PIARC Technical Committee TC 4.5

Issue 4.5.2 : Having indicators representative of the condition of the geotechnical asset for road management.

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Overview: key aspects considered-

- Definition of the Geotechnical Asset
- Asset Management Framework
- Risk based assessment options
- Data management tools
- Application of Performance Indicators and SMART data

Definition of the Geotechnical Asset

Definition of the Geotechnical Asset – key elements

- Earthworks and cuttings
- Road pavement formation
- Foundations to structures
- May include Drainage systems, retaining structures & tunnel portals
- Additional considerations:
  - communication systems
  - noise / visibility barriers
  - 'soft' estate
  - 3rd party utilities
- Capital investment (20-30%)

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Asset Management Framework

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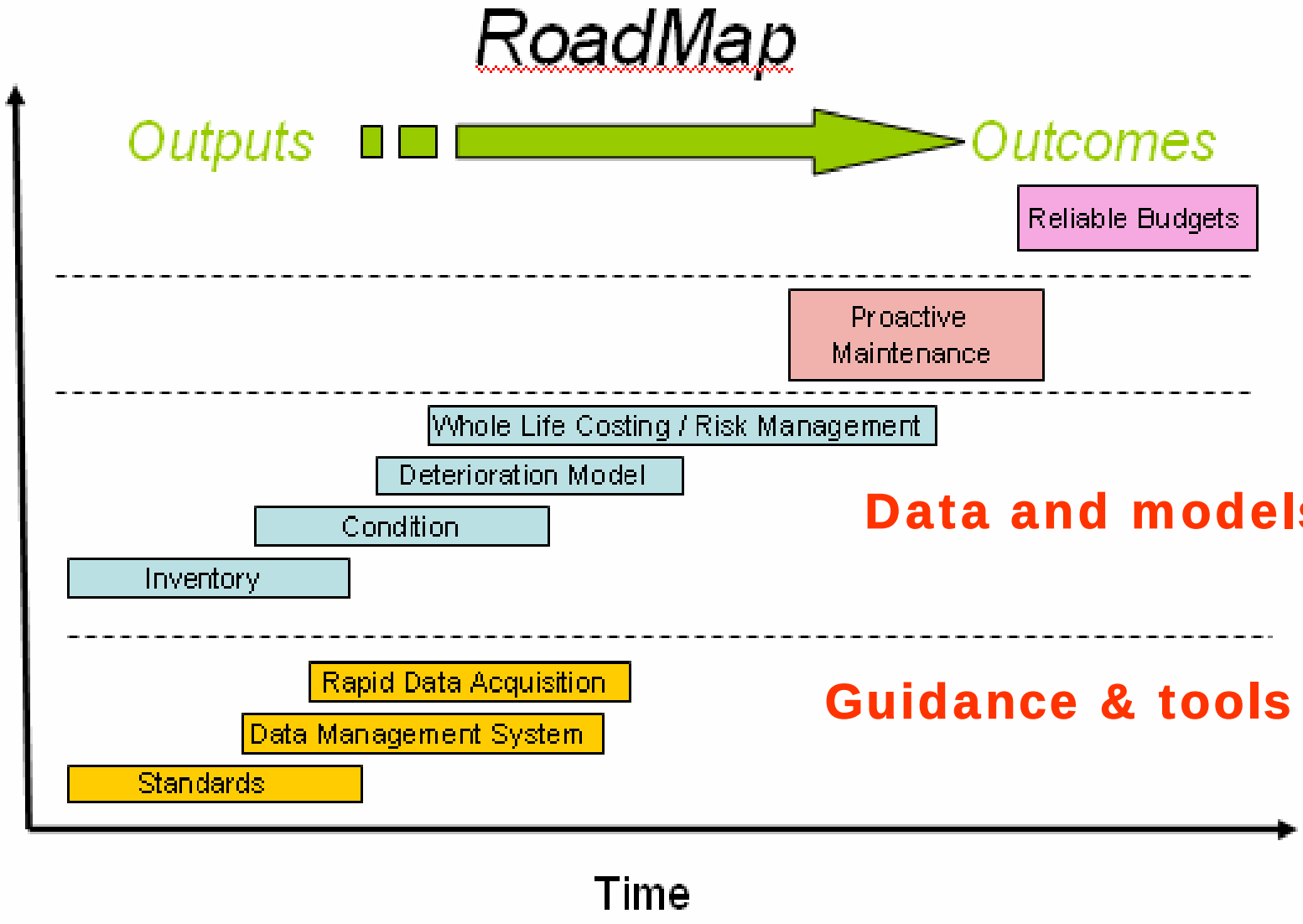
Asset Management Framework

