

Development and application of SUDSLOC in Birmingham

*A GIS-based SUDS selection tool for urban surface
water management*

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The Future of Urban Water: Solutions for Livable and Resilient Cities

Challenges

- WFD - Flood directive
- Sustainable development
- Uncertainty (CC, Urban growth, Financial crisis...)

➤ Surface Water Management in the Urban Environment

UK : Summer floods 2007 – Floods and Water Bill –
Surface water management plan

- Identify the flood risk
- Long-term strategy to reduce the flood risk
- Stakeholders involvement
- SUDS (Sustainable Urban Drainage System)

K.I.S.S. ?

- **Urban storm water models**

Good representation of the physical phenomena but non-user friendly and complex as limited to technical issues

- **SUDS**

Wide range of structures, impacts on water quantity and quality, of technical constraints, of costs and benefits

- **Stakeholders**

Diverse with different knowledge, skills and role

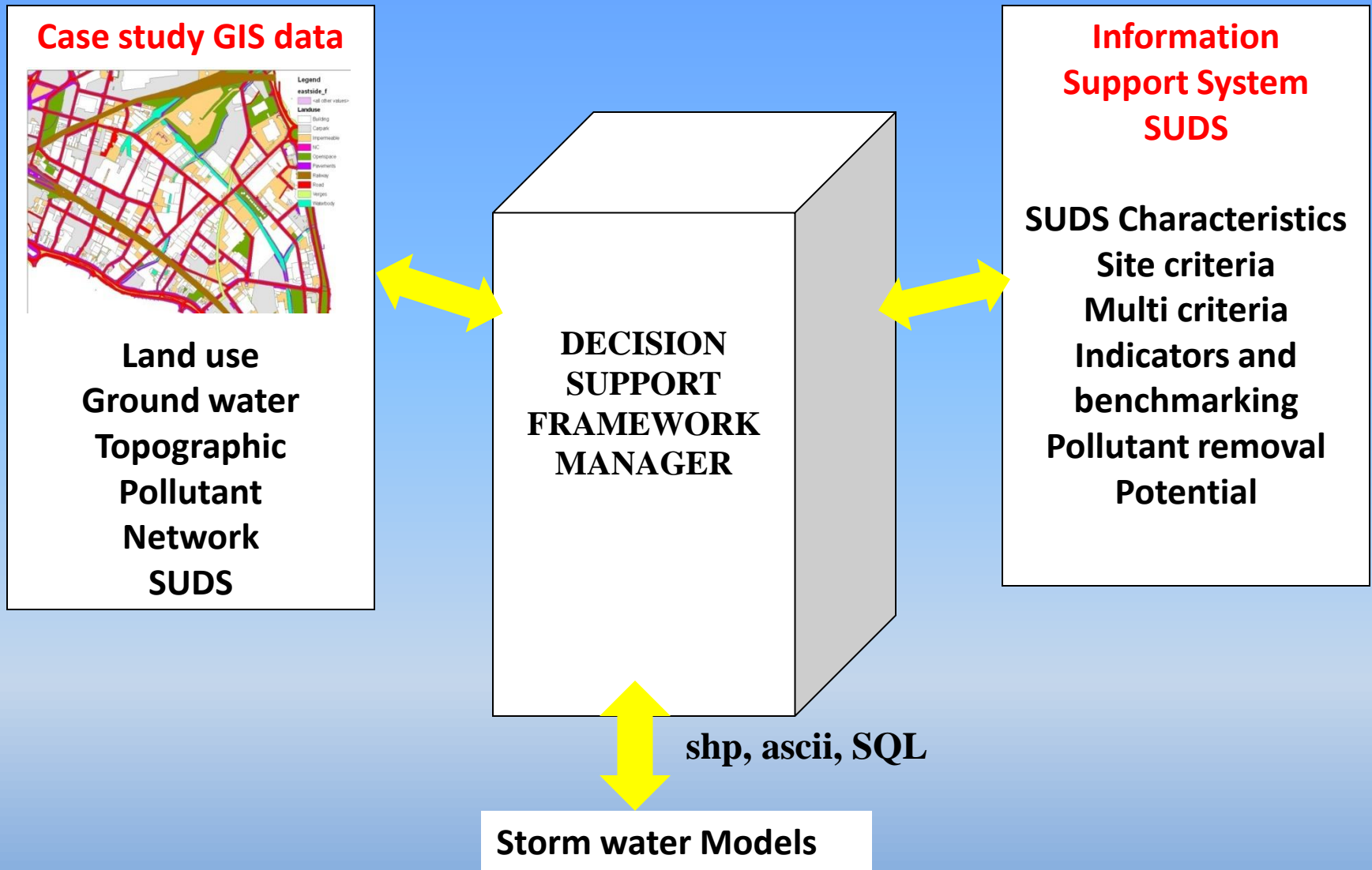
TOOLS TO MANAGE LOCAL FLOOD RISK AND IDENTIFY CRITICAL DRAINAGE AREAS

- ✓ where flooding will occur and HOW
- ✓ opportunities for mitigating - SUDS measures
- ✓ improved public/stakeholder engagement
- ✓ assist forward emergency planning

