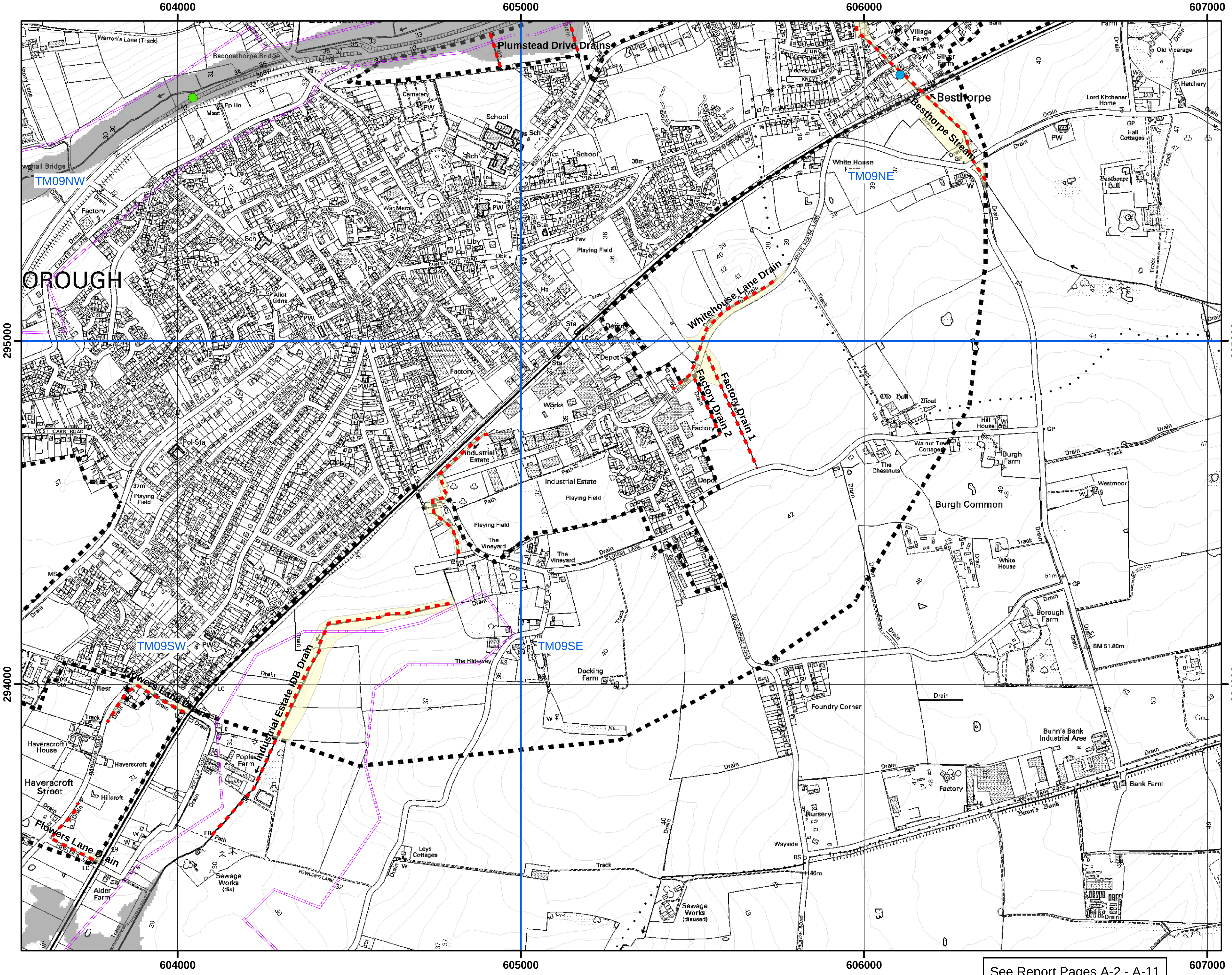
Appendix C: Flood Mapping of Possible Development Sites and Larger Villages

Flood maps have been produced for every proposed development site. They show the predicted fluvial flood extents for the 1 in 100 year return period, as well as the approximate location of historical flood records from all sources considered including fluvial, surface water, sewer, and infrastructure failure.



Legend

Modelled Fluvial Flood Extents:

- 1 in 100 year Envelope (Envelope derived from latest available modelling data)
- 1 in 100 year Envelope (Envelope derived from EA Flood Zone Maps)
- 1 in 100 year Envelope (Envelope derived from engineering judgment also refer to flood zone maps.)

Historic Flood Events:

- Fluvial Flood Events
- Surface Water Flood Events
- Infrastructure Failure Flood Events
- Sewer Flood Events
- Sandbag Deliveries
- Flood Warnings
- Maximum Historical Fluvial Flooding Extent based on records from 1937 to 1993 (Source: Environment Agency)

- Main River
- Ordinary Watercourse
- IDB District
- Contours
- 1:10000 OS Tile extent
- Potential Development Area boundary

User Note

The locations of historic flood events are approximate and indicative only. It should be noted that certain locations not shown to be at risk from fluvial flooding may still be at risk from other watercourses not modelled in this study. Amendments will be required in future to account for information gathered subsequently e.g. changes in the hydrological response of the river or additional data arising from observed flood events.

Project Title

Breckland DC Strategic Flood Risk Assessment

MapTitle

Attleborough Site 1

Figure C: A1

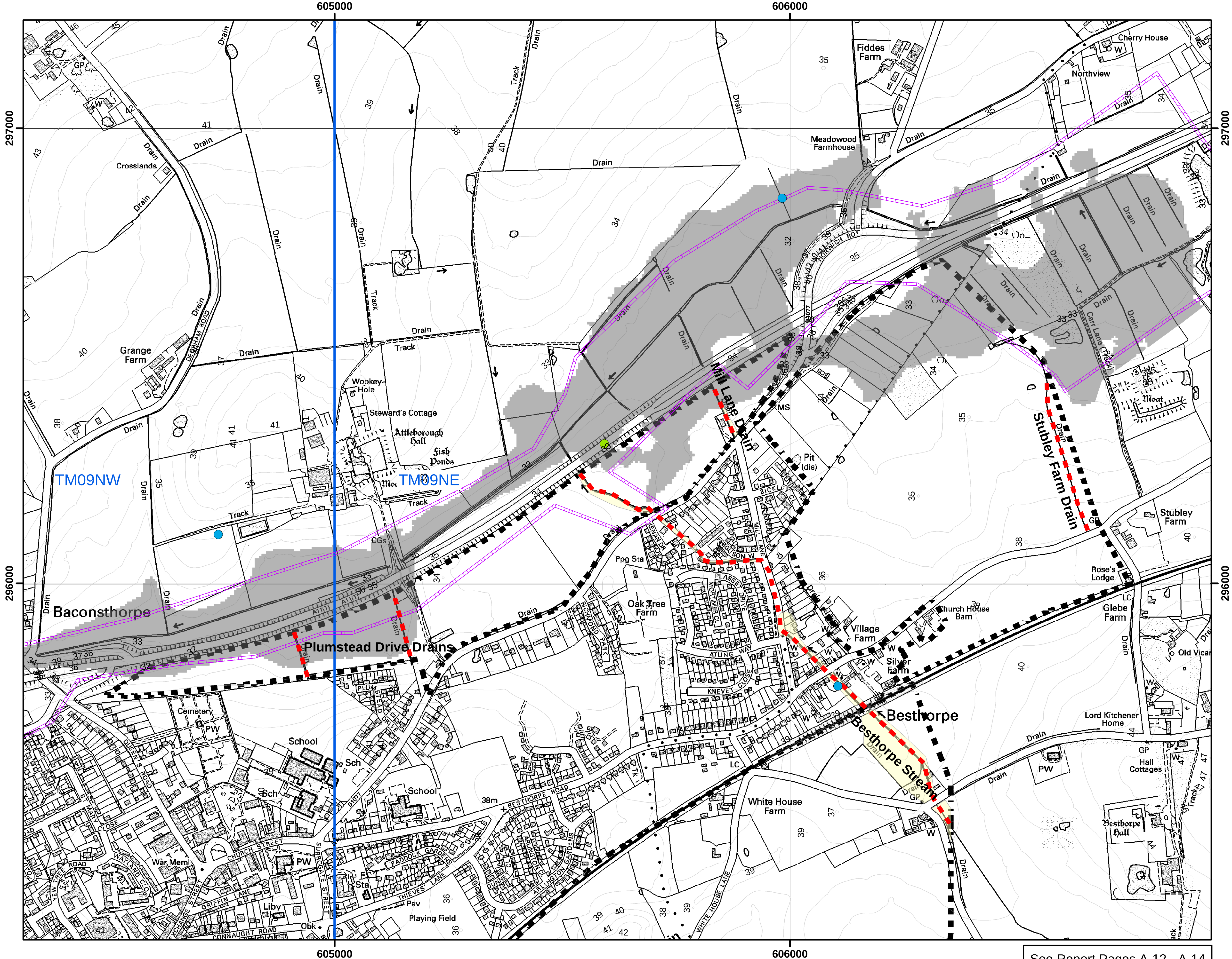
Breckland

Mott MacDonald

Drawing Date 04/02/2008 Rev 4

See Report Pages A-2 - A-11

Drawing ID:\238050 Breckland SFRA Update\Report\Updated Figures\Appendix C\Final_FigureC-A1.pdf



Legend

Modelled Fluvial Flood Extents:

1 in 100 year Envelope
(Envelope derived from latest available modelling data)

1 in 100 year Envelope
(Envelope derived from EA Flood Zone Maps)

1 in 100 year Envelope
(Envelope derived from engineering judgment also refer to flood zone maps.)

Historic Flood Events:

Fluvial Flood Events

Surface Water Flood Events

Infrastructure Failure Flood Events

Sewer Flood Events

Sandbag Deliveries

Flood Warnings

Maximum Historical Fluvial Flooding Extent based on records from 1937 to 1993
(Source: Environment Agency)

Main River

Ordinary Watercourse

IDB District

Contours

1:10000 OS Tile extent

Potential Development Area boundary

User Note

The locations of historic flood events are approximate and indicative only. It should be noted that certain locations not shown to be at risk from fluvial flooding may still be at risk from other watercourses not modelled in this study. Amendments will be required in future to account for information gathered subsequently e.g. changes in the hydrological response of the river or additional data arising from observed flood events.

Project Title

Breckland DC Strategic Flood Risk Assessment

MapTitle

Attleborough Site 2 & 3

Figure C: A2

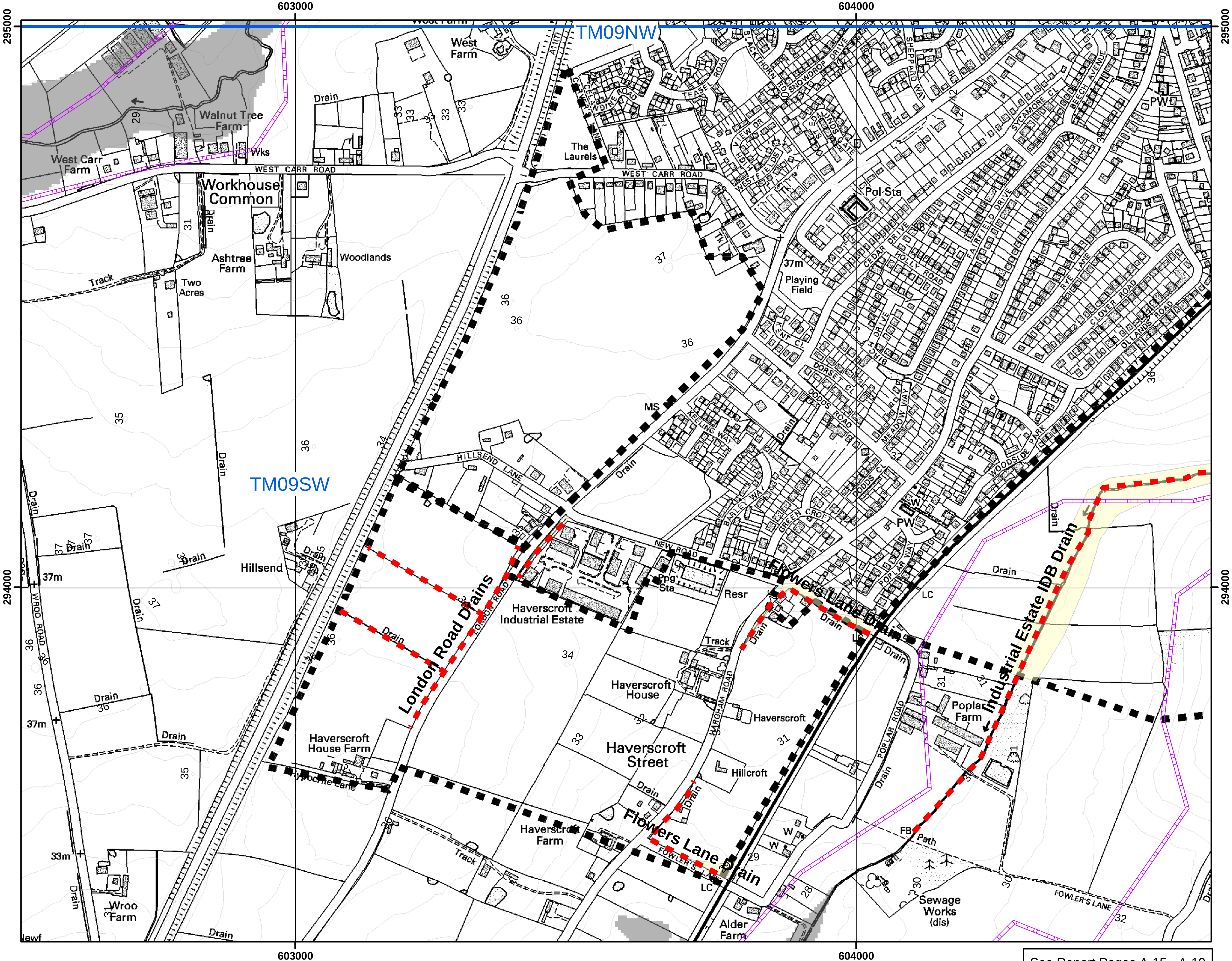
Breckland

Mott MacDonald

Drawing Date 04/02/2008 Rev 4

See Report Pages A-12 - A-14

Drawing ID:\238050 Breckland SFRA Update\Report\Updated Figures\Appendix C\Final_FigureC-A2.pdf



Legend

Modelled Fluvial Flood Extents:

- 1 in 100 year Envelope (Envelope derived from latest available modelling data)
- 1 in 100 year Envelope (Envelope derived from EA Flood Zone Maps)
- 1 in 100 year Envelope (Envelope derived from engineering judgment also refer to flood zone maps.)

Historic Flood Events:

- Fluvial Flood Events
- Surface Water Flood Events
- Infrastructure Failure Flood Events
- Sewer Flood Events
- Sandbag Deliveries
- Flood Warnings
- Maximum Historical Fluvial Flooding Extent based on records from 1937 to 1993 (Source: Environment Agency)

- Main River
- Ordinary Watercourse
- IDB District
- Contours
- 1:10000 OS Tile extent
- Potential Development Area boundary

User Note

The locations of historic flood events are approximate and indicative only. It should be noted that certain locations not shown to be at risk from fluvial flooding may still be at risk from other watercourses not modelled in this study. Amendments will be required in future to account for information gathered subsequently e.g. changes in the hydrological response of the river or additional data arising from observed flood events.

Project Title

Breckland DC Strategic Flood Risk Assessment

MapTitle

Attleborough Site 4 & 5

Figure C: A3

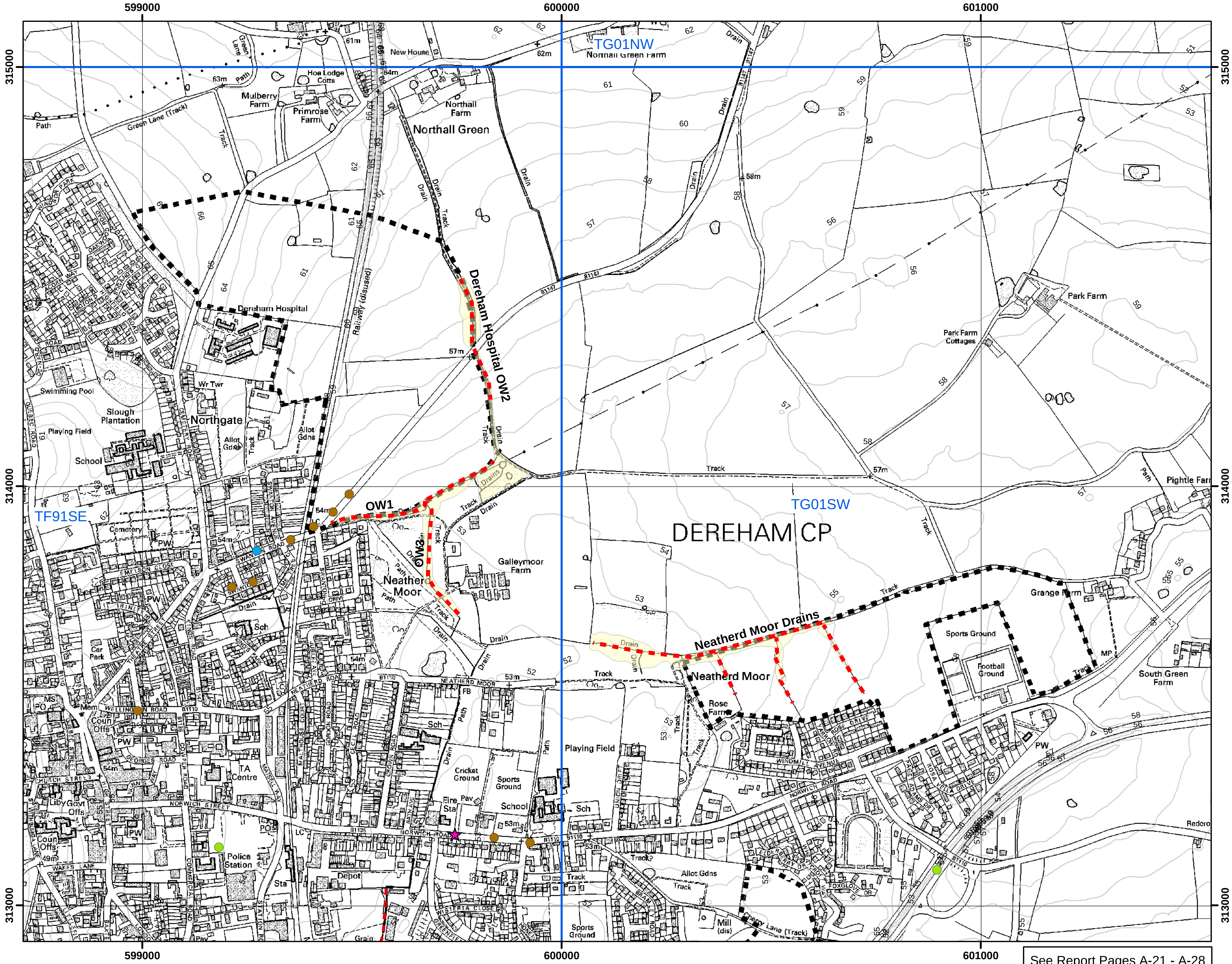
Breckland

Mott MacDonald

Drawing Date 04/02/2008 Rev 4

See Report Pages A-15 - A-19

Drawing ID:\238050 Breckland SFRA Update\Report\Updated Figures\Appendix C\Final_FigureC-A3.pdf



See Report Pages A-21 - A-28

Drawing ID:\238050 Breckland SFRA Update\Report\Updated Figures\Appendix C\Final_FigureC-B1.pdf

Legend

Modelled Fluvial Flood Extents:

- 1 in 100 year Envelope (Envelope derived from latest available modelling data)
- 1 in 100 year Envelope (Envelope derived from EA Flood Zone Maps)
- 1 in 100 year Envelope (Envelope derived from engineering judgment also refer to flood zone maps.)

Historic Flood Events:

- Fluvial Flood Events
- Surface Water Flood Events
- Infrastructure Failure Flood Events
- Sewer Flood Events
- Sandbag Deliveries
- Flood Warnings
- Maximum Historical Fluvial Flooding Extent based on records from 1937 to 1993 (Source: Environment Agency)

- Main River
- Ordinary Watercourse
- IDB District
- Contours
- 1:10000 OS Tile extent
- Potential Development Area boundary

User Note

The locations of historic flood events are approximate and indicative only. It should be noted that certain locations not shown to be at risk from fluvial flooding may still be at risk from other watercourses not modelled in this study. Amendments will be required in future to account for information gathered subsequently e.g. changes in the hydrological response of the river or additional data arising from observed flood events.

Project Title

Breckland DC Strategic Flood Risk Assessment

MapTitle

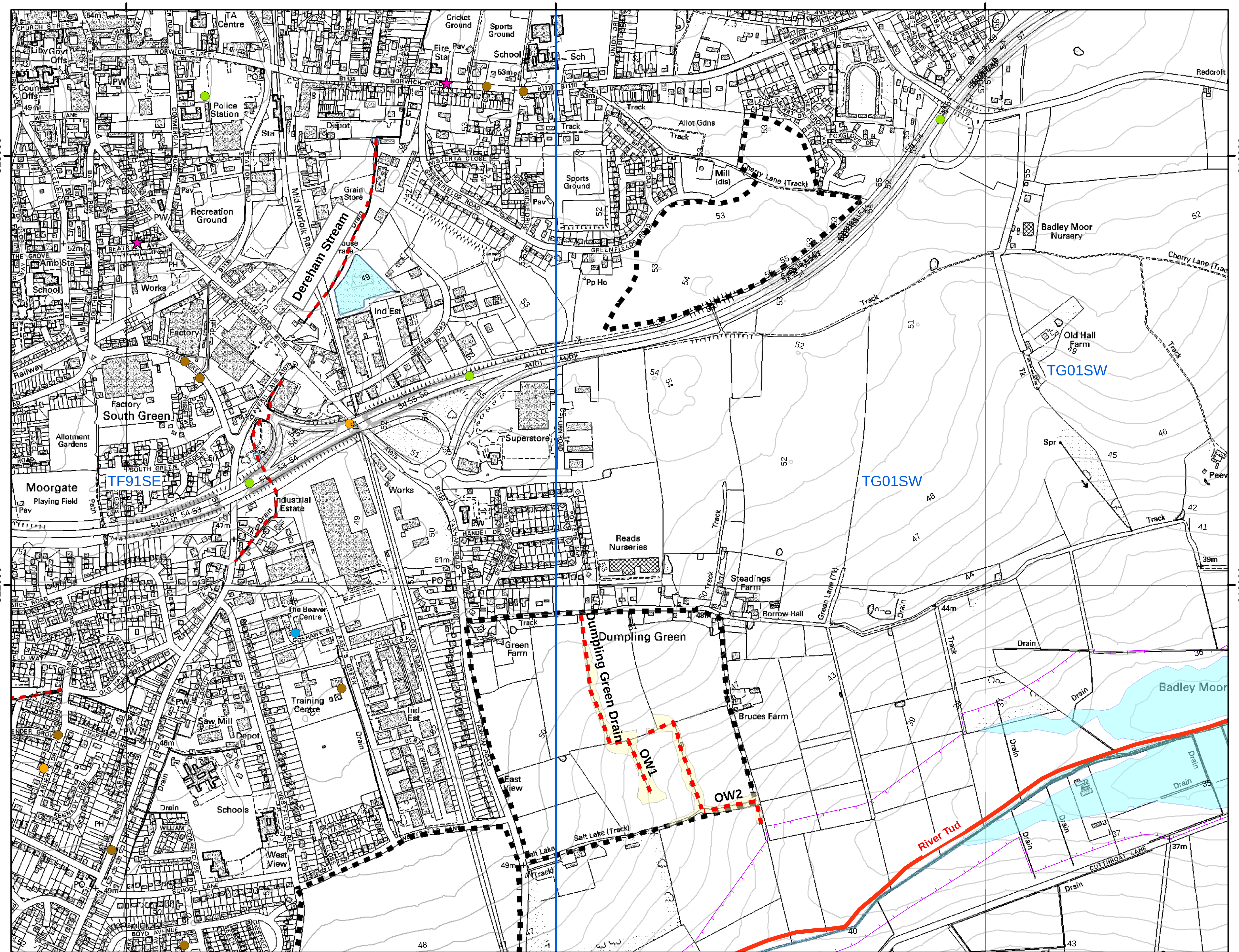
Dereham Site 1 & 3

Figure C: B1

Breckland

Mott MacDonald

Drawing Date 04/02/2008 Rev 4



Legend

Modelled Fluvial Flood Extents:

- 1 in 100 year Envelope (Envelope derived from latest available modelling data)
- 1 in 100 year Envelope (Envelope derived from EA Flood Zone Maps)
- 1 in 100 year Envelope (Envelope derived from engineering judgment also refer to flood zone maps.)

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- Surface Water Flood Events
- Infrastructure Failure Flood Events
- Sewer Flood Events
- Sandbag Deliveries
- Flood Warnings
- Maximum Historical Fluvial Flooding Extent based on records from 1937 to 1993 (Source: Environment Agency)

- Main River
- Ordinary Watercourse
- IDB District
- Contours
- 1:10000 OS Tile extent
- Potential Development Area boundary

User Note

The locations of historic flood events are approximate and indicative only. It should be noted that certain locations not shown to be at risk from fluvial flooding may still be at risk from other watercourses not modelled in this study. Amendments will be required in future to account for information gathered subsequently e.g. changes in the hydrological response of the river or additional data arising from observed flood events.

Project Title

Breckland DC Strategic Flood Risk Assessment

MapTitle

Dereham Site 2 & 4

Figure C: B2

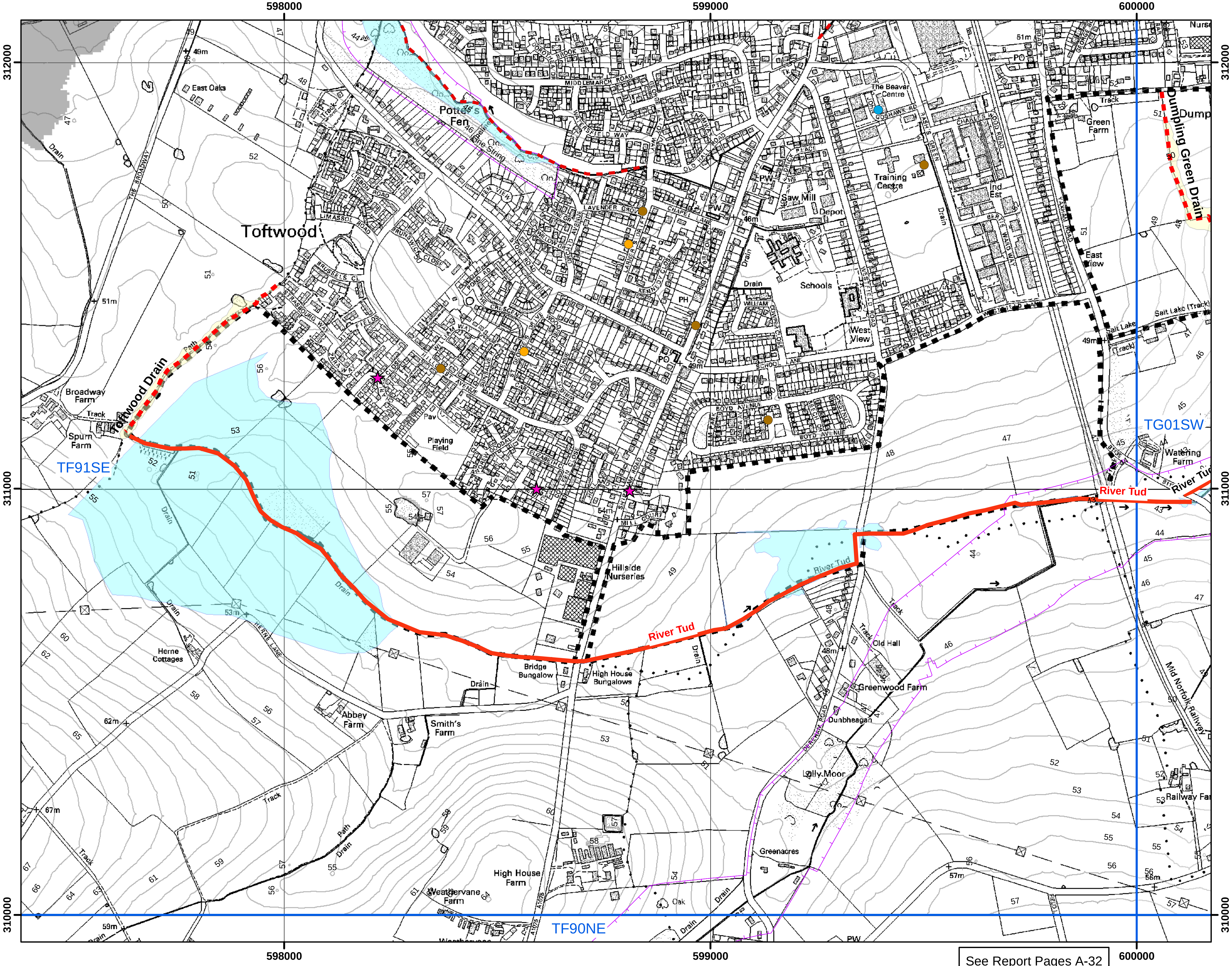
Breckland

Mott MacDonald

Drawing Date 04/02/2008 Rev 4

See Report Pages A-26 - A-31

Drawing ID:\238050 Breckland SFRA Update\Report\Updated Figures\Appendix C\Final_FigureC-B2.pdf



Legend

Modelled Fluvial Flood Extents:
- 1 in 100 year Envelope (Envelope derived from latest available modelling data)
- 1 in 100 year Envelope (Envelope derived from EA Flood Zone Maps)
- 1 in 100 year Envelope (Envelope derived from engineering judgment also refer to flood zone maps.)

