PhD Progress Report

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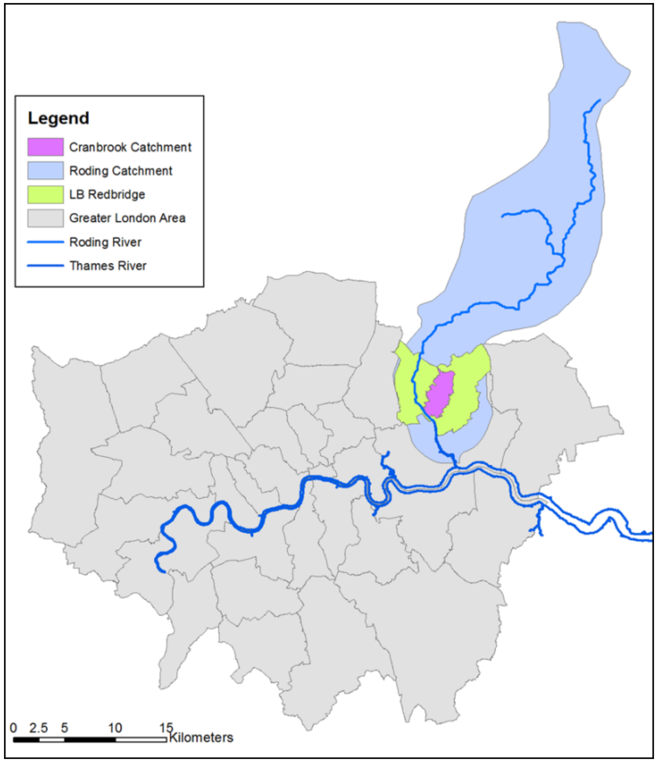
UK pilot locations

- Cranbrook (London Borough of Redbridge)
- Purley (London Borough of Croydon)
- Torquay City Centre (Torbay, Devon)

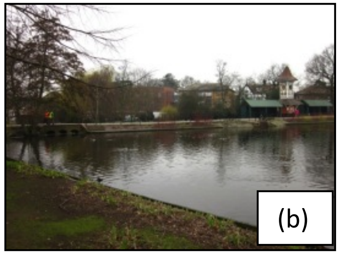
Cranbrook Catchment, London Borough of Redbridge

1. Location and Environmental Setting

- **Area:** aprox. 900 ha
- **Cran Brook:** 5.75km (5.69km culverted)
- Predominantly urban catchment
- Sub-catchment of Roding River catchment
- Has experienced **severe fluvial and surface flooding** in the past. Several flood events reported since 1926, most recent events in October 2000 and February 2009