DSS and SUDSLOC

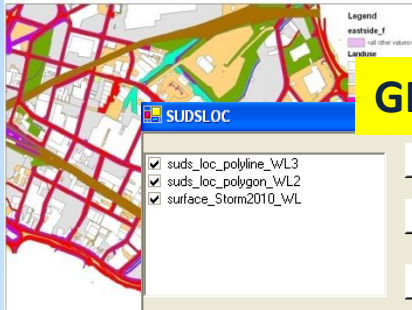
- Is a Geographic Information Decision System Support tool
- Provides support for the identification and location of appropriate SUDS at urban scale
- Supports the integration of data (quantitative and qualitative) from a variety of sources to enable the investigation of the potential benefits of SUDS
- Incorporates user-friendly tools to ensure simplicity and ease of communication
- Requires relatively few skills in GIS (once the spatial data are ready to use)
- Is designed to communicate with storm modelling approach

SUDSLOC TOOL STRUCTURE



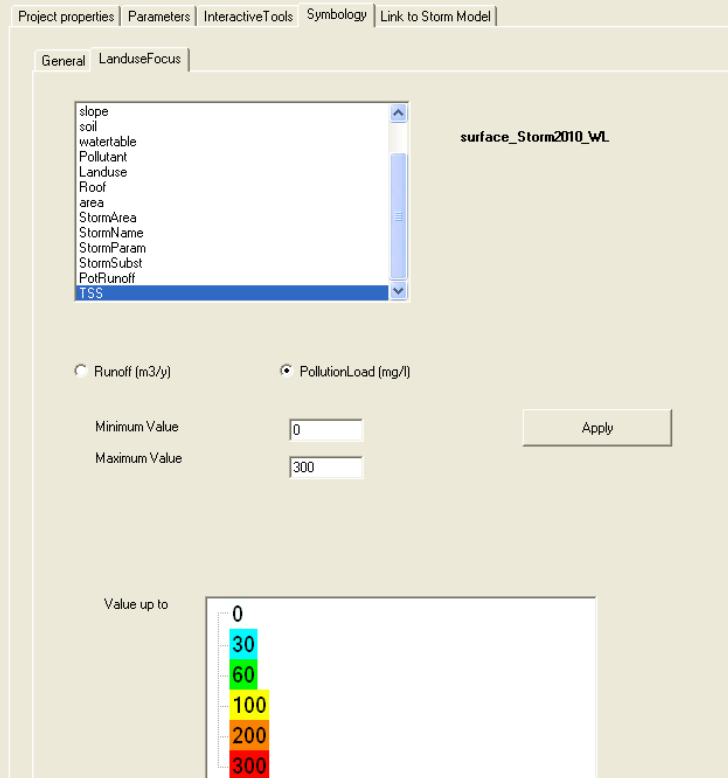
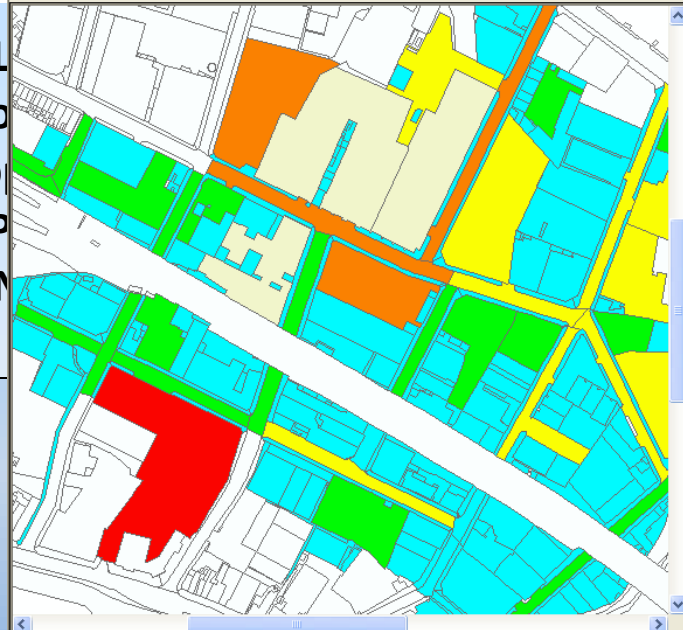
SUDSLOC TOOL STRUCTURE

Case study GIS data



GIS INTERFACE

USER-FRIENDLY INTERFACE



Storm water Models

SUDS assessment component

- Site Criteria

Land use, soil type, slope, depth to groundwater, drainage area, presence of 'flat roof'

Scale unit : road, park, building, pavement

- SUDS pollutant removal potential (Ranking)

Pollutant (TSS, BOD, COD, Nitrates, Phosphates, Cd , Cu,...)

Removal Process (adsorption, settling, microbial degradation, filtration, plant uptake, volatilisation and photolysis)

- Multi-Criteria Comparator (Ranking)

Technical, environmental, economic, operation and maintenance, social and legal criteria

- Catalogue of information

Multi Criteria Comparator

ECONOMIC CRITERIA

LIFE CYCLE COSTS INDICATOR

Benchmarks: Cost Index Appraisal Value

An appreciation of the long term financial implications are important when considering the overall costs of individual best management practice (BMP) devices given that whilst capital costs may be lower than conventional piped systems, operational and maintenance costs may be higher. In addition, there are costs related to risk, residual value and on-going environmental benefits which need to be considered in any long term cost comparison. A whole life cost methodology is summarised in Figure 1 which identifies the various data components needed to undertake a meaningful appraisal. *Capital costs (CAPEX)* include planning and site investigation costs; design and project management; site supervision costs; clearance and land preparation costs; material costs; construction (labour and equipment) costs; planting and post-construction landscaping costs; and land-take costs.