Reactive – unplanned
to
Proactive – planned

Asset Management Framework: building blocks

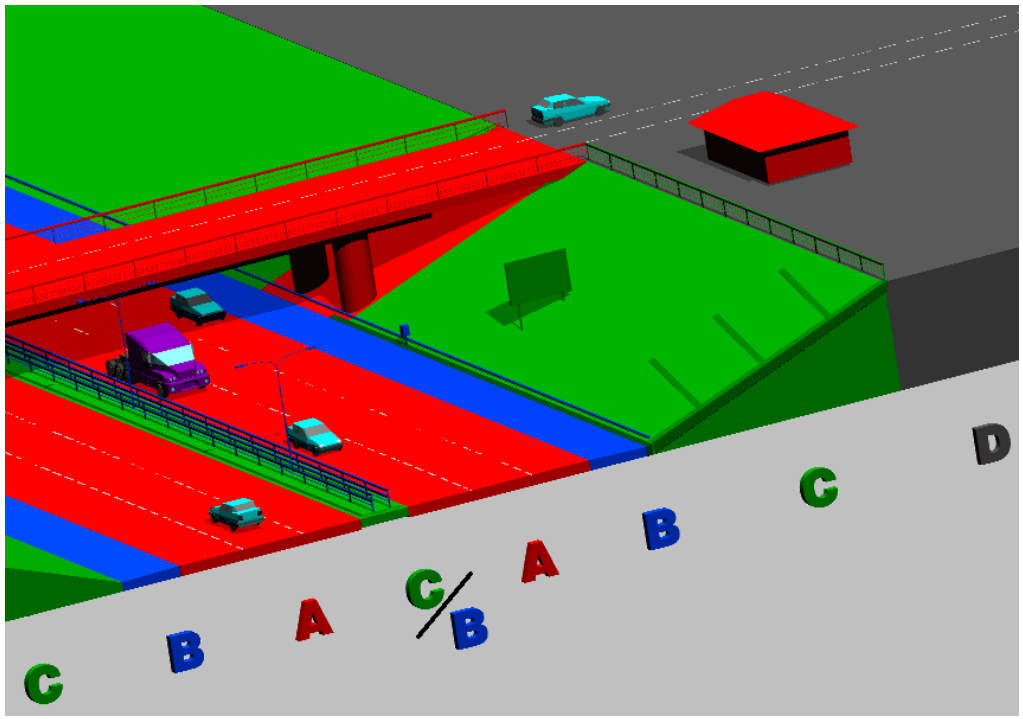


EXAMPLE: UK Geotechnical Asset Management Standard (HD 41/03)

Planning, Inspection & Reporting methodology

Risk based assessment and prioritisation:

What + Where + When ⇒ Risk Level ⇒ Action



RISK MATRIX					
Risk Level NOW for observations of Class and Location Index NOW					
Location Index	Class				
	1A/1B/1C	1D	2A/2B	3A/3B	3C
A	Severe	High	Medium	Negligible	Negligible
B	Severe	Medium	Medium	Negligible	Negligible
C	High	Medium	Low	Negligible	Negligible
D	Medium	Low	Negligible	Negligible	Negligible

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Data Management Tools (Example: HA UK)

Data Management Tools: Example HA UK

- Internet based GIS (Geographical Information System) system

- Links Managers, Specialists, Agents (Design & Maintenance), researchers and 3rd party data suppliers

- Primary long term knowledge repository for Geotechnical and Drainage assets.

- Links to other asset data & systems

- Direct data input by Suppliers / Agents

- Access to tools for reporting & analysis (inc. Risk & Performance)

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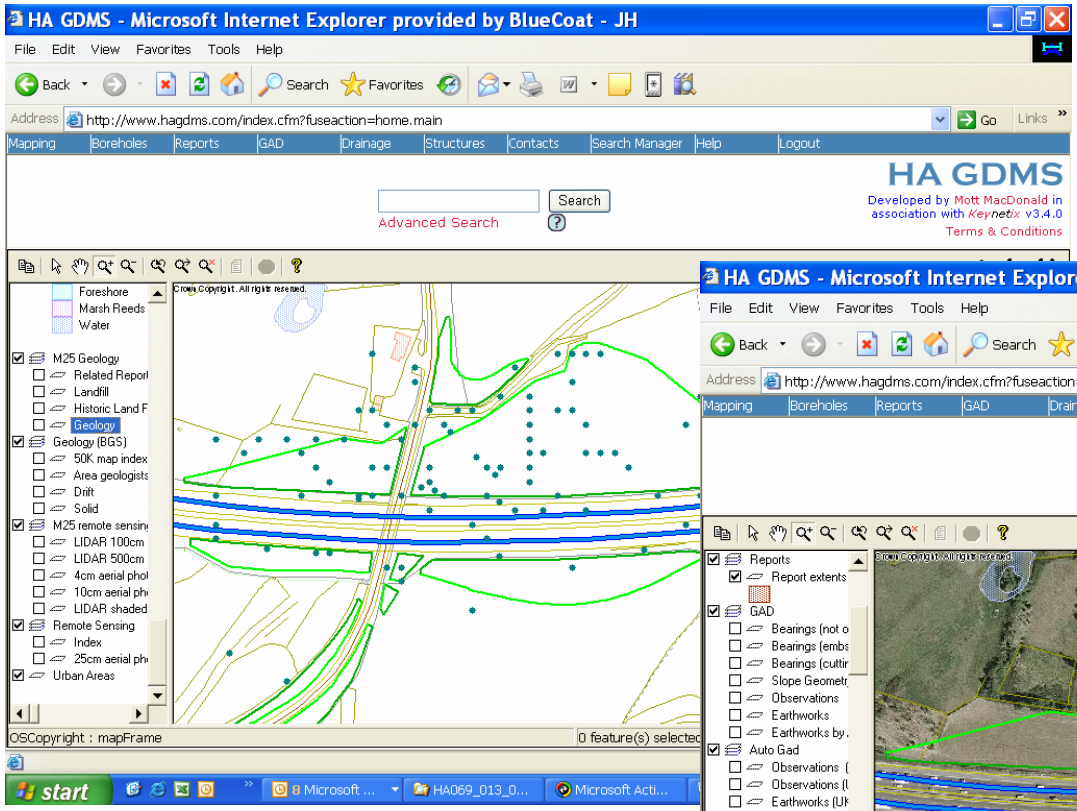
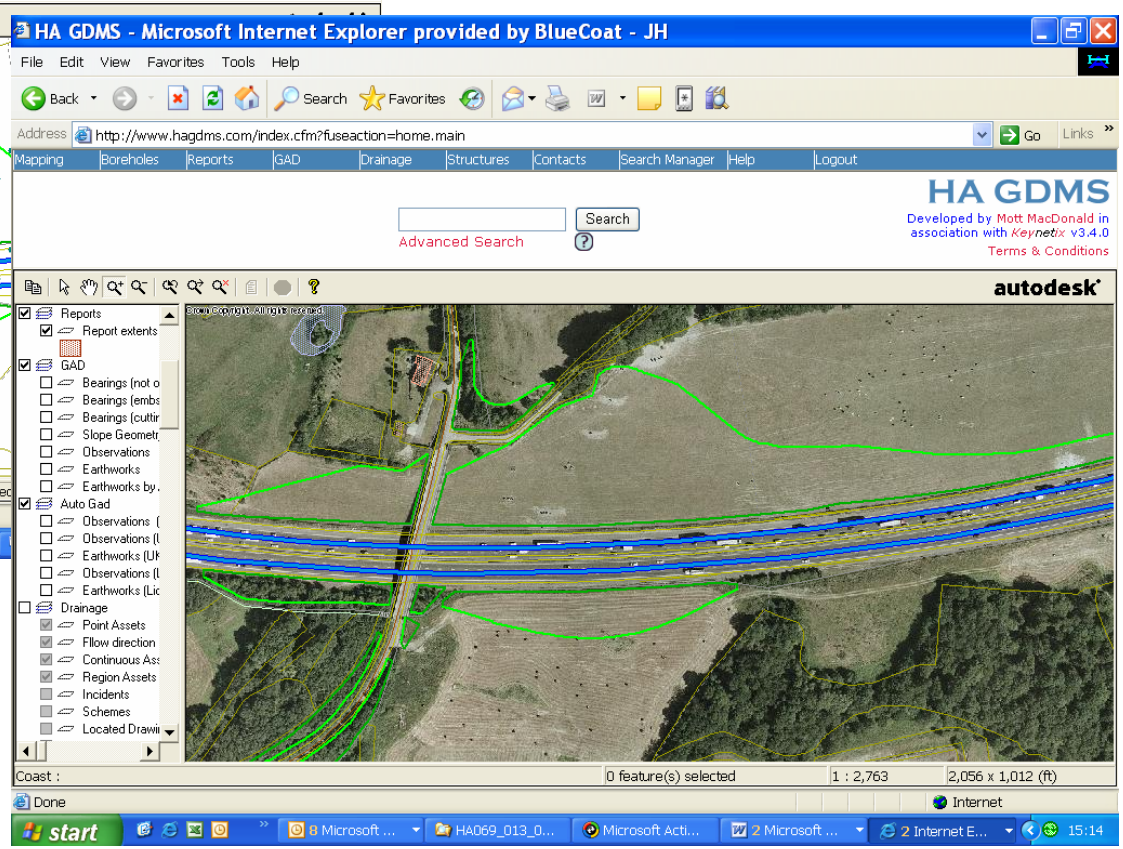
Data Management Tools: Example HA UK