1. Location and Environmental Setting

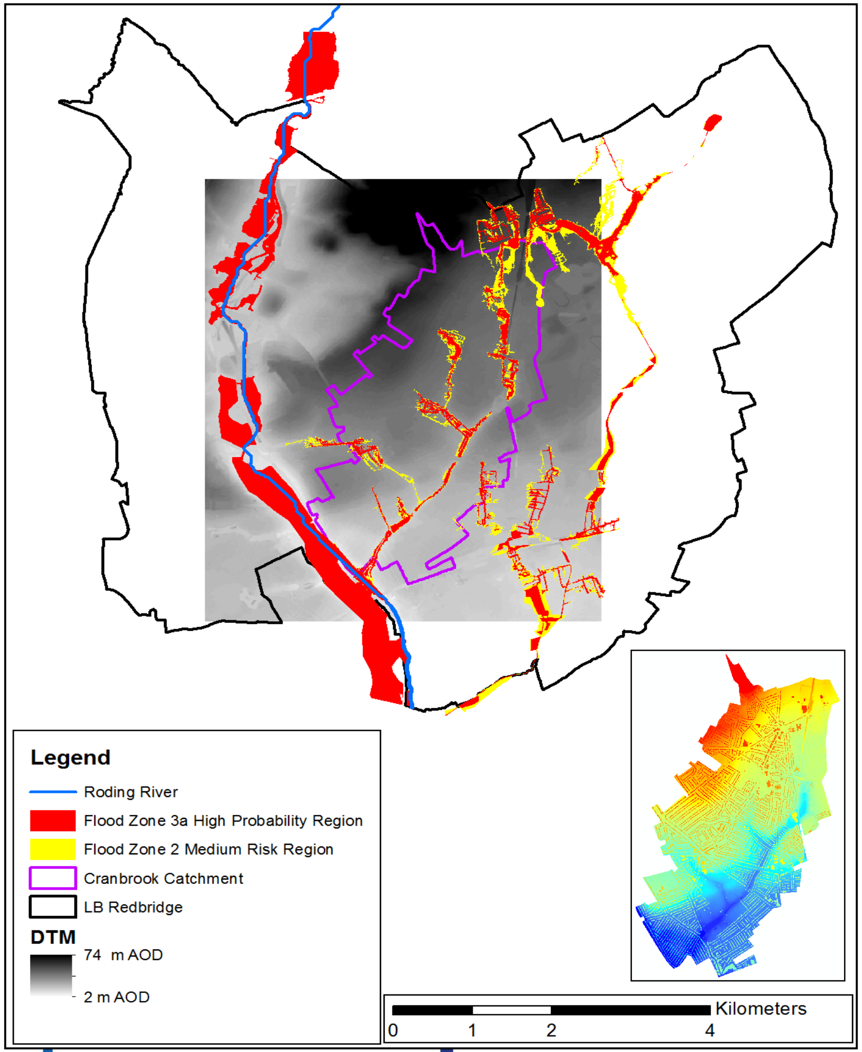


Investing in Opportunities
This project has received European Regional Development Funding through INTERREG IV B.
INTERREG IVB

2. Urban pluvial flood risk problems and management objectives

Flooding mechanisms:

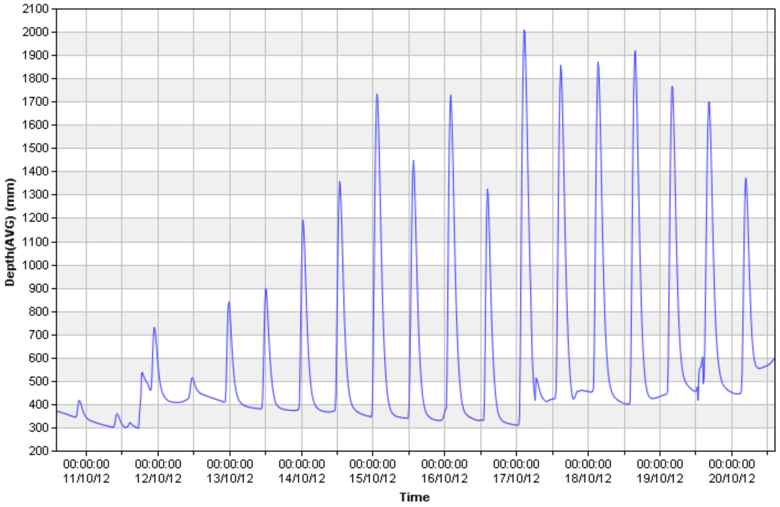
- Overland flow routes associated with surface water flooding generally follow natural drainage pathways
- Interaction of pluvial and fluvial flooding



2. Urban pluvial flood risk problems and management objectives

Flooding mechanisms:

- Overland flow routes associated with surface water flooding generally follow natural drainage pathways
- Interaction of pluvial and fluvial flooding
- Tidal influence
- Highly urbanised area = rapid response to rainfall



2. Urban pluvial flood risk problems and management objectives

Properties at risk of surface water flooding

(for a 1% AEP rainfall event)

Type of property	Infrastructure (PPS25 Categories)*			Households		Commercial Properties	
	Essential	Highly Vulnerable	More Vulnerable	All	Basements Only	All	Basements Only
Flood depth > 0.03 m**	2	2	10	1896	120	251	16
Flood depth > 0.50 m***	2	1	1	266	0	23	0

- **Essential infrastructure** includes essential transport and utility infrastructure
- **Highly vulnerable infrastructure** includes police, ambulance and fire stations and command centres, in addition to basement dwellings, caravans, emergency dispersal points and installations requiring hazardous substances consent
- **More vulnerable infrastructure** comprises hospitals, residential care homes, students halls of residence, hotels, drinking establishments, amongst others.