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graph LR
    CC[Capital Cost] --> WLC[Whole Life Cost]
    OM[O&M Costs] --> WLC
    SR[Substitution & Replacement Costs] --> WLC
    RC[Risk Costs] --> WLC
    ECB[Environmental Constraint Baseline] --> WLC
    DC[Disposal Costs] --> WLC
    WLC --> DL[Design Life]
    DL --> DS[Developing Scenarios]
    DS --> CPMC[Calculate Present Value Cost]
    DS --> ISDR[Identify Suitable Discount Rate in base period]
    CPMC --> SWLC[Sum to Whole Life Cost]
    ISDR --> SWLC
    
```

Figure 1. Whole Life Cost BMP Appraisal

Project properties | Parameters | Interactive Tools | Symbolage | Link to Storm Model

Unit Operation Process | MCC | Pollutant Removal | Site Criteria

Criteria	weighCriteria	Indicators	WeightingInd	Swale	Filter strip	Filterdrain	Soak
Technical		Floodcontrol	5	2	2	2	2
Technical		Pollutantconc	5	3	2	2	3
Technical	15	Adaptability 1	5	3	2	1	2
Environmental		Impact on rec	25	4	3	4	5
Environmental		Impact on rec	25	4	3	2	2
Environmental	50	Ecological im	0	3	2	1	1
Operation&M		Maintenance	5	3	4	5	4
Operation&M	10	System relab	5	4	3	3	3
Social and ur		Public H & S 1	2	3	5	5	5
Social and ur		Sustainable d	2	3	4	2	2
Social and ur		Public conen	1	2	2	1	0
Social and ur	10	Amenity L ab	5	3	3	2	1
Economic		Life Cycle Co	5	4	4	4	2
Economic	5	Long term aff	0	4	5	1	1
Legal & Urban		Adoption Stat	5	0	3	4	2
Legal & Urban	10	Building dev	5	3	4	5	3
