Integrating Professional River Study Techniques into School Fieldwork

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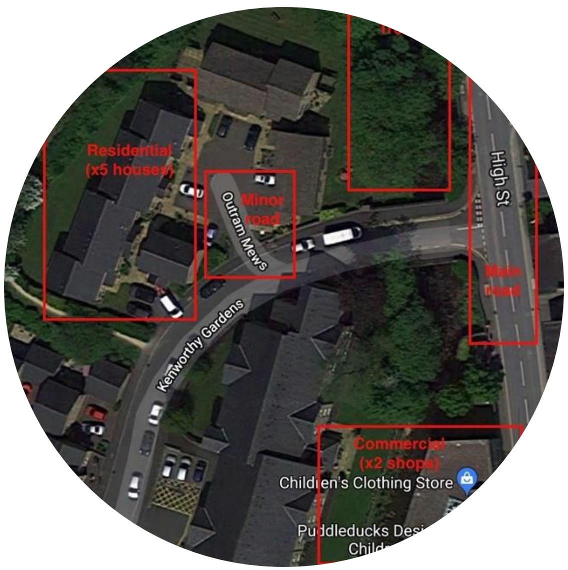
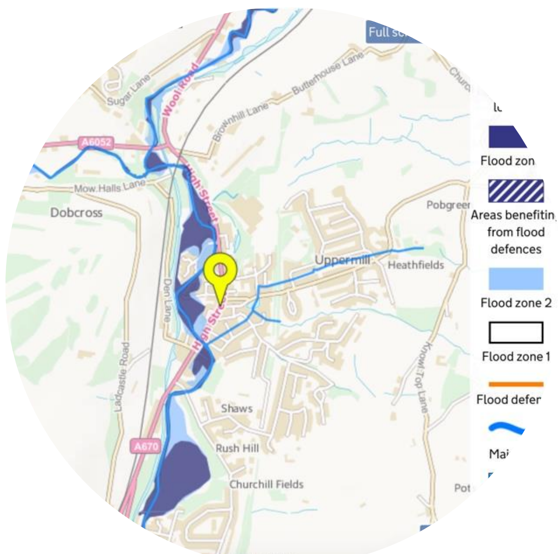
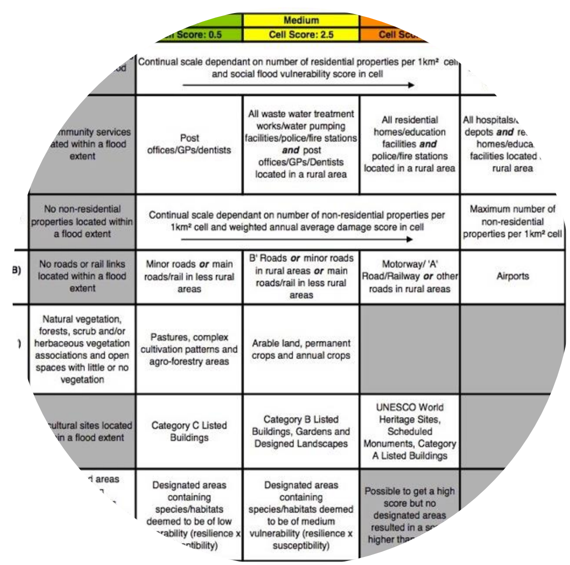
Project 2:
Flood Hazard Assessment







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Background & Introduction

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Flood risk assessment and management strategies are of increasing concern for local and national governments

- Protect human life and infrastructure
- Critical for planning new infrastructure
- Critical for budgeting water resources
- Prepare communities for changing river regimes due to climate change and/or human interference upstream
- Should be considered in terms of both hazard and risk

Hazard: a potential source of harm

Risk: likelihood of a hazard causing harm

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‘Real-world’ Examples

Flood risk assessments performed as standard by governments and private organisations at all levels. For example:

- The 2011 Torbay Flood Risk Assessment
- The 2015 Haringey Flood Risk Assessment
- The Scottish National Flood Risk Assessment
- Flood risk assessment documentation used by the USA Federal Emergency Management Agency (FEMA) for training

Pre-Fieldwork Activities

Research Questions & Hypotheses

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Research should be framed around scientific questions & hypotheses

For example:

- Changes to flood risk according to land use type
- Changes to flood risk according to runoff and infiltration rates

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Pre-Fieldwork Activities

Site Selection

Access to land adjoining a natural watercourse

At least 2–3 sites for comparison

For example:

- River flowing across a floodplain
- River flowing through an area of changing topography / gradient (e.g., steep river valley)
- River meander site
- River flowing through an urban area
- River flow interrupted by full-width engineered structure (e.g., dam or weir)
- River flow interrupted by other human intervention (e.g., bridge supports, flood defences)
- Confluence of two watercourses
- For comparison: man-made water course (i.e., a canal)