Historic Flood Events:
- Fluvial Flood Events
- Surface Water Flood Events
- Infrastructure Failure Flood Events
- Sewer Flood Events
- Sandbag Deliveries
- Flood Warnings
- Maximum Historical Fluvial Flooding Extent based on records from 1937 to 1993 (Source: Environment Agency)

- Main River
- Ordinary Watercourse
- IDB District
- Contours
- 1:10000 OS Tile extent
- Potential Development Area boundary

User Note
The locations of historic flood events are approximate and indicative only. It should be noted that certain locations not shown to be at risk from fluvial flooding may still be at risk from other watercourses not modelled in this study. Amendments will be required in future to account for information gathered subsequently e.g. changes in the hydrological response of the river or additional data arising from observed flood events.

Project Title

Breckland DC Strategic Flood Risk Assessment

MapTitle

Dereham Site 5

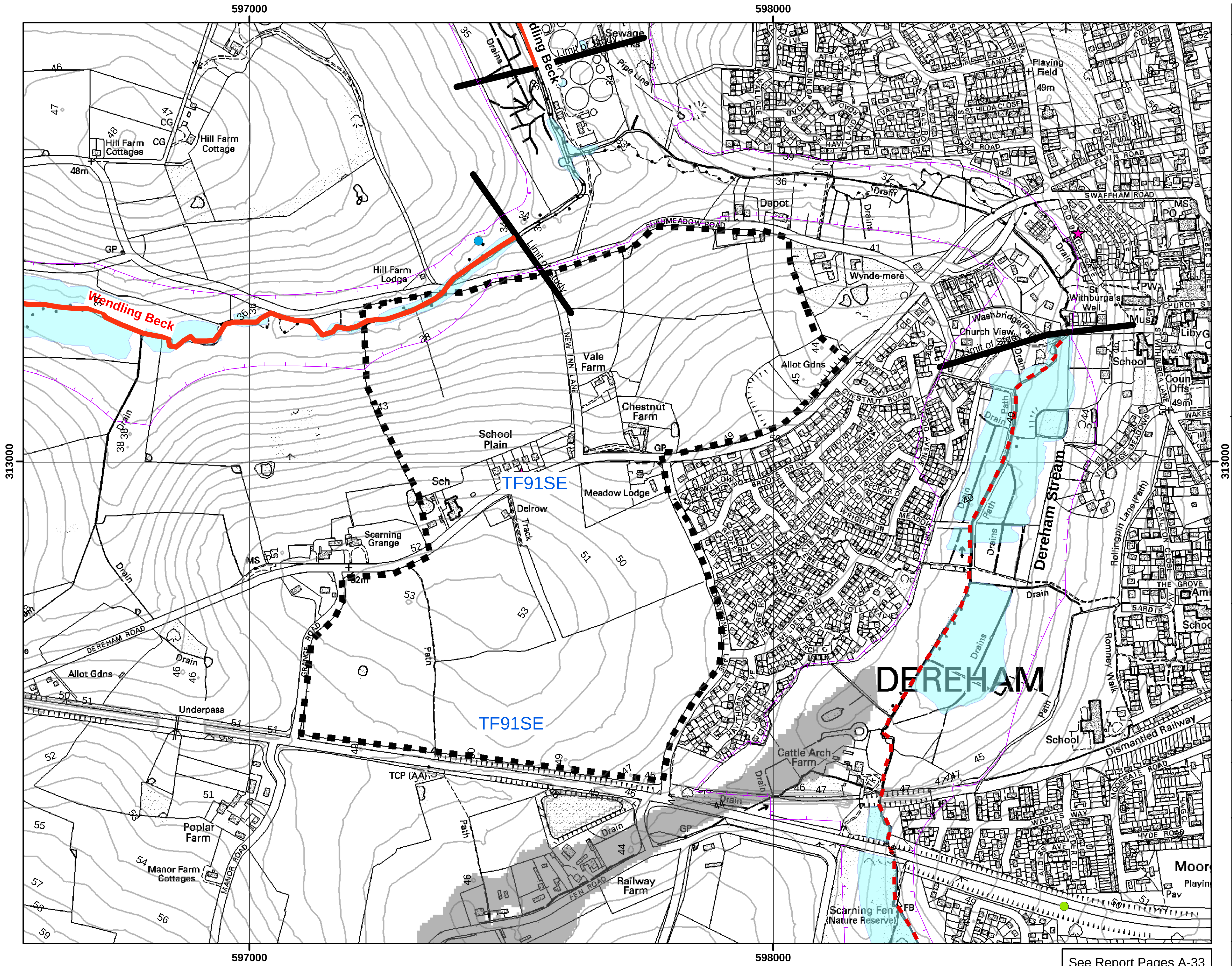
Figure C: B3

Breckland
Mott MacDonald

Drawing Date 04/02/2008 Rev 4

See Report Pages A-32

Drawing ID:\238050 Breckland SFRA Update\Report\Updated Figures\Appendix C\Final_FigureC-B3.pdf



Legend

Modelled Fluvial Flood Extents:

- 1 in 100 year Envelope (Envelope derived from latest available modelling data)
- 1 in 100 year Envelope (Envelope derived from EA Flood Zone Maps)
- 1 in 100 year Envelope (Envelope derived from engineering judgment also refer to flood zone maps.)

Historic Flood Events:

- Fluvial Flood Events
- Surface Water Flood Events
- Infrastructure Failure Flood Events
- Sewer Flood Events
- Sandbag Deliveries
- Flood Warnings
- Maximum Historical Fluvial Flooding Extent based on records from 1937 to 1993 (Source: Environment Agency)

- Main River
- Ordinary Watercourse
- IDB District
- Contours
- 1:10000 OS Tile extent
- Potential Development Area boundary

User Note

The locations of historic flood events are approximate and indicative only. It should be noted that certain locations not shown to be at risk from fluvial flooding may still be at risk from other watercourses not modelled in this study. Amendments will be required in future to account for information gathered subsequently e.g. changes in the hydrological response of the river or additional data arising from observed flood events.

Project Title

Breckland DC Strategic Flood Risk Assessment

MapTitle

Dereham Site 6

Figure C: B4

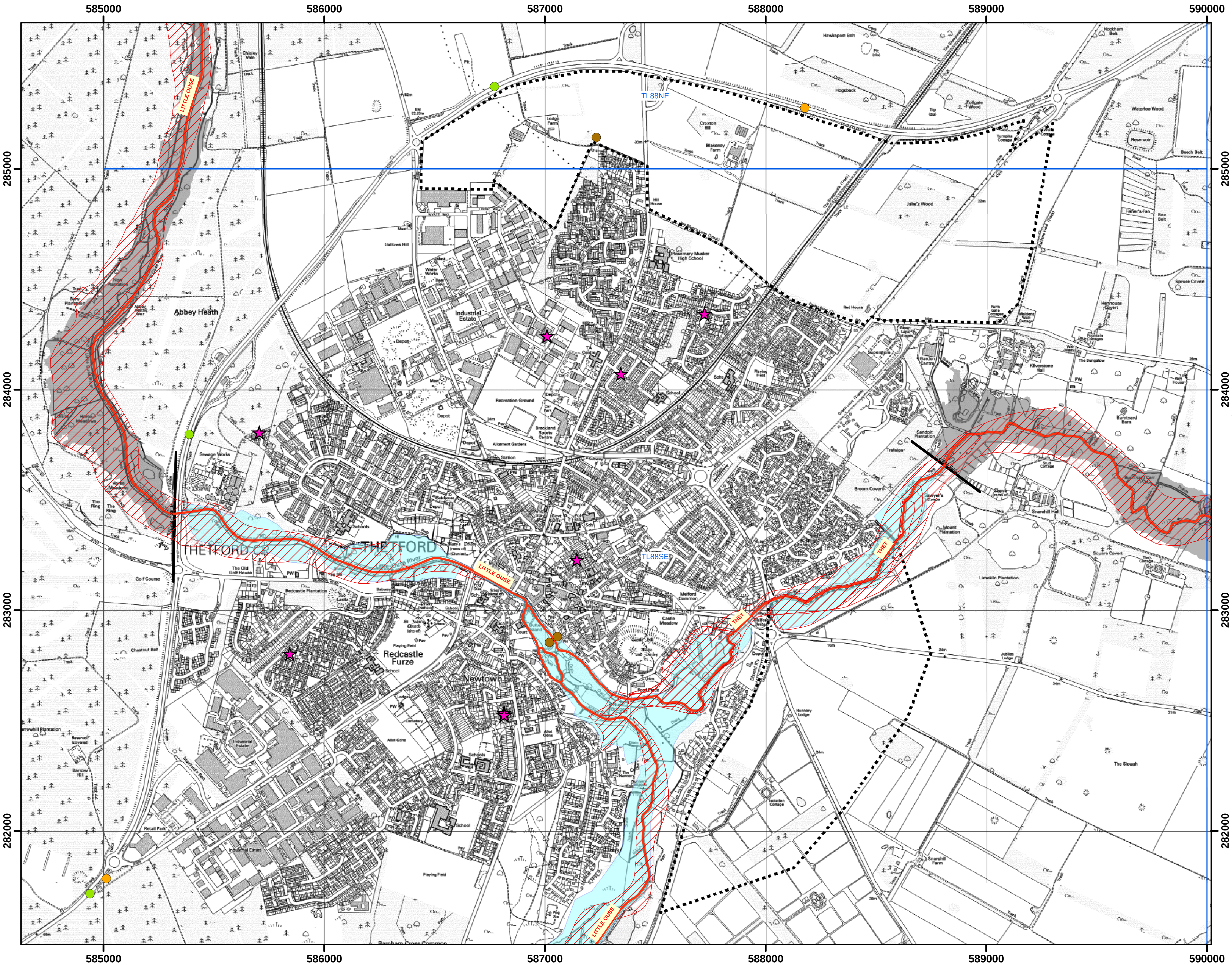
Breckland

Mott MacDonald

Drawing Date 04/02/2008 Rev 4

See Report Pages A-33

Drawing ID:\238050 Breckland SFRA Update\Report\Updated Figures\Appendix C\Final_FigureC-B4.pdf



Legend

Modelled Fluvial Flood Extents:

- 1 in 100 year Envelope (Envelope derived from latest available modelling data)
- 1 in 100 year Envelope (Envelope derived from EA Flood Zone Maps)
- 1 in 100 year Envelope (Envelope derived from engineering judgment also refer to flood zone maps.)

Historic Flood Events:

- Fluvial Flood Events
- Surface Water Flood Events
- Infrastructure Failure Flood Events
- Sewer Flood Events
- Sandbag Deliveries
- Flood Warnings
- Maximum Historical Fluvial Flooding Extent based on records from 1937 to 1993 (Source: Environment Agency)

- Main River
- Ordinary Watercourse
- IDB District
- Contours
- 1:10000 OS Tile extent
- Potential Development Area boundary

User Note

The locations of historic flood events are approximate and indicative only. It should be noted that certain locations not shown to be at risk from fluvial flooding may still be at risk from other watercourses not modelled in this study. Amendments will be required in future to account for information gathered subsequently e.g. changes in the hydrological response of the river or additional data arising from observed flood events.

Project Title

Breckland DC Strategic Flood Risk Assessment

MapTitle

Thetford

Figure C: D1

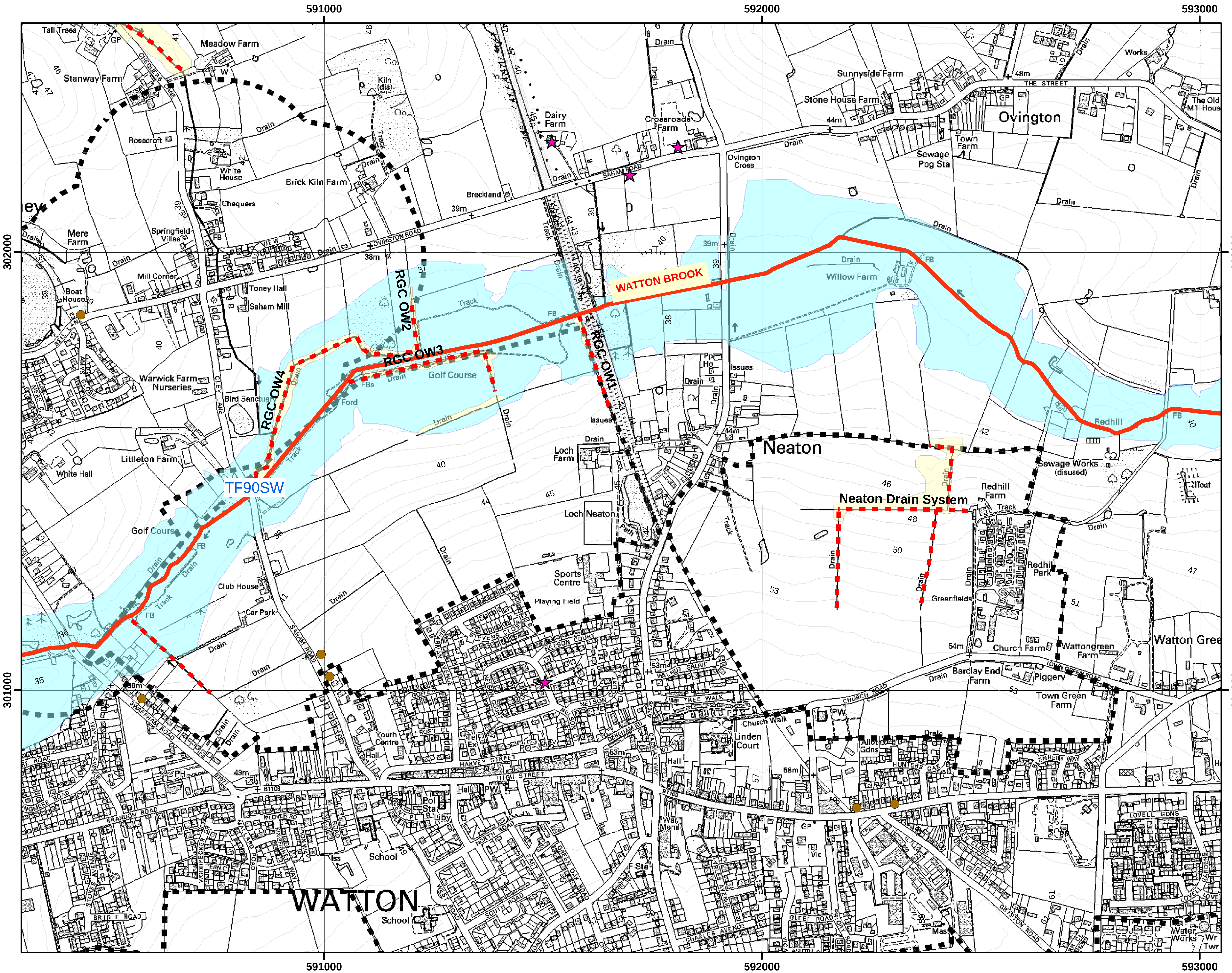
Breckland

Mott MacDonald

Drawing Date 04/02/2008 Rev 4

See Report Pages A-37 - A42

Drawing ID:\238050 Breckland SFRA Update\Report\Updated Figures\Appendix C\Final_FigureC-D1.pdf



Legend

Modelled Fluvial Flood Extents:

- 1 in 100 year Envelope (Envelope derived from latest available modelling data)
- 1 in 100 year Envelope (Envelope derived from EA Flood Zone Maps)
- 1 in 100 year Envelope (Envelope derived from engineering judgment also refer to flood zone maps.)

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- Infrastructure Failure Flood Events
- Sewer Flood Events
- Sandbag Deliveries
- Flood Warnings
- Maximum Historical Fluvial Flooding Extent based on records from 1937 to 1993 (Source: Environment Agency)

- Main River
- Ordinary Watercourse
- IDB District
- Contours
- 1:10000 OS Tile extent
- Potential Development Area boundary

User Note

The locations of historic flood events are approximate and indicative only. Not shown to be at risk from fluvial flooding may still be at risk from other watercourses not modelled in this study. Amendments will be required in future to account for information gathered subsequently e.g. changes in the hydrological response of the river or additional data arising from observed flood events.

Project Title

Breckland DC Strategic Flood Risk Assessment

MapTitle

Watton Site 1 & 2

Figure C: E1

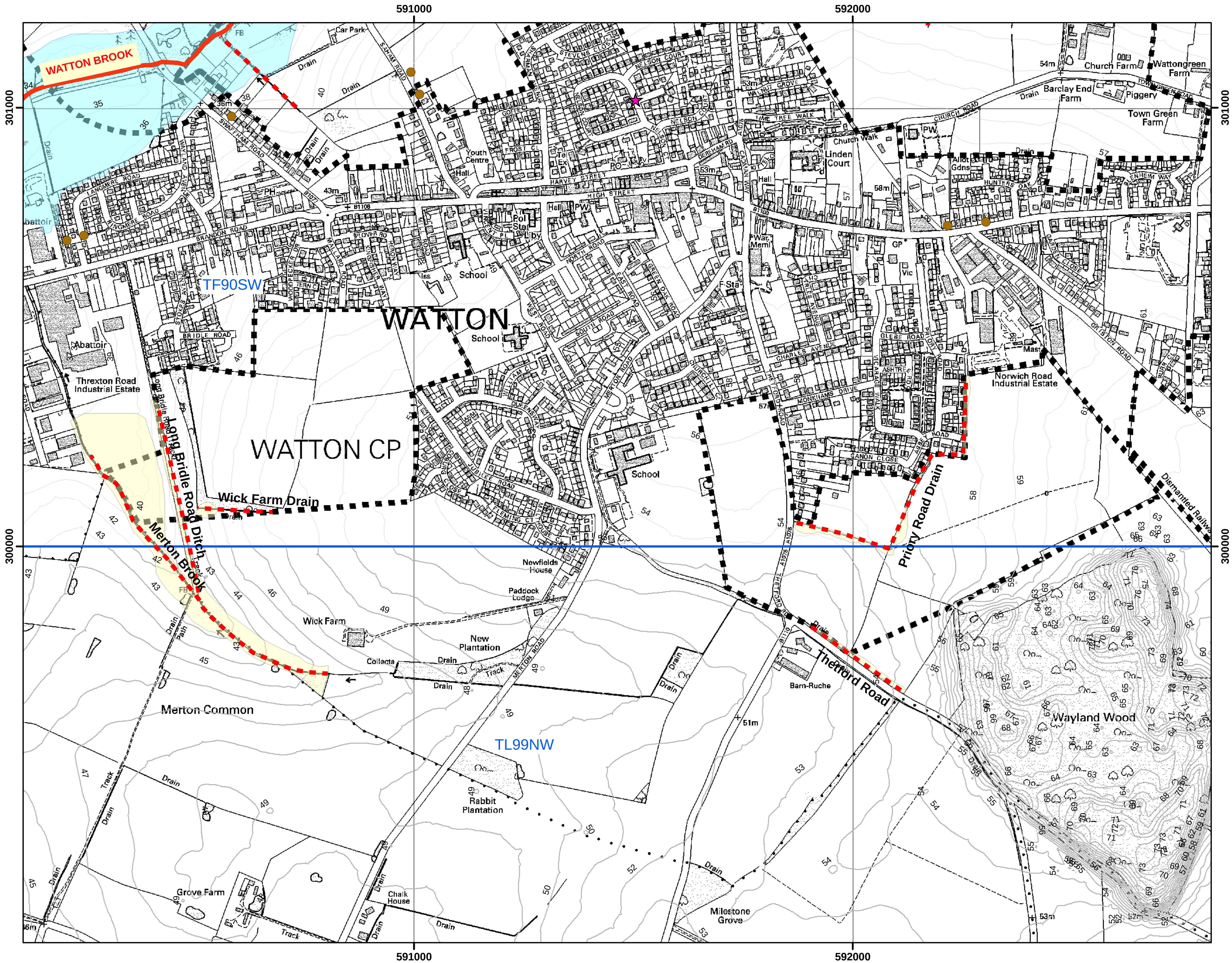
Breckland

Mott MacDonald

Drawing Date 04/02/2008 Rev 4

See Report Pages A-43 - A-52

Drawing ID:\238050 Breckland SFRA Update\Report\Updated Figures\Appendix C\Final_FigureC-E1.pdf



Legend

Modelled Fluvial Flood Extents:

1 in 100 year Envelope (Envelope derived from latest available modelling data)

1 in 100 year Envelope (Envelope derived from EA Flood Zone Maps)

1 in 100 year Envelope (Envelope derived from engineering judgment also refer to flood zone maps.)

Historic Flood Events:

Fluvial Flood Events

Surface Water Flood Events

Infrastructure Failure Flood Events

Sewer Flood Events

Sandbag Deliveries

Flood Warnings

Maximum Historical Fluvial Flooding Extent based on records from 1937 to 1993 (Source: Environment Agency)

Main River

Ordinary Watercourse

IDB District

Contours

1:10000 OS Tile extent

Potential Development Area boundary

User Note

The locations of historic flood events are approximate and indicative only. It should be noted that certain locations not shown to be at risk from fluvial flooding may still be at risk from other watercourses not modelled in this study. Amendments will be required in future to account for information gathered subsequently e.g. changes in the hydrological response of the river or additional data arising from observed flood events.

Project Title

Breckland DC Strategic Flood Risk Assessment

MapTitle

Watton Site 3 & 5

Figure C: E2

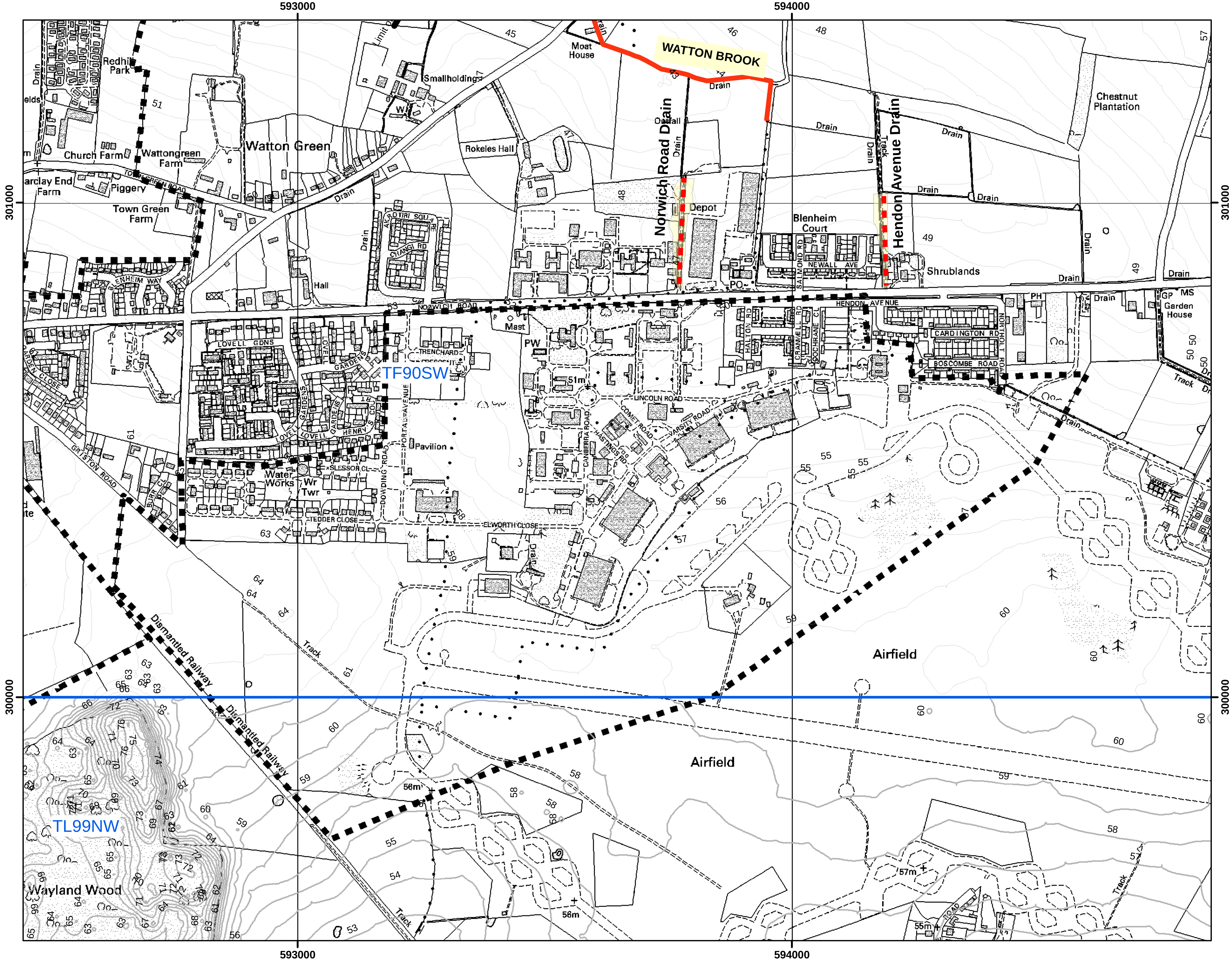
Breckland

Mott MacDonald

Drawing Date 04/02/2008 Rev 4

See Report Pages A-53 - A-58

Drawing ID:\238050 Breckland SFRA Update\Report\Updated Figures\Appendix C\Final_FigureC-E2.pdf



Legend

Modelled Fluvial Flood Extents:

- 1 in 100 year Envelope (Envelope derived from latest available modelling data)
- 1 in 100 year Envelope (Envelope derived from EA Flood Zone Maps)
- 1 in 100 year Envelope (Envelope derived from engineering judgment also refer to flood zone maps.)

Historic Flood Events:

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- Surface Water Flood Events
- Infrastructure Failure Flood Events
- Sewer Flood Events
- Sandbag Deliveries
- Flood Warnings
- Maximum Historical Fluvial Flooding Extent based on records from 1937 to 1993 (Source: Environment Agency)

- Main River
- Ordinary Watercourse
- IDB District
- Contours
- 1:10000 OS Tile extent
- Potential Development Area boundary

User Note

The locations of historic flood events are approximate and indicative only. It should be noted that certain locations not shown to be at risk from fluvial flooding may still be at risk from other watercourses not modelled in this study. Amendments will be required in future to account for information gathered subsequently e.g. changes in the hydrological response of the river or additional data arising from observed flood events.