Total / sum of	100		100	364	300	300	299

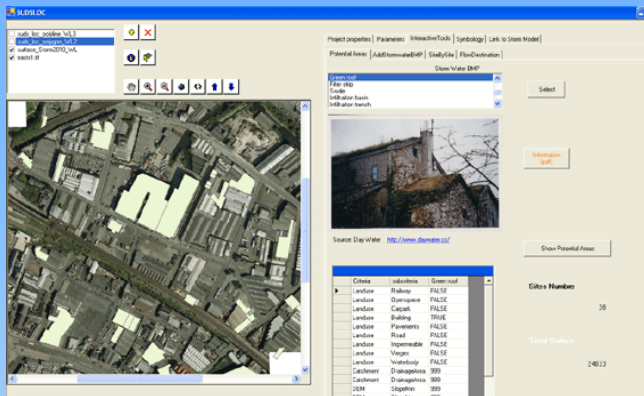
Perform Ranking Save

Information (pdf)

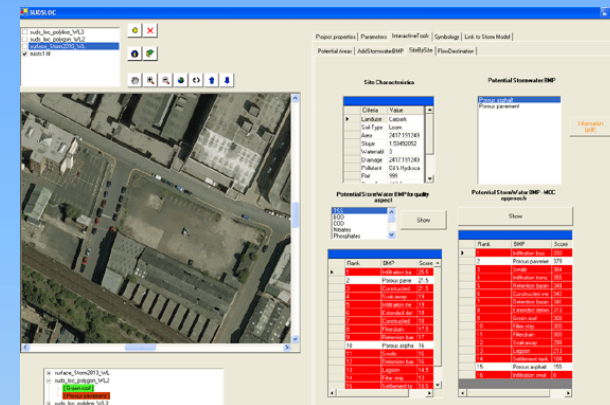
Rank	BMP	Score
1	Infiltration bas	393
2	Porous pave	378
3	Swale	364
4	Infiltration tre	352
5	Pretention bas	344
6	Constructed	343
7	Detention bas	341
8	Extended det	311
9	Green roof	308
10	Filter strip	300
11	Filterdrain	300
12	Soak away	299

Interactive Map functionalities

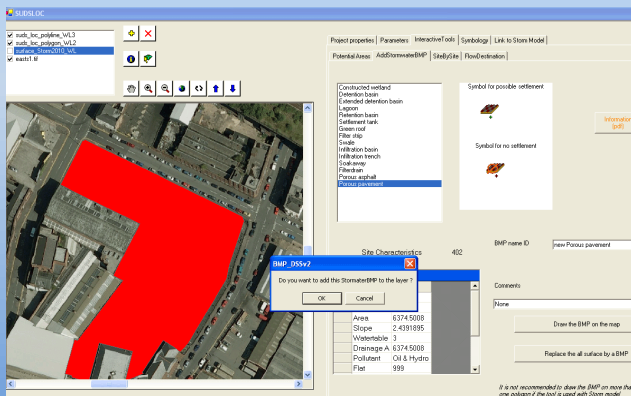
Potential Areas



Site-by-site assessment



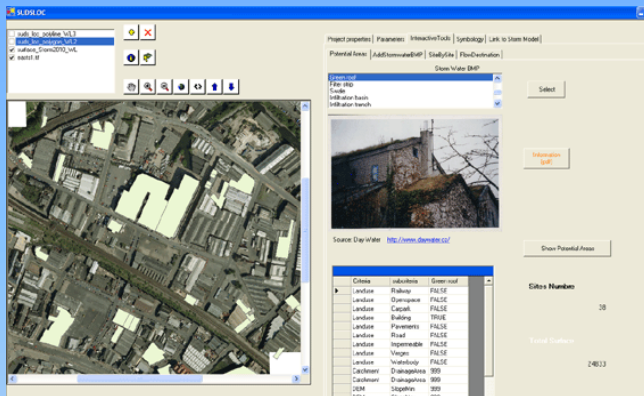
Add a SUDS and export



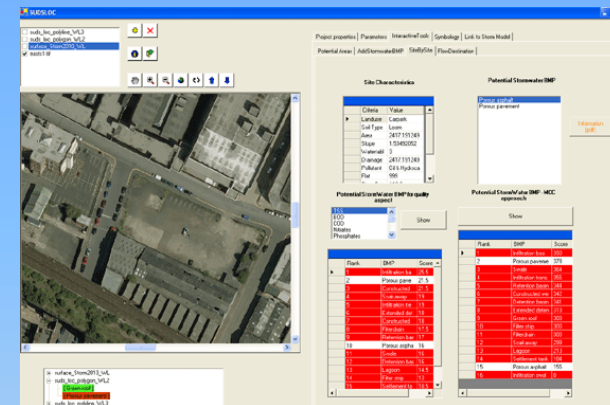


Interactive Map functionalities

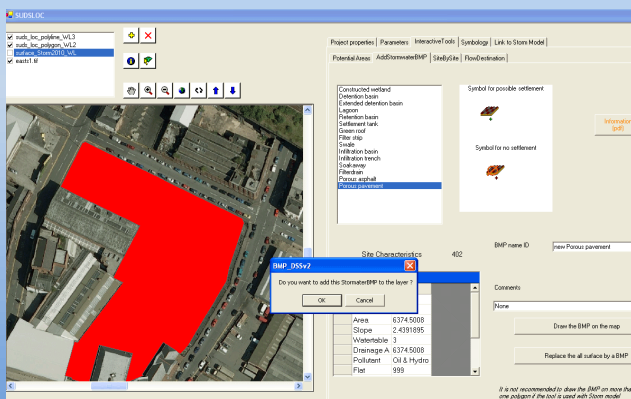
Potential Areas