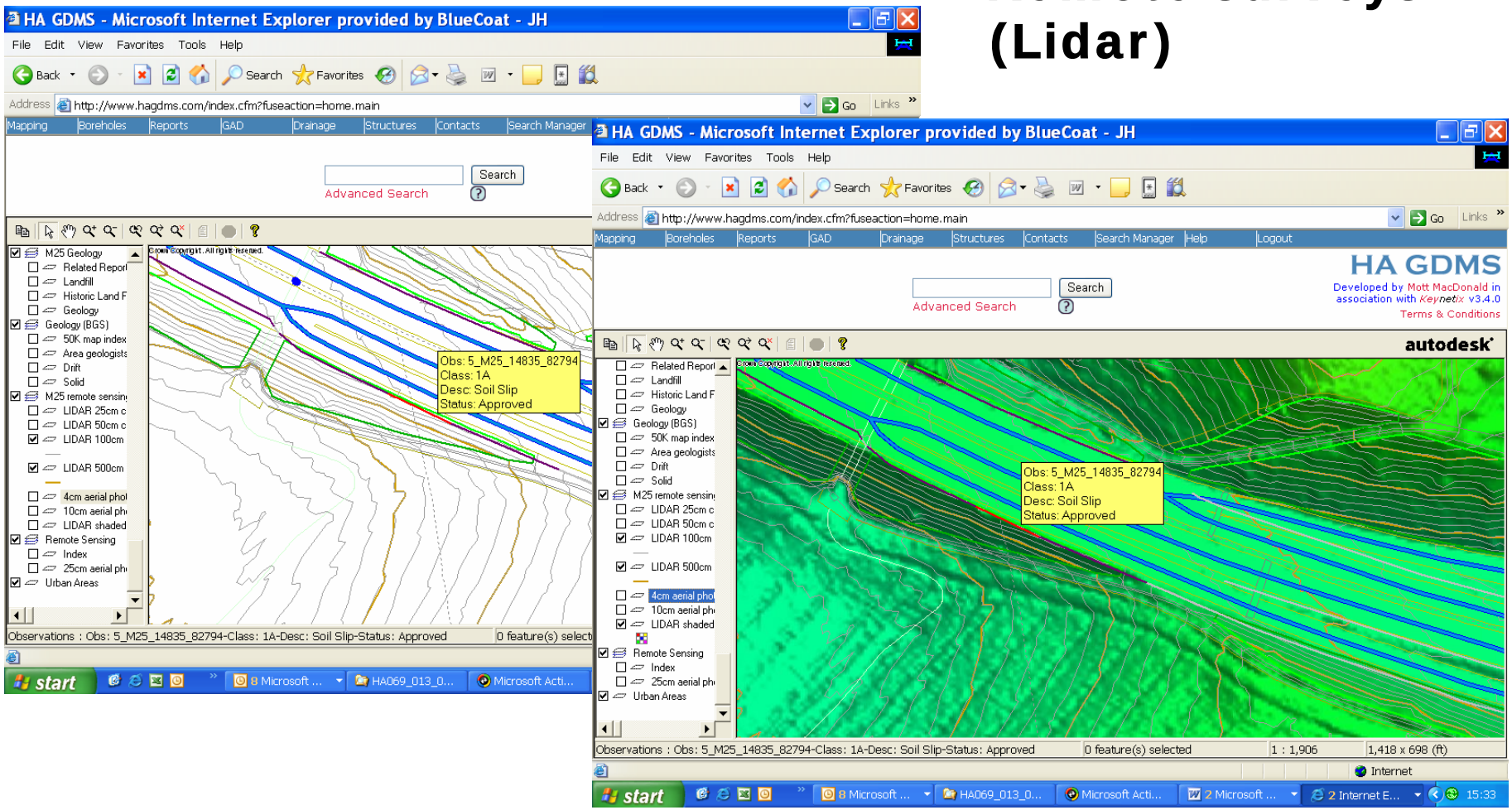




Map based surveys, aerial photography and investigation data

Data Management Tools: Example HA UK

Remote surveys (Lidar)