Project Title

Breckland DC Strategic Flood Risk Assessment

MapTitle

Watton Site 4

Figure C: E3

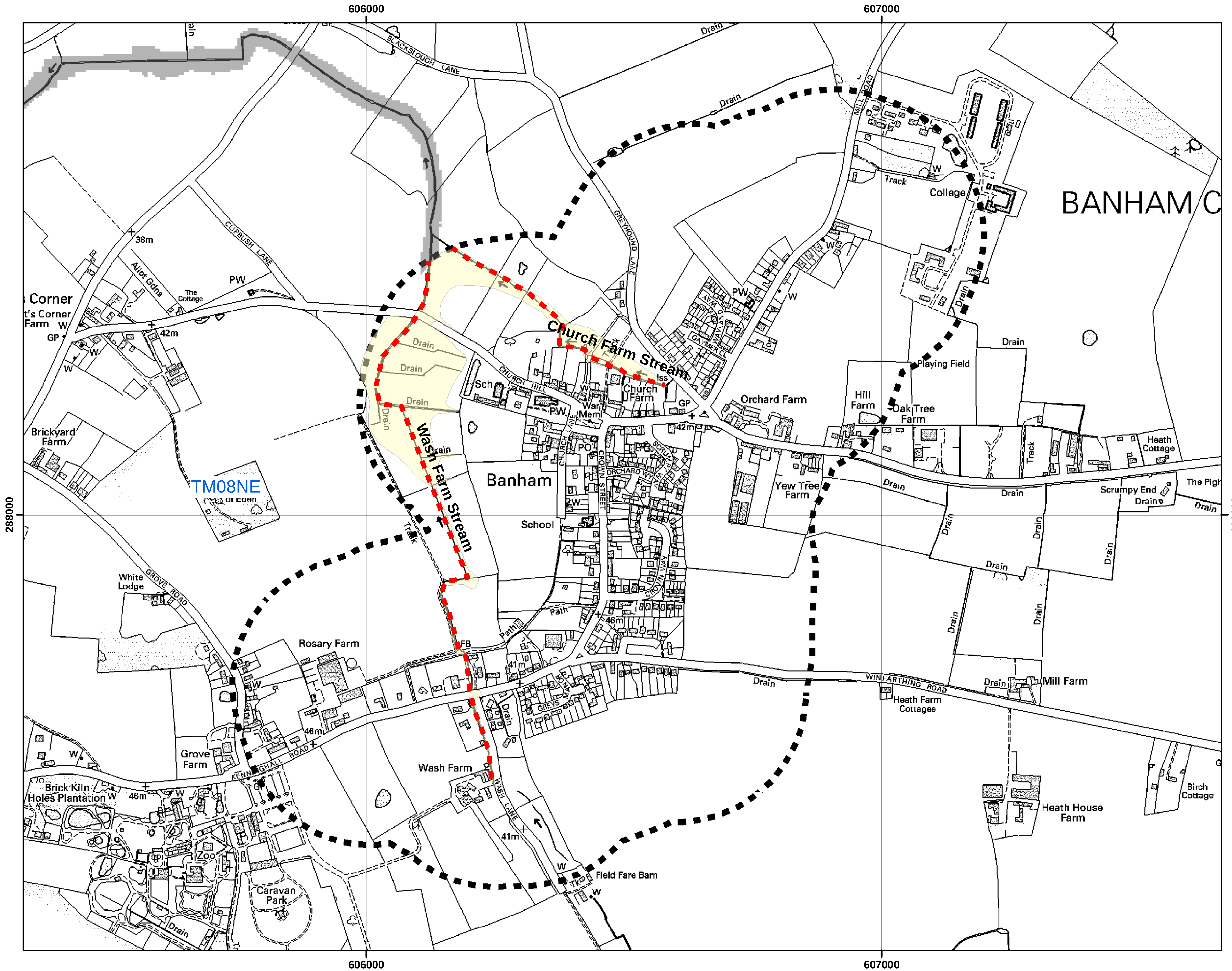
Breckland

Mott MacDonald

Drawing Date 04/02/2008 Rev 4

See Report Pages A-55 - A-56

Drawing ID:\238050 Breckland SFRA Update\Report\Updated Figures\Appendix C\Final_FigureC-E3.pdf



Legend

Modelled Fluvial Flood Extents:

1 in 100 year Envelope (Envelope derived from latest available modelling data)

1 in 100 year Envelope (Envelope derived from EA Flood Zone Maps)

1 in 100 year Envelope (Envelope derived from engineering judgment also refer to flood zone maps.)

Historic Flood Events:

Fluvial Flood Events

Surface Water Flood Events

Infrastructure Failure Flood Events

Sewer Flood Events

Sandbag Deliveries

Flood Warnings

Maximum Historical Fluvial Flooding Extent based on records from 1937 to 1993 (Source: Environment Agency)

Main River

Ordinary Watercourse

IDB District

Contours

1:10000 OS Tile extent

Potential Development Area boundary

User Note

The locations of historic flood events are approximate and indicative only. It should be noted that certain locations not shown to be at risk from fluvial flooding may still be at risk from other watercourses not modelled in this study. Amendments will be required in future to account for information gathered subsequently e.g. changes in the hydrological response of the river or additional data arising from observed flood events.

Project Title

Breckland DC Strategic Flood Risk Assessment

MapTitle

Banham

Figure C: F1

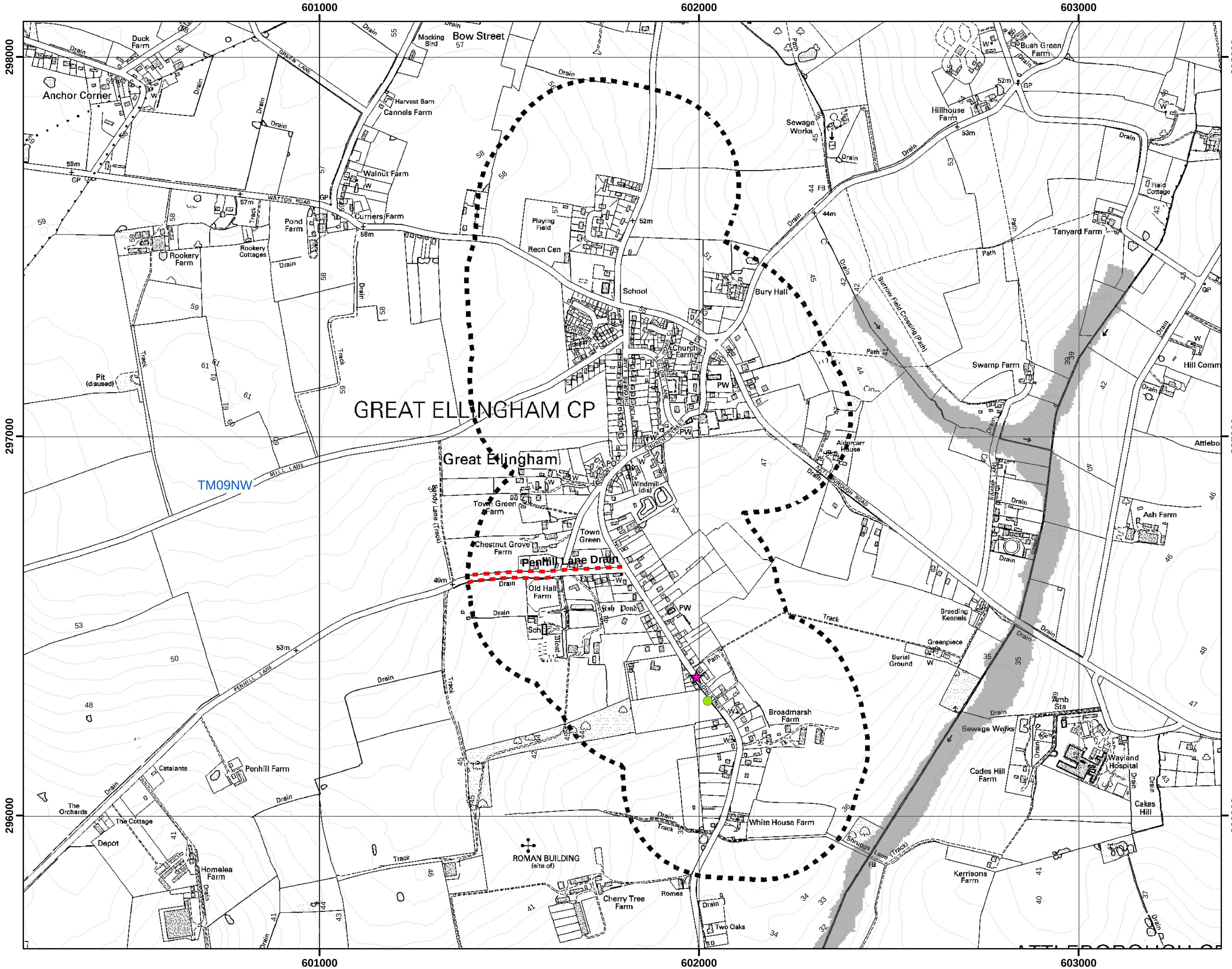
Breckland

Mott MacDonald

Drawing Date 04/02/2008 Rev 4

See Report Pages B-3 - B-6

Drawing ID:\238050 Breckland SFRA Update\Report\Updated Figures\Appendix C\Final_FigureC-F1.pdf



Legend

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- 1 in 100 year Envelope (Envelope derived from latest available modelling data)
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Historic Flood Events:

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- Sewer Flood Events
- Sandbag Deliveries
- Flood Warnings
- Maximum Historical Fluvial Flooding Extent based on records from 1937 to 1993 (Source: Environment Agency)

- Main River
- Ordinary Watercourse
- IDB District
- Contours
- 1:10000 OS Tile extent
- Potential Development Area boundary

User Note

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Project Title

Breckland DC Strategic Flood Risk Assessment

MapTitle

Great Ellingham

Figure C: G1

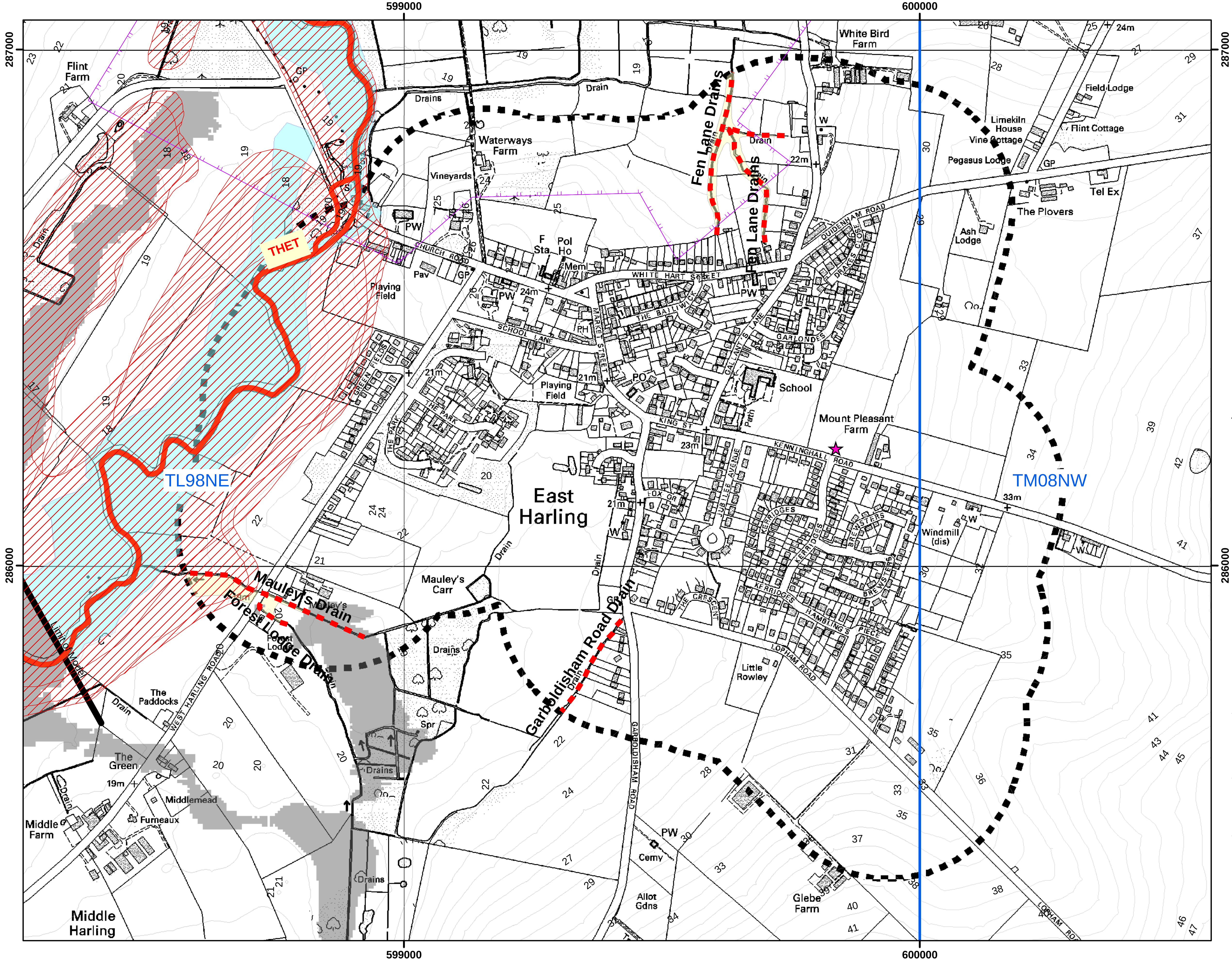
Breckland

Mott MacDonald

Drawing Date 04/02/2008 Rev 4

See Report Pages B-7 - B-8

Drawing ID:\238050 Breckland SFRA Update\Report\Updated Figures\Appendix C\Final_FigureC-G1.pdf



Legend

Modelled Fluvial Flood Extents:

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- IDB District
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User Note

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Project Title

Breckland DC Strategic Flood Risk Assessment

MapTitle

East Harling

Figure C: H1

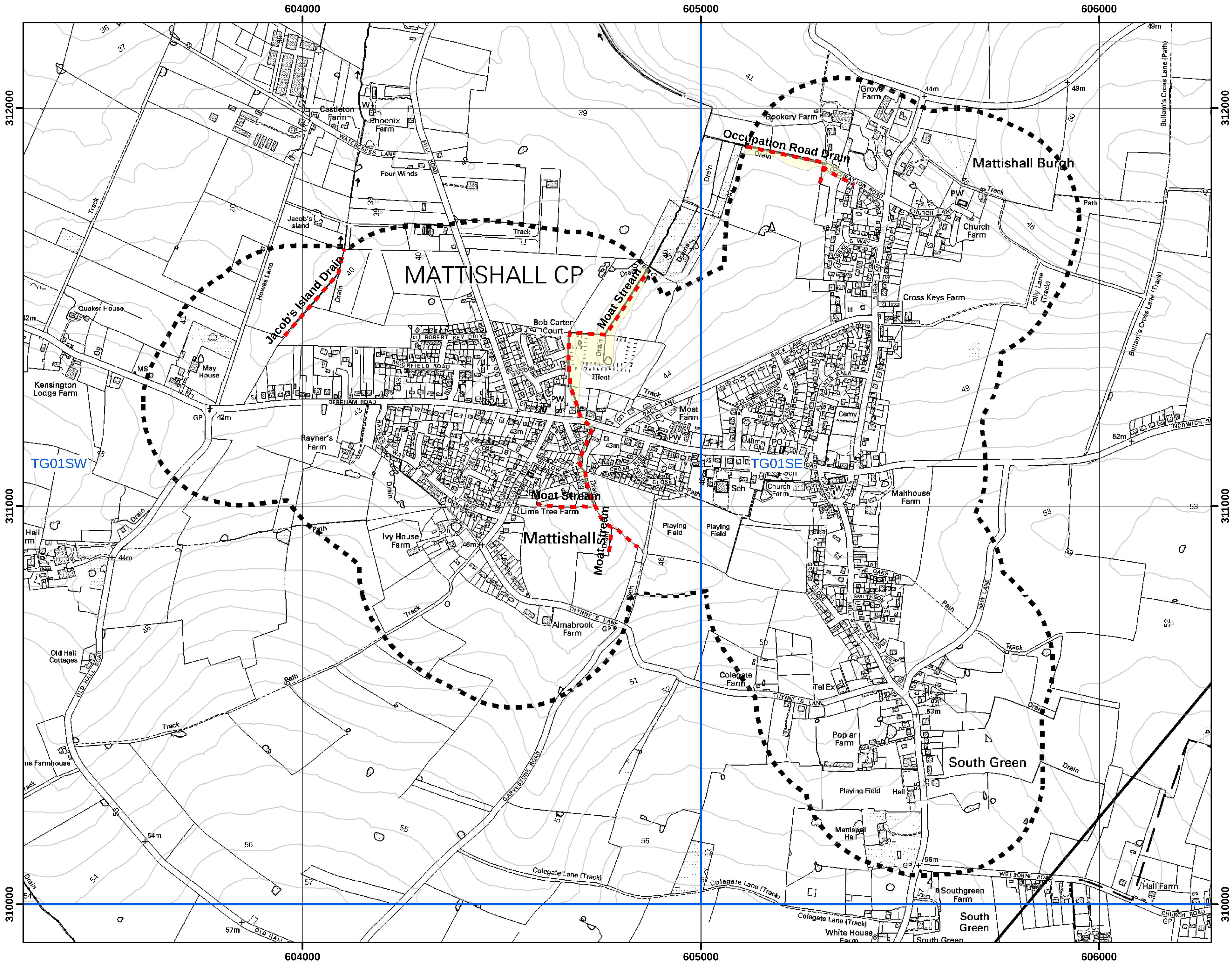
Breckland

Mott MacDonald

Drawing Date 04/02/2008 Rev 4

See Report Pages B-9 - B-11

Drawing ID:\238050 Breckland SFRA Update\Report\Updated Figures\Appendix C\Final_FigureC-H1.pdf



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1 in 100 year Envelope (Envelope derived from EA Flood Zone Maps)

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Historic Flood Events:

Fluvial Flood Events

Surface Water Flood Events

Infrastructure Failure Flood Events

Sewer Flood Events

Sandbag Deliveries

Flood Warnings

Maximum Historical Fluvial Flooding Extent based on records from 1937 to 1993 (Source: Environment Agency)

Main River

Ordinary Watercourse

IDB District

Contours

1:10000 OS Tile extent

Potential Development Area boundary

User Note

The locations of historic flood events are approximate and indicative only. It should be noted that certain locations not shown to be at risk from fluvial flooding may still be at risk from other watercourses not modelled in this study. Amendments will be required in future to account for information gathered subsequently e.g. changes in the hydrological response of the river or additional data arising from observed flood events.

Project Title

Breckland DC Strategic Flood Risk Assessment

MapTitle

Mattishall

Figure C: I1

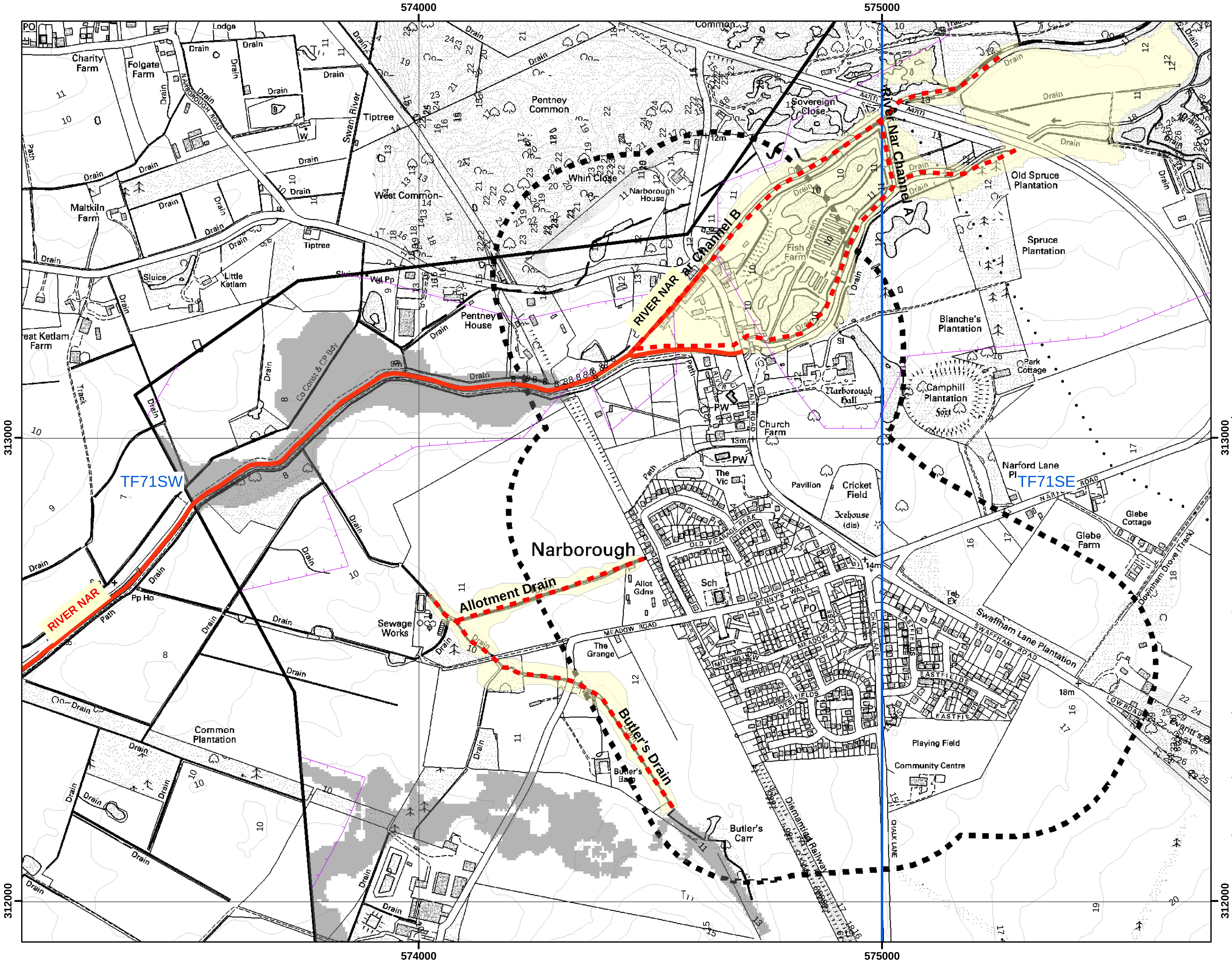
Breckland

Mott MacDonald

Drawing Date 04/02/2008 Rev 4

See Report Pages B-13 - B-16

Drawing ID:\238050 Breckland SFRA Update\Report\Updated Figures\Appendix C\Final_FigureC-I1.pdf



Legend

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- Main River
- Ordinary Watercourse
- IDB District
- Contours
- 1:10000 OS Tile extent
- Potential Development Area boundary

User Note

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Project Title

Breckland DC Strategic Flood Risk Assessment

MapTitle

Narborough

Figure C: J1

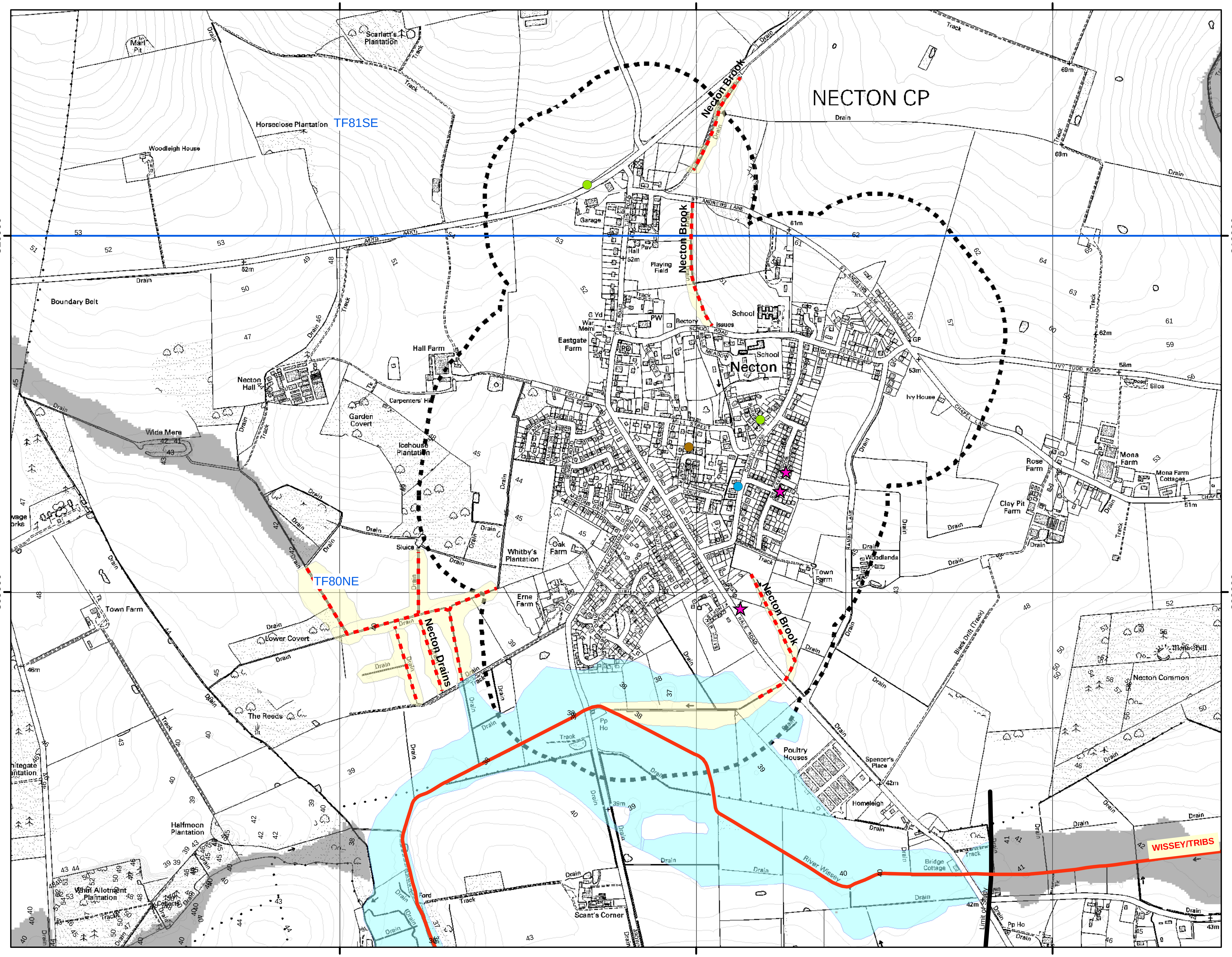
Breckland

Mott MacDonald

Drawing Date 04/02/2008 Rev 4

See Report Pages B-13 - B-16

Drawing ID:\238050 Breckland SFRA Update\Report\Updated Figures\Appendix C\Final_FigureC-J1.pdf



Legend

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- Surface Water Flood Events
- Infrastructure Failure Flood Events
- Sewer Flood Events
- Sandbag Deliveries
- Flood Warnings
- Maximum Historical Fluvial Flooding Extent based on records from 1937 to 1993 (Source: Environment Agency)

- Main River
- Ordinary Watercourse
- IDB District
- Contours
- 1:10000 OS Tile extent
- Potential Development Area boundary

User Note

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Project Title

Breckland DC Strategic Flood Risk Assessment

MapTitle

Necton

Figure C: K1

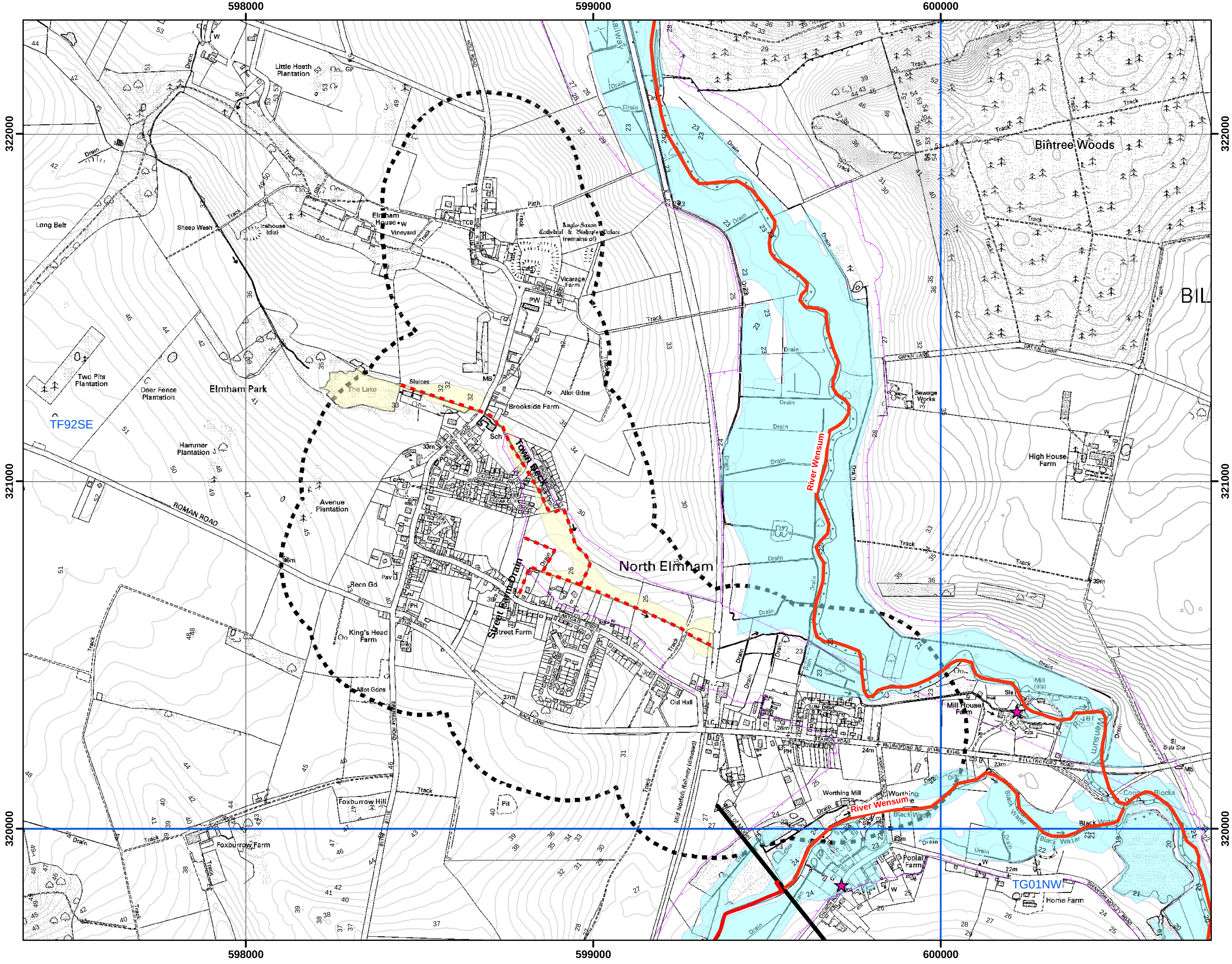
Breckland

Mott MacDonald

Drawing Date 04/02/2008 Rev 4

See Report Pages B-25 - B-28

Drawing ID:\238050 Breckland SFRA Update\Report\Updated Figures\Appendix C\Final_FigureC-K1.pdf



Legend

Modelled Fluvial Flood Extents:

1 in 100 year Envelope (Envelope derived from latest available modelling data)

1 in 100 year Envelope (Envelope derived from EA Flood Zone Maps)

1 in 100 year Envelope (Envelope derived from engineering judgment also refer to flood zone maps.)

