across the wider catchment, as well as new strategic land allocation within Milton Keynes itself. In doing so, the study will also assess the potential to use the Milton Keynes balancing lakes, which Anglian Water are the operational manager for, beyond their original design function. The study is being led by Milton Keynes City Council but developed in partnership with Anglian Water and the Environment Agency.

Separately the Environment Agency had plans to do new modelling on the wider catchment to update the Flood Map for Planning (Rivers and Sea) and the Risk of Flooding from River and Sea Maps. Rather than the Environment Agency producing a model in isolation it is more effective for the work to be done as part of APCA – BLS. This will be more efficient and a benefit to all partners because by allowing combined modelling to be produced for all the different sources of flood risk, Risk Management Authorities will have a comprehensive understanding of the flooding mechanisms within the Milton Keynes area. This will allow them to work from the same baseline information.

1. Introduction

The most recent fluvial and surface water modelling for the Milton Keynes area is not currently integrated despite the strategic approach to flood management and drainage infrastructure within Milton Keynes. Most notably, the fluvial model for this part of the catchment of the Great River Ouse and associated tributaries is also outdated. Previous drainage studies carried out with partners have assessed the flooding arising from river flow but did not simulate flooding arising from within the urban areas due to any restrictions in the capacity of the storm sewer network.

2. Development of Milton Keynes

The Great Ouse catchment is a large catchment in the East of England draining an area of 8,596 km^2 from its headwaters near Brackley in Northamptonshire, flowing through Buckingham to Milton Keynes, through to Bedford and St Neots, and then down to St Ives to Earith and into the Fens system with the Cambridgeshire Lodes and Ely Ouse system flowing in from the eastern side as it makes its way down to The Wash. The River Tove, which drains from the northwest at Towcester and the River Ouzel, draining the catchment to the south from Leighton Buzzard, flow into the River Great Ouse.

Milton Keynes Development Corporation, established in 1967, was tasked with producing a masterplan for a new town. Prior to 1970, the land around the village of Milton Keynes was agricultural and drained naturally to the Great Ouse via its main tributaries the River Ouzel and Loughton Brook. Flooding of the area had previously occurred, the worst of which was in 1947 that resulted in substantial flooding in Newport Pagnell.

It was recognised that the development of Milton Keynes would change the hydraulic characteristics of the catchment as some development would impact on existing watercourses and the associated floodplain. The Development Corporation chose to mitigate these impacts through the innovative implementation of lakes combined with a positive drainage system. The capacity of the system was based on the projected long-term development proposals for the town within the designated area (8,800 ha). The western half of the designated area formed nearly the total catchment of Loughton Brook whilst the eastern half was approximately 14% of the total catchment of the Ouzel.

The Great Ouse River Authority laid down the design criteria as follows:

- Storage on the Loughton Brook should be designed for storms of a frequency of 1 in 10 years (10% Annual Exceedance Probability (AEP)) to 1 in 15 years (7% AEP) event.
- Storage on the Ouzel should be designed for the capacity required should there be a re-occurrence of the 1947 floods.

Records suggest that approximately 80% of the design storage is to compensate for the loss of floodplain to development and on 20% is for the resulting increased runoff. Willen and Caldecotte Lakes are located along the River Ouzel and are the largest of the balancing lakes regulated by Anglian Water (Figure 1). They provide offline flow balancing for the River Ouzel. Gates in the river adjacent to these lakes are operated by an automatic control system, which diverts flow from the river to the lakes in response to a set of operating rules. Other lakes in Milton Keynes do not have this feature and include fixed weir levels.