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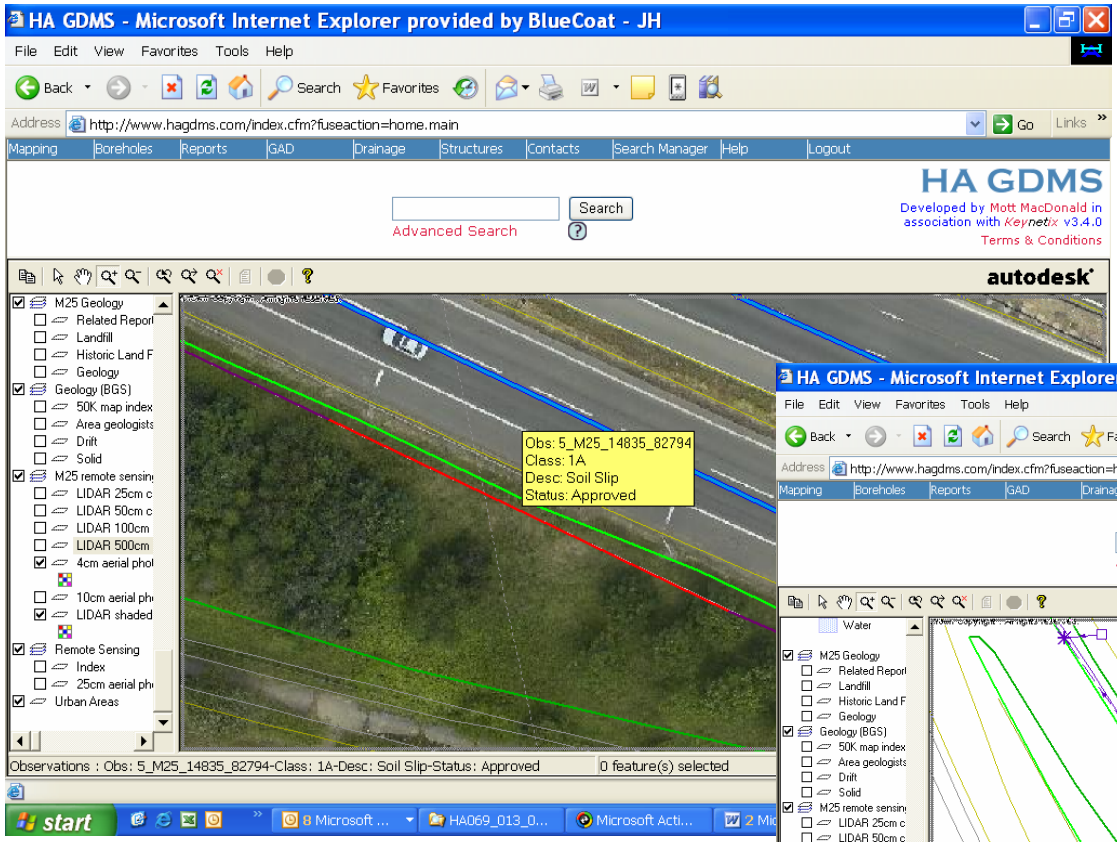
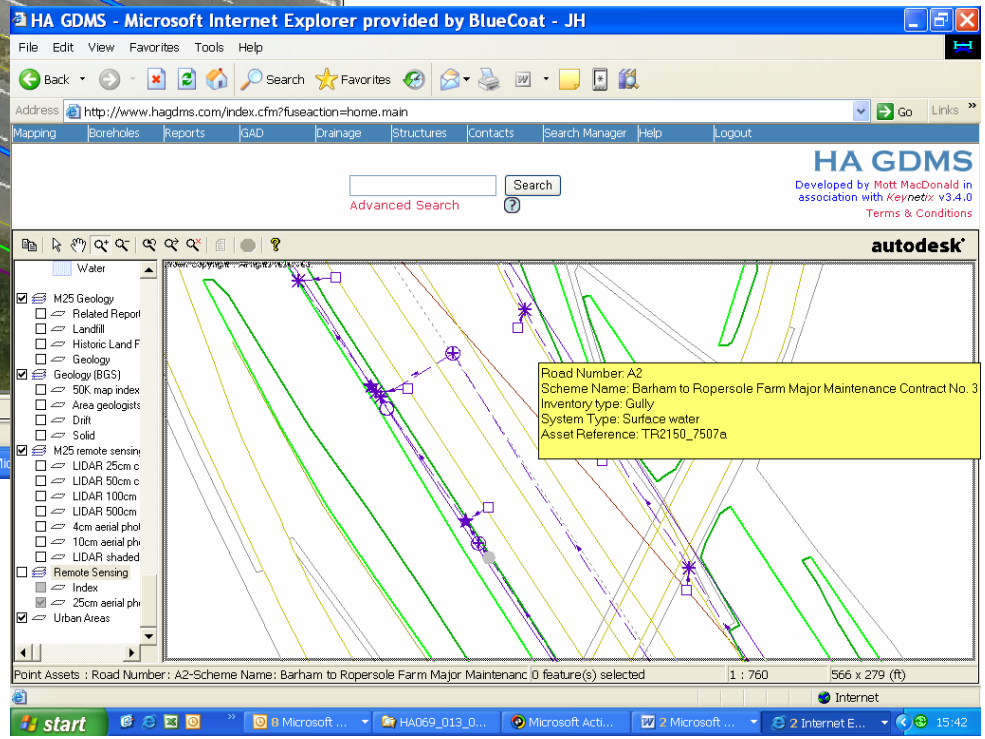
Data Management Tools: Example HA UK