Historic Flood Events:

Fluvial Flood Events

Surface Water Flood Events

Infrastructure Failure Flood Events

Sewer Flood Events

Sandbag Deliveries

Flood Warnings

Maximum Historical Fluvial Flooding Extent based on records from 1937 to 1993 (Source: Environment Agency)

Main River

Ordinary Watercourse

IDB District

Contours

1:10000 OS Tile extent

Potential Development Area boundary

User Note

The locations of historic flood events are approximate and indicative only. It should be noted that certain locations not shown to be at risk from fluvial flooding may still be at risk from other watercourses not modelled in this study. Amendments will be required in future to account for information gathered subsequently e.g. changes in the hydrological response of the river or additional data arising from observed flood events.

Project Title

Breckland DC Strategic Flood Risk Assessment

MapTitle

North Elmham

Figure C: L1

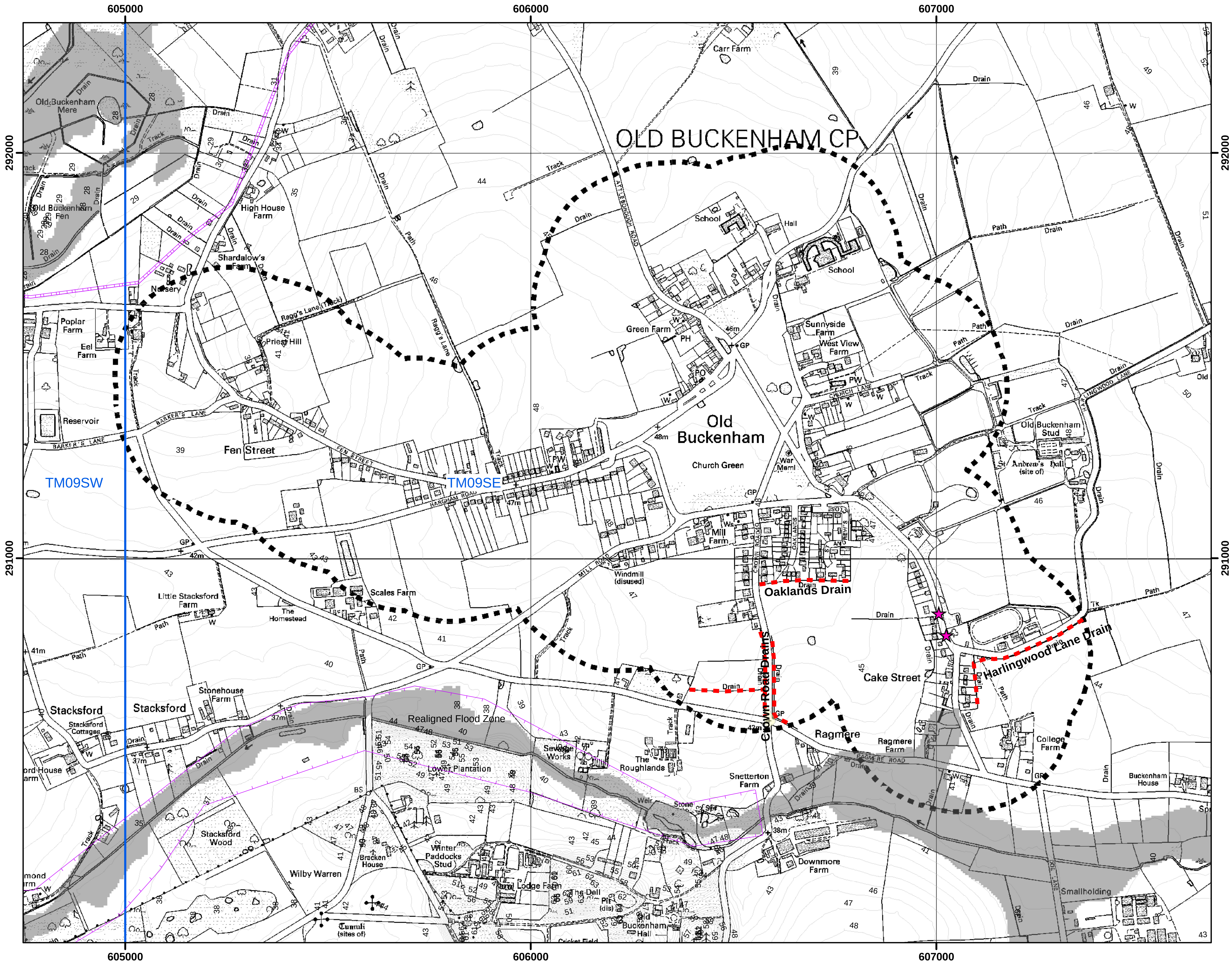
Breckland

Mott MacDonald

Drawing Date 04/02/2008 Rev 4

See Report Pages B-29 - B-32

Drawing ID:\238050 Breckland SFRA Update\Report\Updated Figures\Appendix C\Final_FigureC-L1.pdf



Legend

Modelled Fluvial Flood Extents:

1 in 100 year Envelope (Envelope derived from latest available modelling data)

1 in 100 year Envelope (Envelope derived from EA Flood Zone Maps)

1 in 100 year Envelope (Envelope derived from engineering judgment also refer to flood zone maps.)

Historic Flood Events:

Fluvial Flood Events

Surface Water Flood Events

Infrastructure Failure Flood Events

Sewer Flood Events

Sandbag Deliveries

Flood Warnings

Maximum Historical Fluvial Flooding Extent based on records from 1937 to 1993 (Source: Environment Agency)

Main River

Ordinary Watercourse

IDB District

Contours

1:10000 OS Tile extent

Potential Development Area boundary

User Note

The locations of historic flood events are approximate and indicative only. It should be noted that certain locations not shown to be at risk from fluvial flooding may still be at risk from flood risk from other watercourses not modelled in this study. Amendments will be required in future to account for information gathered subsequently e.g. changes in the hydrological response of the river or additional data arising from observed flood events.

Project Title

Breckland DC Strategic Flood Risk Assessment

MapTitle

Old Buckenham

Figure C: M1

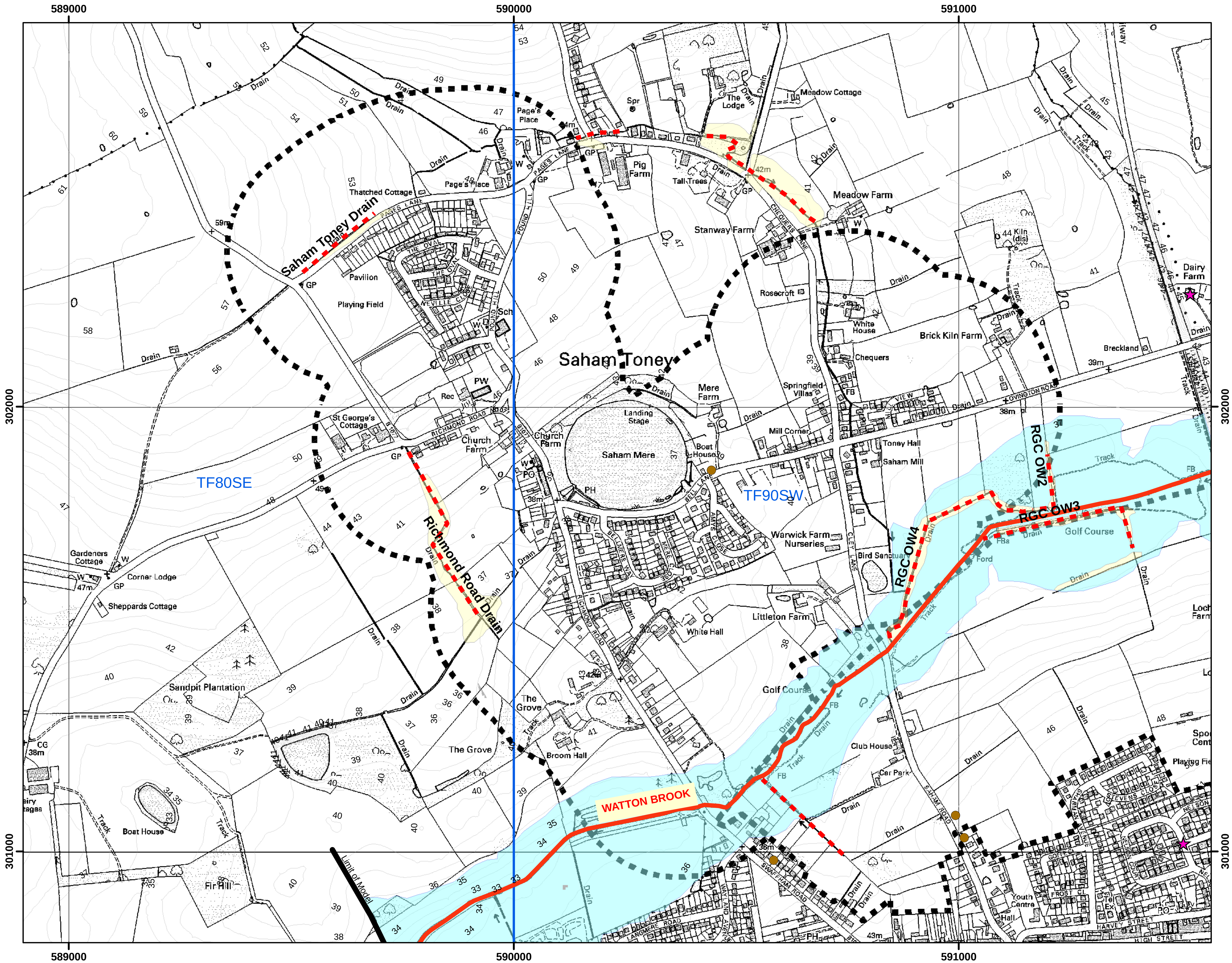
Breckland

Mott MacDonald

Drawing Date 04/02/2008 Rev 4

See Report Pages B-33 - B-35

Drawing ID:\238050 Breckland SFRA Update\Report\Updated Figures\Appendix C\Final_FigureC-M1.pdf



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See Report Pages B-37 - B-39

Legend

Modelled Fluvial Flood Extents:

- 1 in 100 year Envelope (Envelope derived from latest available modelling data)
- 1 in 100 year Envelope (Envelope derived from EA Flood Zone Maps)
- 1 in 100 year Envelope (Envelope derived from engineering judgment also refer to flood zone maps.)

Historic Flood Events:

- Fluvial Flood Events
- Surface Water Flood Events
- Infrastructure Failure Flood Events
- Sewer Flood Events
- Sandbag Deliveries
- Flood Warnings
- Maximum Historical Fluvial Flooding Extent based on records from 1937 to 1993 (Source: Environment Agency)

- Main River
- Ordinary Watercourse
- IDB District
- Contours
- 1:10000 OS Tile extent
- Potential Development Area boundary

User Note

The locations of historic flood events are approximate and indicative only. It should be noted that certain locations not shown to be at risk from fluvial flooding may still be at risk from other watercourses not modelled in this study. Amendments will be required in future to account for information gathered subsequently e.g. changes in the hydrological response of the river or additional data arising from observed flood events.

Project Title

Breckland DC Strategic Flood Risk Assessment

MapTitle

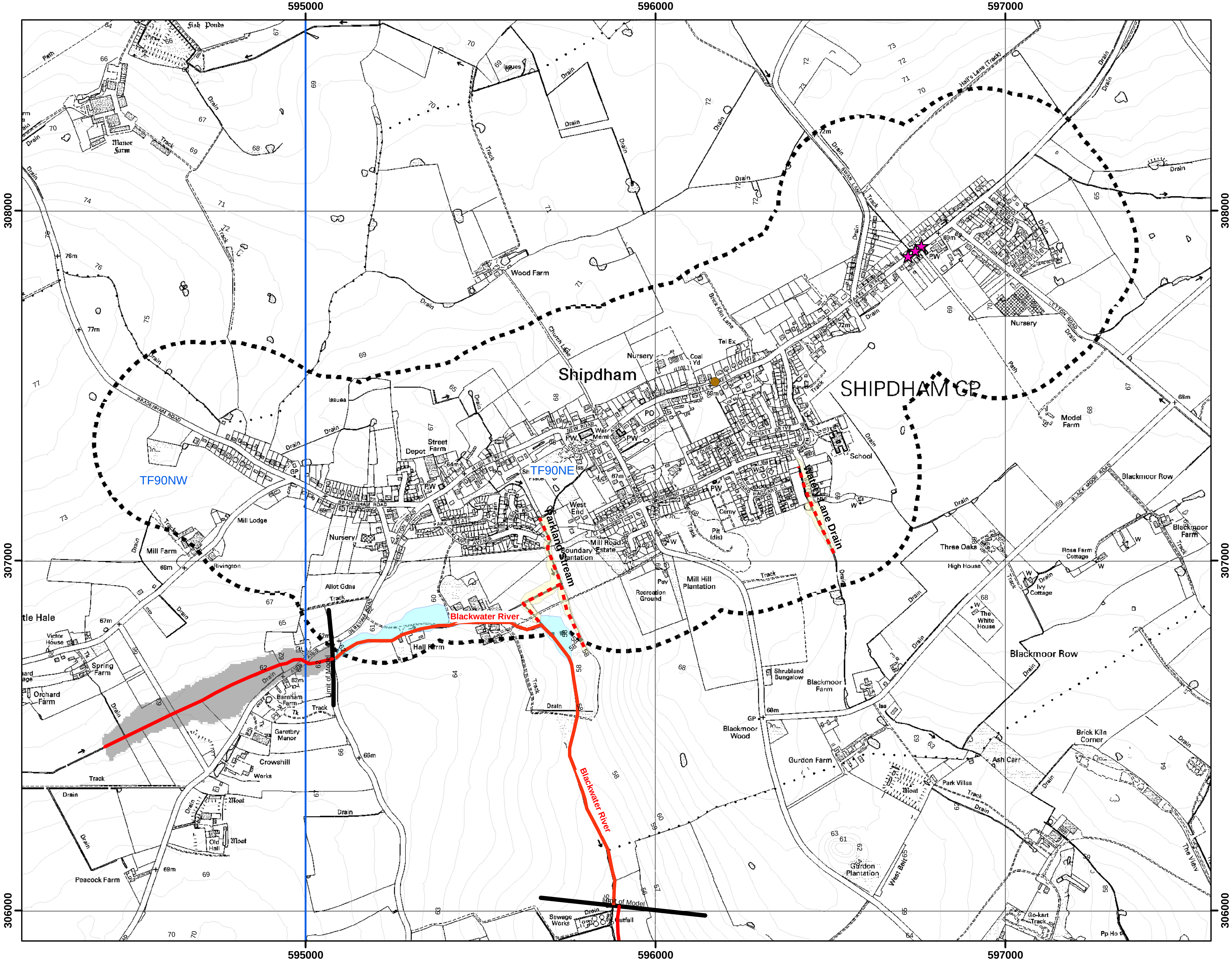
Saham Toney

Figure C: N1

Breckland

Mott MacDonald

Drawing Date 04/02/2008 Rev 4



Legend

Modelled Fluvial Flood Extents:

- 1 in 100 year Envelope (Envelope derived from latest available modelling data)
- 1 in 100 year Envelope (Envelope derived from EA Flood Zone Maps)
- 1 in 100 year Envelope (Envelope derived from engineering judgment also refer to flood zone maps.)

Historic Flood Events:

- Fluvial Flood Events
- Surface Water Flood Events
- Infrastructure Failure Flood Events
- Sewer Flood Events
- Sandbag Deliveries
- Flood Warnings
- Maximum Historical Fluvial Flooding Extent based on records from 1937 to 1993 (Source: Environment Agency)

- Main River
- Ordinary Watercourse
- IDB District
- Contours
- 1:10000 OS Tile extent
- Potential Development Area boundary

User Note

The locations of historic flood events are approximate and indicative only. It should be noted that certain locations not shown to be at risk from fluvial flooding may still be at risk from other watercourses not modelled in this study. Amendments will be required in future to account for information gathered subsequently e.g. changes in the hydrological response of the river or additional data arising from observed flood events.

Project Title

Breckland DC Strategic Flood Risk Assessment

MapTitle

Shipdham

Figure C: O1

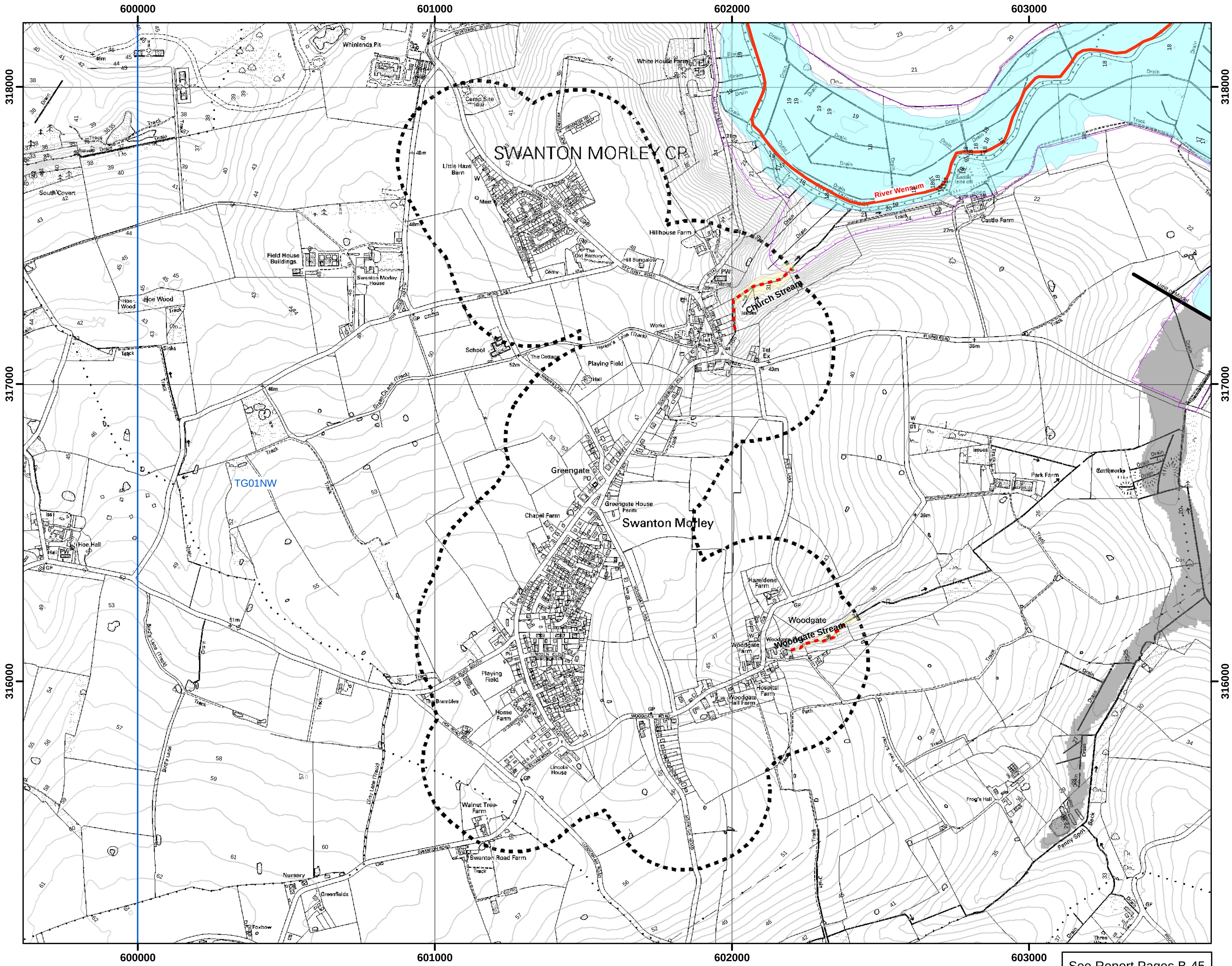
Breckland

Mott MacDonald

Drawing Date 04/02/2008 Rev 4

See Report Pages B-40 - B-44

Drawing ID:\238050 Breckland SFRA Update\Report\Updated Figures\Appendix C\Final_FigureC-O1.pdf



Legend

Modelled Fluvial Flood Extents:

- 1 in 100 year Envelope (Envelope derived from latest available modelling data)
- 1 in 100 year Envelope (Envelope derived from EA Flood Zone Maps)
- 1 in 100 year Envelope (Envelope derived from engineering judgment also refer to flood zone maps.)

Historic Flood Events:

- Fluvial Flood Events
- Surface Water Flood Events
- Infrastructure Failure Flood Events
- Sewer Flood Events
- Sandbag Deliveries
- Flood Warnings
- Maximum Historical Fluvial Flooding Extent based on records from 1937 to 1993 (Source: Environment Agency)

- Main River
- Ordinary Watercourse
- IDB District
- Contours
- 1:10000 OS Tile extent
- Potential Development Area boundary

User Note

The locations of historic flood events are approximate and indicative only. It should be noted that certain locations not shown to be at risk from fluvial flooding may still be at risk from other watercourses not modelled in this study. Amendments will be required in future to account for information gathered subsequently e.g. changes in the hydrological response of the river or additional data arising from observed flood events.

Project Title

Breckland DC Strategic Flood Risk Assessment

MapTitle

Swanton Morley

Figure C: P1

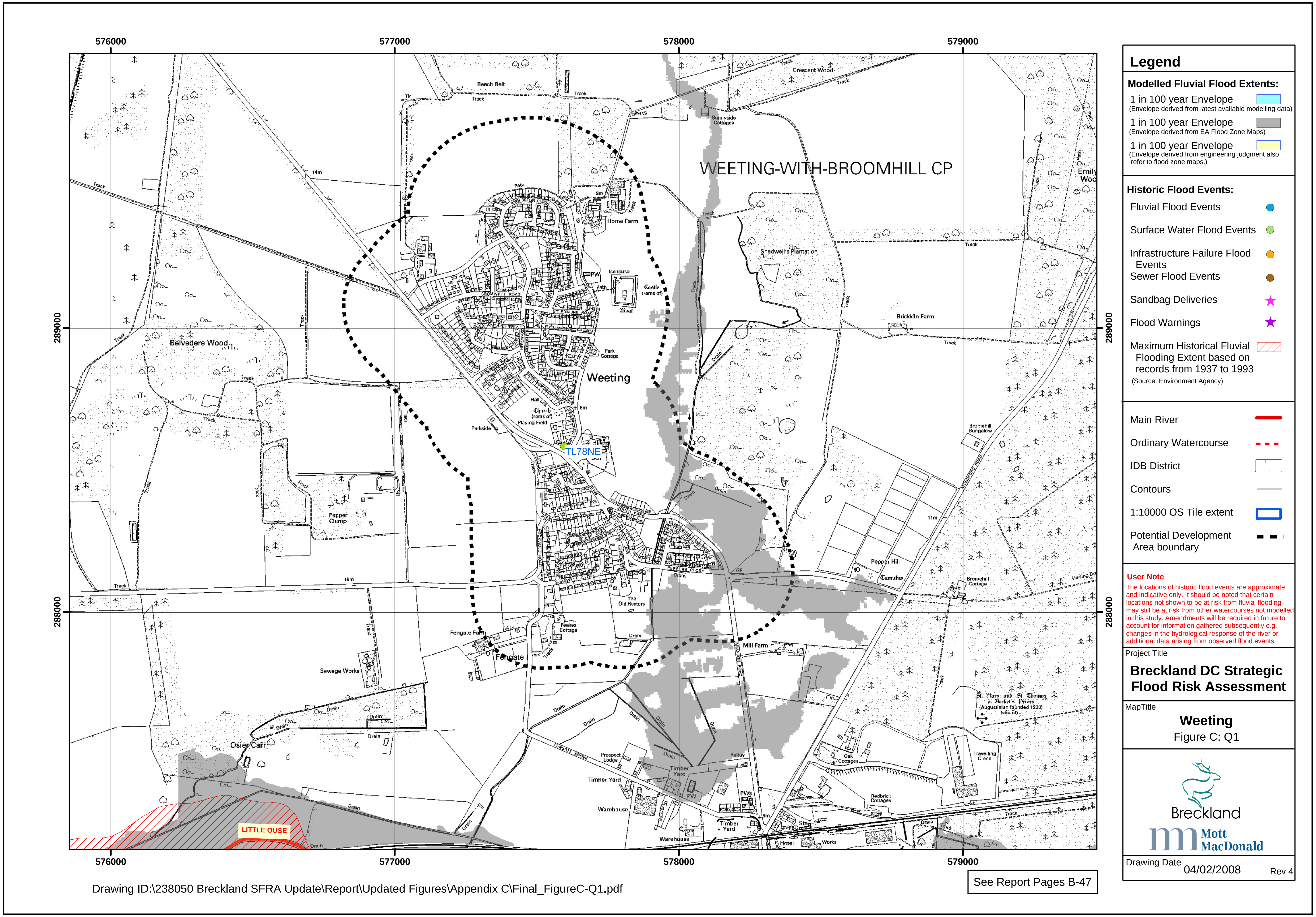
Breckland

Mott MacDonald

Drawing Date 04/02/2008 Rev 4

See Report Pages B-45

Drawing ID:\238050 Breckland SFRA Update\Report\Updated Figures\Appendix C\Final_FigureC-P1.pdf



See Report Pages B-47

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Appendix D: Hydraulic Modelling

In Stage 2 of the study (2005), six new hydraulic models had been constructed and three existing models had been utilised.