2. Urban pluvial flood risk problems and management objectives

Impacts of flooding in the Cranbrook catchment

- Damage to residential properties, business and open spaces

  = thousands £££ of damage + social impacts

- Flood water combined with sewage when surcharging occurs has led to environmental damage.
- Roads have been inundated, causing severe disruption to transport

2. Urban pluvial flood risk problems and management objectives

Historical flood events in the Cranbrook catchment

- **30/31st Oct 2000:**
  - Heavy rainfall + high water levels in Roding River
  - Very wet October – October rainfall: Tr = 1:134 yrs
  - Individual storm event: Tr = 1:4 yrs
  - Approx. 100 houses flooded + main roads

- **9th February 2009:**
  - Heavy rainfall -> Snowmelt -> Increase in water levels in Roding River

    = Coincidental fluvial & pluvial flooding

- **Multiple localised surface water flood events in recent years:** June 2006, July 2006, January 2012

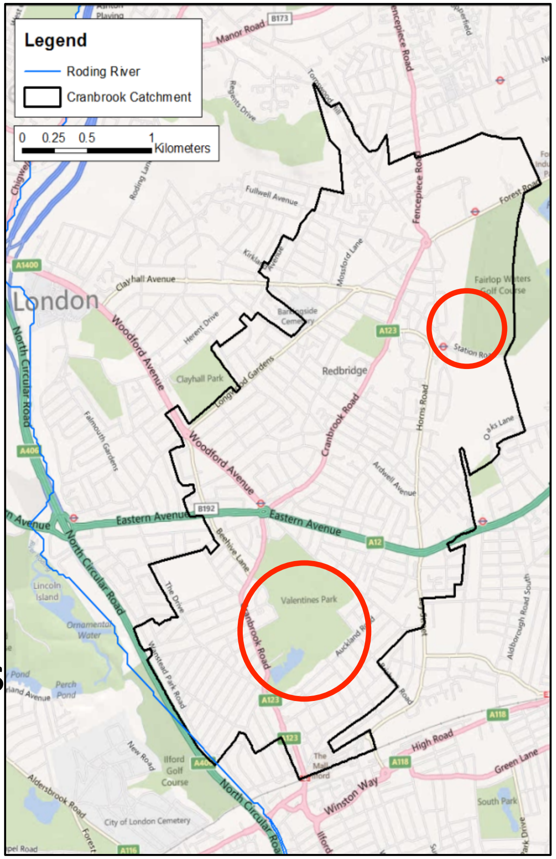
2. Urban pluvial flood risk problems and management objectives

Potential SWFR mitigation alternatives

1. **Storage at Fairlop Gravel Extraction Site**, including day-lighting of a portion of the Cran Brook and remediation of the current extraction site

2. **Increase storage potential at Valentine's Park**:
   - Increasing weir level at downstream end of park lake
   - Restoration of open channel section and surrounding floodplain area
   - Reduce peak points currently diverted around lake

3. **Local property resistance and resilience measures for residual risk**: £1k-£5k for houses, £3k-£10k for commercial properties

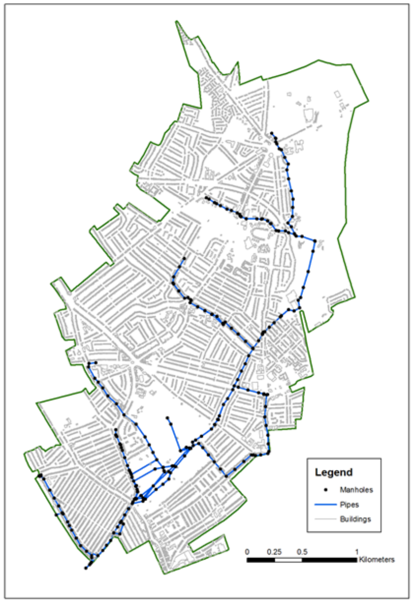


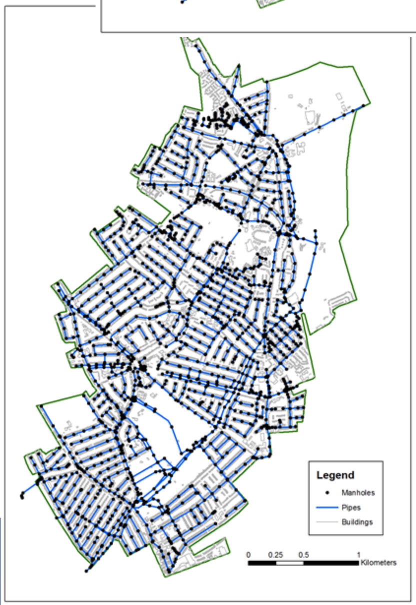
4. **Improved event management – forecasting**