Overlay asset information

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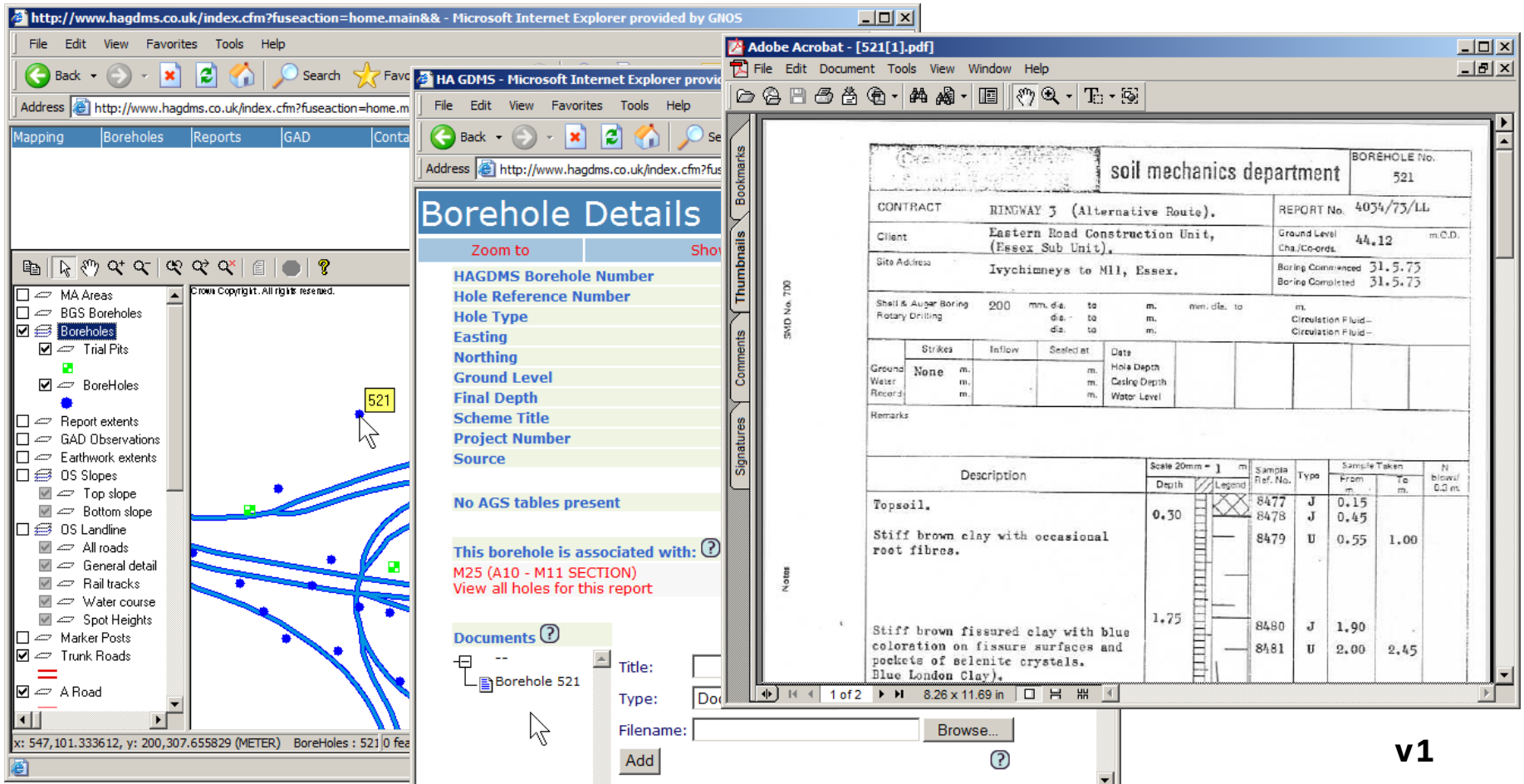
Data Management Tools: Example HA UK

Link to associated investigation records & reports



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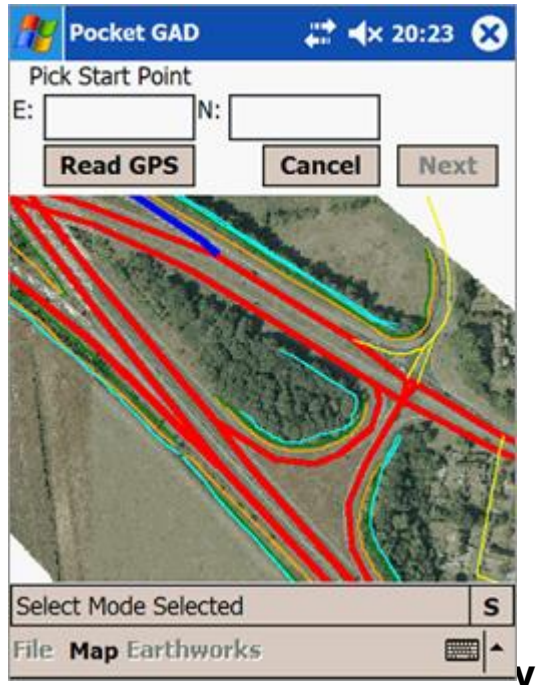
Electronic Field Data Capture

- GPS geo-referencing + PDA
- Display existing survey and aerial photography
- Improved speed and accuracy
- Field checking and update of existing data



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Performance Indicators for the Geotechnical Asset

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Performance Indicators

Good performance indicators for asset management should demonstrate:

- **due regard for safety**
- **focus on customer and operational reliability**
- **responsible stewardship**
- **due regard for the environment**
- **efficient management**
- **Scope for continuous improvement**

Performance Indicators

Indicators should be 'SMART' –

- **Specific – defining what you want to achieve.**
- **Measurable – be able to measure whether you are meeting these objectives or not.**
- **Achievable - Are the objectives you set, achievable and attainable?**
- **Realistic – Can you realistically achieve the objectives with the resources you have?**
- **Timely – When do you want to achieve the set objectives?**