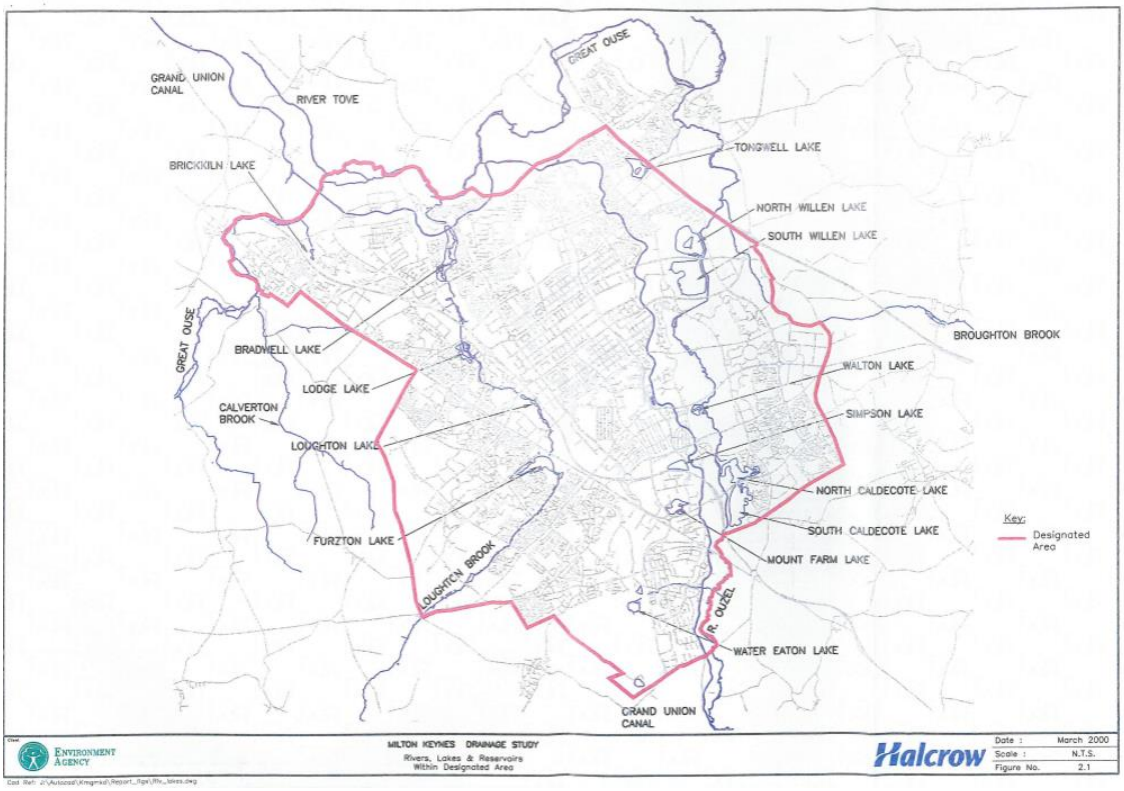

Figure 1: Drawing from initial Drainage Strategy (2000) showing larger watercourses and lakes in relation to original Designated Area

Below is a summary of the main modes of operation of the system and the principles behind the control algorithm for Willen and Caldecotte Lake:

- Fully automatic (water levels and flow monitored and target flows set by control algorithm, gate movements to achieve target flow determine automatically)
- Manual/semi-automatic (target flows set manually but gate movements to achieve target flow determined automatically)
- Fully manual (gates raised/lowered manually on site)

Under fully automatic mode there are two main operations possible – 'Ouse' mode (or 'protection' mode – also the mode used when any part of the monitoring system fails) and 'Ouzel' mode:

- Ouse mode is activated when high rising flows are detected at the Newport Pagnell gauge and there is low flow in the Ouzel. A low target flow of 2 m^3s^{-1} is set at both Caldecotte and Willen gates.
- Ouzel mode is activated when i) the flow downstream of Willen and Broughton Brook exceeds both 1.6 times the flow measured at Waterhall gauge and 11.5 m^3s^{-1} and ii) high flow conditions exist in the Ouse (greater than 40 m^3s^{-1}). Target flows at Caldecotte and Willen are then calculated by the control algorithm to limit the flow downstream of Willen to the appropriate

flow rate. The target flow rates are sent to the gate control systems, which then raise or lower the gates to achieve the target flow rate.

A journal paper in 1979, estimated the total cost of all flood control works, including the balancing lake facilities, river improvement works as well as gauging stations would have amounted to the region of £7M (Figure 2). Accounting for inflation, and similar goods and services current costs would be around 4.8 times this amount.