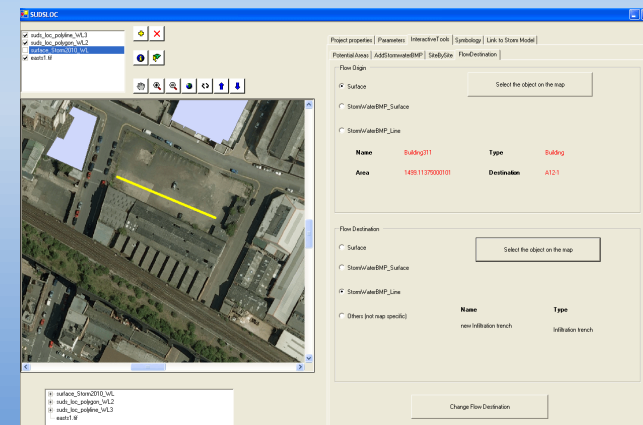
Site-by-site assessment



Add a SUDS and export



Flow destination



1D/2D COUPLED MODELLING FOR SURFACE PLUVIAL FLOODING



SUDSLOC

Informed decision
Site selection
SUDS characteristics

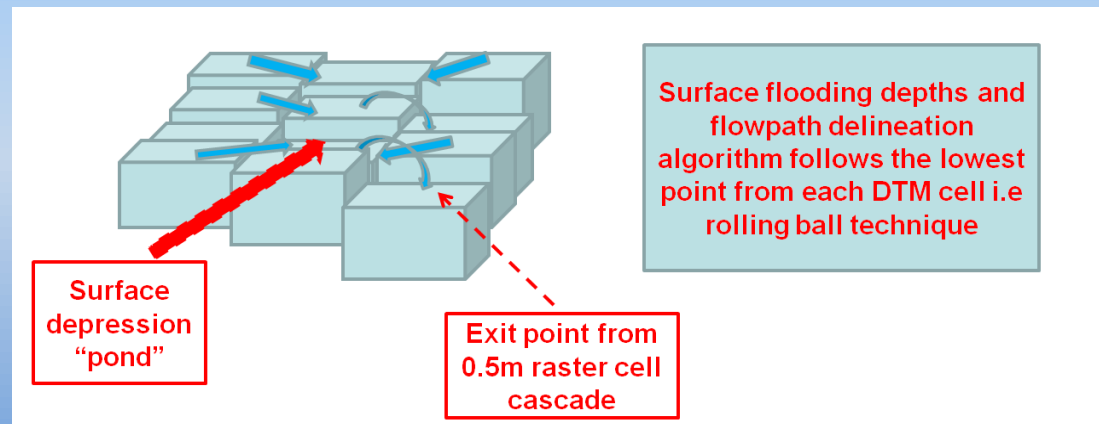
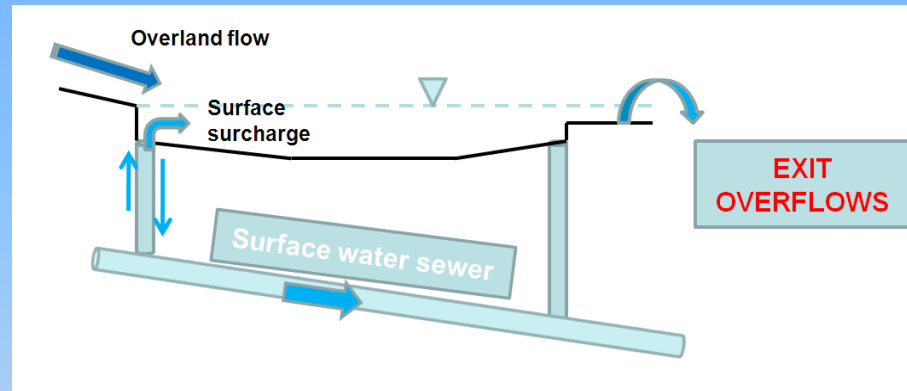
SQL

STORM.XXL model

<http://www.sieker.de/>

FLOOD AREA

<http://www.geomer.de>
2D visualisation



Application Birmingham Eastside

Identifying Critical Drainage Areas:

- Identify “hotspot “ flooding during extreme storm events
- Quantify depth and spatial distribution of flooding
- Identify flood flow paths
- Identify appropriate temporary storage, attenuation and treatment facilities