3. Characteristics of drainage and monitoring system

Sewer system: 2 models - simplified and complete

	Simplified Model	Complete Model
Total contributing area (ha)	845.6590	865.2000
Number of nodes	242	1776
Number of pipes	270	1816
Total pipe length (km)	15.8944	98.0458
Number of subcatchments	51	1765
Max subcatchment size (ha)	61.5740	11.5400
Min subcatchment size (ha)	1.1620	0.0030
Mean subcatchment size (ha)	16.5815	0.4902
Standard Deviation of subcatchment size (ha)	13.1768	0.7072
Rainfall-runoff model	Fixed for impervious surfaces / NewUK for pervious surfaces	
Length of longest path to critical point or final outfall (m)	5.0158	6.1042
Time of concentration (min)	56	70

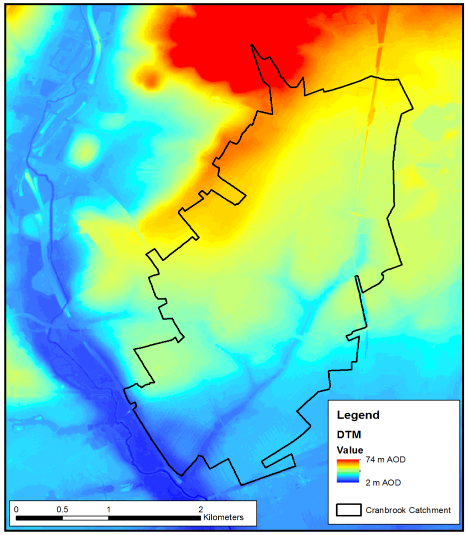




3. Characteristics of drainage and monitoring system

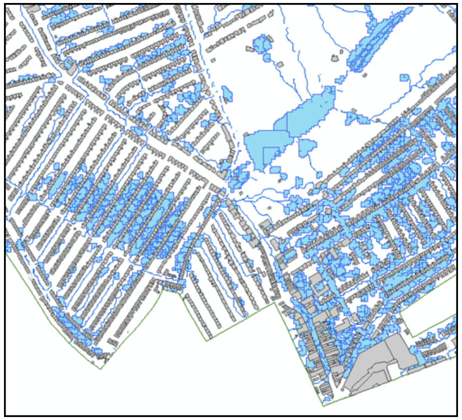
DTM:

- 1 m horizontal resolution LiDAR-generated DTM (2010)
- Stated vertical accuracy of ±0.15 m and horizontal accuracy smaller than the pixel size
- Composite generated by merging data from different, overlapping surveys, at different resolutions



Surface models:

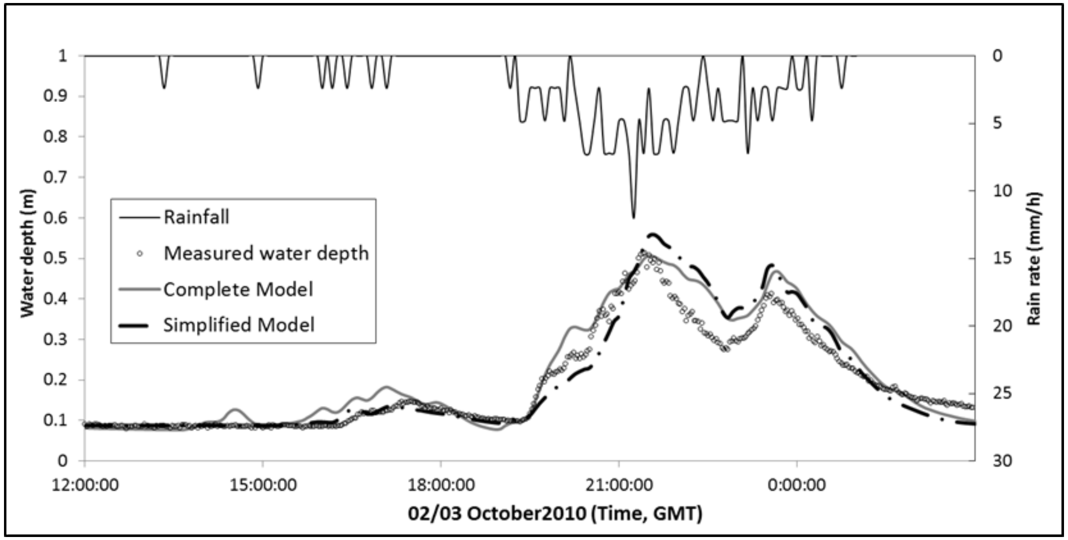
- 1D: set of storage nodes (ponding locations) + open channels (overland pathways)
- 2D: triangular mesh
- Hybrid: 1D/2D