NAME	TYPE	GROSS AREA OF CATCH-MENT (ha)	PAVED AREA (ha)	METHOD OF CONTROL	MAXI-MUM ALLOW-ABLE DIS-CHARGE (Cumec)	VOLUME OF STORAGE (m^3)	STATIC VOLUME IN LAKE (m^3)	AREA OF LAKE (ha)	AREA OF WATER AT DESIGN LEVEL (ha)	PROB-ABLE MAXI-MUM FLOOD (Cumec)	COST (£1000)
WILLEN	Excavated Lake and Earth Dam	27 700	1306	Gate and Side Weir	N/A	943 000	1 100 000	65	74	595	1324
CALDECOTTE	Excavated Lake and Earth Dam	25 500		Gate and Side Weir	N/A	570 000	660 000	41	45	556	3306 Est.
BRADWELL	Earth Dam	4030	520	Twin Throttle Pipe	11	235 000	N/A	N/A	16	262	484
LOUGHTON	Earth Dam	2380	296	Throttle Pipe	4	291 000	40 000	2.3	16	210	560
FURZTON	Earth Dam	1886	—	—	—	—	—	—	—	131	500 Est.
WATER EATON PERMANENT	Excavated Brick Pit	1766	145	Twin Penstocks and Side Weir	7	152 000	462 000	5.5	6.9	115	900 Est.
LINFORD PITS	Excavated Gravel Pit	456	45	Weir	2.33	54 000	Not Known	15	16	N/A	30
TONGWELL	Excavated Lake	529	276	Flume and Side Weir	1.4	165 000	230 000	10	11.5	75	415
SIMPSON	Earth Dam	525	158	Throttle Pipe	1.4	170 000	N/A	N/A	11	75	207
MOUNT FARM	Excavated Gravel Pit	262	170	Weir	2.4	31 500	90 000	8.0	8.2	N/A	17
WALTON	Excavated Lake	279	183	Flume and Side Weir	1	66 000	10 000	3.1	3.4	N/A	140
BRICKKILN	Earth Dam	206	87	Throttle Pipe	1.1	67 000	N/A	N/A	3	67	264
WOUGHTON NORTH	Temporary Excavated Basin	111	41	Orifice Plate and Side Weir	0.6	10 000	N/A	N/A	1.0	N/A	30
WATER EATON TEMPORARY	Temporary Excavated Basin	62	23	Orifice and broad Crested Weir	0.28	3000	N/A	N/A	0.5	N/A	22
BLEAK HALL	Temporary Earth Dam	39	15	Throttle Pipe	0.07	5000	N/A	N/A	0.8	10.0	10

Figure 2: Appendix extract from 'Design and construction of balancing lakes at Milton Keynes', Davis and Woods, Chartered Municipal Engineer, Vol. 106 (1979)

Sustainable drainage systems (or SuDS) are designed to control surface water run off close to where it falls, combining a mixture of built and nature-based techniques to mimic natural drainage, whilst accounting for the impacts of climate change. They provide benefits for water quantity, water quality, biodiversity, and amenity. SuDS are not intended to reduce flooding on a development site. SuDS are designed to reduce the impact that the surface water drainage system of one site has elsewhere.

Since the initial design and construction of the strategic drainage system built for stormwater management in Milton Keynes, the technical and legislation requirements to manage surface water

has significantly progressed. The National Planning Policy Framework requires that major developments incorporate SuDS. Furthermore, it requires that development in areas at risk from flooding, should demonstrate that it also incorporated SuDS. Planning practice guidance bolsters this requirement by providing what information is to be submitted with a planning application.

Policies FR1 – FR3 of Plan:MK (the current Local Plan) includes locally specific strategic flood risk management policies to maintain and continue the sustainable drainage model of Milton Keynes, which prohibits development within the floodplain and seeks flood management and drainage infrastructure to be provided as part of a maintained, multifunctional blue green infrastructure. On this basis, all new development must incorporate a surface water drainage system with acceptable flood control. This typically results in storage of surface water being slowly detained within individual development parcels.