For best results, include at least one urban and one non-urban location

Pre-Fieldwork Activities

Metadata: Cartography

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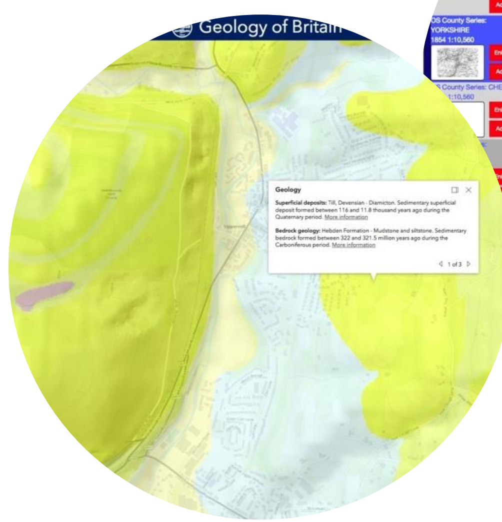
- Political & topographical maps (e.g., Ordnance Survey, Google)
  - National-, regional-, catchment-, local-scale
- Geological maps (e.g., BGS iGeology App / BGS GeoIndex)
  - Satellite & aerial maps/images
    - Land use maps
    - Historical maps



e.g., Uppermill, Greater Manchester

- Google Maps satellite image
  - 1854 political map
    - Geological map

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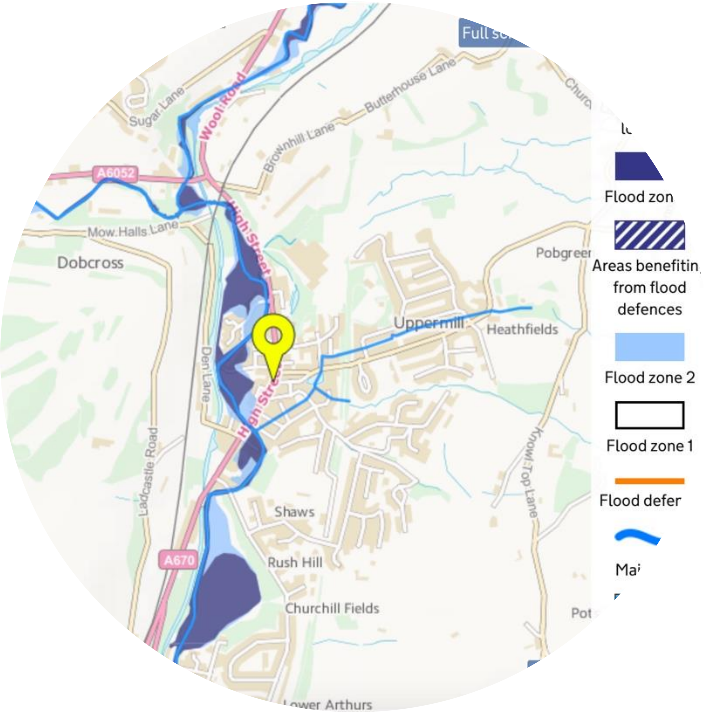
Pre-Fieldwork Activities

Metadata: Hazard Maps

For each site, students should source flood hazard maps

Ideally (for this study), these should NOT be 'risk maps'

(creating risk maps is the purpose of the study)



Other secondary data sources

- Local and national press
- Local knowledge
- Historic flood maps
- UK Magic Map of designated land

Pre-Fieldwork Activities

Research Techniques

No ‘one size fits all’

- Dependent on field area/ field sites
- Dependent on features & processes to measure
- Dependent on research questions and hypotheses
- Dependent on spatial and temporal scales of study
- Dependent on available resources (i.e., time, money, expertise)

Professional flood risk assessments include:

- Landscape characterisation (e.g., topography, geology, soils, streamflow data, rainfall data)
- Historical flood data (e.g., government records, newspaper articles, local knowledge, flood marks on buildings and other infrastructure)
- Inventories of residential land, services (e.g., hospitals, schools, transport routes), agricultural land, businesses, protected land (e.g., cultural, historical, environmental or scientific sites)
- Identification of areas most susceptible to flooding
- Data on existing flood defences