The three existing models were:

- Dereham Stream through Dereham, modelled in 1991 by Mott MacDonald;
- River Thet and Little Ouse at Thetford, modelled by Royal Haskoning in 2000;
- River Wensum and Wendling Beck, modelled by Babtie, Brown and Root in 2003.

The six new models were constructed using the iSIS software. They were all simple steady-state models constructed using existing cross-section survey data provided by the EA. Where necessary, the cross-sections were extended onto the floodplain using the terrain data. Table D.1 summarises the hydraulic modelling which had been undertaken for Stage 2 of the study.

Table D.1: Summary of New Hydraulic Models

River	Study Area	Model Length (km)	Upstream Limit	Downstream Limit	Survey Date	Cross Section Spacing (m)
Tud	Dereham	2.3	5981 3109	6002 3109	1993	250
Watton Br	Watton	4.9	5937 3019	5896 3006	1991	200
Wissey	Necton	3.2	5888 3082	5873 3084	1992	200
Blackwater	Shipdham	1.5	5951 3067	5958 3061	1993	250
Tud	Mattishall	4.5	6026 3122	6066 3127	1993	250
Thet	East Harling	3.1	5981 2859	5983 2878	1993-1994	200

In Stage 3 of the study (2007), newer models commissioned by the EA between 2005 and 2007 have been used wherever possible:

- The River Tud model built by JBA for BBR in 2005 superseded the River Tud at Dereham and the River Tud at Mattishall models built by MM in 2005.
- The River Upper Yare model built by JBA for BBR in 2005 superseded the River Blackwater at Shipdham built by MM in 2005.
- The River Thet and River Little Ouse at Thetford built by Halcrow in 2006 superseded the River Thet and River Little Ouse at Thetford built by Royal Haskoning in 2000.

All the models which have been used for the Stage 3 of the Study are described in detail in Sections D.1 – D.8 below.

As part of the SFRA update (Stage 3), the 1 in 20-year event has been modelled to re-delineate the extent of the functional floodplain, as defined in PPS25. For this purpose, 1 in 20-year model inflows have been estimated using the FEH method, and not the Re-FEH method. The Re-FEH method is the latest update of the FEH method, which produces lower flow estimates when using the rainfall-runoff module. However this latest update of FEH has not been used in order to be consistent with the work undertaken in 2005 and the existing 100-year outline. This is a conservative choice.

D.1 Watton Brook at Watton

The model extends from Ovington Road Bridge for nearly 5 km to the downstream edge of Watton.

D.1.1 Hydrology

At the downstream limit the catchment area is 42 km^2. The design inflows were calculated at this point.

The FEH rainfall-runoff method has been adopted to calculate design flows as there are no gauging stations on Watton Brook and it gives more conservative flows than the statistical method. A critical storm duration of 15 hours was utilised. This gives the following peak design flows:

5%	15.0 m^3/s
1%	23.0 m^3/s

D.1.2 Hydraulics

The model nodes are spaced at 200 metres. The model has a total of 44 nodes, of which five are structures. These are all bridges modelled with the iSIS bridge units. The floodplain is modelled with extended cross sections extracted from the LiDAR data.

The channel survey extends as far upstream as Willow Farm. In order to extend the model further upstream to Ovington Road Bridge, three channel cross sections were surveyed. These measurements were integrated into the model through assigning them bank top levels, equivalent to the LiDAR data extended section taken at the same location. Therefore, the water levels for the upstream reach of the model are less reliable.

There is a single, normal depth downstream boundary at section 10.991, a farm access bridge.

D.1.3 Mapping

The modelled water levels from the new iSIS model were mapped at each of the node locations.

These levels were converted to a water surface taking into account floodplain flow and ineffective flow in built-up areas. Discontinuities were included at railway and road embankments.

The water surface was then intersected with a DTM built from a combination of LiDAR and SAR data. LiDAR are available for 95% of the Watton area. For the remaining 5%, IFSAR data have been used, after adjusting them by -0.4m so that they match the LiDAR data, as discussed in Section 2.1 of this report.

The resulting flood extents were reviewed and mapped. The review process was conducted using information from the iSIS models in conjunction with O.S. mapping, topographic levels and hillshade. As the unfiltered LiDAR has been used, some discontinuities were due to LiDAR returns from the tops of housing or trees. These were identified in the review process and where appropriate included within the flood envelope.

The 100-year outline obtained with this modelling technique shows a larger extent than the 1000-year outline from the EA Flood Zones. As discussed in Section 2.3 of the report, this kind of inconsistency was expected, as the methods used to derive the outlines for the SFRA and for EA Flood Zones are different. The SFRA uses results from detailed hydrological and hydraulic modelling of all Main Rivers to obtain flood levels, and combines these with ground level information predominantly sourced from LiDAR techniques giving a vertical accuracy of +/- 15cm. For the EA Flood Zone maps, the basic zoning has been based on a relatively coarse national hydrological model combined with a new national DTM sourced from IFSAR techniques, giving a vertical accuracy of +/- 70cm. MM therefore believes that the new 100-year outline obtained with the detailed modelling of the Watton Brook is more representative than the 1000-year outline from the EA Flood Zones.

D.2 River Wissey at Necton

The River Wissey is modelled from Holme Hale Bridge downstream to Erneford Bridge, a length of 3.2 km.

D.2.1 Hydrology

At the downstream limit the catchment area is 40 km^2. The design inflows were calculated at this location.

The FEH rainfall-runoff method has been adopted to calculate design flows as there are no gauging stations this far upstream on the River Wissey, and it gives slightly more conservative flows than the statistical method. A critical storm duration of 15 hours was utilised. This gives the following peak design flows:

5%	15.3 m^3/s
1%	23.5 m^3/s

D.2.2 Hydraulics

The model nodes are spaced at 200 metres. The model has a total of 21 nodes, of which 2 are structures. Are all bridges modelled with the iSIS USBPR bridge units. The floodplain is modelled with extended cross sections extracted from the LiDAR or SAR data.

There is a single, normal depth downstream boundary located at Erneford Bridge.

D.2.3 Mapping

The modelled water levels from the new iSIS model were mapped at each of the node locations.

These levels were converted to a water surface taking into account floodplain flow. Discontinuities were included at road embankments.

The water surface was then intersected with a DTM built from a combination of LiDAR and SAR data. LiDAR are available for 5% of the Necton area. For the remaining 95%, IFSAR data have been used, after adjusting them by -0.4m so that they match the LiDAR data, as discussed in Section 2.1 of this report.

The resulting flood extents were reviewed and mapped. The review process was conducted using information from the iSIS models in conjunction with O.S. mapping, topographic levels and hillshade. As the unfiltered LiDAR has been used, some discontinuities were due to LiDAR returns from the tops of housing or trees. These were identified in the review process and where appropriate included within the flood envelope.

D.3 River Thet at East Harling

A 3.1 km length model has been constructed of the River Thet. This extends from 250m downstream of the railway to near The Paddocks.

D.3.1 Hydrology

At the downstream limit the catchment area is 266 km^2. Design inflows have been calculated using the statistical method at the gauging station at Brigham, 3 km downstream. The catchment area at the gauging station is 275 km^2.

There are 35 years of record at Bridgham, with the largest recorded flow being around 15 m^3/s. Single site analysis was undertaken and this gave a 1% flow of 19.0 m^3/s. To confirm this, analysis was undertaken for the River Thet at Melford, which is located further downstream and has a catchment area of 312 km^2. This gauging station has an out-of-bank rating curve which shows a good fit to the check spot gaugings and is considered more reliable for flood flows than the Thet at Bridgham. There are 40 years of record at the Melford site. Single site analysis gave a 1% flow of 21.5 m^3/s at Melford, which when scaled down to take account of catchment area gives a 1% flow of 19.0 m^3/s at Bridgham. Therefore, the two sites correspond well, which increases confidence in the calculated values.

Therefore, the following peak design flows were adopted:

5%	14.8 m^3/s
1%	19.0 m^3/s

D.3.2 Hydraulics

The model nodes are spaced at 200 metres. The model has a total of 34 nodes, of which 3 are structures. The structures are all located where the River Thet passes under Church Road. At this location the channel splits into two due the location of a mill. A side weir takes the main channel out of the mill pond and under a flat single span bridge under Church Road. The remainder of the channel passes through an arch bridge under the road. Survey of any mill structures is not available, however SAR data was utilised to synthesise some additional cross sections in this area. The two channels rejoin about 100 metres downstream of Church Road.

The floodplain is modelled with extended cross sections extracted from the SAR data.

There is a single, normal depth downstream boundary at channel section 16.800.

D.3.3 Mapping

The modelled water levels from the new iSIS model were mapped at each of the node locations.

These levels were converted to a water surface taking into account floodplain flow and ineffective flow in built-up areas. Discontinuities were included at road embankments.

The water surface was then intersected with a DTM built from IFSAR data, as there is no LiDAR coverage in East Harling. IFSAR data have been adjusted by -0.4m so that they match the LiDAR data, as discussed in Section 2.1 of this report.

The resulting flood extents were reviewed and mapped. The review process was conducted using information from the iSIS models in conjunction with O.S. mapping and topographic levels.

D.4 Dereham Stream at Dereham

Dereham Stream was modelled by Mott MacDonald in 1991 using HYDRO-1D. The original study was undertaken for King's Lynn Consortium of IDBs to consider capacity of the channel and look at flood alleviation options. The model has since been adapted to reflect several changes in the catchment, including a new culvert at Larners Road.

D.4.1 Hydrology

The original model was constructed using FSR techniques. The hydrology has been updated as part of this study to use FEH techniques. As mentioned earlier, the FEH CD ROM does not properly define the catchment boundaries in Dereham. These were modified and the FEH statistical method was utilised to calculate design inflows for the 5% and 1% events. For the purpose of this study, the catchment was split into a more urban upstream area of 1.5 km^2 and a more rural downstream area of 8 km^2.

This gave the following design inflows, which are broadly comparable to those used as the inflow to the Wensum model for the Strategy Study once the error in the catchment areas has been changed:

	Upstream	Downstream
5%	1.0 m^3/s	2.96 m^3/s
1%	1.4 m^3/s	4.2 m^3/s

However these inflows have been further adjusted so that the water levels obtained with the Dereham Stream model match recorded events. The final inflows which have been used in the model are:

	Upstream	Downstream
5%	1.45 m^3/s	3.98 m^3/s
1%	1.75 m^3/s	4.75 m^3/s

D.4.2 Hydraulics

The model network has remained unchanged as we have no new survey data for this stream. The model inflows were changed to reflect the design flows estimated above, and these were distributed so that the flow increased gradually down the stream.

The modelled levels produced are comparable to the design levels produced in the original study.

D.4.3 Mapping

Cross sections were plotted into GIS from the maps in the original reports. The levels for the design events were attached to each of these cross sections. These levels were converted to a water surface taking into account floodplain flow and ineffective flow in built-up areas. Discontinuities were included at railway and road embankments.

The water surface was then intersected with a DTM built from a combination of LiDAR and SAR data. LiDAR are available for approximately 90% of the Dereham area. For the remaining 10%, IFSAR data have been used, after adjusting them by -0.4m so that they match the LiDAR data, as discussed in Section 2.1 of this report.

The resulting flood extents were reviewed and mapped. The review process was conducted using information from the iSIS models in conjunction with O.S. mapping and topographic levels. As the unfiltered LiDAR has been used, some discontinuities were due to LiDAR returns from the tops of housing or trees. These were identified in the review process and where appropriate included within the flood envelope.

D.5 River Thet and Little Ouse River at Thetford

Halcrow carried out a Standard of Protection Study in 2006 for the Thet and the Little Ouse in Thetford. A 1D hydraulic model was constructed using iSIS to model up to the 200-year event, and a further 2D computer model prepared using Tuflow to model the 1000-year event. The output from this study has been utilised in the SFRA to create new fluvial flood extent maps in Thetford.

D.5.1 Hydrology

Hydrological inflow boundaries were estimated by Halcrow for the 1 in 5, 10, 25, 50, 75, 100, 200 and 1000-year flood events, the methodology comprised:

- Statistical analysis of annual maxima of the Rectory Bridge, Euston and Melford Bridge flow gauging stations
- Determination of hydrograph average shape from gauges records
- Production of inflow design hydrographs by scaling the average shape to fit the statistical analysis
- Determination of the average phasing of the input hydrographs from the Thet and Little Ouse from analysis of observed events.

MM estimated the hydrological inflow boundary for the 1 in 100-year with climate change scenario by scaling the 100-year hydrograph from Halcrow by 1.2.

D.5.2 Hydraulics

The iSIS 1D hydraulic model was built from topographic survey and LiDAR data. It comprises 8.5 km of in-channel modelling, linked together via floodplain spills and storage areas. The model has a total of 467 nodes. There is a constant elevation downstream boundary at Abbey Heath weir.

D.5.3 Mapping

Halcrow produced 100-year and 1000-year flood outlines, which have been used for the SFRA.

Additionally MM produced the 25-year and 100-year with climate change outlines to inform the SFRA. The 25-year flood outline was used to produce the boundaries of the Functional Floodplain Zone, instead of the 20-year flood outline as recommended in PPS25. This conservative decision was taken in consultation with the Breckland District Council because the 25-year water levels were readily available and can be expected to be very similar to the 20-year water levels.

Cross sections were plotted into GIS using geographical referencing data from the .gxy iSIS file provided by Halcrow. The cross-section locations were reviewed to ensure consistency with the structure locations. The locations of the modelled storage areas were also provided by Halcrow and reviewed by MM. The levels for the design events were attached to each of the cross sections and storage areas. These levels were converted to a water surface taking into account floodplain flow and ineffective flow in built-up areas. Discontinuities were included at railway and road embankments.

The water surface was then intersected with a DTM entirely built from LiDAR data. The resulting flood extents were reviewed and mapped, particularly to ensure consistency with the existing 100-year and 1000-year flood outlines. The review process was conducted using information from the iSIS models in conjunction with O.S. mapping and topographic levels. As the unfiltered LiDAR has been used, some discontinuities were due to LiDAR returns from the tops of housing or trees. These were identified in the review process and where appropriate included within the flood envelope.

D.6 River Wensum and Wendling Beck

Babtie, Brown and Root (BBR) carried out a Strategy Study in 2003 for the Upper River Wensum. It covers the Upper River Wensum and its major tributaries the Whitewater and Wendling Beck. A hydraulic model was constructed using iSIS to predict flood levels in the study area. The output from this study has been utilised in the SFRA to create flood extent maps for Wendling Beck to the north of Dereham and Wendling Beck and the River Wensum around North Elmham.

D.6.1 Hydrology

Hydrological analysis was carried out for the Strategy Study by JBA Consulting. The study used the FEH statistical method to calculate inflows as it was clear that the rainfall-runoff method overestimated flows in this catchment.

The study calculated inflows for a range of return periods, including the 1% and 4% events.

D.6.2 Hydraulics

The iSIS 1D hydraulic model was built from topographic survey and LiDAR data. Depending on its characteristics, the floodplain has been represented by either extended cross-sections or reservoir units. The total length of modelled watercourses is 86 km and the number of nodes in the model is 1,325 (including spills and flood storage areas as well as channel cross sections and structures). Cross sections are spaced at 250m intervals.

D.6.3 Mapping

BBR produced the 25-year, 100-year and 100-year with climate change flood outlines, which have been used for the SFRA. The 25-year flood outline was used to produce the boundaries of the Functional Floodplain Zone, instead of the 20 year flood outline as recommended in PPS25. This conservative decision was taken in consultation with the Breckland District Council because the 25 year flood outline was readily available and can be expected to be very similar to the 20-year flood outline.

D.7 River Upper Yare

Babtie, Brown and Root (BBR) carried out a Flood Risk Study in 2005 for the River Yare. It covers the River Yare, the River Tas and associated Main River branches and Critical Ordinary Watercourses (COWs). A hydraulic model was constructed by JBA Consulting for the flood risk study using iSIS to predict flood levels in the study area. The output from this study has been utilised to create flood extent maps of the River Yare throughout the SFRA area. The River Yare is also called the River Blackwater in its upstream part.

D.7.1 Hydrology

The study used the FEH statistical method to calculate inflows as it was clear that the rainfall-runoff method overestimated flows in this catchment.

The study calculated inflows for a range of return periods, including the 1% and 4% events.

D.7.2 Hydraulics

The upstream part of the River Yare corresponding to the portion within the SFRA area has been modelled in steady state. Flow within the river channel is represented using cross sections. In the steady-state models, all floodplains are represented using extended cross sections. This is a conservative approach as it assumes that there is an unlimited volume of water available to fill any storage areas on the floodplain. LiDAR and Nextmap elevation data were used to represent areas outside the channel, together with spot level survey in the villages of Mulbarton and Wacton where no LiDAR data was available. The typical cross section spacing is relatively wide, at 250m.

D.7.3 Mapping

BBR produced the 25-year, 100-year and 100-year with climate change flood outlines, which have been used for the SFRA. The 25-year flood outline was used to produce the boundaries of the Functional Floodplain Zone, instead of the 20-year flood outline as recommended in PPS25. This conservative decision was taken in consultation with the Breckland District Council because the 25-year flood outline was readily available and can be expected to be very similar to the 20-year flood outline.

D.8 River Tud

Flood risk modelling of the River Tud model has been undertaken by Babtie, Brown and Root in 2005 for the EA. A hydraulic model was constructed using iSIS to predict flood levels in the study area. The steady state output from this study has been utilised to create flood extent maps of the River Tud all the way through the SFRA area, including Mattishall and Dereham. The River Tud flood mapping report has not been made available to MM, and for this reason MM was not able to provide detailed information on the hydrology and the hydraulics of the model.

The examination of the modelling files shows that BBR produced two different versions of the model, a steady-state version and an unsteady one. In the steady-state version, all floodplains are represented using extended cross sections. This is a conservative approach as it assumes that there is an infinite volume of water available to fill any storage areas on the floodplain. In the unsteady version of the model, the floodplain is represented with reservoirs units. MM opted for the conservative approach.

D.8.1 Mapping

MM produced the 25-year, 100-year and 100-year with climate change outlines of the River Tud within the SFRA area, including Mattishall and Dereham. The 25-year flood outline was used to produce the boundaries of the Functional Floodplain Zone, instead of the 20-year flood outline as recommended in PPS25. This conservative decision was taken in consultation with the Breckland District Council because the 25-year water levels were readily available and can be expected to be very similar to the 20-year water levels.

Cross sections were plotted into GIS using geographical referencing data from a MapInfo GIS layer provided by BBR. The levels for the design events were attached to each of the cross sections. These levels were converted to a water surface taking into account floodplain flow and ineffective flow in built-up areas. Discontinuities were included at railway and road embankments.

The water surface was then intersected with a DTM entirely built from LiDAR data. The resulting flood extents were reviewed and mapped. The review process was conducted using information from the iSIS model in conjunction with O.S. mapping and topographic levels. As the unfiltered LiDAR has been used, some discontinuities were due to LiDAR returns from the tops of housing or trees. These were identified in the review process and where appropriate included within the flood envelope. In addition, ground elevations used at the upstream end of the iSIS model were found to be 4 m higher than in the DTM, leading to unrealistically large predicted flood extents for the upstream reach of the River Tud. These extents have been adjusted manually.

Appendix E: Estimation of the additional runoff generated by large proposed developments

The methodology described in the SUDS Manual (CIRIA C697, 2007) was used to provide initial estimates of the peak runoff rates and volumes from the proposed development sites and their greenfield equivalents.

The following data relating to the proposed developments have been provided by the Breckland District Council:

- Developments types, residential or employment
- Locations of the developments
- Indicative density of the proposed residential developments
- Range of number of houses for the proposed residential developments
- Indicative areas of the proposed employment developments.

The types and locations of the proposed developments are shown on the maps included in Appendices A and B.

Owing to the uncertainty related to the density and number of houses of the proposed residential developments, MM have estimated runoff rates and volumes for a range of housing densities and number of houses centred on the values provided by the Council. The housing density, number of houses and employment development areas which have been used to perform the runoff calculations are shown in Table E.1.

Regulatory authorities normally require the **developed rate of runoff** to be not greater than the greenfield runoff rate for a range of annual flow rates probabilities up to 1% probability flow. MM estimated the rate of runoff for the 100% and the 1% probabilities events. Additional flow rate probabilities should be considered when producing surface water strategies. The **runoff volume** has been estimated on the basis of the 100 year, 6 hour rainfall event, which is recommended in the Preliminary Rainfall Runoff Management guidance and in the SUDS Manual for the assessment of the long-term storage.

As required by PPS25, climate change impacts on the runoff have been assessed. Owing to the current uncertainty with regards to the type of development and its associated lifetime, it was agreed with Breckland District that two climate change scenarios for the runoff rate would be considered:

- From 2055 to 2085: +20% in the peak rainfall intensity
- From 2085 to 2115: +30% in the peak rainfall intensity

E.1 Greenfield Runoff

E.1.1 Estimating Greenfield Runoff Rates

The size of the development determines the method that should be used to estimate runoff. As all the proposed development areas in Breckland are less than 200 ha, the Institute of Hydrology Report 124 *Flood estimation for small catchments* has been used to determine peak greenfield runoff rates.

The catchment mean annual peak flow can be determined from the following equation:

$$QBAR_{rural} = 0.00108 \times AREA^{0.89} \times SAAR^{1.17} \times SOIL^{2.17}$$

$QBAR_{rural}$	=	Catchment mean annual peak flow (m^3/s)
AREA	=	Development area (km^2)
SAAR	=	Standard average annual rainfall for 1941 to 1970 (mm)
SOIL	=	Soil index

Residential developments areas were not directly provided by the Council and have been estimated using the following formula:

$$AREA = \frac{H}{d}$$

d	=	Density of housing (no. of houses / ha),
H	=	Number of houses

Values for SAAR and SOIL for each proposed development area were obtained from the *Wallingford Procedure for Europe* (Kellagher, 2000). However, as these values within each settlement were very similar, an average value for all the proposed developments within each settlement has been used. These values are shown in Table E.2.

To estimate the peak flow rates for the 1-year and 100-year return periods, the UK Growth Curve Factors from FSSR 16 (IH, 1985) were applied to the $QBAR_{rural}$. The growth curve factors are dependant on the geographical location within UK. It was determined that the whole Breckland District was located within the Hydrometric Area 5.

Final estimates of greenfield peak flow rates are shown in Tables E.1 and E.2 for the proposed residential developments and employment developments respectively.

E.1.2 Estimating Greenfield Runoff Volumes

The following equation has been used to calculate the greenfield runoff volumes for each development site for the 1-year and 100-year events:

$$Greenfield \quad Runoff \quad Volume = RD \times A \times PR_g$$

RD	=	Rainfall Depth (mm)
A	=	Proposed Development Area (m^2)
PR_g	=	Total Percentage Runoff for the greenfield catchment, assumed to be equal to SPR

Rainfall depths have been estimated using the Depth Duration Frequency model (DDF) included in the FEH CD-ROM. As the proposed development areas are mostly small, it has been assumed that the rainfall frequency at a point was valid for the entire proposed development areas and that no areal reduction factor was needed. Rainfall depth estimates are shown in Table E.3.

Final estimates of greenfield runoff volumes are shown in Tables E.3 and E.4 for the proposed residential developments and employment developments respectively.

E.2 Development Runoff

E.2.1 Estimating Development Runoff Rates

The *Modified Rational Method* has been used to calculate the rate of runoff from the proposed development sites, using the following equation:

$$Q_p = 3.61 \times C_v \times I \times A_i$$

Q_p = Peak Runoff in (l/s)
C_v = Volumetric Runoff Coefficient
I = Rainfall Intensity (mm/hr)
A_i = Impermeable Area (ha)

The maximum rainfall intensity (I) has been obtained by using the shortest storm duration for which the whole development area contributes to peak runoff. This has been assumed to be 15 minutes as the DDF model is not valid for shorter durations. Rainfall intensity estimates are shown in Table E.3.

The volumetric runoff coefficient has been calculated using the following equation:

$$C_V = \frac{PR_d}{PIMP}$$

PR_d = Percentage Runoff for the developed catchment
PIMP = Percentage of Impermeable area

Owing to the current uncertainty in the PIMP values for the proposed employment developments, a 60%-90% range has been assessed.

For housing developments, the percentage of impermeable area has been calculated as a function of the density of each development by assuming a standard impermeable area per house of 0.015ha, including roofing and surrounding streets. This resulted in the following equation for percentage of impermeable area:

$$PIMP = 0.015 \times d \times 100$$

d = Density of housing (no. of houses / ha)

The percentage runoff of the proposed developed sites has been calculated using the following equation from the *Fixed Wallingford Procedure UK model*:

$$PR_d = 0.829 PIMP + 25 SOIL + 0.078 UCWI - 20.7$$

UCWI = Urban Catchment Wetness Index

The UCWI for each catchment has been derived from the figure relating UCWI to SAAR in the Wallingford Procedure, using the conservative winter profile. UCWI values are shown in Table E.2.

Final estimates of "developed peak flow rates" are shown in Tables E.4 and E.5 for the proposed residential developments and employment developments respectively.

E.2.2 Estimating Long-Term Storage Volumes

Long-term storage aims specifically to address the additional volume of runoff caused by the development. The basis for sizing this storage is the 100 year, 6 hour rainfall event. The intention of long-term storage is to allow the volume equal to the greenfield runoff to discharge at greenfield rate, while the additional runoff should be discharged as infiltration or very low rate (2 l/s/ha). The objective is to protect the river during times of extreme flooding.

The following equation has been used to estimate the runoff volume from the proposed development sites:

$$Developed\ \ Runoff\ \ Volume = RD \times A \times \left[\frac{PIMP}{100}(\alpha 0.8) + \left(1 - \frac{PIMP}{100}\right)\left(\beta . \frac{SPR}{100}\right) \right]$$

RD	=	Rainfall Depth for the 100-year return period 6 hour event
α	=	Proportion of paved area draining to the network or directly to the river
β	=	Proportion of pervious area draining to the network or directly to the river
SPR	=	Surface Percentage Runoff obtained from the FEH CD-ROM

Both α and β have been taken as 1 in order to be conservative.

SPR values are shown in Table E.2.

The long-term storage volume estimates have been obtained by subtracting the greenfield runoff volumes from the developed runoff volumes for the 100 year, 6 hour rainfall event. Final estimates of the long-term storage volumes required are shown in Tables E.6 and E.7 for the proposed residential developments and employment developments respectively.