Milton Keynes City Council, as Lead Local Flood Authority (LLFA), is a statutory consultee in planning applications for all major development in relation to the management of surface water drainage. However, LLFA advice can also be sought on other planning applications, which raise surface water or other local flood risk issues.

3. Flooding History

Prior to the development of the town of Milton Keynes there was regular flooding of the Great Ouse, River Ouzel and Loughton Brook. During the floods of 1947 and 1968, several areas around Bletchley, Newport Pagnell, Bradwell, Loughton and Simpson were seriously affected. However, Milton Keynes is unusual as the development of the 'new town' has meant that there have since been significant changes to the catchment characteristics, with increased run off from urban areas mitigated by a drainage network of public storm sewers, re-engineered watercourses, culverted sections, and balancing lakes inherited from predecessor organisations. Other significant flooding in previous years after the town of Milton Keynes was formed, occurred in April 1998 and July 2007, both after heavy rainfall fell on already saturated ground.

More recently, in May 2018, Milton Keynes experienced a very intense summer storm, which led to the exceedance of local drainage networks. The flooding during 27 May 2018 is estimated to have affected 1,000 properties across Milton Keynes (both rural and urban areas), of which half were internally flooded. This included residential, commercial, educational, and healthcare facilities. Several local roads were flooded and closed, leading to travel disruption. The total economic damages associated with this flood event are estimated at £7M based on the finding of the Milton Keynes Independent Flood Review (2019), Appendix H - Economic Costs prepared by AECOM. The Milton Keynes Section 19 report for the event concluded that the flooding experienced in Milton Keynes was the result of heavy rainfall overwhelming the capacity of the drainage network, resulting in surface water flows gravitating towards low points in the local topography causing internal flooding to over 315 residential properties.

Significant flooding from main river and associated tributaries most recently occurred in October (primarily the River Ouzel) and again in December of 2020. The flood incident that occurred during December 2020 was the result of a combination of river, surface water and groundwater flooding. Intense rainfall in the upper catchment of the River Great Ouse during 23 December fell on to an unusually saturated catchment, which likely led to more surface water runoff than would be expected if the catchment was dry and groundwater was at normal levels. A total of 93 properties were reported to have internally flooded in Milton Keynes during the December flood event broadly across seven locations - Stony Stratford, Newport Pagnell, Lavendon, Ravenstone, Tathall End, Sherington and Bletchley. Olney was also impacted by the event, though no internal flooding was reported.

June 2021 was another very intense summer storm that impacted localised areas such as Bletchley and Fenny Stratford, West Bletchley, and Wolverton. This triggered a Section 19 flood investigation report.

Winter 2023/2024 has been a prolonged period of wet weather for England. Early January, Storm Henk resulted in severe weather warnings and floods across England. February was one of the

wettest on record since 1871 for England. Flooding was widespread again in April, in the aftermath of Storm Kathleen and Storm Pierrick. Whilst these events did not result in any formal flood investigations within Milton Keynes, it has led to increased reports of repeat flooding on roads, footpaths, and landscaped areas.

4. Previous Drainage Studies (and Associated Outputs)

- *Milton Keynes Drainage Strategy (2000)*

In 2000, Halcrow Group Ltd. conducted a study of the Milton Keynes drainage network on behalf of a coalition of flood management authorities at the time, which aimed to:

1) Assess whether the existing drainage network could serve infill development within the original Milton Keynes Development Area (DA).
2) Identify any problems with the drainage network for existing levels of development within the DA to act as a baseline.
3) Assess the impact of future development up to and beyond 2011 on flood risk downstream of Milton Keynes.
4) Identify constraints on strategic future development proposals and outline sustainable drainage solutions for future incorporation.

Once the study was carried out, it confirmed that the existing strategic drainage measures could serve contemporary and infill development levels within the DA up to the 1 in 100 year storm event, which itself was calculated as more severe than the floods of 1947, informed by the original attenuation capacity for Willen and Caldecotte Lakes. An assessment of the impact of future development on flood risk and identification of strategic constraints was made (Table 1).