https://www.rgs.org/schools/teaching-resources/sampling-techniques/

Pre-Fieldwork Activities

Logistical Planning

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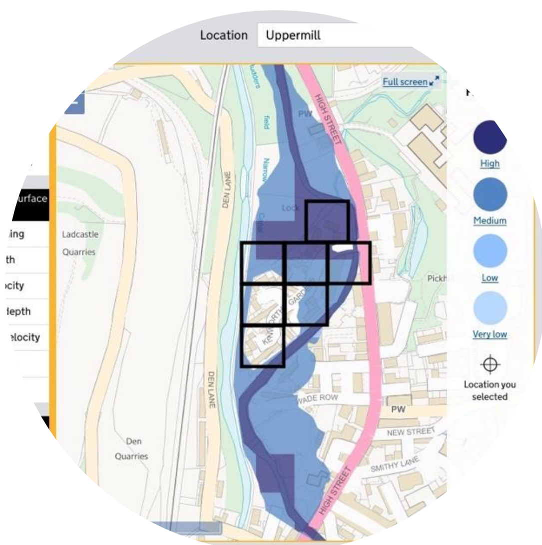
Field Plan

- Dependent on time available
- Dependent on number of sites & transit times
- Dependent on number of team members
- Dependent on data collection techniques

Methodology for flood risk assessment should include:



- Sub-divided field sites (e.g., gridded segments). Data should be collected from each sub-area
- During analysis, data from sub-areas can be combined to produce a comprehensive flood risk assessment for each site

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Pre-Fieldwork Activities

Logistical Planning

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Field Kit (Universal)

- Clothing (long trousers, long sleeves, wet weather gear, boots)
- Field note book
- Charged mobile phone
- GPS device
- Camera
- Sharpened pencils
- First aid kit

Field Kit (Fieldwork Specific)

- Research equipment (e.g., tape measure, stopwatch, etc.)

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Pre-Fieldwork Activities

Logistical Planning

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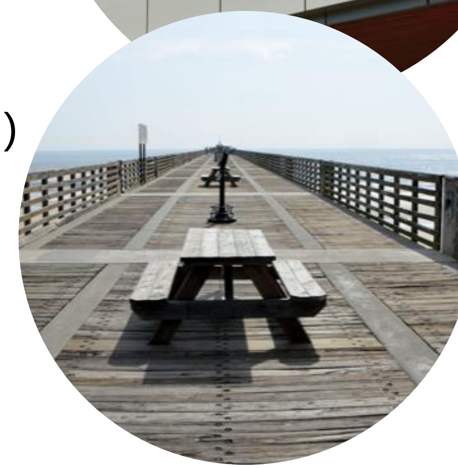
Site Practicalities

- Parking (incl. bus parking)
- Toilets
- Picnic sites
- Shops & cafes
- Field centres & visitor centres
- Accessibility (roads, foot paths, etc.)
- Nearest A&E Department



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Pre-Fieldwork Activities

Logistical Planning

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Risk Assessment

Hazard	Control Measures	Residual Risk
Working in/near water	Assessment of flow conditions; work in groups, avoid loose clothing, always walk downstream, take small steps ……. etc.	MEDIUM
Uneven / unstable ground	Keep to flat areas; walk with care; ……. etc.	LOW
Biological hazards (insects, Giant Hogweed, etc.).	Insect repellent; stay away from undergrowth; ….. etc.	LOW

https://www.rgs.org/in-the-field/fieldwork-in-schools/fieldwork-safety-and-planning/risk-assessments/

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Data Collection Technique

Field Notebook

Critical fieldwork aspect

Record of sites, activities, & data

For professionals, field notebook can be a legal document

- Date, time, weather conditions, investigator mood
- Name of field site, GPS waypoint name, co-ordinates
- Brief site description (e.g., land use, human infrastructure, natural features & processes, vegetation, other relevant observations)
- Site sketch
- Record of methods & collected data

Data Collection Technique

Field Notebook

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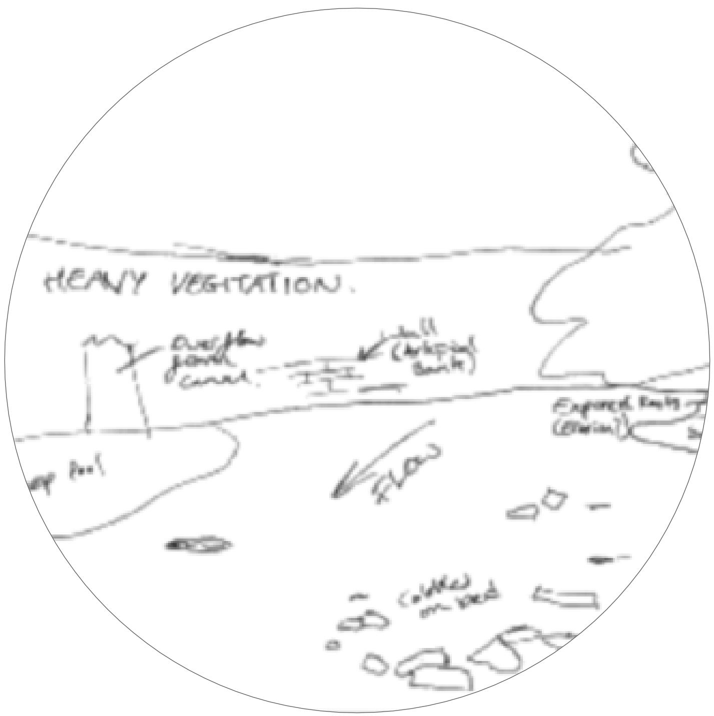
Site Sketch Good Practice