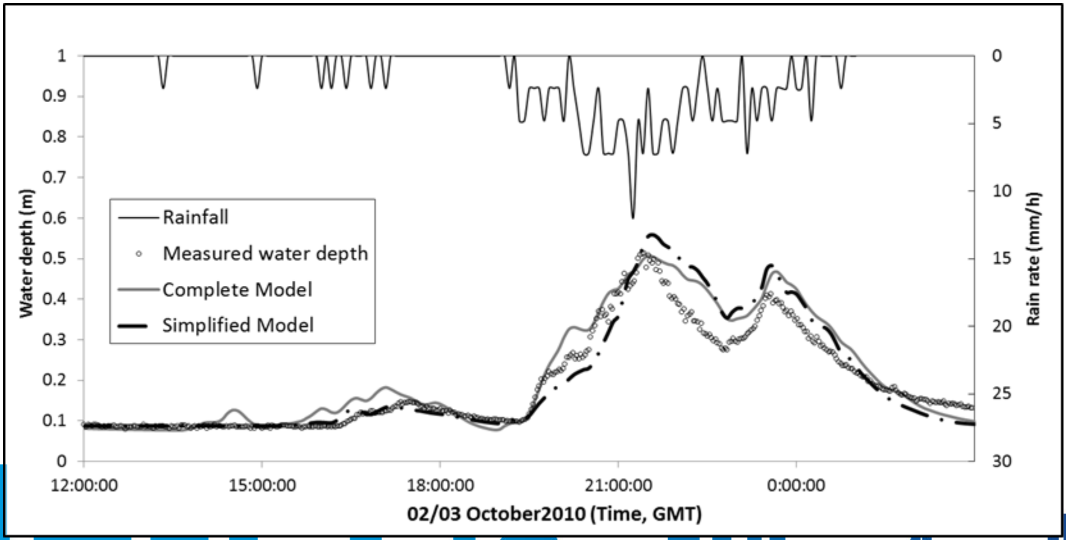


3. Characteristics of drainage and monitoring system

Dual-drainage models

- 1D-1D, 1D-2D
- Calibration





3. Characteristics of drainage and monitoring system

Local monitoring system

- **3 tipping bucket rain gauges**

  With 1 min data “sampling”

- **2 pressure sensor for monitoring water levels in the Roding River**

  Real time frequency: 5/10 min

- **2 sensors for water depth measurement in sewers**

  Real time frequency: 5/10 min.