Table 1: Milton Keynes Drainage Strategy (2000) Recommendations and Implementation

Recommendation	**How it was taken forward**
Flows and water levels in each of the principal water courses should be recorded and archived. Organisations should co-ordinate their responsibilities for different areas in this regard. This information should be used to calibrate the model.	An extensive network of gauging stations exists throughout England with specific areas in Milton Keynes to capture and record flows and water levels.
Operational manuals for each of the balancing lakes should be produced based on comprehensive surveys.	A functional design specification manual exists detailing the technical operation of the balancing lakes (2003).
The gate operating controls should be identified in detail and then	Gate opening controls have been identified. Current operation remains automatic as standard practice since their

optimised to suit the existing development conditions.	creation. APCA – BLS will assess if existing lakes can be optimised to suit existing development conditions beyond their original function.
Additional developments should include their own strategic source control, designed to an agreed uniform design standard.	Modern day developments are required by national and local policy and guidance to incorporate their own surface water management systems.
The model should be developed and used to assess future proposals for development beyond current planned levels.	Modelling was further developed in the Milton Keynes Drainage Strategy (2003). The Environment Agency has carried out modelling for the Great Ouse development, but this requires updating. More sophisticated modelling will be taken forward in the APCA – BLS that will account for climate change.
All organisations with responsibility for planning within and around Milton Keynes should co-ordinate the development of a catchment wide Sustainable Urban Drainage Policy. The benefits of the original Plan in 1970 should be recognised and used to demonstrate the need for a new strategy for future development.	The Milton Keynes Drainage Strategy – Development and Flood Risk Supplementary Planning Guidance (SPG) (2004) was created, although is now outdated. Subsequent versions of NPPF, PPG, Local Plans, CIRIA The SuDS Manual and Sustainable Drainage Systems: Non-statutory technical standards for sustainable drainage systems (2015), as well as local guidance, have informed development throughout Milton Keynes.

- *Milton Keynes Drainage Strategy (2003)*

In 2003, Halcrow Group Ltd. were appointed to further undertake the Milton Keynes Drainage Strategy by the Milton Keynes Client Group. Following on from the recommendations of the Milton Keynes Drainage Study (2000), the modelling utilised was refined and updated, and an incumbent study and report was produced. This served the purpose of reaffirming the original conclusions of the previous study and the featured three main revisions were expanded on (Table 2).

Table 2: Milton Keynes Drainage Strategy (2003) Recommendations and Implementation

Recommendation	How it was taken forward
Update the modelling in line with the recommendations from the 2000 study.	Loughton and Broughton Brook hydrological models were included in the 2003 modelling, alongside more up to date and precise input data for hydrological analysis. Development scenarios were expanded to include projections for 2011 and focused on the impacts of development in Calverton and Broughton Brooks as part of the contemporary Western and Eastern expansion areas.
Make use of the more sophisticated technology to make future modelling more representative and applicable to a range of different development scenarios. Incorporate up to date climate change projections, flood zones based on greater return intervals, and demonstrate the impact of more complex flood zone modelling on the operation of Willen and Caldecotte Lakes.	In 2004, the Milton Keynes Drainage Strategy – Development and Flood Risk Supplementary Planning Guidance (SPG) 2004 was produced. The SPG was formally adopted as a material consideration for planning by Milton Keynes City Council and remains as such to the present day. APCA – BLS will carry forward the work done in the Milton Keynes Drainage Study (2003) by assessing the potential for the balancing lakes to be used beyond their original design capacity, utilising up to date climate change scenarios and more advanced hydrological modelling in doing so.

- *Milton Keynes Drainage Strategy – Development and Flood Risk Supplementary Planning Guidance (SPG) (2004)*

Supplementary Planning Documents are intended to provide detailed guidance on policies and proposals in the Development Plan documents. Prior to 2004 Supplementary Planning Guidance (SPG) documents were issued.

Milton Keynes City Council's Flood Risk SPG is adopted as a material planning consideration and built on national legislation to maximise flood risk betterment. Emphasis was placed on taking a strategic view of flood risk for site areas, including greater flood risk assessment requirements and a preference expressed for source control measures over traditional positive drainage. Development within expansion areas were required to be accompanied by a framework covering drainage proposals, contribution to strategic flood control and phasing measures.