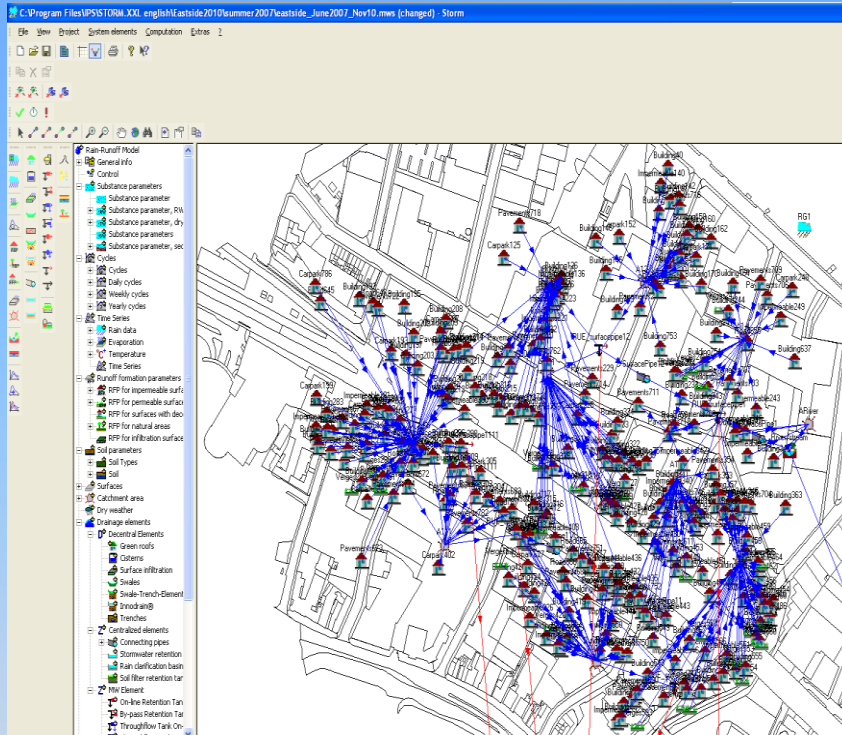
Eastside

12 ha

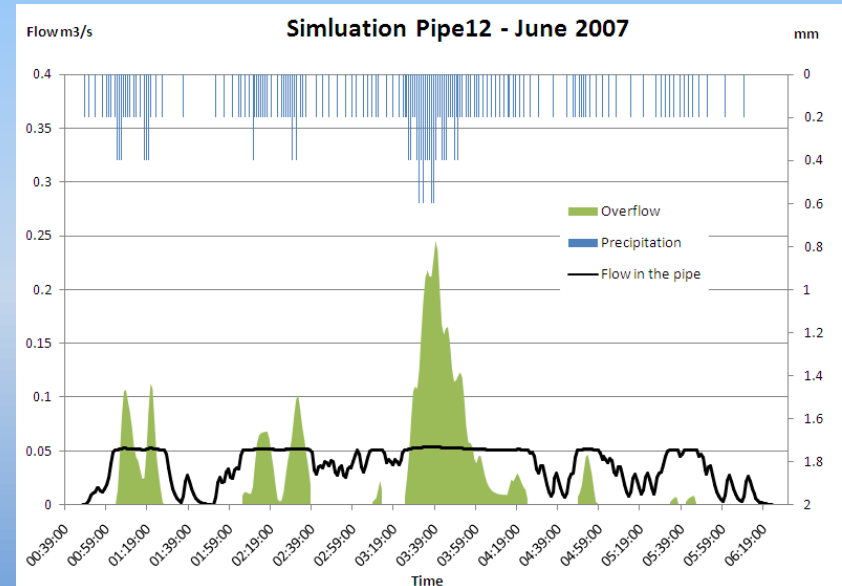
Dense urban area

Old industry – new development

Pluvial surface water flooding

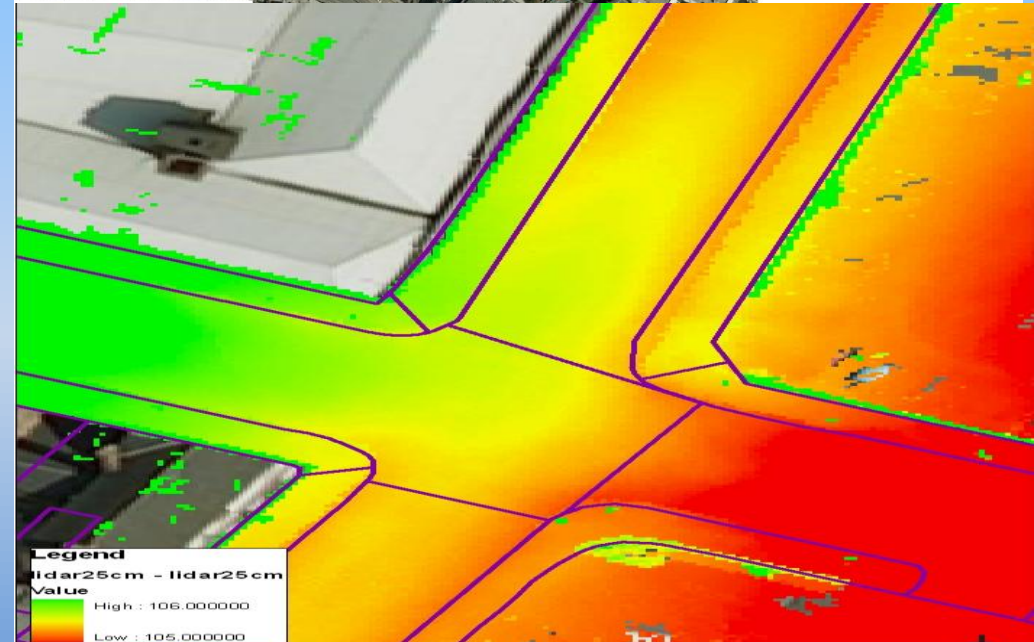
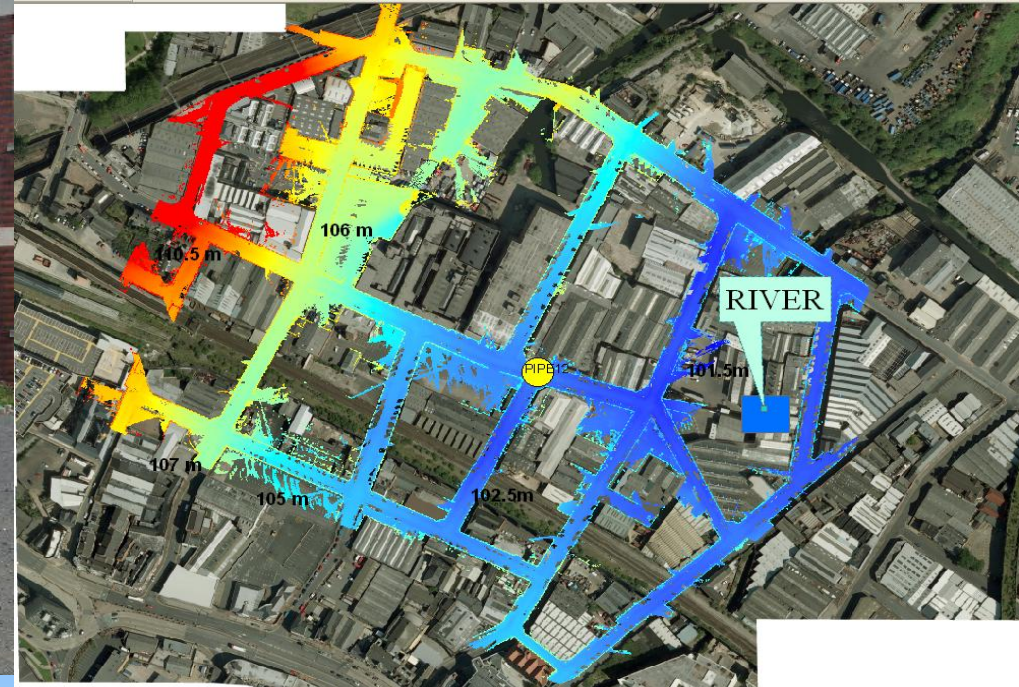


**PREDICTED FLOW DISTRIBUTION AND
EXCEEDANCE OVERFLOWS FOR AN EXTREME
EVENT (STORM model)**

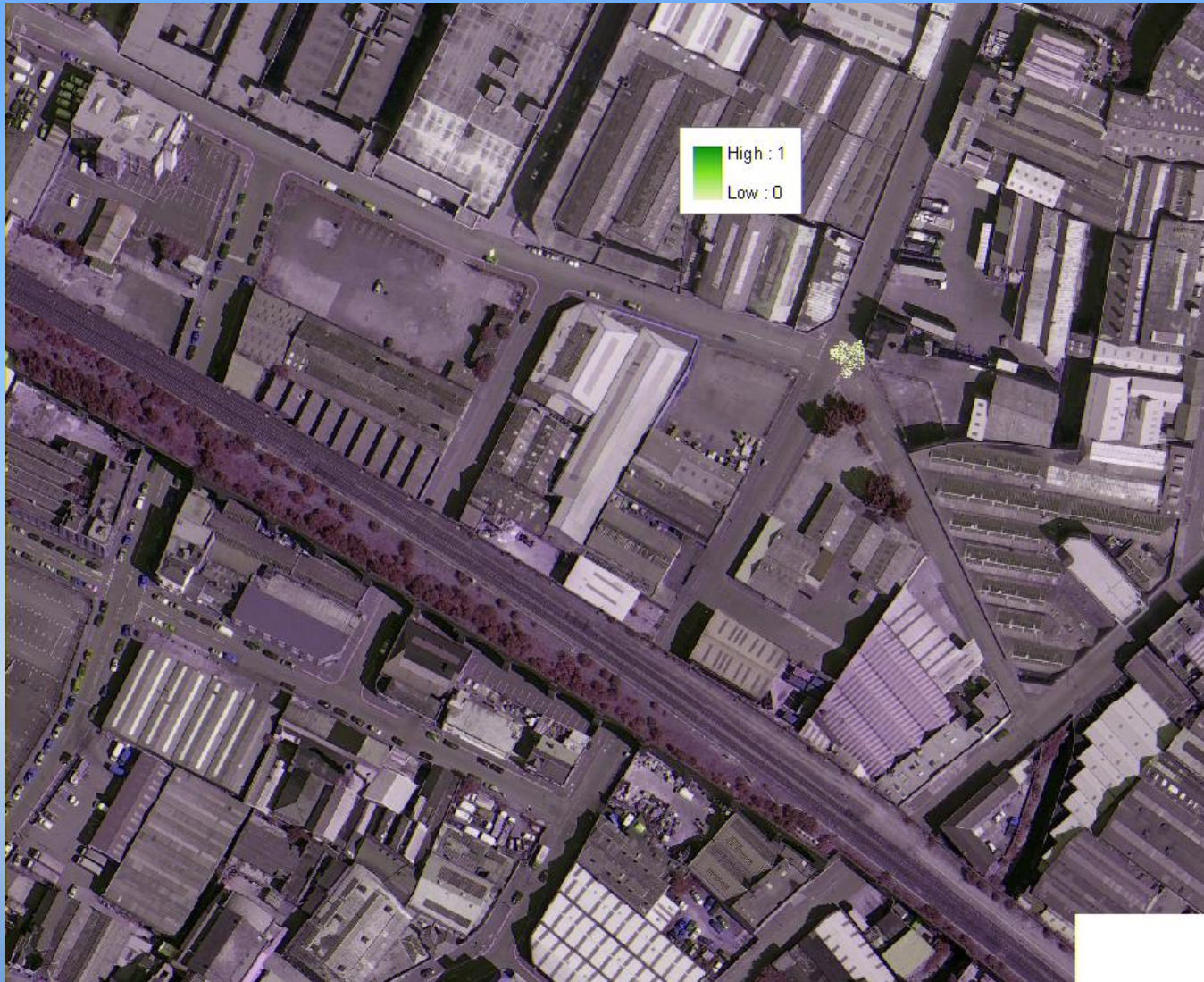


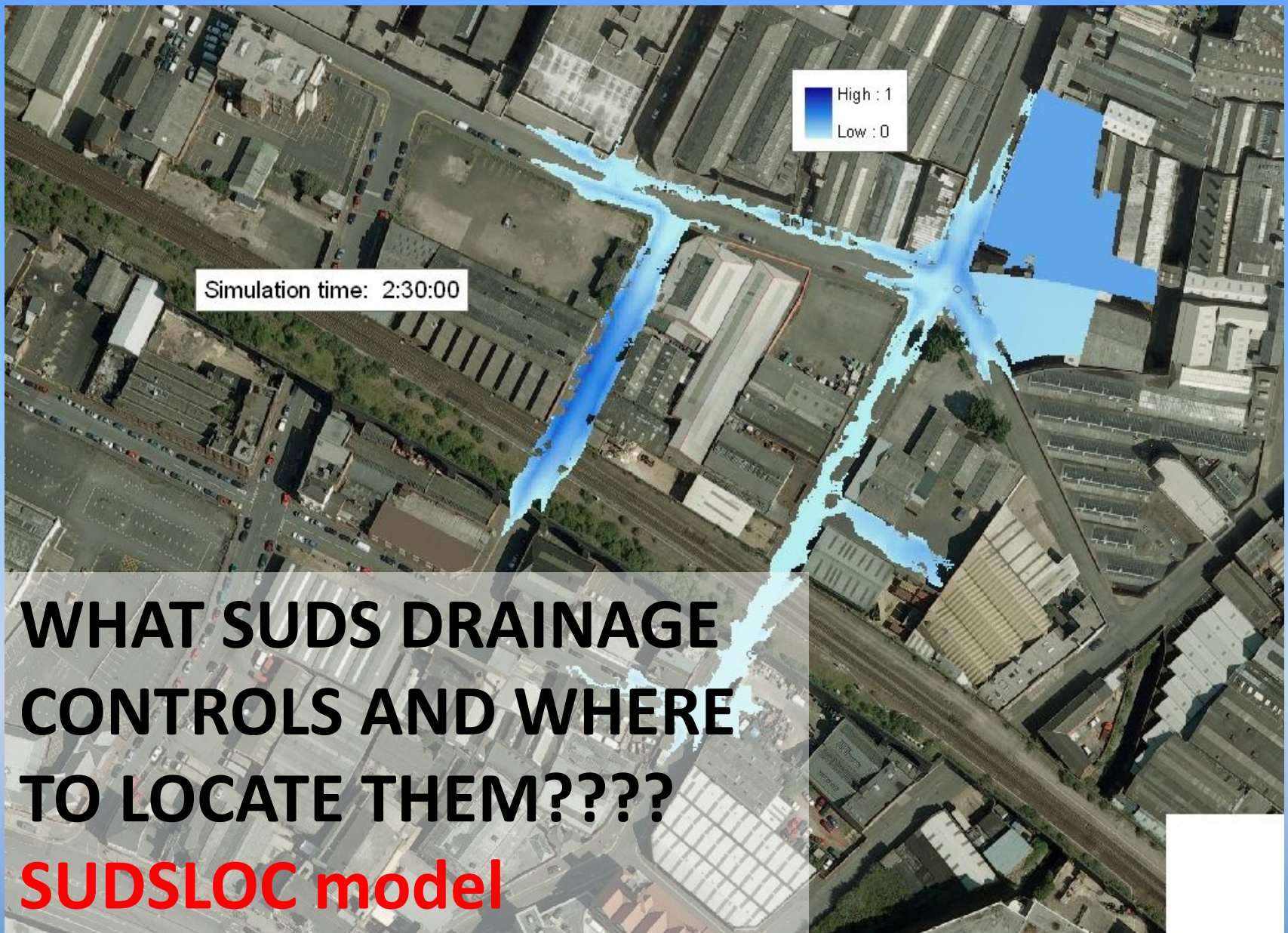
LiDAR MOBILE SURVEY

Raster Cell 0.1m (Arup)



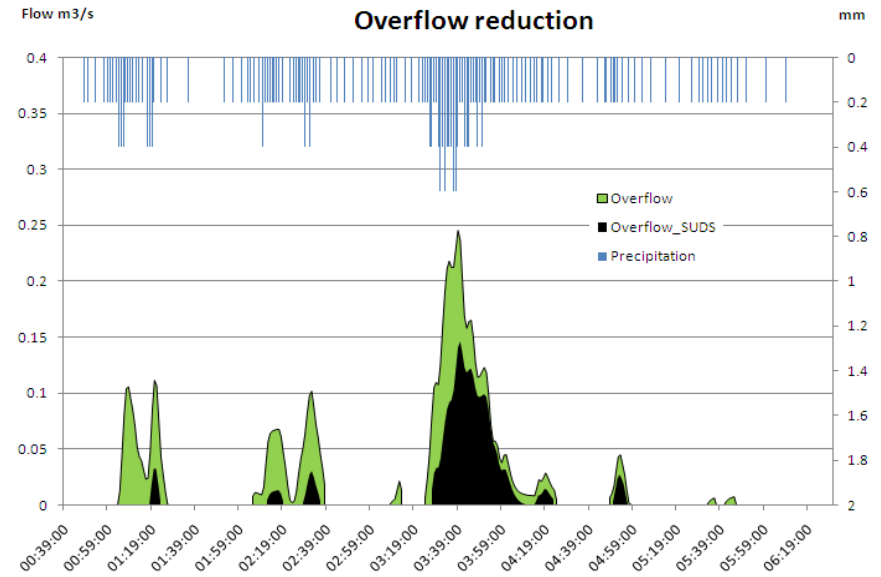
Summer flood June 2007



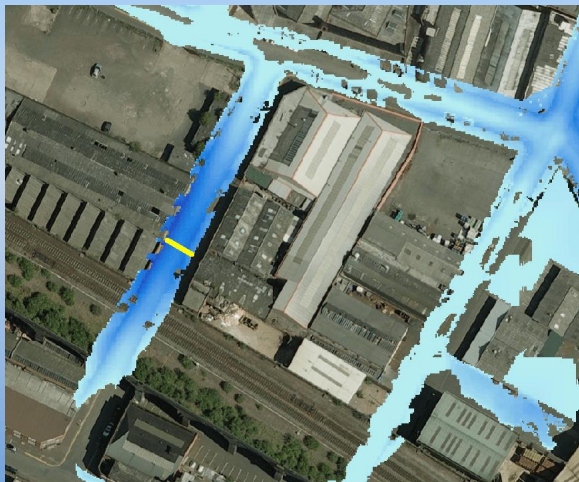


Simulation Pipe12 - June 2007

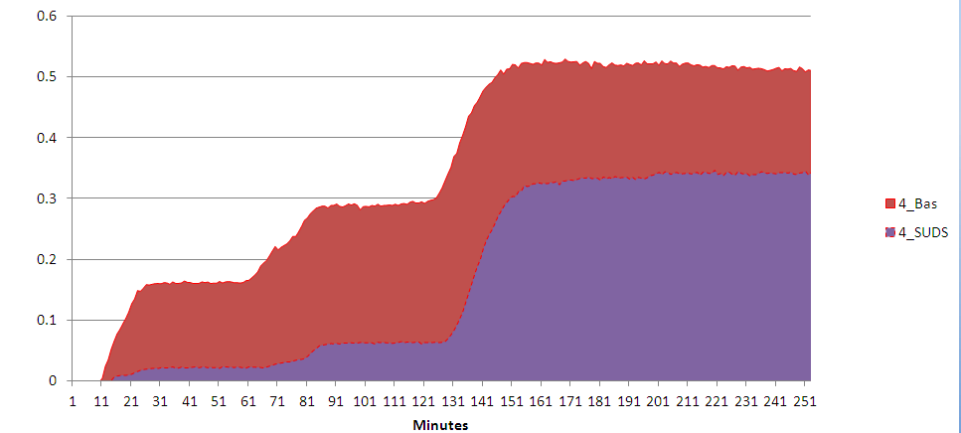
Overflow reduction



In total decrease from 1240 to 838 m³ (pipe12)



Flood depth (m) with and without SUDS on a road



CONCLUSIONS

- Accurate, robust methodology for **identifying and quantifying** local “hotspot” surface water (pluvial) flooding associated with extreme storm events
- Identifies “**critical drainage areas**”
- Provides methodological basis for **preparation of emergency flood planning** (e.g. safe access/escape routes, evacuation etc..)
- Basis **for selecting and locating appropriate SUDS drainage** controls for the mitigation of extreme event surface flooding and pollution impacts
- Provides **flexible communication tool** for stakeholder and public consultation and information on flood procedures and mitigation measures

Thank you