Performance Indicators: Geotechnical Asset

In Short-term - Output Based Indicators

Asset features

- Earthwork condition
- Risk categorisation

Asset Management

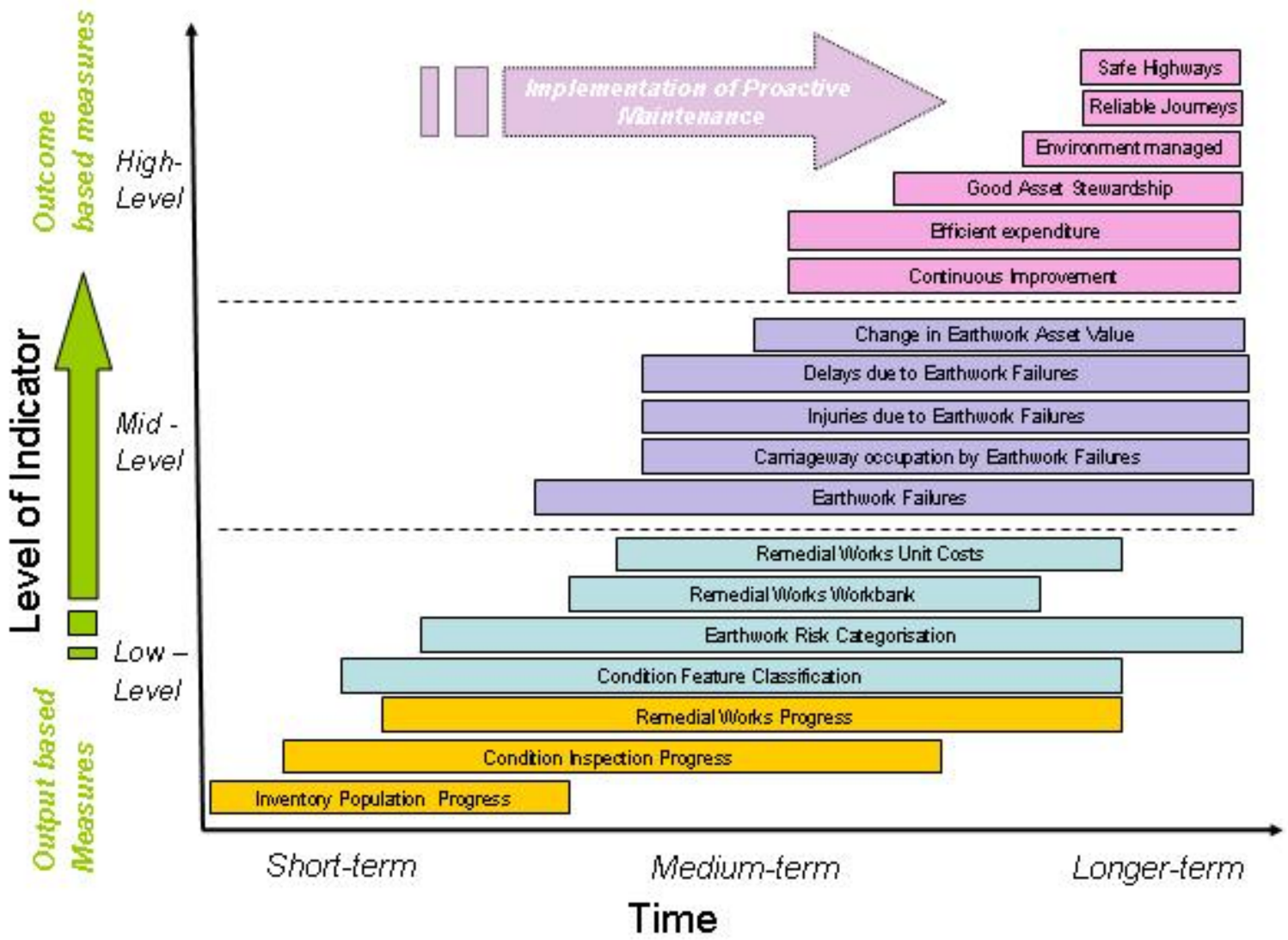
- Inspection progress
- Remedial works progress
- Works costs

Performance Indicators: Geotechnical Asset

In Longer-Term - Outcome Based

- Number / frequency of earthwork failures (Deterioration Analysis)
- Delays to the highway network due to earthwork failures (Network Resilience)
- Injuries due to earthwork failures (Safety analysis)
- Earthwork asset value (Network Valuation)

RoadMap for Development



Application of Performance Indicators (and SMART data).

Satisfying Management Requirements: Performance Targets, Network evaluation and Valuation.

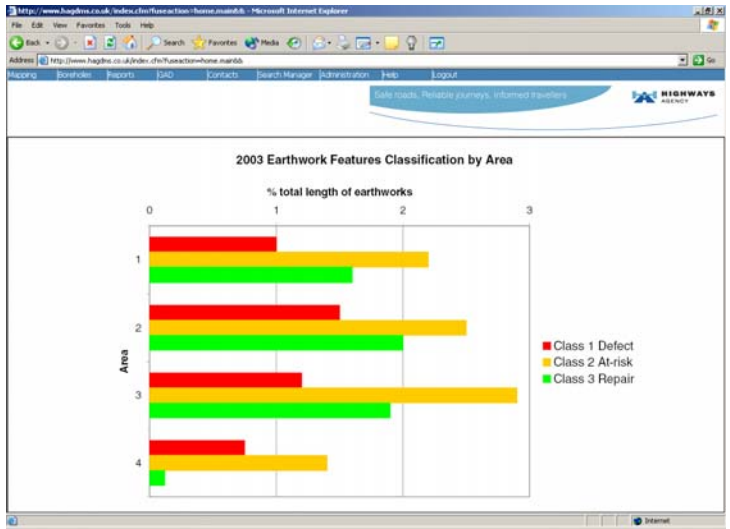
Area 3 Principal Inspection and Risk Category Summary

Sum of length in km	Road														
Current Risk Level	A1	A27	A3	A3(M)	A303	A308(M)	A31	A34	A404	A404(M)	A41	A435	M27	M4	Grand Total
S		0.0407	0.0883			0.3018	0.0148	0.4659	0.0439		0.0053	0.0335			0.9942
H			0.2929	0.3898		0.0372	0.1753	4.1982	0.0047	0.0796	0.0372		0.012	1.3566	6.5835
M			6.0572	1.6622		0.2267	0.3286	8.4497	1.8701	0.5296	0.0217		0.0022	7.3101	26.4581
L	0.6984		4.4258	0.044		0.2137	0.026	52.2676	2.6867					0.049	60.4112
N			1.0949	0.3737	0.2028	0.2973	0.1021	0.9451	0.0183		0.0318				3.066
(blank)			5.583	5.932		0.853	0.121		4.67					60.9993	78.1583
Grand Total	0.6984	0.0407	17.5421	8.4017	0.2028	1.9297	0.7678	66.3265	9.2937	0.6092	0.096	0.0335	0.0142	69.715	175.6713

Area Basis

Inventory Index = 55%
(Inspected length / Total Length)

Condition Index = 92%
(% length < High Risk)