However, contemporary understanding of flood risk and climate change has progressed beyond the knowledge base that informed the SPG. The guidance is now inconsistent with modelling data, national policy and guidance and the Local Plan. APCA – BLS could inform an overhaul of this document, building on national legislation and considering the paradigmatic progress made in the field of flood risk since 2004, just as the 2003 Drainage Study informed the current version of the SPG.

5. Asset Performance and Capacity Assessment – Balancing Lakes Study (APCA – BLS)

The overall aim of APCA - BLS is to improve our understanding of strategic flood risk management within the study area of Milton Keynes and the interactions between the surface water drainage and fluvial networks. It will provide an overdue review as the last drainage study that was carried out in 2003 (expanding on the 2000 initial study). An updated understanding considering the latest data and information will assist all relevant stakeholders in planning the future flood and water infrastructure needed for the growth of Milton Keynes up to 2050 (and beyond). This is of particular importance with the increased occurrence and scale of both surface and fluvial flooding within Milton Keynes and the surrounding area.

The study will further aim to model and assess the potential to use the Milton Keynes balancing lakes beyond their original design function to manage future flooding. This will include the larger automated wet lakes such as Willen and Caldecotte Lakes along the River Ouzel; however it will also consider the wider balancing lakes system and other principal watercourses within Milton Keynes catchment, such as Loughton Brook within the drainage district of the Bedford Group of Drainage Boards.

In addition, new modelling will be produced utilising recently acquired channel surveys, to investigate the levels and flows of the river within the Milton Keynes area itself as well as the rural reach between Leighton Buzzard and Milton Keynes. This will create new flood extents, which can be incorporated into the Environment Agency's Flood Map for Planning.

The primary project partners are Milton Keynes City Council (Lead), Environment Agency and Anglian Water. The objectives of the study are:

1) Provide an updated written overview and supporting plan(s) of the design capacity and catchments of the strategic drainage network including the lakes, watercourses, and primary surface water sewer network (as defined by Anglian Water Services).

2) Undertake an assessment of whether (and how) the development of Milton Keynes has changed from the original design as well as following the earlier Milton Keynes Drainage Studies.

3) Assess the current condition and performance of all the original lakes listed and any new relevant structures constructed compared to their design capacity within the lakes.

4) Model and assess the performance of the strategic drainage network of Milton Keynes for a range of annual exceedance probability (AEP) scenarios including an assessment of future climate change scenarios (these should be based on the UKCP18 projections) and growth forecasts. This should also include modelling any recent significant flooding events (e.g. December 2020).

5) Model and assess the potential to use the Milton Keynes balancing lakes beyond their original design function to manage future flooding. Based on these findings, identify potential measures and procedures that would be required to use the balancing lakes to manage flood risk from multiple sources of flooding.

6) Provide an assessment of how additional development within the catchment upstream of Milton Keynes (e.g. Leighton Buzzard, Buckingham) will impact upon the strategic surface water network (this should be in line with relevant Local Plan(s), Plan:MK and MK 2050 Strategy). This should also consider how development within Milton Keynes may impact on downstream areas.

7) Outline whether the strategic surface water network has capacity for the projected level of growth within the surrounding area of Milton Keynes and if not, outline any upgrades, or additional strategic or largescale measures that may be required to the lakes or connecting infrastructure, such as controls and watercourses throughout Milton Keynes e.g. BMK Waterway.

8) Based on the findings of the study, identify potential measures or procedures that could be considered within Milton Keynes to improve the relationship between the existing river and surface water network for existing and future developments. This should also review any recommendations made in Section 19 investigation reports resulting from the December 2020 event.

Additional modelling requirements of the Environment Agency will also seek:

1) To improve the understanding of the mechanisms of flooding within the catchment to help improve readiness and incident response capabilities.

2) To provide information to identify any capital schemes to manage flood risk.

3) To provide credible flood risk information to customers in the form of level and flow data and mapped flood extents incorporating the latest guidance on climate change.

4) Update the Agency's published flood map for planning (flood zones 2 and 3) and respond to evidence-based reviews.

5) Use the new hydrology, which has been procured as part of the approved APCA - BLS. If this is not possible, a new hydrological assessment will be required.