- Include major features
- Sense of scale and spatial distribution of features



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Data Collection Technique

Likelihood of Flooding (Flood Hazard)

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Data to be collected on various contributors to flood risk

What is Measured?

- Flood hazard (i.e., likelihood of flooding)
  - See *Pre-Fieldwork Activities*

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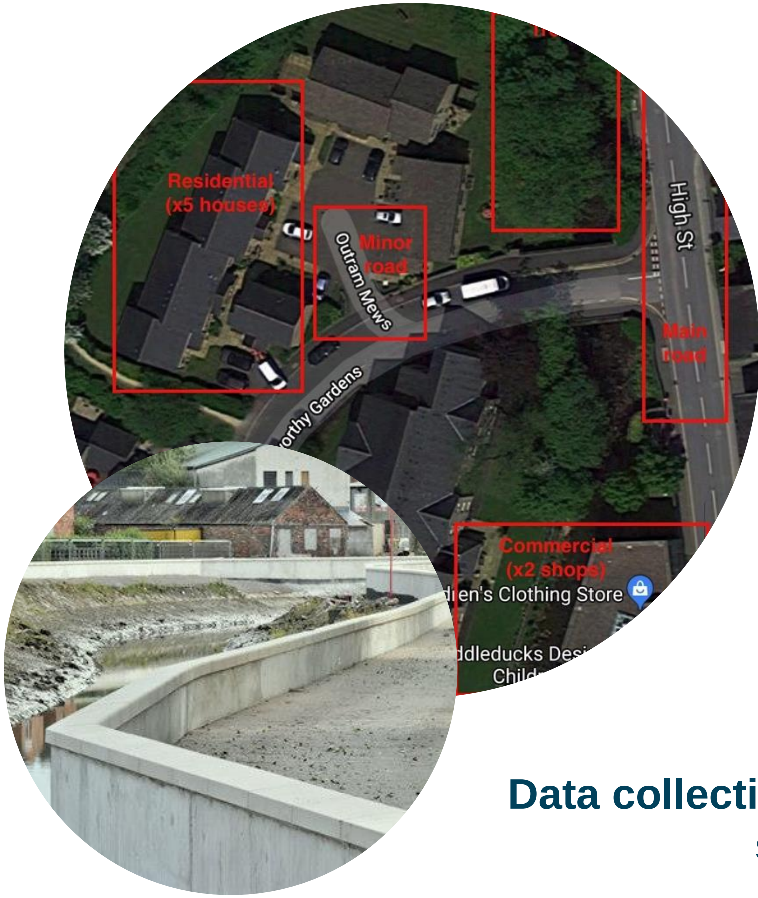
Data Collection Technique

Infrastructure Inventory



What is Measured?

- Residential infrastructure (e.g., houses, apartments)
- Community facilities (e.g., hospitals, police, post office, doctors, water treatment plants, etc.)
- Commercial infrastructure (e.g., shops & business)
- Transport infrastructure (e.g., motorways, A roads, B roads, railways)
- Non-agricultural green spaces
- Agricultural land
- Protected land (e.g., designated sites of scientific, ecological, cultural, or historical importance)
- Flood mitigation infrastructure

Data collection from fieldwork only, or from aerial/satellite images supported by field-based ground-truthing

Report data in terms of total area (m^2) or total number of units (e.g., number of houses)

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Data Collection Technique

Traffic & Pedestrian Surveys

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What is Measured?

- Number of pedestrians passing a given point in a given timespan
  - Number of vehicles passing a given point in a give timespan

Make careful note of time-of-day and weather conditions

Data Collection Technique

Permeable Pavement and/or Infiltration

What is Measured?

Area of impermeable pavement

- Qualitative estimate from visual observations (e.g., ‘high’, ‘medium’ ‘low’, ‘none’)
- Mapped using GPS-based land mapping (of metre rules for small areas)
- Estimates from aerial/satellite images (e.g., Google Maps)

Infiltration

- Time taken for a given volume of water(placed in a section of drainpipe or similar) to drain into the ground
- Should be measured for systematic spots within each site or gridded sub-site

Data Collection Technique

Flood Risk Assessment

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Site Requirements

- Field sites accessible to the public, safe to access, and within proximity to a river.