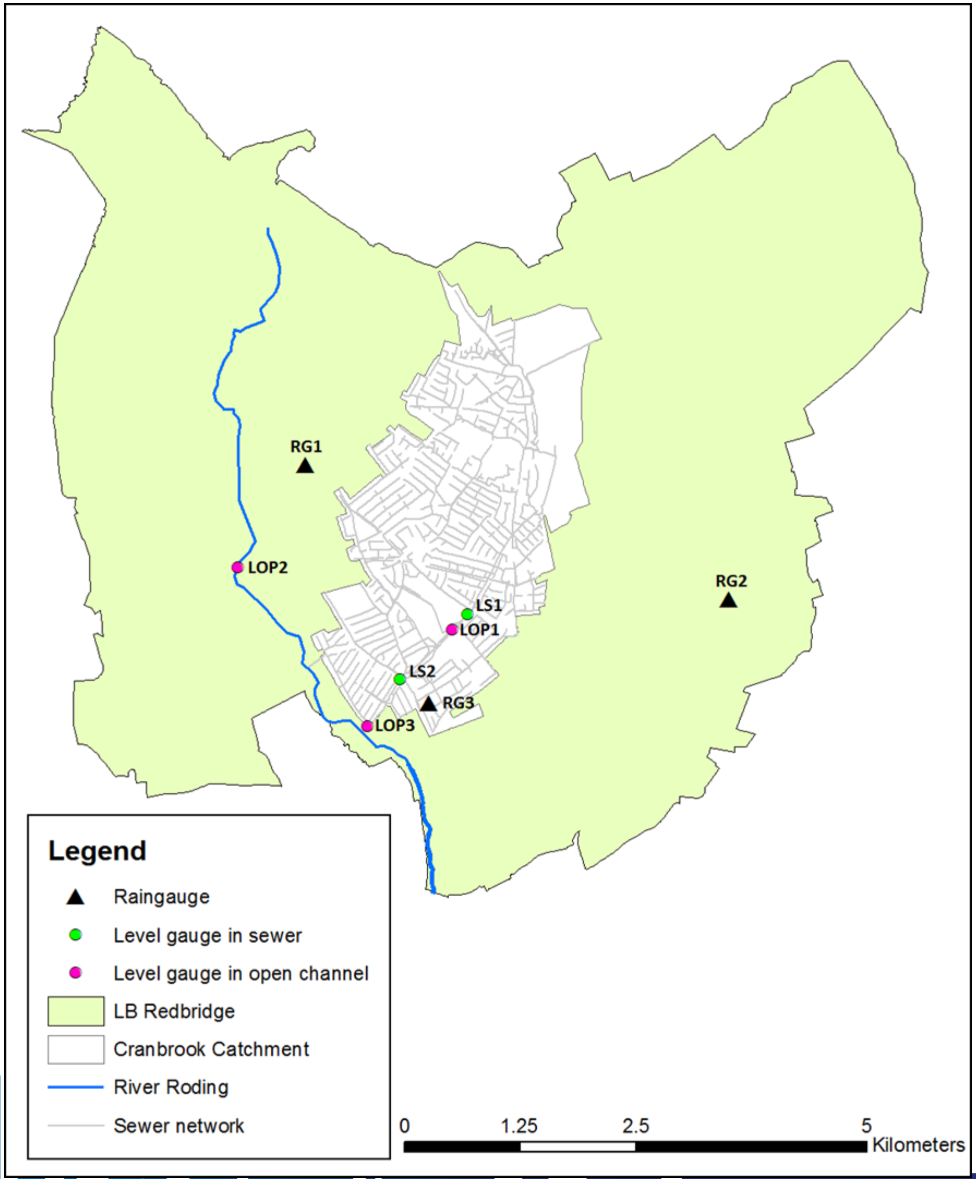
- **1 sensors for water depth measurement in open channels**

  Sampling frequency: 5/10 min

All sensors are equipped with data acquisition and real-time access wireless communication units

3. Characteristics of drainage and monitoring system

Local monitoring system



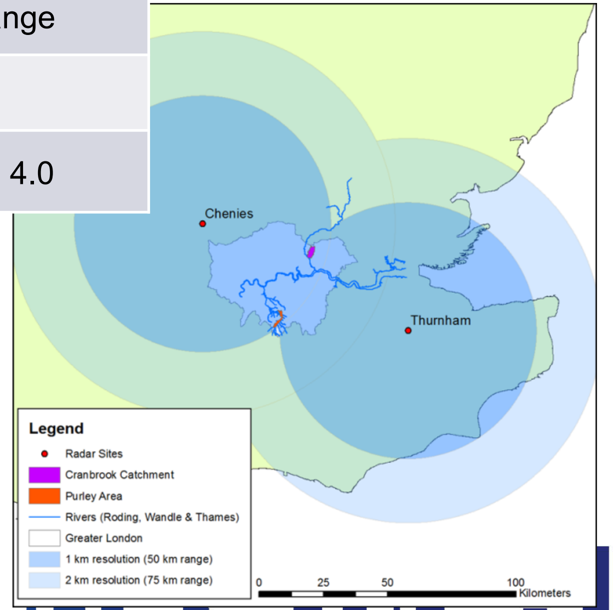
3. Characteristics of drainage and monitoring system