Table E.1: Data related to the scale of developments

Settlement	Type	Proposed residential Developments				Proposed Employment Developments
		Housing Density (houses/ha)		Houses Number		Areas (ha)
		MIN	MAX	MIN	MAX	
Thetford	growth point	35	45	4000	6000	38
Attleborough	town	32	42	1000	4000	10
Dereham	town	32	42	500	1000	8
Swaffham	town	32	42	480	720	5
Watton	town	32	42	280	420	3
Shipdham	village	25	35	80	120	0
Great Ellingham	village	25	35	40	60	0
Harling	village	25	35	40	60	0
Narborough	village	25	35	40	60	0
Banham	village	25	35	0	50	0
Mattishall	village	25	35	0	50	0
Necton	village	25	35	0	50	0
North Elmham	village	25	35	0	50	0
Old Buckenham	village	25	35	0	50	0
Saham Toney	village	25	35	0	50	0
Swanton Morley	village	25	35	0	50	0
Weeting	village	25	35	0	50	0

Table E.2: Catchment Descriptors

Settlement	SPR (%)	SAAR (mm/year)	$UCWI_{winter}$	SOIL
Thetford	9	600	121	0.15
Attleborough	32	651	126	0.40
Dereham	35	688	130	0.40
Swaffham	12	672	128	0.15
Watton	34	650	126	0.40
Shipdham	37	710	132	0.40
Great Ellingham	36	650	126	0.40
Harling	6	620	123	0.40
Narborough	8	640	125	0.15
Banham	35	630	124	0.40
Mattishall	37	645	126	0.40
Necton	31	690	130	0.40
North Elmham	34	645	126	0.15
Old Buckenham	39	640	125	0.40
Saham Toney	30	650	126	0.40
Swanton Morley	35	665	128	0.30
Weeting	5	630	124	0.15

Table E.3: Rainfall Estimates

Settlement	Rainfall Depth (mm) Storm Duration = 600 min			Rainfall Intensity (mm/hour) Storm Duration = 15 min			
	RD_{100y}	$RD_{100y+20\%}$	$RD_{100y+30\%}$	I_{1y}	I_{100y}	$I_{100y+20\%}$	$I_{100y+30\%}$
Thetford	72	86	93	31	155	186	202
Attleborough	70	84	91	31	151	182	197
Dereham	69	83	90	31	156	187	203
Swaffham	67	80	87	33	156	187	203
Watton	69	83	90	31	157	189	204
Shipdham	72	86	93	31	156	188	203
Great Ellingham	72	87	94	30	152	182	197
East Harling	70	84	91	31	156	187	203
Narborough	72	87	94	31	146	176	190
Banham	70	84	90	32	157	188	204
Mattishall	70	84	91	32	154	184	200
Necton	70	83	90	32	152	182	197
North Elmham	73	88	95	30	148	178	193
Old Buckenham	69	82	89	32	153	184	199
Saham Toney	69	82	89	32	159	191	206
Swanton Morley	69	83	90	31	156	187	203
Weeting	74	88	96	30	148	177	192

Key	
RD100y	Rainfall depth for the 100 year return period event of 600 minutes duration
$I_{100y+20\%}$	Rainfall intensity for the 100 year return period event of 15 minutes duration, plus 20% to take into account the impact of climate change up to 2055
$I_{100y+20\%}$	Rainfall intensity for the 100 year return period event of 15 minutes duration, plus 20% to take into account the impact of climate change up to 2115

Table E4: Peak Runoff for Proposed Residential Development Sites and Greenfield Equivalents

	GREENFIELD																				
	H_{min} / d_{min} ($A_{i.min}$, $PIMP_{min}$)					H_{max} / d_{min} ($A_{i.max}$, $PIMP_{max}$)					H_{min} / d_{max} ($A_{i.min}$, $PIMP_{max}$)					H_{max} / d_{max} ($A_{i.max}$, $PIMP_{max}$)				
Settlements	Q_{p1y} (l/s)	Q_{p100y} (l/s)	$Q_{p100y+20\%}$ (l/s)	$Q_{p100y+30\%}$ (l/s)	Q_{p100y} (l/s/ha)	Q_{p1y} (l/s)	Q_{p100y} (l/s)	$Q_{p100y+20\%}$ (l/s)	$Q_{p100y+30\%}$ (l/s)	Q_{p100y} (l/s/ha)	Q_{p1y} (l/s)	Q_{p100y} (l/s)	$Q_{p100y+20\%}$ (l/s)	$Q_{p100y+30\%}$ (l/s)	Q_{p100y} (l/s/ha)	Q_{p1y} (l/s)	Q_{p100y} (l/s)	$Q_{p100y+20\%}$ (l/s)	$Q_{p100y+30\%}$ (l/s)	Q_{p100y} (l/s/ha)
Thetford	26.7	125.6	150.7	163.3	1.1	38.3	180.2	216.2	234.3	1.1	21.3	100.4	120.5	130.6	1.1	30.6	144.1	172.9	187.3	1.1
Attleborough	77.8	366.1	439.4	476.0	11.7	267.3	1257.4	1508.9	1634.7	10.1	61.1	287.4	344.9	373.7	12.1	209.8	987.1	1184.6	1283.3	10.4
Dereham	44.8	210.7	252.9	273.9	13.5	83.0	390.5	468.6	507.7	12.5	35.2	165.4	198.5	215.1	13.9	65.2	306.6	367.9	398.5	12.9
Swaffham	5.0	23.5	28.2	30.6	1.6	7.2	33.7	40.5	43.9	1.5	3.9	18.5	22.2	24.0	1.6	5.6	26.5	31.8	34.4	1.5
Watton	25.0	117.7	141.3	153.0	13.5	35.9	168.9	202.6	219.5	12.9	19.6	92.4	110.9	120.1	13.9	28.2	132.6	159.1	172.3	13.3
Shipdham	11.3	53.3	64.0	69.3	16.7	16.3	76.5	91.8	99.4	15.9	8.4	39.5	47.4	51.4	17.3	12.1	56.7	68.0	73.7	16.5
Great Ellingham	5.5	25.9	31.1	33.7	16.2	7.9	37.2	44.7	48.4	15.5	4.1	19.2	23.1	25.0	16.8	5.9	27.6	33.1	35.9	16.1
Harling	5.2	24.6	29.5	31.9	15.3	7.5	35.2	42.3	45.8	14.7	3.9	18.2	21.8	23.7	15.9	5.5	26.1	31.3	33.9	15.2
Narborough	0.6	3.0	3.6	3.9	1.9	0.9	4.4	5.2	5.7	1.8	0.5	2.2	2.7	2.9	2.0	0.7	3.2	3.9	4.2	1.9
Banham	0.0	0.0	0.0	0.0	0.0	6.5	30.5	36.6	39.7	15.3	0.0	0.0	0.0	0.0	0.0	4.8	22.6	27.1	29.4	15.8
Mattishall	0.0	0.0	0.0	0.0	0.0	6.7	31.4	37.6	40.8	15.7	0.0	0.0	0.0	0.0	0.0	4.9	23.2	27.9	30.2	16.3
Necton	0.0	0.0	0.0	0.0	0.0	7.2	33.9	40.7	44.1	17.0	0.0	0.0	0.0	0.0	0.0	5.3	25.2	30.2	32.7	17.6
North Elmham	0.0	0.0	0.0	0.0	0.0	0.8	3.7	4.5	4.9	1.9	0.0	0.0	0.0	0.0	0.0	0.6	2.8	3.3	3.6	1.9
Old Buckenham	0.0	0.0	0.0	0.0	0.0	6.6	31.1	37.3	40.4	15.5	0.0	0.0	0.0	0.0	0.0	4.9	23.0	27.6	29.9	16.1
Saham Toney	0.0	0.0	0.0	0.0	0.0	6.7	31.6	38.0	41.1	15.8	0.0	0.0	0.0	0.0	0.0	5.0	23.5	28.2	30.5	16.4
Swanton Morley	0.0	0.0	0.0	0.0	0.0	3.7	17.4	20.9	22.6	8.7	0.0	0.0	0.0	0.0	0.0	2.7	12.9	15.5	16.8	9.0
Weeting	0.0	0.0	0.0	0.0	0.0	0.8	3.6	4.4	4.7	1.8	0.0	0.0	0.0	0.0	0.0	0.6	2.7	3.2	3.5	1.9

	DEVELOPED																				
	H_{min} / d_{min} ($A_{i.min}$, $PIMP_{min}$)					H_{max} / d_{min} ($A_{i.max}$, $PIMP_{max}$)					H_{min} / d_{max} ($A_{i.min}$, $PIMP_{max}$)					H_{max} / d_{max} ($A_{i.max}$, $PIMP_{max}$)				
Settlements	Q_{p1y} (l/s)	Q_{p100y} (l/s)	$Q_{p100y+20\%}$ (l/s)	$Q_{p100y+30\%}$ (l/s)	Q_{p100y} (l/s/ha)	Q_{p1y} (l/s)	Q_{p100y} (l/s)	$Q_{p100y+20\%}$ (l/s)	$Q_{p100y+30\%}$ (l/s)	Q_{p100y} (l/s/ha)	Q_{p1y} (l/s)	Q_{p100y} (l/s)	$Q_{p100y+20\%}$ (l/s)	$Q_{p100y+30\%}$ (l/s)	Q_{p100y} (l/s/ha)	Q_{p1y} (l/s)	Q_{p100y} (l/s)	$Q_{p100y+20\%}$ (l/s)	$Q_{p100y+30\%}$ (l/s)	Q_{p100y} (l/s/ha)
Thetford	4647	23058	27669	29975	202	6971	34587	41504	44963	202	4863	24127	28952	31365	271	7294	36190	43428	47047	211
Attleborough	1366	6649	7979	8644	213	5465	26597	31916	34576	213	1374	6685	8022	8690	281	5495	26739	32087	34760	214
Dereham	692	3452	4143	4488	221	1383	6904	8285	8976	221	694	3464	4157	4503	291	1388	6928	8313	9006	222
Swaffham	582	2774	3329	3606	185	873	4161	4993	5410	185	611	2914	3497	3789	255	917	4371	5246	5683	194
Watton	384	1932	2318	2511	221	577	2897	3477	3767	221	386	1942	2330	2524	291	580	2913	3495	3787	222
Shipdham	111	554	665	721	173	166	832	998	1081	173	111	556	668	723	243	167	835	1002	1085	174
Great Ellingham	53	265	317	344	165	80	397	476	516	165	53	267	320	347	233	80	400	480	520	167
Harling	54	270	324	351	169	81	405	486	527	169	55	273	328	355	239	82	409	491	532	171
Narborough	42	202	242	263	126	64	303	364	394	126	46	219	263	285	192	69	329	395	428	137
Banham	0	0	0	0	0	69	340	408	442	170	0	0	0	0	0	69	344	412	447	172
Mattishall	0	0	0	0	0	69	335	402	436	168	0	0	0	0	0	70	338	405	439	169
Necton	0	0	0	0	0	70	334	401	434	167	0	0	0	0	0	70	336	403	437	168
North Elmham	0	0	0	0	0	51	257	308	334	128	0	0	0	0	0	56	279	334	362	139
Old Buckenham	0	0	0	0	0	70	333	400	433	167	0	0	0	0	0	70	336	404	437	168
Saham Toney	0	0	0	0	0	69	346	416	450	173	0	0	0	0	0	70	349	419	454	175
Swanton Morley	0	0	0	0	0	63	314	377	408	157	0	0	0	0	0	65	324	389	422	162
Weeting	0	0	0	0	0	52	254	304	330	127	0	0	0	0	0	56	276	331	359	138

Key	
H_{min} / d_{min} ($A_{i.min}$, $PIMP_{min}$)	Minimum number of houses (H_{min}) is equivalent to a minimum impervious area (A_{imin}); Minimum density of houses (d_{min}) is equivalent to minimum percentage impervious area ($PIMP_{min}$)
Q_{p1y} (l/s)	Peak runoff for the 1 year return period storm
Q_{p100y} (l/s)	Peak runoff for the 100 year return period storm
$Q_{p100y+20\%}$ (l/s)	Peak runoff for the 100 year return period storm plus 20% to take into account the impact of climate change up to 2055
$Q_{p100y+30\%}$ (l/s)	Peak runoff for the 100 year return period storm plus 30% to take into account the impact of climate change up to 2115

Table E5: Peak Runoff for Proposed Employment Development Sites and Greenfield Equivalents

Settlements	GREENFIELD				
	Q_{p1y} (l/s)	Q_{p100y} (l/s)	$Q_{p100y+20\%}$ (l/s)	$Q_{p100y+30\%}$ (l/s)	Q_{p100y} (l/s/ha)
Thetford	10.0	47.1	56.6	61.3	0.3
Attleborough	28.2	132.8	159.4	172.7	3.7
Dereham	24.7	116.1	139.4	151.0	4.1
Swaffham	1.9	8.8	10.6	11.5	0.5
Watton	9.7	45.4	54.5	59.0	4.3

Settlements	DEVELOPED									
	Minimum					Maximum				
	Q_{p1y} (l/s)	Q_{p100y} (l/s)	$Q_{p100y+20\%}$ (l/s)	$Q_{p100y+30\%}$ (l/s)	Q_{p100y} (l/s/ha)	Q_{p1y} (l/s)	Q_{p100y} (l/s)	$Q_{p100y+20\%}$ (l/s)	$Q_{p100y+30\%}$ (l/s)	Q_{p100y} (l/s/ha)
Thetford	1812	8990	10789	11688	237	2879	14285	17142	18571	376
Attleborough	549	2672	3206	3473	267	828	4031	4837	5241	403
Dereham	444	2216	2659	2880	277	668	3336	4003	4337	417
Swaffham	253	1205	1446	1566	241	400	1906	2287	2477	381
Watton	165	832	998	1081	277	250	1255	1506	1631	418

Table E6: Additional Runoff Volume due to Residential Development

PRESENT DAY

	H_{min} / d_{min} ($A_{i,min}$, $PIMP_{min}$)						H_{max} / d_{min} ($A_{i,max}$, $PIMP_{max}$)						H_{min} / d_{max} ($A_{i,min}$, $PIMP_{max}$)						H_{max} / d_{max} ($A_{i,max}$, $PIMP_{max}$)					
Settlements	Greenfield Runoff (m^3)	Greenfield Runoff (m^3/ha)	Developed Runoff (m^3)	Developed Runoff (m^3/ha)	Extra Runoff to store (m^3)	Long Term Storage (m^3/ha)	Greenfield Runoff (m^3)	Greenfield Runoff (m^3/ha)	Developed Runoff (m^3)	Developed Runoff (m^3/ha)	Extra Runoff to store (m^3)	Long Term Storage (m^3/ha)	Greenfield Runoff (m^3)	Greenfield Runoff (m^3/ha)	Developed Runoff (m^3)	Developed Runoff (m^3/ha)	Extra Runoff to store (m^3)	Long Term Storage (m^3/ha)	Greenfield Runoff (m^3)	Greenfield Runoff (m^3/ha)	Developed Runoff (m^3)	Developed Runoff (m^3/ha)	Extra Runoff to store (m^3)	Long Term Storage (m^3/ha)
Thetford	7731	68	38088	333	30357	266	11596	68	57132	333	45536	266	6013	68	36370	409	30357	342	9019	68	54555	409	45536	342
Attleborough	7049	226	12041	385	4993	160	28195	226	48165	385	19970	160	5371	226	10363	435	4993	210	21482	226	41452	435	19970	210
Dereham	3763	241	6108	391	2345	150	7525	241	12215	391	4690	150	2867	241	5212	438	2345	197	5734	241	10424	438	4690	197
Swaffham	1170	78	4463	298	3293	220	1755	78	6694	298	4939	220	891	78	4184	366	3293	288	1337	78	6276	366	4939	288
Watton	2087	239	3418	391	1331	152	3131	239	5127	391	1996	152	1590	239	2921	438	1331	200	2386	239	4381	438	1996	200
Shipdham	841	263	1213	379	372	116	1262	263	1820	379	558	116	601	263	973	426	372	163	902	263	1459	426	558	163
Great Ellingham	414	259	605	378	191	119	621	259	907	378	286	119	296	259	487	426	191	167	444	259	730	426	286	167
Harling	70	44	380	237	310	194	105	44	569	237	465	194	50	44	360	315	310	271	75	44	540	315	465	271
Narborough	91	57	403	252	313	195	136	57	605	252	469	195	65	57	377	330	313	273	97	57	566	330	469	273
Banham	0	0	0	0	0	1	489	245	723	362	234	117	0	0	0	0	0	0	349	245	584	409	234	164
Mattishall	0	0	0	0	0	0	512	256	739	370	227	114	0	0	0	0	0	0	366	256	593	415	227	159
Necton	0	0	0	0	0	0	431	216	687	343	255	128	0	0	0	0	0	0	308	216	563	394	255	179
North Elmham	0	0	0	0	0	0	501	251	752	376	251	126	0	0	0	0	0	0	358	251	609	426	251	176
Old Buckenham	0	0	0	0	0	0	535	267	745	373	210	105	0	0	0	0	0	0	382	267	592	415	210	147
Saham Toney	0	0	0	0	0	0	414	207	669	335	256	128	0	0	0	0	0	0	295	207	551	386	256	179
Swanton Morley	0	0	0	0	0	0	477	238	713	356	236	118	0	0	0	0	0	0	341	238	576	403	236	165
Weeting	0	0	0	0	0	0	71	35	486	243	415	208	0	0	0	0	0	0	50	35	466	326	415	291

FROM 2055 TO 2085 (+20% in peak rainfall intensity)

	H_{min} / d_{min} ($A_{i,min}$, $PIMP_{min}$)						H_{max} / d_{min} ($A_{i,max}$, $PIMP_{max}$)						H_{min} / d_{max} ($A_{i,min}$, $PIMP_{max}$)						H_{max} / d_{max} ($A_{i,max}$, $PIMP_{max}$)					
Settlements	Greenfield Runoff (m^3)	Greenfield Runoff (m^3/ha)	Developed Runoff (m^3)	Developed Runoff (m^3/ha)	Extra Runoff to store (m^3)	Long Term Storage (m^3/ha)	Greenfield Runoff (m^3)	Greenfield Runoff (m^3/ha)	Developed Runoff (m^3)	Developed Runoff (m^3/ha)	Extra Runoff to store (m^3)	Long Term Storage (m^3/ha)	Greenfield Runoff (m^3)	Greenfield Runoff (m^3/ha)	Developed Runoff (m^3)	Developed Runoff (m^3/ha)	Extra Runoff to store (m^3)	Long Term Storage (m^3/ha)	Greenfield Runoff (m^3)	Greenfield Runoff (m^3/ha)	Developed Runoff (m^3)	Developed Runoff (m^3/ha)	Extra Runoff to store (m^3)	Long Term Storage (m^3/ha)
Thetford	9277	81	45706	400	36429	319	13915	81	68558	400	54643	319	7215	81	43644	491	36429	410	10823	81	65466	491	54643	410
Attleborough	8459	271	14450	462	5991	192	33834	271	57799	462	23964	192	6445	271	12436	522	5991	252	25778	271	49743	522	23964	252
Dereham	4515	289	7329	469	2814	180	9030	289	14659	469	5628	180	3440	289	6254	525	2814	236	6880	289	12508	525	5628	236
Swaffham	1404	94	5355	357	3951	263	2106	94	8033	357	5927	263	1070	94	5021	439	3951	346	1605	94	7532	439	5927	346
Watton	2505	286	4102	469	1597	182	3757	286	6152	469	2395	182	1908	286	3505	526	1597	240	2863	286	5258	526	2395	240
Shipdham	1010	316	1456	455	446	139	1515	316	2184	455	669	139	721	316	1167	511	446	195	1082	316	1751	511	669	195
Great Ellingham	497	311	726	454	229	143	745	311	1089	454	343	143	355	311	584	511	229	200	532	311	876	511	343	200
Harling	84	52	456	285	372	232	126	52	683	285	558	232	60	52	432	378	372	325	90	52	647	378	558	325
Narborough	109	68	484	302	375	234	163	68	726	302	563	234	78	68	453	396	375	328	117	68	679	396	563	328
Banham	0	0	0	0	0	0	587	294	868	434	281	140	0	0	0	0	0	0	419	294	700	490	281	197
Mattishall	0	0	0	0	0	0	614	307	887	444	273	136	0	0	0	0	0	0	439	307	712	498	273	191
Necton	0	0	0	0	0	0	517	259	824	412	306	153	0	0	0	0	0	0	370	259	676	473	306	214
North Elmham	0	0	0	0	0	0	602	301	903	451	301	151	0	0	0	0	0	0	430	301	731	512	301	211
Old Buckenham	0	0	0	0	0	0	642	321	894	447	253	126	0	0	0	0	0	0	458	321	711	498	253	177
Saham Toney	0	0	0	0	0	0	496	248	803	402	307	154	0	0	0	0	0	0	354	248	662	463	307	215
Swanton Morley	0	0	0	0	0	0	572	286	855	428	283	141	0	0	0	0	0	0	409	286	692	484	283	198
Weeting	0	0	0	0	0	0	85	42	583	291	498	249	0	0	0	0	0	0	61	42	559	391	498	349

FROM 2085 TO 2155 (+30% in peak rainfall intensity)

	H_{min} / d_{min} ($A_{i,min}$, $PIMP_{min}$)						H_{max} / d_{min} ($A_{i,max}$, $PIMP_{max}$)						H_{min} / d_{max} ($A_{i,min}$, $PIMP_{max}$)						H_{max} / d_{max} ($A_{i,max}$, $PIMP_{max}$)					
Settlements	Greenfield Runoff (m^3)	Greenfield Runoff (m^3/ha)	Developed Runoff (m^3)	Developed Runoff (m^3/ha)	Extra Runoff to store (m^3)	Long Term Storage (m^3/ha)	Greenfield Runoff (m^3)	Greenfield Runoff (m^3/ha)	Developed Runoff (m^3)	Developed Runoff (m^3/ha)	Extra Runoff to store (m^3)	Long Term Storage (m^3/ha)	Greenfield Runoff (m^3)	Greenfield Runoff (m^3/ha)	Developed Runoff (m^3)	Developed Runoff (m^3/ha)	Extra Runoff to store (m^3)	Long Term Storage (m^3/ha)	Greenfield Runoff (m^3)	Greenfield Runoff (m^3/ha)	Developed Runoff (m^3)	Developed Runoff (m^3/ha)	Extra Runoff to store (m^3)	Long Term Storage (m^3/ha)
Thetford	10050	88	49514	433	39465	345	15075	88	74272	433	59197	345	7816	88	47281	532	39465	444	11725	88	70922	532	59197	444
Attleborough	9163	293	15654	501	6490	208	36654	293	62615	501	25961	208	6982	293	13472	566	6490	273	27927	293	53888	566	25961	273
Dereham	4892	313	7940	508	3049	195	9783	313	15880	508	6097	195	3727	313	6775	569	3049	256	7454	313	13551	569	6097	256
Swaffham	1521	101	5802	387	4281	285	2281	101	8702	387	6421	285	1159	101	5439	476	4281	375	1738	101	8159	476	6421	375
Watton	2714	310	4443	508	1730	198	4070	310	6665	508	2595	198	2067	310	3797	570	1730	259	3101	310	5696	570	2595	259
Shipdham	1094	342	1577	493	483	151	1641	342	2366	493	725	151	781	342	1265	553	483	211	1172	342	1897	553	725	211
Great Ellingham	538	336	786	491	248	155	808	336	1180	491	372	155	385	336	633	553	248	217	577	336	949	553	372	217
Harling	91	57	494	308	403	252	136	57	740	308	604	252	65	57	468	409	403	352	97	57	701	409	604	352
Narborough	118	74	524	328	406	254	177	74	786	328	609	254	84	74	491	429	406	355	126	74	736	429	609	355
Banham	0	0	0	0	0	0	636	318	940	470	304	152	0	0	0	0	0	0	454	318	759	531	304	213
Mattishall	0	0	0	0	0	0	665	333	961	481	296	148	0	0	0	0	0	0	475	333	771	540	296	207
Necton	0	0	0	0	0	0	561	280	892	446	332	166	0	0	0	0	0	0	400	280	732	513	332	232
North Elmham	0	0	0	0	0	0	652	326	978	489	327	163	0	0	0	0	0	0	465	326	792	554	327	229
Old Buckenham	0	0	0	0	0	0	695	348	969	484	274	137	0	0	0	0	0	0	497	348	770	539	274	191
Saham Toney	0	0	0	0	0	0	538	269	870	435	333	166	0	0	0	0	0	0	384	269	717	502	333	233
Swanton Morley	0	0	0	0	0	0	620	310	926	463	307	153	0	0	0	0	0	0	443	310	749	524	307	215
Weeting	0	0	0	0	0	0	92	46	631	316	540	270	0	0	0	0	0	0	66	46	605	424	540	378

Table E7: Additional Runoff Volume due to Employment Development

	PRESENT DAY											
	Minimum						Maximum					
Settlements	Greenfield Runoff (m³)	Greenfield Runoff (m³/ha)	Developed Runoff (m³)	Developed Runoff (m³/ha)	Extra Runoff to store (m³)	Long Term Storage (m³/ha)	Greenfield Runoff (m³)	Greenfield Runoff (m³/ha)	Developed Runoff (m³)	Developed Runoff (m³/ha)	Extra Runoff to store (m³)	Long Term Storage (m³/ha)
Thetford	2570	68	14106	371	11536	304	2570	68	19874	523	17304	455
Attleborough	2256	226	4253	425	1997	200	2256	226	5251	525	2996	300
Dereham	1926	241	3427	428	1501	188	1926	241	4178	522	2251	281
Swaffham	390	78	1762	352	1372	274	390	78	2448	490	2058	412
Watton	716	239	1286	429	570	190	716	239	1571	524	855	285

	FROM 2055 TO 2085 (+20% in peak rainfall intensity)											
	Minimum						Maximum					
Settlements	Greenfield Runoff (m³)	Greenfield Runoff (m³/ha)	Developed Runoff (m³)	Developed Runoff (m³/ha)	Extra Runoff to store (m³)	Long Term Storage (m³/ha)	Greenfield Runoff (m³)	Greenfield Runoff (m³/ha)	Developed Runoff (m³)	Developed Runoff (m³/ha)	Extra Runoff to store (m³)	Long Term Storage (m³/ha)
Thetford	3084	81	16927	445	13843	364	3084	81	23849	628	20765	546
Attleborough	2707	271	5103	510	2396	240	2707	271	6301	630	3595	359
Dereham	2312	289	4113	514	1801	225	2312	289	5013	627	2701	338
Swaffham	468	94	2114	423	1646	329	468	94	2938	588	2470	494
Watton	859	286	1543	514	684	228	859	286	1885	628	1026	342

	FROM 2085 TO 2155 (+30% in peak rainfall intensity)											
	Minimum						Maximum					
Settlements	Greenfield Runoff (m³)	Greenfield Runoff (m³/ha)	Developed Runoff (m³)	Developed Runoff (m³/ha)	Extra Runoff to store (m³)	Long Term Storage (m³/ha)	Greenfield Runoff (m³)	Greenfield Runoff (m³/ha)	Developed Runoff (m³)	Developed Runoff (m³/ha)	Extra Runoff to store (m³)	Long Term Storage (m³/ha)
Thetford	3342	88	18338	483	14997	395	3342	88	25836	680	22495	592
Attleborough	2932	293	5528	553	2596	260	2932	293	6827	683	3894	389
Dereham	2504	313	4456	557	1951	244	2504	313	5431	679	2927	366
Swaffham	507	101	2291	458	1784	357	507	101	3182	636	2675	535
Watton	930	310	1672	557	741	247	930	310	2042	681	1112	371

Appendix F: Historic Flooding Records

F.1 Environment Agency data

Table F.1: Historic flood events recorded in Thetford

Date	Location	Description
9 August 1843	Thetford	Many houses flooded to 2ft deep, especially affecting in Bridge Street
20th Century	Thetford	The town centre suffered serious flooding on several occasions
26 August 1912	Thetford	Parts of the town suffered flooding but little structural damage and no loss of life
January 1915	Hockwold, 20km NW of Thetford	Little Ouse burst its bank
1939	Thetford	Memorable flooding of Thetford's rivers
1947	Thetford	Memorable flooding of Thetford's rivers
19 March 1947	Hockwold, 20km NW of Thetford	Little Ouse burst over 15m of its bank, flooding over 2500 ha of West Norfolk fenland
September 1968	Thetford	High water levels, out of bank flow and flooding, especially in Bridge Street

Source: Thetford Standard of Protection Study

Table F.2: Properties flooded during Upper River Wensum flood in October 1993

River	Location	Number of Properties Affected
Wensum	Lyng	Nine
Wensum	Lenwade	Two
Wendling Beck	Wendling	Two
Wendling Beck	Scarning	Five
Wendling Beck	Worthing	Three
Wendling Beck	Gressenhall	One