Equipment & Costs

- Tape measure (low cost) or GPS-enabled device (high cost) for land use mapping
- Stopwatch (low cost) for infiltration measurements and traffic & pedestrian surveys
- Section of drainpipe (or similar item) and stopwatch (low cost) for infiltration measurements

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Data Collection Technique

Flood Risk Assessment

Data Resolution Needs

- Land use inventories: for small sites or sub-sites within a gridded area, all features should be recorded (e.g., total number of houses [or area covered by residential buildings])
- Infiltration: at least 3–5 measurements per sub-site, allowing for calculation of average (mean) values and associated data spread (e.g., standard deviation)
- Traffic & pedestrian surveys: at least 5–10 minutes, repeated at different times of the day (at the very least, consideration of time-of-day should be made clear when presenting results)

Professional Measurement Techniques

- Similar data to those collected here
    - Remote sensing data

Post-Fieldwork Activities

Data Organisation & Input

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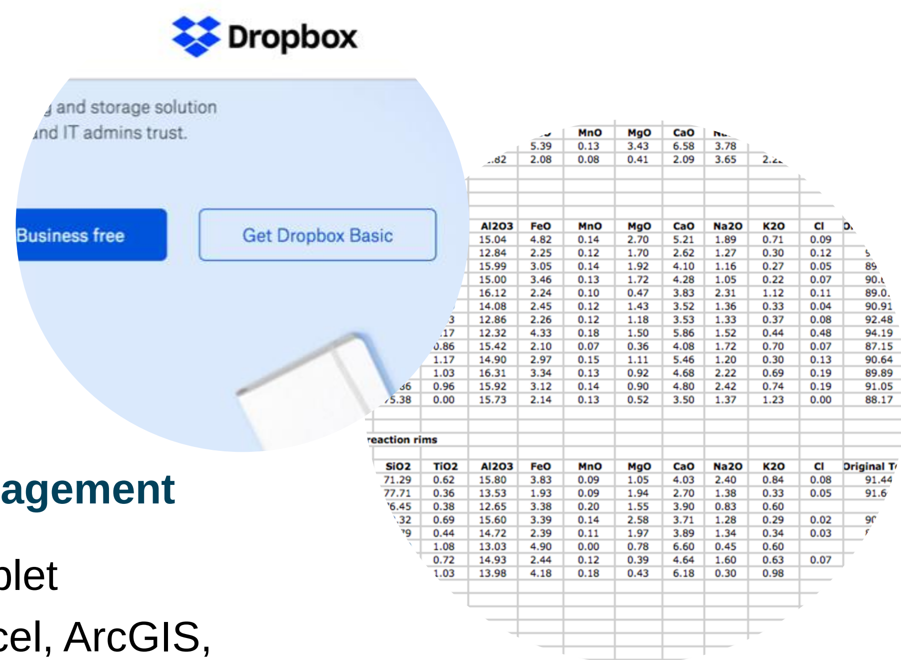
For professionals, fieldwork is only the start



Post-fieldwork activities are the longest part of any project

The first step is data organisation and management

- Transfer field data to computer or tablet
- Consider storage options (e.g., Microsoft Excel, ArcGIS, Google Earth)
- For groups, develop data management plan & sharing facilities (e.g., Google Drive, Dropbox)

Post-Fieldwork Activities

Data Analysis & Interpretation

Appropriate use of:

- Statistical techniques (e.g., data averaging, data spread, etc.)
- Chart types and tables
- Spatial analysis (e.g., ArcGIS, which is freely available to UK schools)

Interpretation and analysis should:

- Reflect and be supported by the data
- Compare and contrast different sites
- Consider the results of similar studies & compare data with available secondary data sources
- Return to original scientific questions and hypotheses
- Consider how results would change under different conditions (e.g., changing seasons, after a storm event)
- Consider how results may change in the future (e.g., impacts of climate change)