The study does not look to deliver any projects/flood alleviation schemes. The study will not recommend/identify areas for development.

6. Relevant Strategies and Studies

The Flood and Water Management Team are leading on this study, in the role of Lead Local Flood Authority (LLFA). The Flood and Water Management Act 2010 requires Risk Management Authorities to co-operate with each other, act in a manner that is consistent with the National Flood and Coastal Erosion Risk Management Strategy for England and the local flood risk management strategies developed by Lead Local Flood Authorities, and exchange information.

As LLFA, MKCC are responsible for coordinating the management of local flood risks (i.e. risks of flooding from surface water, ground water and ordinary (smaller) watercourses). This proposal is in accordance with the 2020 Flood and Coastal Erosion Risk Management Strategy, particularly Ambition One: Climate resilient places - working with partners to bolster resilience to flooding now and in the future. The wider study proposal is also in accordance with the adopted Great Ouse Catchment Flood Management Plan (2010) and recent Flood Risk Managements Plans (2021 - 2027), which seek to reduce flood risk to properties within the catchment.

- *Local Plan (MKCC)*

The current Local Plan for Milton Keynes, Plan:MK, was adopted by Milton Keynes City Council in March 2019. One of the strategic objectives of the Plan is to deliver land for a minimum of 26,500 (OAN figure) new homes within the Borough between 2016 and 2031, principally within and adjacent to the city. The plan however allocates sufficient land for a minimum of 30,900 new homes. Milton Keynes City Council remains committed to realising the town's potential. This is reflected in the Council's 'MK Futures 2050' programme to manage the ambitious long-term future for Milton Keynes and proposes aspirational development growth options for Milton Keynes and the surrounding areas for up to 2050. However, this increase in development could cause additional pressure on the existing drainage network beyond its original capability and design without further assessment.

The 'MK City Plan 2050' will take forward Milton Keynes City Council's Strategy for 2050, which set out a vision for Milton Keynes over the next 28 years and to do so sustainably. It will also build on the previous Plan:MK from 2019 and will plan the city's development until 2050. This is also a key part of the Council Plan to build an environment that can thrive, is progressive and delivers a sustainable future for new and existing residents.

- *Level 1 Strategic Flood Risk Assessment (MKCC)*

An updated SFRA for Milton Keynes is currently being prepared. This Level 1 Strategic Flood Risk Assessment (SFRA) can be used to inform the Local Plan on the location of future development and the preparation of sustainable policies for the long-term management of flood risk, provided the potential implications of the recent changes to the Planning Practice Guidance (PPG) are understood. The APCA – BLS, will update hydraulic modelling for the Great Ouse catchment, including a 3.3% AEP

event flood outline that may be used to represent the functional floodplain, and flood outlines that incorporate climate change in line with national guidance.

- *Milton Keynes Infrastructure Study & Strategy (MKCC)*

A Milton Keynes Infrastructure Study & Strategy (MKISS) is currently being prepared. The MKISS will represent a central piece of Local Plan evidence, aimed at ensuring that adequate supporting infrastructure is provided so that Milton Keynes City Council's ambitions for growth are developable, sustainable, and equitable. As part of this, green/blue infrastructure as well as flood risk and water management are a key consideration within the study. The APCA – BLS will outline whether the strategic surface water network has capacity for the projected level of growth within the surrounding area of Milton Keynes and if not, outline any upgrades, or additional strategic or largescale measures that may be required. Furthermore, it will identify potential measures or procedures that could be considered within Milton Keynes to improve the relationship between the existing river and surface water network for existing and future developments.

- *Great Ouse Strategic Flood Risk Intervention Study (EA)*

The Environment Agency are currently progressing the Great Ouse Strategic Flood Risk Intervention Study (GO-SIS). The aim of this study is to gain a better understanding of current flood risk across the Great Ouse catchment, and how this will be impacted by climate change and growth, in particular strategic growth, and new infrastructure across the catchment. The study will consider fluvial and surface water flood risk and Environment Agency assets. The aim is to identify if there are viable flood risk management activities (modelling of potential flood risk management scenarios) that could reduce flood risk and mitigate any increase in flood risk associated with future changes. This evidence will provide a baseline understanding of flood risk to influence others making decisions (i.e. on development) across the catchment.