Source: Upper River Wensum Strategy Study

Table F.3: Large Raised Reservoirs

Reservoir	Location	Undertaker	Physical Status	NGR	Risk Category	Capacity (m^3)
Battles East	Near Swaffham	Knights Farms Ltd	In Operation	TF7390010400	Unknown	91,000
Bridgeham Reservoir	Near Thetford	Paul Rackham Ltd	Under Construction	TL9560086500	Unknown	230,000
Buckenham Tofts Upper	Near Thetford	Ministry of Defence	In Operation	TL8400095000	D	30,000
Caldecote Farm	Near Swaffham	Heygate Farm (Swaffham) Ltd	In Operation	TF7610004000	Unknown	90,000
Chalk Breck	Beachamwell	D.H. Sanderson and Son Ltd	Under Construction	TF7550008300	Unknown	140,000
Cley Breck North	Near Swaffham	Knights Farms Ltd	In Operation	TF7700003800	Unknown	70,000
Croxton Park Reservoir	Thetford	Croxton Park Ltd	Under Construction	TL8640086800	Unknown	320,000
Dillington Carr	Near Dereham	Gorgate Ltd	In Operation	TF9729416426	A	55,993
Fourteen Acre Field	Near Swaffham	Heygate Farm (Swaffham) Ltd	In Operation	TF8020007600	D	184,500
Hadler's Hole, Croxton Hall Farm Reservoir	Thetford	Goucher	Under Construction	TL8790086700	Unknown	140,000
Hall Farm Reservoir Illington	Thetford	Richard Johnston Ltd	Under Construction	TL9450089300	Unknown	230,000
Hamrow Farm	Near Whissonett	Stangroom Bros Ltd	In Operation	TF9110023800	Unknown	29,000
Hanger End (ID114)	Near Narborough	Narborough Farms Ltd	In Operation	TF7490810333	B	27,523
Highmoor Drove	Northwold	J.W. Spencer Farms Ltd	Under Construction	TL7680098100	Unknown	Unknown
Honey Pots (Field 6)	Near Swaffham	Knights Farms Ltd	In Operation	TF7730000600	Unknown	31,000
Kirk Hall Farm	Attleborough	Kirk Hall Farms	In Operation	TL9920095100	Unknown	81,000
Larkshall Farm Reservoir	Near Thetford	Messrs R.G. Abrey Farms	In Operation	TL9210089100	Unknown	25,000
Narford Lake	Near Kings Lynn	Fountaine	In Operation	TF7600014000	Unknown	400,000
R G Abrey Millenium Reservoir	Near Thetford	Abrey	Under Construction	TL9250089200	Unknown	460,000
South Pickenham	Near Swaffham	South Pickenham Estate Company Ltd	In Operation	TF8570003300	Unknown	312,500
Stanford Water	Near Thetford	Ministry of Defence	In Operation	TL8610095000	Unknown	85,000
Swangey Farm Reservoir	Attleborough	P F Southgate Limited	Under Construction	TM0150094300	Unknown	113,000
Top Strong Land	Near Oxborough	Oxborough Farms Ltd	In Operation	TF7580002900	D	92,000
Warren Farm Beachamwell	Near Swaffham	Heygate Farm (Swaffham) Ltd	In Operation	TF7770006300	D	92,000
Warren Gun Breck	Near Swaffham	Knights Farms Ltd	In Operation	TF7970002600	Unknown	332,000

F.2 Breckland Council data

Table F.4: Breckland Council historic flood events data

Date	Location	Type	Severity	Cause
Prior to 2005	Norwich Road, Attleborough		High – houses flooded to a depth of 3ft	Unknown
Prior to 2005	Toftwood, Dereham		Medium – localised flooding of numerous properties	Dereham Stream
Prior to 2005	Swanton Road, Dereham		Medium – localised flooding of numerous properties	Dereham Stream
Prior to 2005	Long Street, Great Ellingham	Surface water	Low	Insufficient capacity of drain running along Long Street
Prior to 2005	Swaffham		Unknown	Surface water drainage issues
After 2005	Toftwood, Dereham		Low	Blocked pipe
After 2005	Carbrooke		Low	Lack of ditch maintenance
After 2005	Great Ellingham	Surface water	Low	Highway runoff and lack of ditch maintenance
After 2005	Toftwood, Dereham		Low	Undersized pipes
After 2005	Norwich Road, Besthorpe		Low	Undersized culverts and blocked ditches
After 2005	Chantry Lane, Necton	Fluvial flooding	Medium – several properties	Undersized culvert
After 2005	Mill Lane, Attleborough		Medium – several properties	Blockage of trash screen on culvert

Table F.5: Breckland Council sandbag deliveries

Date	Street	Area
31/08/2005	Northfield Road	Swaffham
02/11/2005	Longfields	Swaffham
03/11/2005	Heidi Close	Dereham
04/11/2005	Longfields	Swaffham
10/11/2005	Longfields	Swaffham
18/11/2005	Old Becclesgate	Dereham
19/06/2006	Old Becclesgate	Dereham
27/06/2006	Griston Road	Caston
24/08/2006	Byron Walk	Thetford
24/08/2006	Melville Road	Croxton
24/08/2006	Stanford Road	Thetford
24/08/2006	Elgin Way	Thetford
24/08/2006	St Johns Way	Thetford
24/08/2006	Earls Street	Thetford
24/08/2006	St Marys Crescent	Thetford
24/08/2006	St Marys Crescent	Thetford
10/10/2006	Norwich Road	Dereham
07/12/2006	Market Street	Shipdham
10/01/2007	The Street	Rocklands
10/01/2007	The Street	Rocklands
10/01/2007	Thorpe Farm Cottages	Shadwell
10/01/2007	Bunwell Road	Besthorpe
10/01/2007	Silver Street	Besthorpe
10/01/2007	-	Caston
10/01/2007	Long Street	Great Ellingham
10/01/2007	Kenninghall Road	Harling
10/01/2007	Cake Street	Old Buckenham
11/01/2007	Manor Close	Lyng
11/01/2007	Market Street	Shipdham
12/01/2007	Cake Street	Old Buckenham
17/01/2007	-	Cranworth
19/06/2007	Church Road	Worthing
21/06/2007	Fairfields	Thetford
22/06/2007	Old Becclesgate	Dereham
25/06/2007	Fakenham Road	Horningtoft
25/06/2007	Hammond Place	Lyng
25/06/2007	Fakenham Road	Horningtoft
25/06/2007	Station Lane	Thuxton
25/06/2007	Brandon Road	Swaffham
25/06/2007	Post Office Lane	Reymerston
25/06/2007	New Road	Whissonsett

25/06/2007	-	Twyford
25/06/2007	Brackenwoods	Necton
26/06/2007	Saham Road	Ovington
26/06/2007	Saham Road	Ovington
26/06/2007	Saham Road	Ovington
26/06/2007	The Street	Caston
27/06/2007	Billingford Road	North Elmham
27/06/2007	Manor Close	Hockering
27/06/2007	Port Row	Lyng
27/06/2007	Port Row	Lyng
28/06/2007	Port Row	Lyng
28/06/2007	The Street	Bridgham
28/06/2007	Port Row	Lyng
28/06/2007	Shipdham Road	Dereham
28/06/2007	Hale Road	Necton
28/06/2007	Nelson Court	Watton
28/06/2007	Saham Road	Ovington
28/06/2007	Old Bridge	Gressenhall
28/06/2007	Dereham Road	Litcham
29/06/2007	Saham Road	Ovington
29/06/2007	School Plain	Scarning
29/06/2007	The Street	Foxley
02/07/2007	Ash Close	Swaffham
02/07/2007	Sporle Road	Swaffham
02/07/2007	The Paddocks	Swaffham
05/07/2007	Brackenwoods	Necton
05/07/2007	Market Street	Shipdham
05/07/2007	Market Street	Shipdham
05/07/2007	Beatrice Avenue	Dereham
19/07/2007	Blenheim Crescent	Tittleshall
26/07/2007	Charles Close	Dereham
03/07/2007	Dodma Road	Weasenham St P

F.3 Anglian Water data

Table F.6: Anglian Water Sewer Flooding Data

Date	Location Town	Location Detail	Reporting Category	Register Frequency
10/04/1998	Bawdeswell	Reepham Rd	Internal	1 in 10
	Dereham	Boyd Ave	External	1 in 10
	Dereham	Hillcrest	External	1 in 10
	Dereham	Norwich Road	External	2 in 10
	Dereham	Norwich Road	External	1 in 20
	Dereham	Rash's Grn	External	1 in 20
	Dereham	Shipdham Rd	External	1 in 20
	Dereham	South Green	External	1 in 10
	Dereham	South Green	External	1 in 20
	Dereham	Swanton Grove	External	1 in 20
	Dereham	Swanton Grove	External	1 in 20
	Dereham	Swanton Road	External	1 in 20
	Dereham	Swanton Road	External	1 in 20
	Dereham	Swanton Road	External	1 in 20
	Dereham	Swanton Road	External	1 in 20
	Dereham	Wellington Road	External	1 in 20
	Dereham	Larner's Drift	Internal	2 in 10
	Saham Toney	Bell Lane	External	1 in 10
	Shipdham	Chapel Street	Internal	2 in 10
31/08/2006	Thetford	Bridges Walk	External	1 in 20
	Thetford	Bridges Walk	Internal	1 in 20
	Thetford	Fairfields	Internal	2 in 10
	Thetford	Fairfields	Internal	2 in 10
	Thetford	Fairfields	Internal	2 in 10
	Thetford	Fairfields	Internal	2 in 10
	Thetford	Fairfields	Internal	2 in 10
	Thetford	Fairfields	Internal	2 in 10
	Thetford	Fairfields	Internal	2 in 10
	Thetford	Fairfields	Internal	2 in 10
	Thetford	Fairfields	Internal	2 in 10
	Thetford	Fairfields	Internal	2 in 10
	Thetford	Fairfields	Internal	2 in 10
	Thetford	Fairfields	Internal	2 in 10
	Thetford	Fairfields	Internal	2 in 10
	Thetford	Fairfields	Internal	2 in 10
	Thetford	Fairfields	Internal	2 in 10
	Thetford	Fairfields	Internal	2 in 10
	Thetford	Fairfields	Internal	2 in 10
	Thetford	Fairfields	Internal	2 in 10
	Thetford	Fairfields	Internal	2 in 10

Date	Location Town	Location Detail	Reporting Category	Register Frequency
24/08/2006 and 03/03/2007	Watton	Norwich Road	External	2 in 10
06/10/2006	Watton	Saham Road	External	1 in 20
23/08/2006	Watton	Saham Road	External	1 in 20
17/08/2006	Watton	Swaffham Road	External	1 in 20
	Watton	Norwich Road	Internal	2 in 10
	Watton	Norwich Road	Internal	1 in 10
	Watton	Norwich Road	Internal	2 in 10
	Watton	Norwich Road	Internal	2 in 10
	Watton	Wissey Grove	External	1 in 10
	Watton	Wissey Grove	External	1 in 10
	Whissonsett	North View	External	1 in 20

Note:

- Each line corresponds to one property which has been flooded. For data protection reasons, Anglian Water did not provide the exact property identifications.
- Date – in the DG5 Register only the earliest and most recent event dates are recorded. For rate of recurrence see Frequency. No date does not infer that no flood event has occured.
- Internal – flooding occurred within the property
- External – flooding occurred outside the property

F.4 Highways Agency data

There are two trunk roads in the Breckland District under the authority of the Highways Agency (the A11 and the A47). Data of historic flood events on these roads since 2002 is presented in Table F.7:

Table F.7: Highways Agency historic flood events data

Date Of Call	Location	Description
15/08/2002	A47 Between Honningham & Hockering	Flooding in residents' gardens
06/11/2002	A47 slip road to Swaffham	Flood on road
29/12/2002	A47 Dereham by-pass	Serious flooding on road
14/03/2003	A47 Dereham, between Middlemitch + Moorgate roads	Flooding on underpass
30/07/2003	A47 Dereham just after B11110 Junction	Flooding across main carriageway, risk of aquaplaning
20/12/2003	A47 Wending junction near Beeston	Flood in carriageway
06/02/2004	A11 Attleborough bypass	Flood in lane 2
26/04/2004	A11 Snetterton	Flooding on underpass
28/04/2004	A11 Stone Cross, Roudham Heath	Flooding on underpass
04/05/2004	A11 Stone Cross	Area flooding due to pump not working
08/07/2004	A47 Hockering	Flooding reported as "torrent" across road eastbound
09/07/2004	A47 Dereham	Blocked gully near pond causing flood
12/08/2004	A47 at Necton	Flooding quite bad eastbound
23/08/2004	A11 Stone Cross	Bad flooding
27/08/2004	A11 Quidenham	Flood on road
14/10/2004	A11 Thetford Bypass	Flood on road
07/07/2005	A47 between Scarling & Little Fransham	Blocked gully causing possible flooding westbound
03/08/2006	A11 Stone Cross, Roudham Heath	Flooding road – pump needs assessing
24/08/2006	A11 Thetford between A1075 R/Bt and Croxton interchange	Flooded central reservation and north side – gully heads need freeing up
24/08/2006	A11 Thetford, south of Sainsburys roundabout	Lay-by entrance flooded
20/09/2006	A11 S/B Snetterton. Stone cross	Flooding on underpass
01/10/2006	A11 Stone Cross, Roudham Heath	Flood warning signs requested
02/10/2006	A11 Stone Cross, Roudham Heath	High level flooding
10/01/2007	A11 Besthorpe	Flooding in both lanes
21/01/2007	A11 1st Turn for Thetford	Flooding under road, due to a fault with the pumping station
08/05/2007	A11 Thetford just south of BP garages	Flood on road
25/06/2007	A47 approx 1 mile after Little Fransham	Reports of flood water approx 2ft deep & 100 yards in length
25/06/2007	A47 Mattishall turning	Localised flooding

F.5 Online Newspaper "Lynn News"

Floods bring hidden dangers

Published Date: 12 September 2002

KEY PLAYERS are being brought together to try to find a solution to major flooding problems that occur in Swaffham after sudden downpours. Swaffham Town Council is inviting Anglian Water, the EA, Norfolk County Council highways and Breckland Council's environmental health department to a meeting at the town hall on Wednesday, October 3.

And South West Norfolk MP Gillian Shephard, who contacted the EA about the town's surface water problems, also hopes to be there. She said: "I have always found the best solution to a difficult problem is to get all the interested parties round the table. "If you do this it means nobody can shelter behind anyone else." I'm sure there's a common aim to solve this problem and that those responsible need to know how local people feel!"

Town Mayor Mr Ben Emmerson told the Lynn News that he had been complaining about flooding in the Sporle Road, New Sporle Road and West Acre Road areas after heavy rain for the past 30 years. "We get raw sewage coming up and that creates a health problem because in hot weather there are children paddling in the floodwater," he pointed out.

Seventy-six-year-old Harold Clarke, a Swaffham resident all his life, is among those who have written to the town council calling for action to stop the flooding. He lives at 19 Sporle Road, close to one of the worst problem spots, and after a thunderstorm on July 30 had floodwater covering half his front garden. Mr Clarke said if the drain covers remained clear they could cope with heavy rain but flooding occurred when they became blocked by rubbish and debris. Overflow from Northwell Pool and water running down Sporle Road and off three nearby housing estates added to the flooding and the pressure lifted heavy manhole covers off sewers, he said. "Effluent gets into the water and children play in it and splash it over each other. "It only needs something to get in an eye, nose, mouth or ear to cause horrendous disease," he added. His neighbour Isabel Caseiro said that it was hard to stop her two-year-old son Kevin from playing in the water because he saw other youngsters were splashing about in it and thought it was like being at the seaside.

Mrs Pat Moore said water always laid in the road near her home at 11 Longfields after heavy downpours, and cars passing through it sent waves across her garden. "It's alright for ducks but not for us," she said. Widow Gwen Mortimer, of 4 New Sporle Road, has even resorted to keeping a heavy plant pot on a drain cover in her front garden to stop it coming off after deluges. "Last time it was like a river on the road outside, with sewage and everything in it," she said.

Storm brings havoc

Published Date: 20 June 2003

THUNDER, lightning and heavy rain caused havoc across West Norfolk on Tuesday evening with power cuts, flash flooding and a 1,000-year-old church tower struck by lightning.

A spokesman for electricity provider 24Seven said West Norfolk was the most seriously affected area on its East Anglian power grid and a weather expert said some towns and villages received half their average monthly rainfall in the space of an hour. RAF Marham's weather station recorded 22.6mm, just under an inch, of rainfall in only an hour between 7pm and 8pm – average monthly rainfall figures are 50mm. More than 3,000 households were left without power when electricity supplies were struck by lightning and homes in West Winch, Downham and Gaywood were affected by flash flooding. Norfolk fire service reported an extremely busy evening pumping water out of homes and Lynn police responded to calls in Castle Rising, West Winch, Weeting and Blackborough End between 7pm and 9pm because of flooded roads.

The most spectacular damage was done when a bolt of lightning hit the 90ft-high tower of Grimston's St Botolph's Church blasting half a tonne of masonry and stonework onto the lower 6ft-high turret roof and scattering it for 50 yards on the ground. Churchwarden Roger Haywood said the explosion, which he described as a "huge bang, red flash and clouds of dust", happened at about 6.30pm and caused about £20,000 of damage to the church, which dates back to about 1200AD. It also attracted about 100 onlookers, among them young scouts and school governors who were attending meetings at nearby Grimston Junior School. Part of the graveyard has now been fenced off and Mr Haywood said they would be unable to ring the church bells until the damage was fixed.

West Winch couple Paul and Carol Rose, of Southfield Drive, said they deeply appreciated help from villagers when their house was flooded. Mr Rose said: "Children were slowing down traffic to prevent further flooding from inconsiderate drivers, people came with buckets and waded in ten inches of water to bail us out."

The high voltage network serving the Woottons was hit by lightning leaving 2,800 in North and South Wootton without power from about 6.30pm. Service was restored between 7pm and 8.45pm. Lightning also caused two faults on the network at Tottenhill at about 7.30pm interrupting power supplies to 450 customers. Service was restored between 1.45am and 7.30am on Wednesday with seven customers waiting until noon.

Weatherquest forecaster Mr Phil Garner said the storm moved into the area from Wisbech at about 5.30pm and moved out through Swaffham and the Creakes by 8pm. He said it was a typical summer storm caused by hot air, built up over the previous few days, from the south meeting cold air moving in from the west. Thanks for flood help...see Page 14.

Flooding hell

Published Date: 29 June 2007

Polluted floodwater lies around a house and garage in Chantry Lane, Necton, on Monday evening following a downpour that day.

Elderly people living in low-lying parts of Necton feared their homes were about to be flooded with sewage-polluted water as torrential rain hit the village this week. Firefighters were called in on Monday evening to pump away floodwater threatening bungalows in Chantry Lane, Chantry Court and Mill Street – in scenes similar to the devastating floods in Yorkshire shown on TV news reports.

Necton Parish Council chairman Frank Woodward's phone was inundated with calls for help from OAPs that day." It rained like hell in the morning and I noticed the drains were blocked in Chantry Lane," he said. The parish council tried to get Anglian Water to send a team to find out why water was lying up to two feet deep in Mill Street and Chantry Lane, but without success. Calls were also made to Norfolk County Council, which recently had someone inspect a culvert in Chantry Lane, and to Breckland Council, which provided sandbags for those in immediate danger but not enough, he said. Mr Woodward stressed: "In these situations, the emergency services are not adequate. "When you try to talk to someone you find the office is shut. "People panic because they want something done straight away; you can't just have emergencies in office hours." The pensioners were worried and some were walking around in pyjamas because they were getting sewage in the house."

Eighty-six-year-olds Elsie and Albert Kellingray watched anxiously as water swamped their garden in Chantry Lane up to the doorstep, reviving frightening memories of a similar experience in 1982 when they had six inches of floodwater in their bungalow. "The rain was so torrential – I have never seen anything like it," Mrs Kellingray said. "The sewage was bubbling up from a big drain near our bungalows." A neighbour called the fire service about 6pm and the firefighters laid two pipes to take the surplus water to a dyke. Bernard Bell (69), who lived in Chantry Lane from 1967 to 1997, said during exceptional and prolonged storms the culvert could not cope with the excess amount of surface water from the new housing estates, and flooding resulted. On Monday, raw sewage got into the floodwater where a manhole cover had lifted. "If the fire brigade had not pumped out from that low place I'm sure some of those bungalows would have been flooded out again," he said.

An Anglian Water spokesman said there were no pump failures or blockages at its Necton pumping station. "It was just the sheer quantity of the downpour and that's not something our system is designed to take in such a short time," she said. "We seem to be seeing this more across the country – there's a whole rash of issues that need looking at, including highway gulleys, maintenance of historical drainage dykes and ditches, the amount of tarmacadam used and the run-off from brickweave drives." A county council spokesman said: ""We fully appreciate that this is a serious concern and are working with Breckland Council to address the flooding issues in the village as quickly as we can." We think that there is a blockage in the culvert and need to find out first what is causing it. We are therefore arranging to have it inspected by CCTV."

Appendix G: Data Sources for Fluvial Modelling and Mapping

G.1 Terrain Data

Figure G.1 shows the coverage of LiDAR data in Breckland. SAR data covers the entire district.

G.2 Hydrological Data

Table G.1: River Gauging Stations in Breckland

Gauge Name and No.	River	NGR	Dates of Record	Indication of Data Quality (from HiFlows Project)
Abbey Heath (33034)	Little Ouse	TL85108440	1969 - 2000	Good, high stage records are mostly in bank, within reliable part of rating.
County Bridge Euston (33011)	Little Ouse	TL89208020	1960 - 2001	Good, full rating of site produced including out of bank flow estimation
Rectory Bridge (33013)	Sapiston	TL89557905	1960 - 2001	Good up to flows of $8m^3/s$
Melford (33019)	Thet	TL88008300	1963 - 2002	Good, rating included for out of bank flow shows good fit to gauging.
Bridgham (33044)	Thet	TL95708550	1968 - 2002	Poor at high flows, out of bank flow rating not found, and there is limited gauging at low flow.
Redbridge (33046)	Thet	TL99609230	1968 -2002	Poor at high flows, no out of bank flow rating has been collected
Quidenham (33045)	Whittle	TM02708780	1969 - 2002	Good, quality reduces at high flows
Stonebridge (33048)	Larling Brook	TL92759070	1970 - 2002	Good up to 0.358 m3/s, no out of bank rating collected
Northwold Total (33006)	Wissey	TL77109650	1956 - 1979, 1985 - 2002	Poor, an out of bank rating has been developed for the main weir however this does not fit the gaugings above a stage of 0.3m on the main weir
Buckenham Tofts (33049)	Stanford Water	TL83909500	1967 - 1973	Poor at high flows, no high flow rating collected
Marham (33007)	Nar	TF72351200	1970 - 2002	Good for data after 1982
Costessey Park (34005)	Tud	TG17001130	1961 - 2002	Good, including high flows
Colney (34001)	Yare	TG18200820	1958 - 2002	Poor, full rating review needed. No suitable rating found
Costessey Mill (34004)	Wensum	TG17701280	1960 - 1987, 1997 - 1999	Not recommended for high flows
Swanton Morley (34014)	Wensum	TG02001840	1969 - 1999	Not included in the Hi-flows project
Fakenham (34011)	Wensum	TF91902940	1967 - 2002	Poor, the gate operations make the use of this site very limited.

Figure G.2 shows the location of river gauging stations in Breckland.