Data limitations should be considered and clearly presented

Post-Fieldwork Activities

Data Analysis: Risk Assessment Matrix

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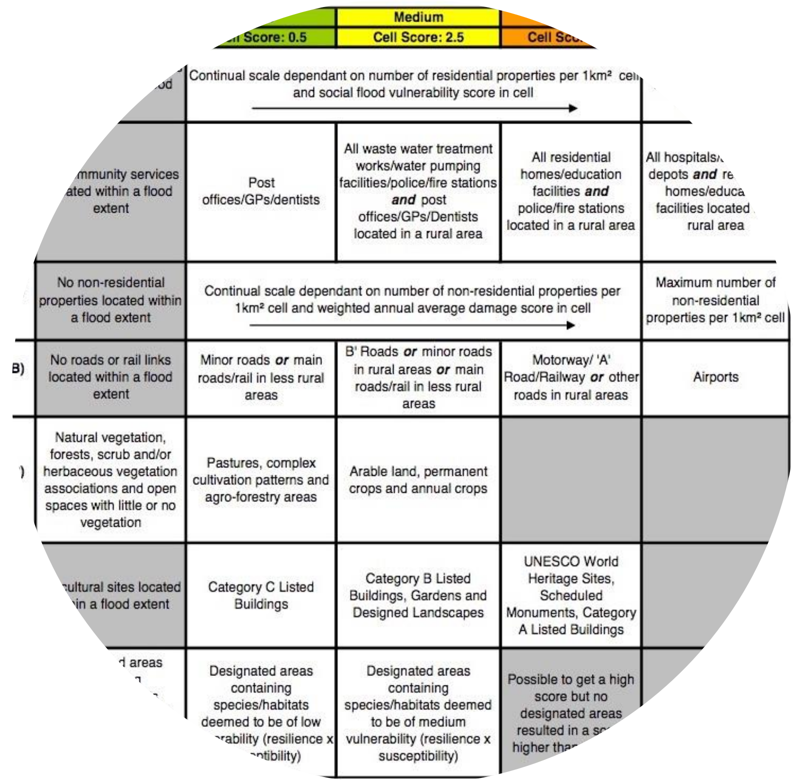
Combine different risk variables to assess total flood risk

- Create a multi-parameter risk table to include each measured variable
  - To create table, devise a 3- or 4-point category system for each variable
  - For example, for residential properties, categories could be 'none', 'low density', 'medium density' , 'high density'
- For each category, assign a risk point score
- For example, for residential properties, could be 'none' = 0, 'low density' = 1, 'medium density' = 2 , 'high density' = 3



		Score: 0.5	Medium Cell Score: 2.5	Cell Sco	
	od	Continual scale dependant on number of residential properties per 1km² cell and social flood vulnerability score in cell			
	mmunity services ated within a flood extent	Post offices/GPs/dentists	All waste water treatment works/water pumping facilities/police/fire stations *and* post offices/GPs/Dentists located in a rural area	All residential homes/education facilities *and* police/fire stations located in a rural area	All hospitals depots *and* re homes/educa facilities located rural area
	No non-residential properties located within a flood extent	Continual scale dependant on number of non-residential properties per 1km² cell and weighted annual average damage score in cell			Maximum number of non-residential properties per 1km² cell
B)	No roads or rail links located within a flood extent	Minor roads *or* main roads/rail in less rural areas	B' Roads *or* minor roads in rural areas *or* main roads/rail in less rural areas	Motorway/ 'A' Road/Railway *or* other roads in rural areas	Airports
)	Natural vegetation, forests, scrub and/or herbaceous vegetation associations and open spaces with little or no vegetation	Pastures, complex cultivation patterns and agro-forestry areas	Arable land, permanent crops and annual crops		
	ultural sites located in a flood extent	Category C Listed Buildings	Category B Listed Buildings, Gardens and Designed Landscapes	UNESCO World Heritage Sites, Scheduled Monuments, Category A Listed Buildings	
	d areas	Designated areas containing species/habitats deemed to be of low rability (resilience x ntibility)	Designated areas containing species/habitats deemed to be of medium vulnerability (resilience x susceptibility)	Possible to get a high score but no designated areas resulted in a s higher tha	

Use table to assign a risk point score for each measured variable at each site or gridded sub-site

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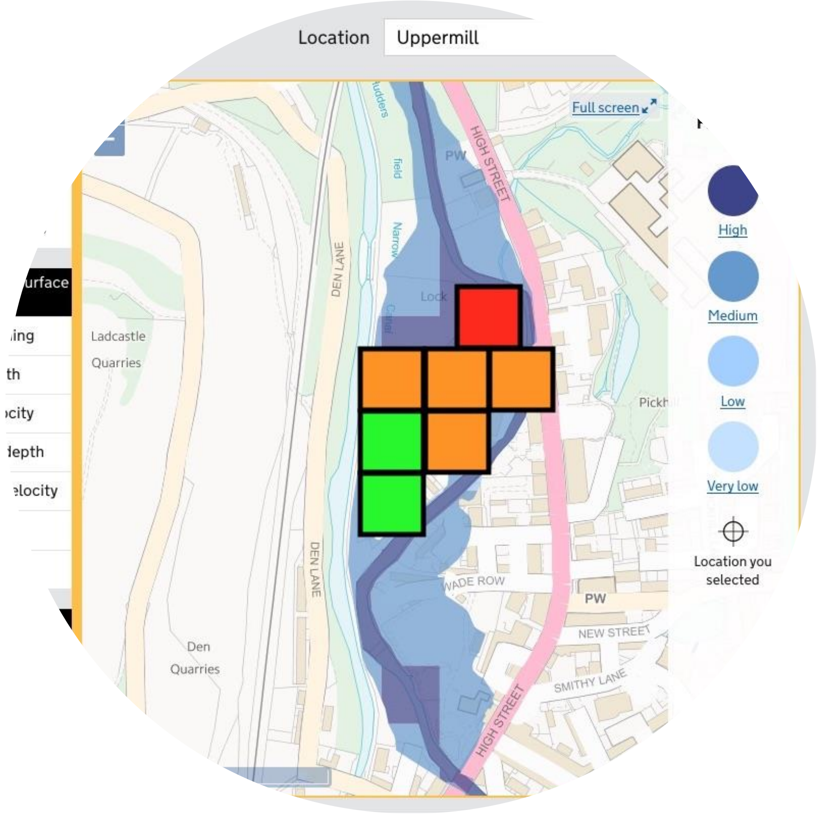
Post-Fieldwork Activities