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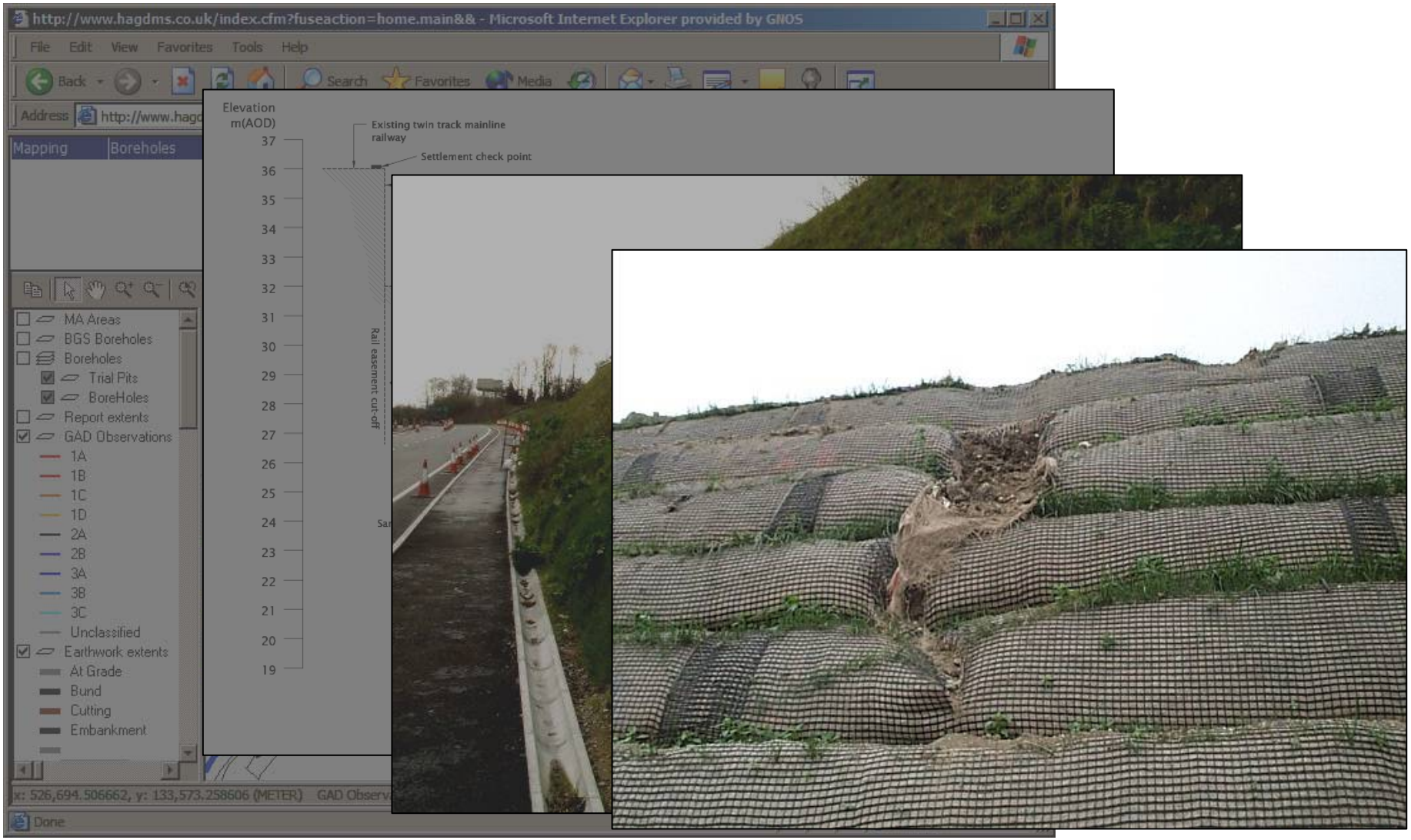
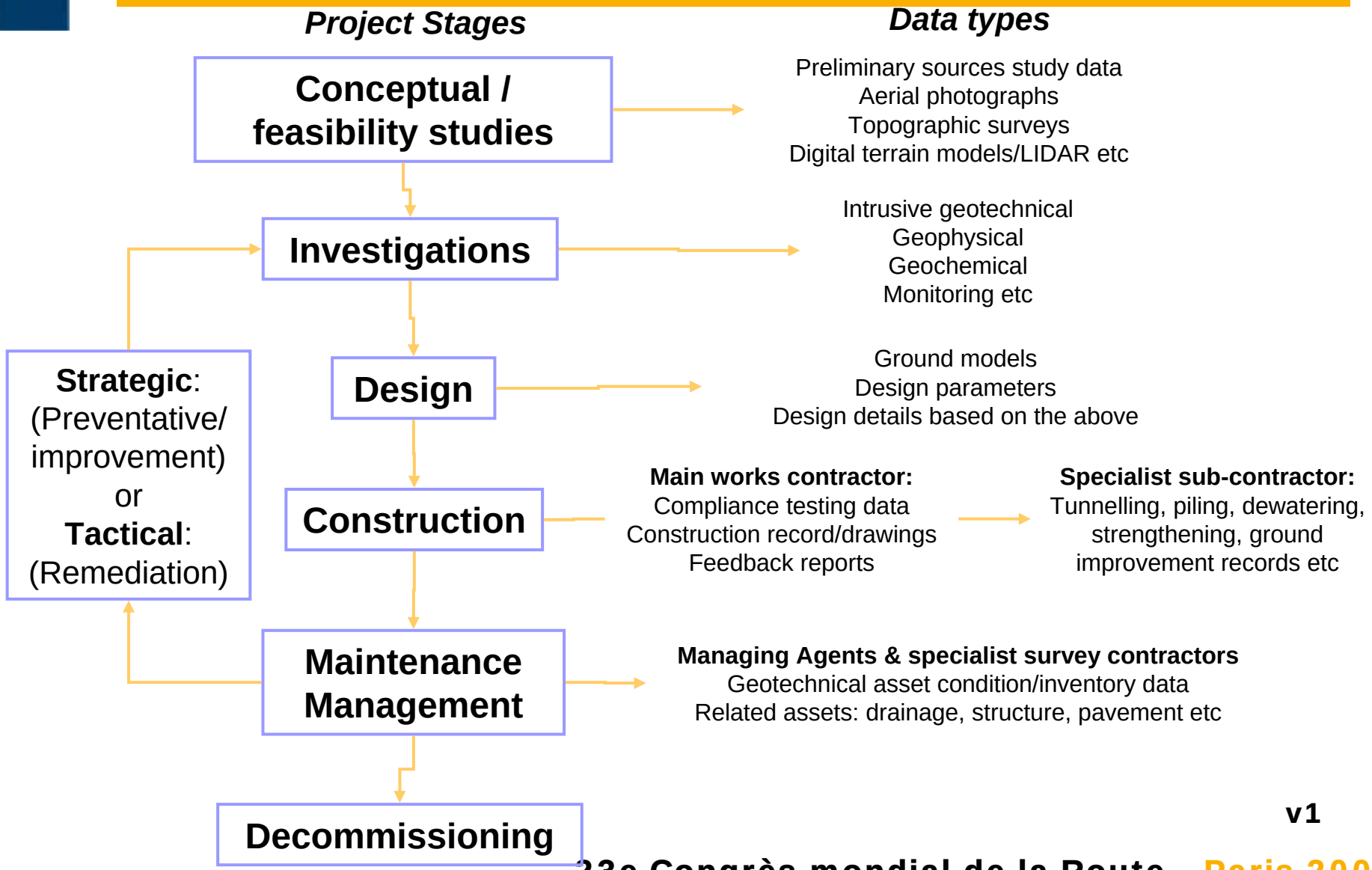
Management of identified Hazards: prioritisation of defect repairs and preventative works.