The objectives of this study are:

- To gain a comprehensive understanding of the existing flood risk within the catchment to act as a baseline, which will include an environmental baseline of the catchment.
- To use this baseline to assess how the catchment might respond to future changes (both climate change and growth), and to consider how effectively strategic interventions could manage both existing and future flood risk.
- To detail the interaction between the upper and lower parts of the catchment to understand how the conveyance of the whole system works, and how implementing flood risk interventions in the upper catchment may affect flows and asset management in the Fens.
- To develop study outputs which will be effective in influencing others, primarily developers, including Development Corporations, to implement strategic flood risk infrastructure that can mitigate the impacts of development and reduce the risk of flooding to existing properties.

As this study is considering the impacts of climate change and growth across the Great Ouse catchment and considering how effectively strategic interventions could manage both existing and future flood risk it provides great opportunities to link into this study. Data, modelling, and information will be shared between the two studies.

7. Summary

The fluvial and surface water modelling for the Great Ouse catchment is outdated and not currently integrated despite the strategic approach to flood management and drainage infrastructure within Milton Keynes. The purpose of the Asset Performance and Capacity Assessment – Balancing Lakes Study is to improve our understanding of flood risk management within the study area and the interactions between the surface water drainage and fluvial networks. It will provide an overdue update to the earlier drainage studies (carried out in 2000 and 2003), which will assist all relevant stakeholders in planning the future flood and water infrastructure needed for the growth of Milton Keynes up to 2050 (and beyond). This is of particular importance with the increased occurrence and scale of both surface and fluvial flooding within Milton Keynes and the surrounding area.

Recommended Reading

Name	Year	Details
Milton Keynes Drainage Strategy	2000	Study objectives: • Revised hydrological analysis. • Assess whether the system can serve the existing planned development. • Identify problems with the system for current level of existing planned development. • Assess the impacts of future developments. • Identify constraints on strategic future development and outline suitable drainage solutions.
Milton Keynes Drainage Strategy	2003	ISIS model from 2000 used as a base: • Revised hydrological analysis. • Loughton and Broughton Brook included.
Independent Flood Review	2019	Whilst there is no statutory requirement to commission an IFR, it was considered appropriate given the scale of impacts of the flooding to "investigate the aspects of public concern raised and make recommendations as necessary".
Flood Risk Investigation: Stony Stratford Section 19 Report	2021	Section 19 report looking at the flooding over 2020/21.
Flood Risk Investigation: Bletchley Section 19 Report	2022	Section 19 report looking at the flooding over 2020/21.
Flood Risk Investigation: Newport Pagnell Section 19 report	2022	Section 19 report looking at the flooding over 2020/21.

Glossary of Terms

Glossary Term	Definition
Attenuation	To reduce the rate of flow through a system, which has the effect of reducing the peak flow and increasing the duration of a flow event.
Balancing Lake	A feature designed to attenuate flows by storing runoff during the storm and releasing it at a controlled rate during and after the storm. These can either be online, i.e. the watercourse continues to flow through the storage area, or offline, i.e. the water is elsewhere and discharged at a point into the watercourse.
Catchment	The area contributing flow to a point on a drainage system. Milton Keynes falls within the wider Great Ouse Catchment.
Main River	A watercourse shown as such on the statutory maps held by the Environment Agency and can include any structure or appliance for controlling the flow of water into, in or out of the channel that is not vested in or controlled by an Internal Drainage Board.
Ordinary Watercourse	Watercourses that include every river, drain, stream, ditch, dyke, sewer (other than public sewer) and passage through which water flows that do not form part of a Main River.
Return Period	Return periods are often used to describe how often a flooding event will occur. Return periods are an average of how often a flood event of that magnitude will occur. The 1 in 100 year return period flood has a 1% chance of occurring in any one year i.e. the odds of it happening are 100 to one. This can be referred to as the 1% AEP storm event (1 in 100 Annual Exceedance Probability).