Data Analysis: Risk Assessment Matrix

For each site or gridded sub-site, sum the scores from each variable



Assign colour codes to score ranges

For example:

- 0–1 = Green
- 2–3 = yellow
- 3–4 = orange
- > 4 = red

Use summed scores and colour-codes to create a colour coded flood risk map

Post-Fieldwork Activities

Data Analysis: Risk Assessment Matrix

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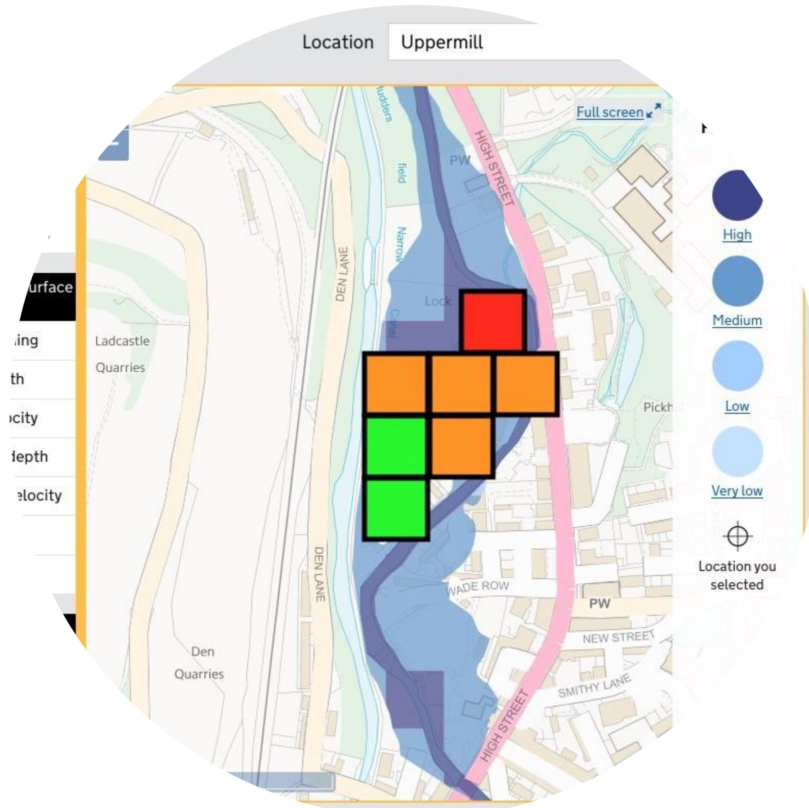
Based on the results, students should:

- Consider whether areas with the highest/lowest flood hazard match those with the highest/lowest flood risk
- Think critically about the method used and consider possible improvements (e.g., should each risk variable hold equal weight? If not, should the point system be weighted?)
- Develop a flood management plan for each location, including possible types of flood defence along with their benefits and pitfalls



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Post-Fieldwork Activities

Data Reporting & Sharing

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Data sharing and open access is required for some professionals

For others, data sharing is restricted to paid clients

- Data sharing & reporting must consider the needs of the audience
  - Can include written reports, oral presentations, graphical representations
  - Present at ‘conferences’, where different teams present concurrently using posters or talks

To reach a broader audience:

- Webpage creation
- Social media & blogging
- Citizen science platforms

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Case Study

Uppermill, Tame River Valley

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Village in the Saddleworth area of Oldham (Greater Manchester & South Pennines)

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Case Study

Uppermill, Tame River Valley

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Confluence of the Tame and Diggle Brook (53°33'11.4"N 2°00'33.5"W)

- Confluence of the Tame River and Diggle Brook
  - Free flowing river course
  - Gentle gravel riverbank
- Adjoining land-use: grass and parkland
- Relatively low impact from flooding