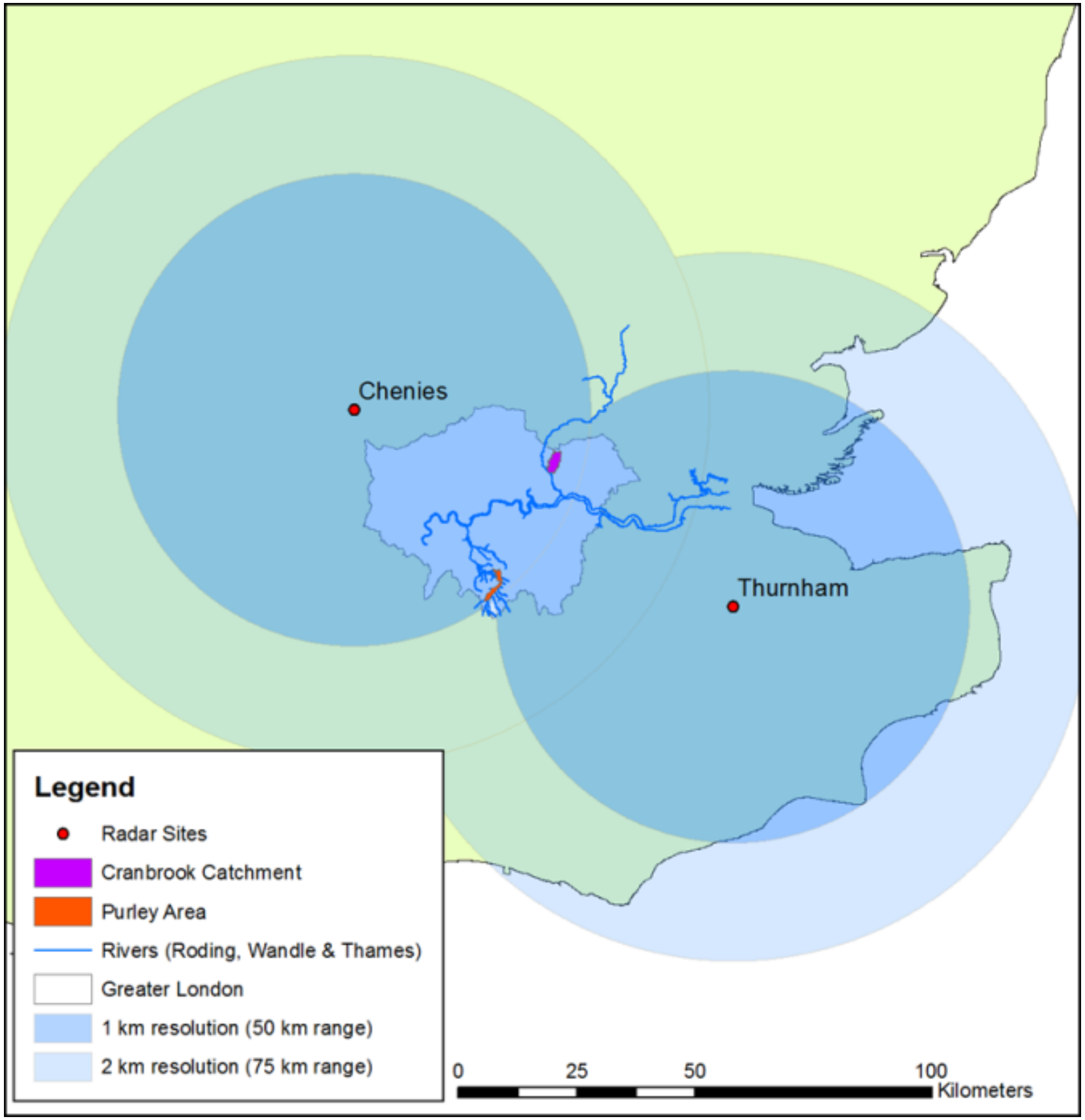
UKMO C-band Radars:

	Chenies	Thurnham
Radar type	C-band	C-band
Polarisation	Single-polarisation*	Dual-polarisation
Doppler (yes/no)	No*	Yes
Antenna	Parabolic 3.6 m diameter, 43 dB gain	
Beamwidth	1°	
Frequency range	5.4 – 5.8 GHz	
Range resolution	1 km up to 50 km range / 2 km up to 75 km range	
Temporal resolution	5 min scan repeat cycle**	
Elevations ($^{\circ}$)	0.5, 1.5, 2.5, 4.0, 5.0	0.5, 1.0, 1.5, 2.5, 4.0

*Currently being upgraded to dual-pol and doppler

**Within the RainGain project the potential benefits of reducing the repetition cycle to 2-3 min will be tested.




Chenies
Thurnham
Legend
Radar Sites
Cranbrook Catchment
Purley Area
Rivers (Roding, Wandle & Thames)
Greater London
1 km resolution (50 km range)
2 km resolution (75 km range)
0
25
50
100
Kilometers