Figure G.1: Coverage of LiDAR Data

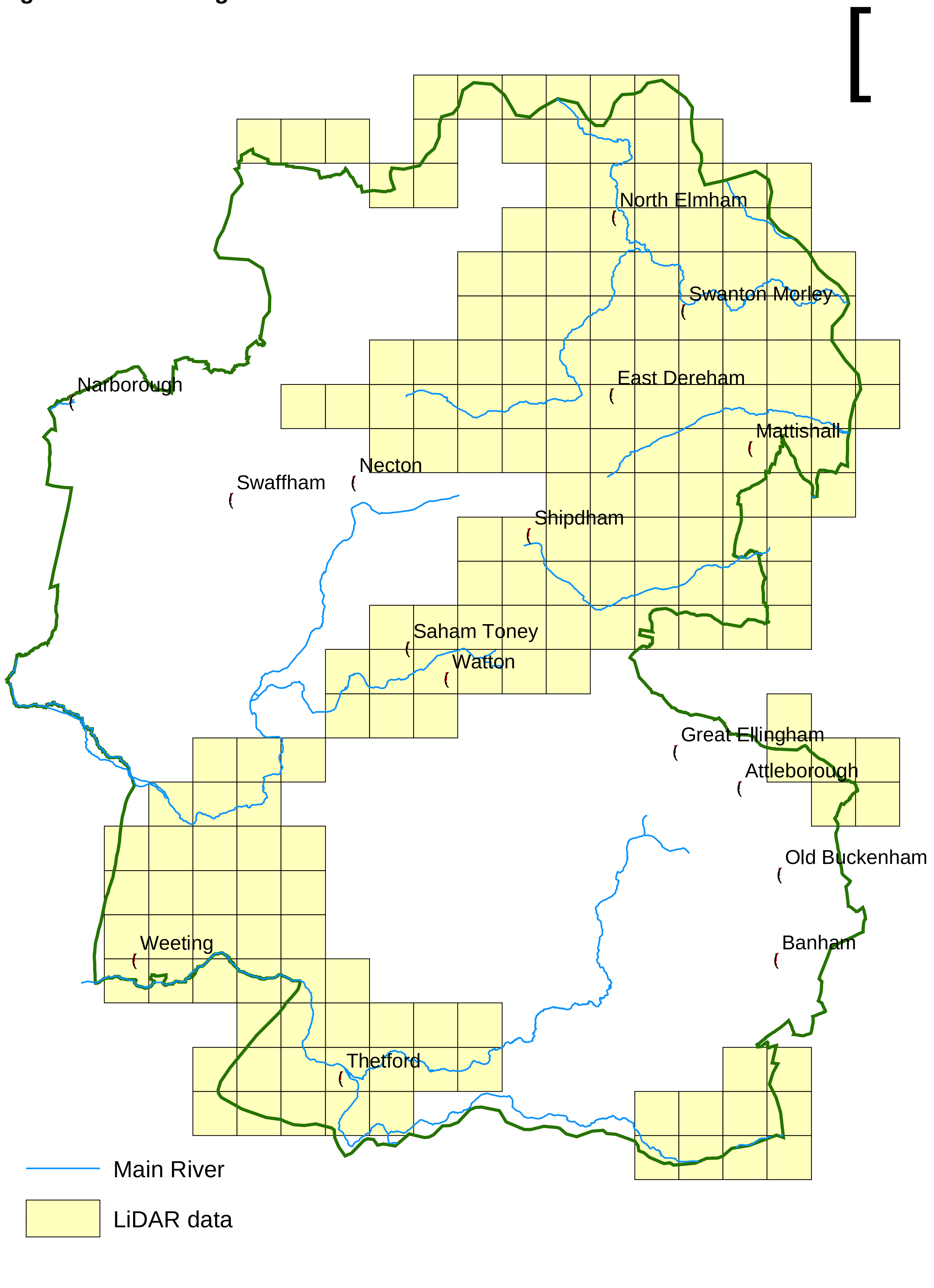


Figure G.2: River Gauging Stations

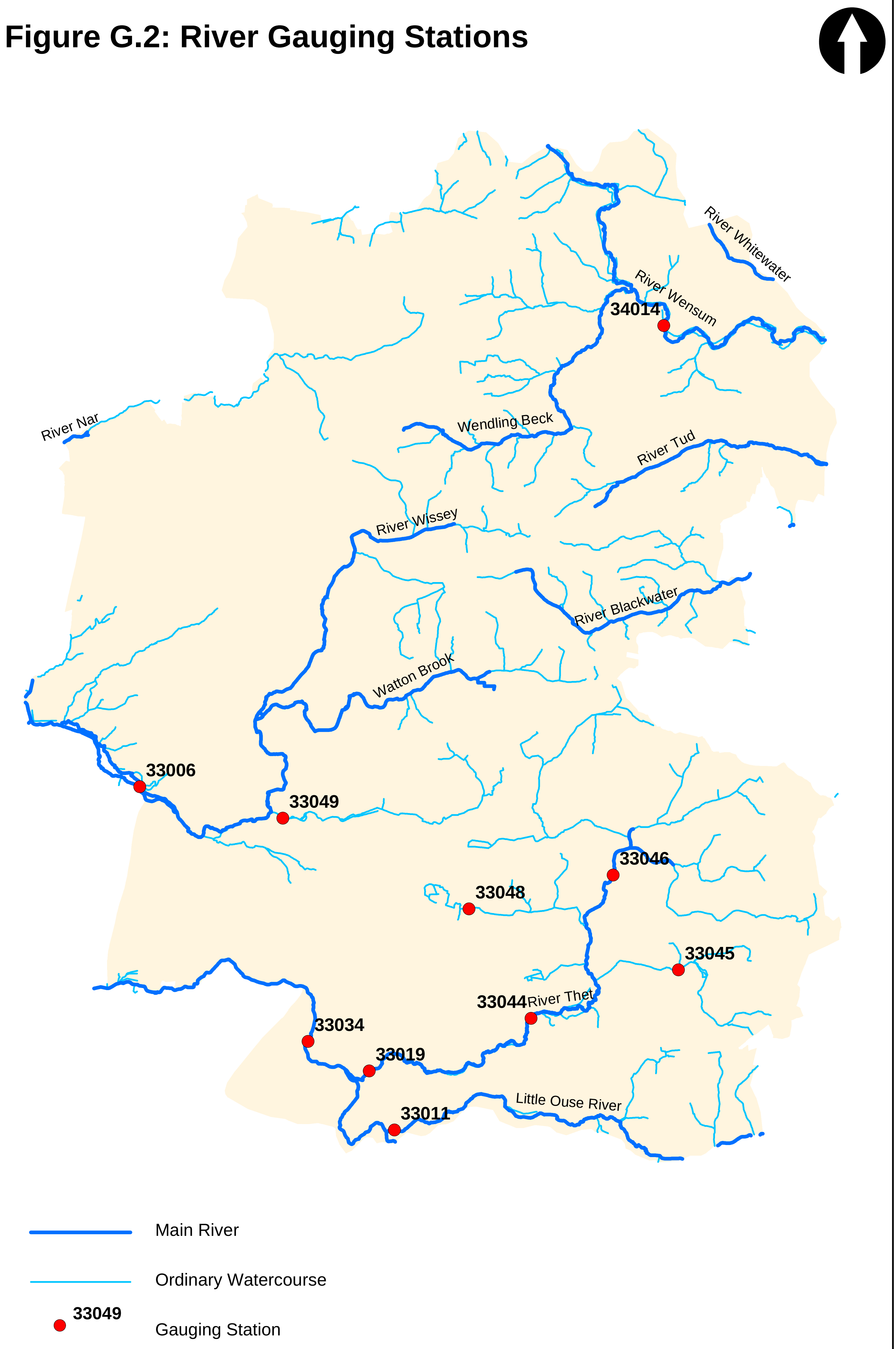
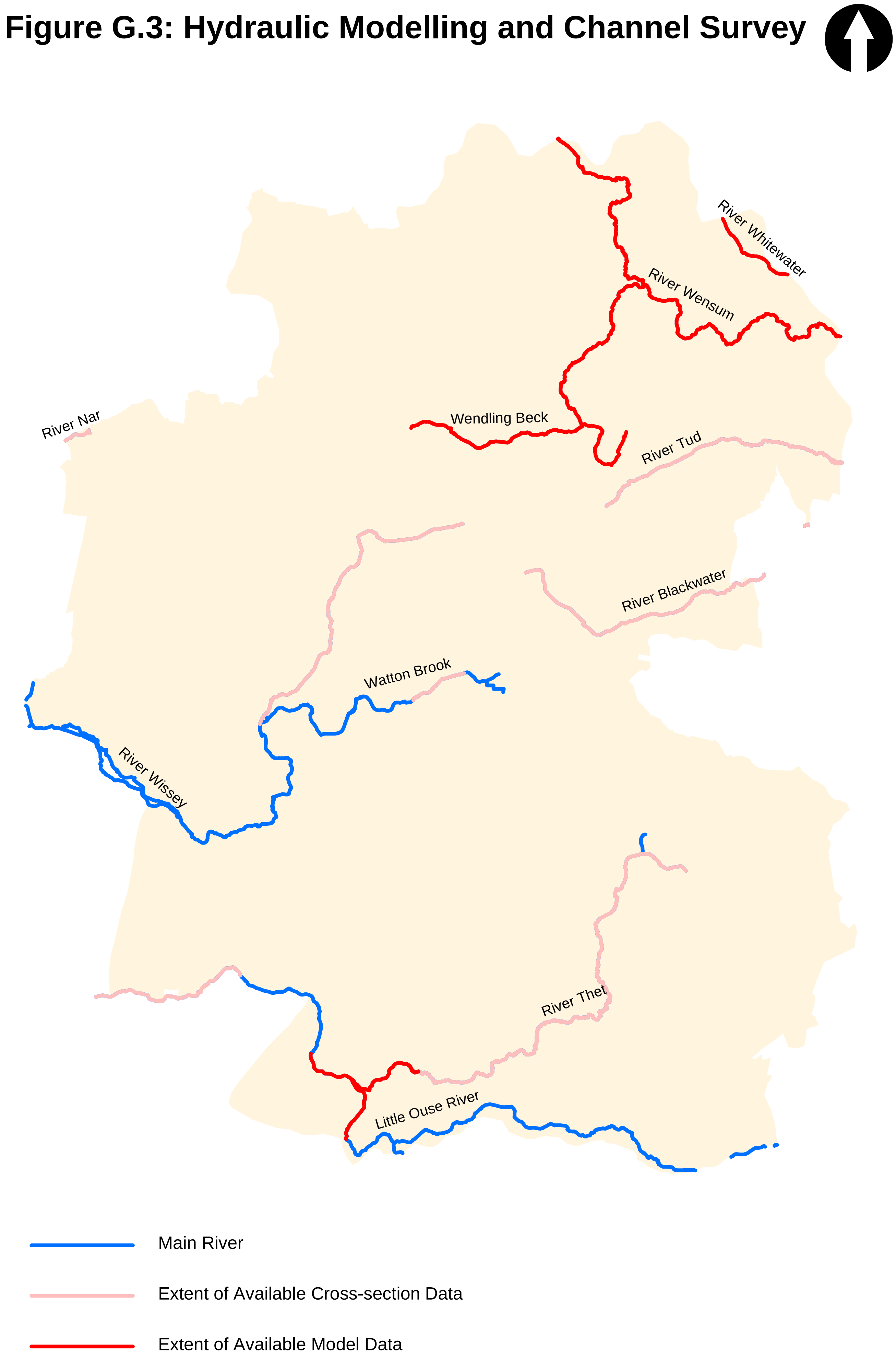


Figure G.3: Hydraulic Modelling and Channel Survey



G.3 Hydraulic Modelling Data

Table G.2: Existing Hydraulic Models in Breckland

Watercourse	Reach covered	Report Date	Report Authors	Client	Software
River Thet and River Little Ouse	Thetford	2006	Halcrow	EA	iSIS
Upper Yare	From Shipdham to western outskirts of Norwich	2005	Babtie, Brown and Root	EA	iSIS
River Tud	From Dereham to confluence with the River Yare	2005	Jeremy Bens Associates	EA	iSIS
River Thet	East Harling	2005	Mott MacDonald	Breckland Council	iSIS
Watton brook	Watton	2005	Mott MacDonald	Breckland Council	iSIS
River Wissey	Necton	2005	Mott MacDonald	Breckland Council	iSIS
River Wensum	River Tat confluence to Costessey Mill, tributaries Wendling Beck and Whitewater.	2003	Babtie, Brown and Root	EA	iSIS
Dereham Stream	Norwich Rd, Dereham to Wendling Brook confluence.	1991	Mott MacDonald	King's Lynn Consortium	HYDRO-1D

These models are the latest versions available for these river reaches.

Table G.3: Channel Cross Section Survey in Breckland

River	Upstream Limit	Downstream Limit	Survey Date	Format	Cross Section Spacing
Whitewater	Main River Limit, Nr Lizard Farm	Blackwater Lane	May 1994	Digital	250m
Tud	Main River Limit, Spurn Farm, Dereham	A47, Honingham	Oct – Nov 1993	Digital	250m
Blackwater (Yare)	Shipdham Road Bridge	Hardingham Gravel Pits	Sept – Oct 1993	Digital	250m
Wensum	Great Ryburgh	Weston Hall	July – Oct 1993	Digital	250m
Wendling Beck	Main River Limit	Conf. with Wensum	May 1993	Digital	250m
Little Ouse	Santon Downham	Brandon	Unknown	Digital	200m
Little Ouse	South Thetford	Abbey Heath Weir	Nov 1992	Digital	150m
Thet	Bridgham	Confluence with Little Ouse	Dec 1993	Digital	200m
Thet	Bridgham	Bridgham	Dec 2000	Digital	100m
Thet	Harling	Bridgham	Dec1993	Digital	200m
Thet	Swangey Fen	Harling	March 1994	Digital	200m
Nar	Main River Limit	South Lynn	March 1993	Digital	200m
Wissey	Main River Limit	Confluence with Watton Brook	Feb 1992	Digital	200m
Watton Brook	Central Watton	Watton	Jan 1991	Hardcopy	200m

Figure E.3 shows the location of the cross section survey and existing hydraulic modelling in Breckland, prior to any modelling completed for the purpose of this study.

Appendix H: Outfalls from Sewage Treatment Works

Data was received from Anglian Water giving details of discharge consents within Breckland. This was rationalised in order to show sewage treatment work outfalls. There are 96 such outfalls in Breckland District; these are shown in Figure H.1 and listed in Table H.6. It should be noted that of the 96 outfalls, only 42 have a consented value for daily "dry weather" discharge and only 15 have a consented value for daily maximum discharge.

The outfalls that could potentially be utilised by the possible development sites are documented below. The selection of potential outfalls has been based on proximity to the possible development sites. The potential outfalls have then been ranked based on a broad assessment of the likely impact of the increased discharges on the receiving watercourse. The full impact of the discharge on the receiving watercourse needs to be considered in detail at the planning stage to take account of the nature and size of specific proposals for development.

H.1 Attleborough

There are four potential sewage works outfalls near Attleborough, one of which discharges to a tributary of the River Thet on the District border (ID 60). The other sewage works discharge into IDB controlled tributaries of the Thet, all of which are shown in the SFRA to flood during a 1% flood event. Of the four sewage treatment works, none have a consented daily maximum discharge, and only Attleborough STW has a consented daily "dry weather" discharge. Attleborough STW has been given the highest rank solely on the fact that it will be discharging further downstream into the Thet system than the three alternatives.

As all the potential receiving watercourses are shown to be prone to flooding during a 1% flood event, detailed assessments would be required before any additional discharges are allowed to them. The detailed assessments should take into account the specific nature and size of proposed developments.

Table H.1: Outfalls from Sewage Works around Attleborough

ID	Rank	EA Reference	Name	Receiving Watercourse	Consented dry weather discharge (m^3/day)
44	1	AW1NF1059	Attleborough STW	Tributary River Thet	2500
54	2	AW1NF1PA	Besthorpe (Bunwell) STW	Tributary River Thet	-
60	2	AW1NF2P	Besthorpe (Norwich) STW	Tributary River Thet	-
01	2	AECLF23	Attleborough Poplar Road STW	Tributary River Thet	-

H.2 Dereham

The only sewage works outfall in Dereham is Dereham STW which discharges into the Main River of Wendling Beck. The STW has a consented daily “dry weather” discharge of 3769 cubic metres. The SFRA has shown that the floodplain downstream of the STW is assessed to flood in a 1% event but does not currently pose a significant flood risk to residential areas.

To assess the full impact of additional discharge downstream of the STW a detailed assessment would be required taking into account the specific nature and size of the proposed development.

Table H.2: Outfalls from Sewage Works around Dereham

ID	Rank	EA Reference	Name	Receiving Watercourse	Consented dry weather discharge (m^3/day)
42	1	AEENF527	Dereham STW	Wendling Beck	3769

H.3 Swaffham

The only sewage works close to Swaffham is Swaffham STW which discharges into the River Wissey to the south of Swaffham. The STW is located approximately 3km from the river and has a consented daily “dry weather” discharge of 1000 m^3. The SFRA assesses that the watercourse would flood in a 1% event, but does not pose a significant flood risk to residential areas immediately downstream of the discharge location.

To assess the full impact of additional discharge downstream of the STW a detailed assessment would be required, taking into account the specific nature and size of the proposed development.

Table H.3: Outfalls from Sewage Works around Swaffham

ID	Rank	EA Reference	Name	Receiving Watercourse	Consented dry weather discharge (m^3/day)
45	1	AW1NF1077	Swaffham STW	River Wissey	1000

H.4 Thetford

There are two potential outfalls close to the town of Thetford. Both of these discharge into the River Little Ouse downstream of Thetford; neither has a consented discharge volume. The two STW are within 700m of each other. Thetford STW has been given the highest rank as it is the larger of the two and is downstream of a major structure across the river. The land downstream of this outfall is largely undeveloped. The maps from the SFRA show that this watercourse will potentially flood in a 1% flood event, with residential areas in Brandon shown to be at flood risk.

To assess the full impact of additional discharge downstream of the STW a detailed assessment would be required, taking into account the specific nature and size of the proposed development.

Table H.4: Outfalls from Sewage Works around Thetford

ID	Rank	EA Reference	Name	Receiving Watercourse	Consented Discharge (m^3/day)
57	1	AW1NF260	Thetford STW	River Little Ouse	-
12	2	AECNF11036	Brandon Rd STW	River Little Ouse	-

H.5 Watton

There are four potential sewage works outflows near Watton. These all eventually discharge into Watton Brook downstream of the town; none of them has a consented discharge volume. Of these outfalls only Watton STW discharges into a Main River. As all outfalls discharge into the same system, Watton STW has been given the highest rank since additional discharge is assessed to have the smallest impact. Information from the SFRA maps shows that this watercourse will potentially flood in a 1% flood event, although no residential areas are currently shown to be at flood risk.

To assess the full impact of additional discharge downstream of the STW a detailed assessment would be required, taking into account the specific nature and size of the proposed development.

Table H.5: Outfalls from Sewage Works around Watton

ID	Rank	EA Reference	Name	Receiving Watercourse	Consented Discharge (m^3/day)
76	1	AW1NF958	Watton STW	Watton Brook	-
19	2	AECNF2140	Bell Lane	Trib of Watton Brook	-
47	2	AW1NF11PA	Ovington STW	Trib of Watton Brook	-
96	2	PRCNF14325	Ockleigh	Watton Wick Brook	-

Table H.6: Outfalls from Anglian Water Sewage Works with Discharge Contents

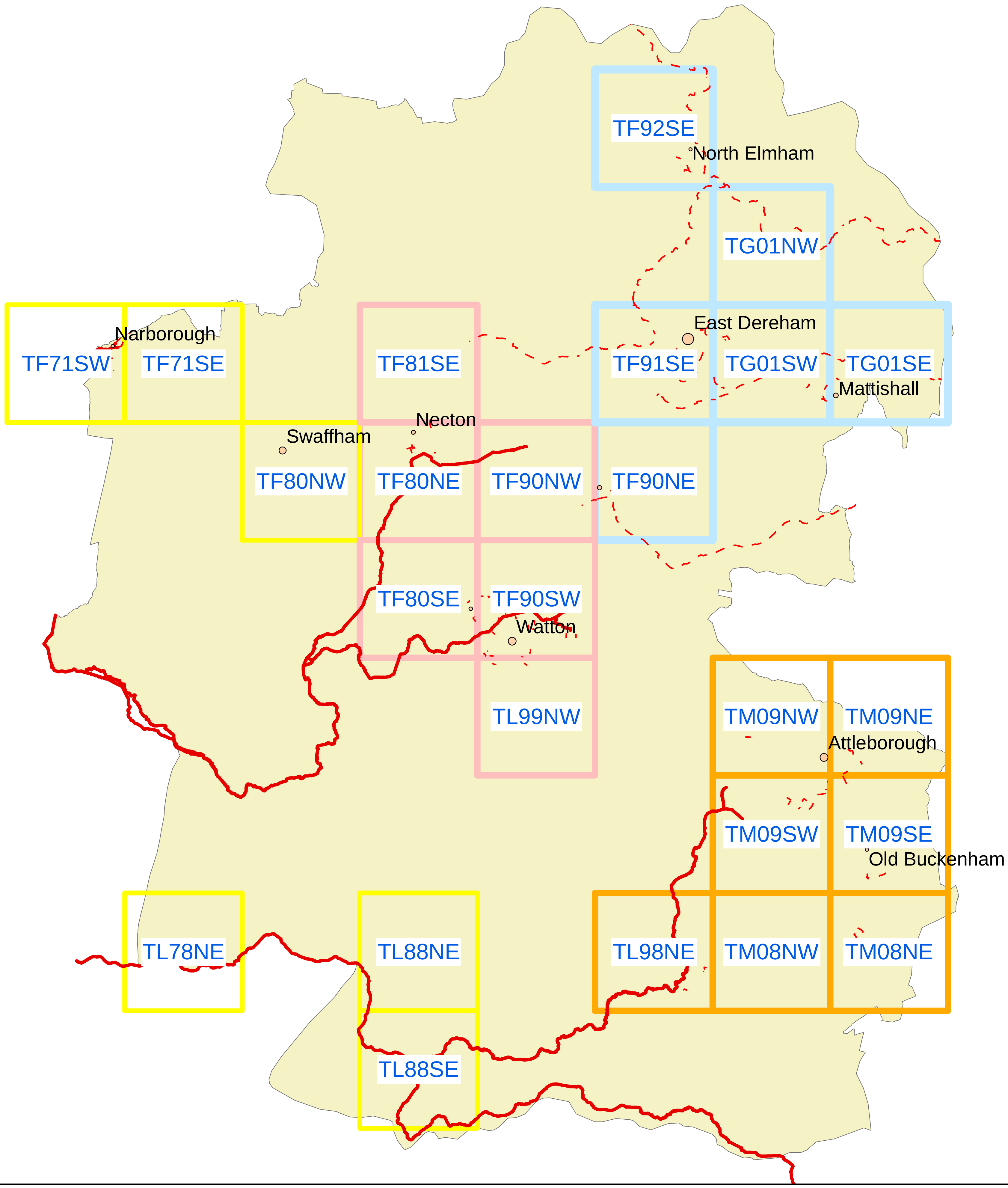
ID	EA Number	Name	Receiving Watercourse	NGR	Dry weather (m^3)	Max daily (m^3)
1	AECLF23	Attleborough Poplar Rd STW		TM0423893497	0	0
2	AECLF26	Croxton Breckwick H STW	Soakaway	TL8715087150	0	0
3	AECLF27	Croxton(Church Av) STW	Soakaway	TL8745086750	0	0
4	AECLF28	Griston(Carbrooke Rd	Soakaway	TL9435099550	0	0
5	AECLF31	Scoulton STW	Soakaway	TF9780000700	0	0
6	AECLF33A	Stow Bedon Station STW	Soakaway	TL9447096410	0	0
7	AECNF10262	Castle Acre STW	Trib R Nar &/or land	TF8239015100	0	0
8	AECNF10452	Caston (Coronation Rd)	unnamed trib River Thet	TL9616097280	0	14
9	AECNF1062	East Harling STW	River Whittle NT	TM0104088040	470	0
10	AECNF11013	Hilborough STW	River Wissey	TL8264099800	0	0
11	AECNF11028	Great Dunham (North) STW	unnamed drain River N	TF8720015080	1	0
12	AECNF11036	Brandon Rd Tps Thetford	R Little Ouse	TL8600083250	0	0
13	AECNF1111	Kenninghall(School) STW	River Whittle NT	TM0380085800	22	0
14	AECNF11621	Carbrooke Church Rd STW	Watton Brook	TF9491002050	70	182
15	AECNF1259	Beeston STW	Trib River Nar	TF9182015960	40	0
16	AECNF15	Rocklands(Rectory) STW		TL9900096040	0	0
17	AECNF2080	Mundford STW	Tributary R Wissey NT	TL7900094400	0	0
18	AECNF2113	Attleborough Road Old Buckenham		TM0625091770	0	0
19	AECNF2140	Bell Lane Saham Toney		TF9061001890	0	0
20	AECNF2695	Wash Lane Banham		TM0621087640	0	0
21	AECNF45	Snetterton STW	River Thet NT	TL9959092270	0	0
22	AECNF8	Kenninghall(Banham) STW	River Whittle NT	TM0380086400	0	0
23	AEELF12293	Brisley Hsw	Groundwater	TF9502021720	4	27
24	AEELF12294	Elsing	Groundwater	TG0531016920	3	19
25	AEELF12295	Garvestone	Groundwater	TG0212007520	8	57
26	AEELF12297	Heath Road Hsw	Groundwater	TG0567017080	5	38
27	AEENF102	Hardingham STW	R Blackwater R Yare NT	TG0428003920	0	0
28	AEENF10356	South Lopham (Church Rd)	Unknown Trib. R Waveney NT	TM0416081660	0	0
29	AEENF10509	Gateley STW	Trib R Wensum NT	TF9617024530	5	6
30	AEENF108	Cranworth STW	Trib River Yare NT	TF9800004700	0	0
31	AEENF112	Little Fransham(Gc) STW	Trib of Wendling Beck	TF9010012730	0	0
32	AEENF119B	Weasenham St.Peter STW	Trib River Wensum NT	TF8515022390	0	0
33	AEENF12055	Foulsham STW	Foulsham Beck R Wensum	TG0246024350	299	0
34	AEENF121	Whinburgh STW	Tributary R Yare NT	TG0090008900	0	0
35	AEENF12129	Horningtoft STW	tributary River Wensum	TF9286023990	4	10
36	AEENF12148	Fprge Cottage CSO	tributary River Tud	TG0472011220	0	0
37	AEENF12417	East Bilney STW	R Blackwater	TF9478019720	22	54
38	AEENF1310	Shipdham STW	R Blackwater	TF9577905939	430	0

ID	EA Number	Name	Receiving Watercourse	NGR	Dry weather (m^3)	Max daily (m^3)
39	AEENF2076	Mattishall STW	River Tud NT	TG0261412051	720	0
40	AEENF245	North Lopham(Kh) STW	Trib River Waveney NT	TM0320083300	0	0
41	AEENF321	Billingford STW	Trib R Wensum NT	TG0175020230	0	0
42	AEENF527	Dereham STW	Wendling Beck R Wensum NT	TF9763313605	3769	0
43	ASCLF11484	Rougham Council Houses STW	To Land	TF8310020620	6	40
44	AW1NF1059	Attleborough STW	Trib River Thet NT	TM0272395104	2500	0
45	AW1NF1077	Swaffham STW	River Wissey NT	TF8335306592	1000	0
46	AW1NF107A	Cockley Cley STW	R Gadder R Wissey NT	TF7957004210	23	0
47	AW1NF11PA	Ovington STW	Trib of Watton Brook	TF9248002300	0	0
48	AW1NF1340	Church End Banham		TM0624088340	0	0
49	AW1NF1457	Little Ellingham STW	Trib River Thet NT	TM0040099100	13	0
50	AW1NF1465	Rocklands Wayland Rd STW		TL9930097300	0	0
51	AW1NF14PA	Thompson STW	Trib River Wissey NT	TL9204096390	0	0
52	AW1NF176	Bradenham STW	River Wissey NT.	TF9110008700	80	0
53	AW1NF18PA	Great Ellingham STW	Trib of Portwood Brook	TM0230097800	110	0
54	AW1NF1PA	Besthorpe(Bunwell) STW	Trib River Thet NT	TM0710095670	0	0
55	AW1NF214	Gooderstone STW	R Gadder R Wissey NT	TF7530002000	112	0
56	AW1NF2506	Hockham STW	Hockham Hall Stream R Thet	TL9518091590	0	0
57	AW1NF260	Thetford STW	Little Ouse	TL8560783716	0	0
58	AW1NF2678	68 The Street	Trib R Little Ouse N	TM0060081500	7	0
59	AW1NF2770	Garboldisham-Hopton Rd	Trib River Little Ouse	TM0027080980	12	0
60	AW1NF2P	Besthorpe(Norwich) STW	Tributary R Thet NT	TM0720097500	0	0
61	AW1NF443A	Merton STW	Trib of Sturston Carr R Wissey	TL9059098560	0	0
62	AW1NF512	STW - Quidenham	Tributary River Thet NT	TM0210089800	10	0
63	AW1NF561A	Two Mile Bottom STW	River Little Ouse NT	TL8530086400	0	0
64	AW1NF61	Barnham STW	Trib R Little Ouse	TL8726279301	136	0
65	AW1NF623A	Old Buckenham STW	Buckenham Stream River Thet N	TM0619290548	0	0
66	AW1NF657A	Little Dunham STW	Trib of R Wissey River Gre	TF8690012500	0	0
67	AW1NF659A	Foulden STW	Foulden Stream River Wissey N	TL7560098800	75	0
68	AW1NF675	Weeting STW	Little Ouse	TL7680087700	0	0
69	AW1NF70A	Great Cressingham STW	Trib River Wissey NT	TF8520002300	0	0
70	AW1NF744A	House at corner Newtown Rd/Main St	Tributary River Nar NT	TF8720014400	0	0
71	AW1NF7P	Gasthorpe STW	Trib R Little Ouse N	TL9768080830	0	0
72	AW1NF832A	Necton (Sporle) STW	Trib R Wissey NT	TF8603509100	0	0
73	AW1NF939A	Brandon STW	River Little Ouse	TL7762086290	0	0
74	AW1NF941	Blo' Norton STW	Trib of Little Ouse	TM0140079400	13	0
75	AW1NF943	Bridgham Biox STW	Trib River Thet NT	TL9610085900	5	0

ID	EA Number	Name	Receiving Watercourse	NGR	Dry weather (m^3)	Max daily (m^3)
76	AW1NF958	Watton STW	Watton Brook	TF8866800123	0	0
77	AW4NF1046X	Swanton Morley Airfield STW	River Wensum NT	TG0150318531	227	0
78	AW4NF199X	North Elmham STW	River Wensum NT	TF9984121291	262	0
79	AW4NF290X	Hockering STW	River Tud NT	TG0780012700	150	0
80	AW4NF314BX	Sparham (Wells Close)	Trib R Wensum NT	TG0710019700	0	0
81	AW4NF325X	Wendling STW	Trib River Wensum	TF9356013620	5	14
82	AW4NF330X	Fransham Sewage Disposal No 1 Site		TF9010012000	0	0
83	AW4NF396X	Fersfield		TM0600083000	0	0
84	AW4NF405BX	Foxley(Laurence Rd) STW	Trib of R Wensum NT	TG0380021800	8	0
85	AW4NF405X	Weasenham All Saints STW	Trib River Wensum NT	TF8490022100	8	0
86	AW4NF418X	East Tuddenham		TG0700011000	0	0
87	AW4NF624X	Bylaugh STW	River Wensum NT	TG0371118324	690	4595
88	AW4NF636X	Tasburgh & Hapton		TM1000090000	0	0
89	AW4NF673X	Stanfield STW	Trib River Wensum NT	TF9360020800	3	0
90	AW4NF673X1	Foxley(Norwich Rd) STW	River Wensum NT	TG0360021500	0	0
91	AW4NF68X	Yaxham Council Houses		TG0000001000	0	0
92	AW4NF790	Litcham STW	Narrowgate Stream	TF8914417228	255	1200
93	AWCNF11341	Narborough STW Feps	unnamed watercourse	TF7405012620	0	0
94	AWCNF11369	Riddlesworth STW	Trib River Little Ouse	TL9552080990	2	7
95	PR1LF2236	Church Road	Internal Drain R Thet	TL9430098800	6	0
96	PRCNF14325	Mr & Mrs J Robertson	Watton Wick Brook	TL9134099810	0	5

Note: Where the dry weather or maximum daily discharge is given as zero, this indicates that no value has been agreed for the consent.

Appendix I: Key Plan for O.S. Map Tiles



Project Title

Breckland DC Strategic Flood Risk Assessment

MapTitle

Key Plan for OS Tiles

Figure I.1

Breckland

Mott MacDonald

Drawing Date 09/03/2005 Rev 1

Drawing ID:\238050 Breckland SFRA\Report\Updated Figures\Key Plan for OS Tiles.mxd