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Case Study

Uppermill, Tame River Valley

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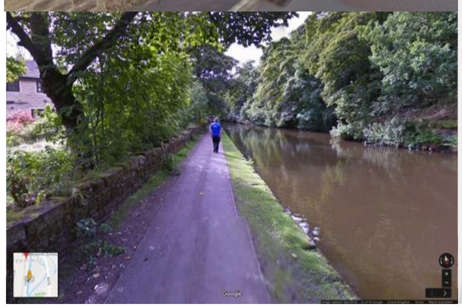
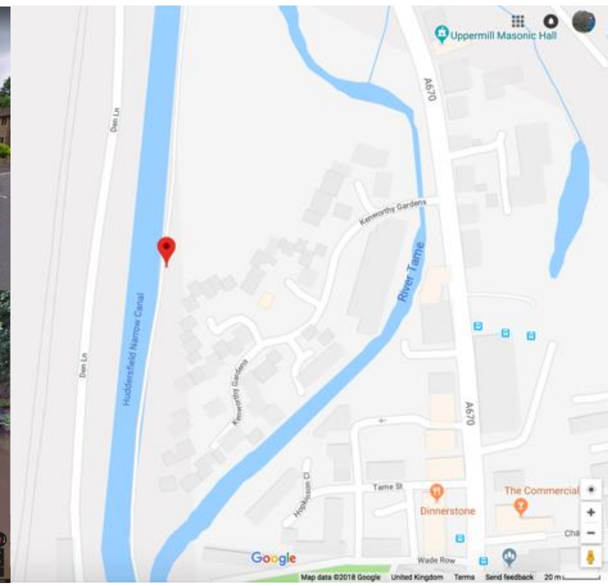
Kenworthy Gardens (53°33'01.7"N 2°00'27.7"W)





- Modern housing development between Huddersfield Narrow Canal and Tame River
  - Surrounded by a flood-protection moat
    - Direct access from canal towpath
      - Direct access from village

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Case Study

Uppermill, Tame River Valley

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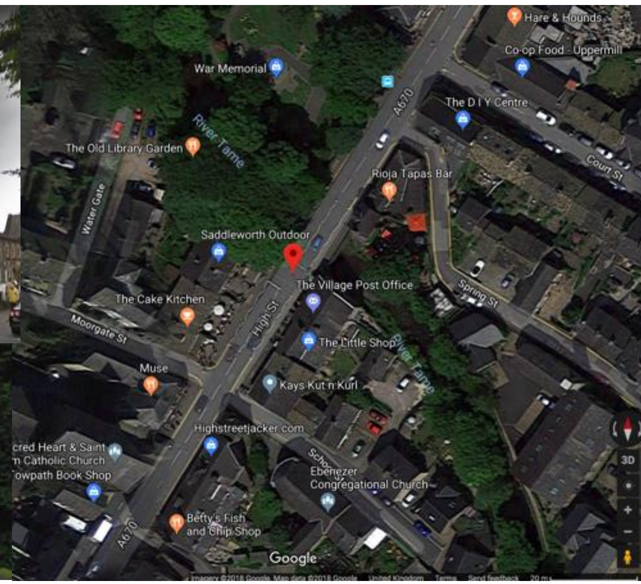
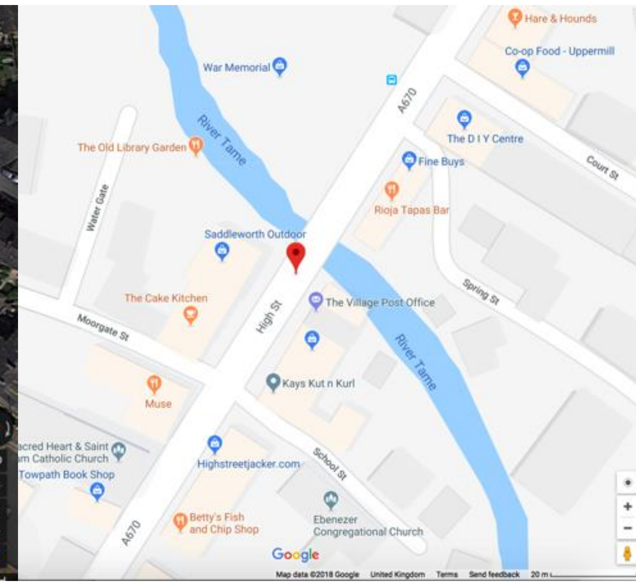
Kitty's Riverside Café Bar (53°32'50.7"N 2°00'23.5"W)





- Busy urban road bridge
- View down to the heavily engineered river course
- River flow forced through confined space
- Closer access to river below bridge
- Area of past flooding
- Flood protection measures in place

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