Coordinated approach to asset data collation, storage and transfer: The Geotechnical Supply Chain



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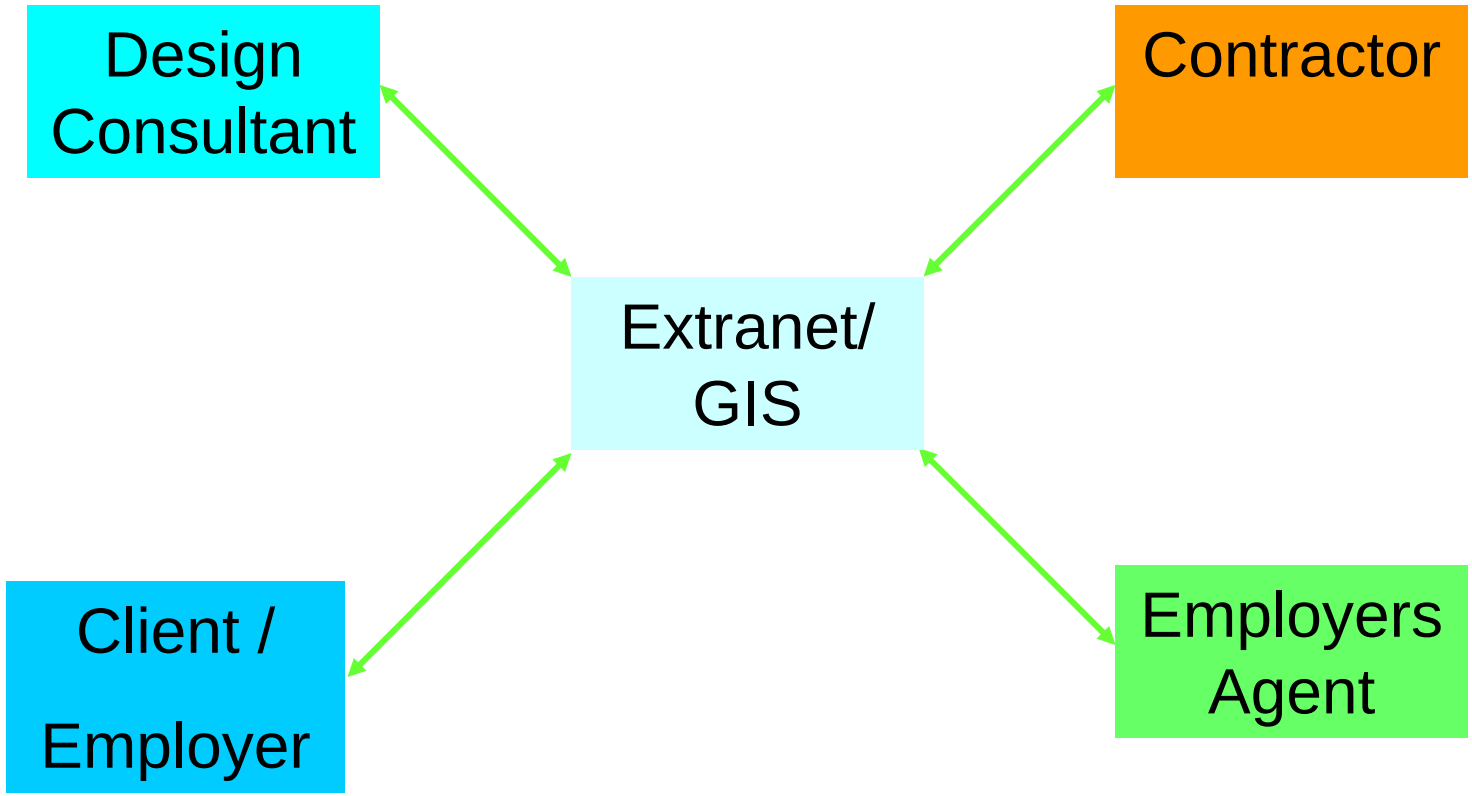
Integration of inventory information in a holistic (multi-disciplinary) manner: EXAMPLE – MAJOR PROJECT



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Integrated assessment of the consequences of new or potential future Risks.

Man Made Risks

Source:

- Oil & gas pipelines
- Chemical works
- Refineries
- Nuclear plants

Hazards:

- Explosion
- Fire / smoke
- Noxious gas
- Radiation

Integrated assessment of the consequences of new or potential future Risks.

Man Made Risks

Source:

- Mining
- Landfill
- structures
- Water features

Hazards:

- Explosion
- Fire / smoke
- Noxious gas/leacheate
- Collapse & settlement
- Flooding

Asssessing the consequences of new or potential future Risks.

Geo Risks

Source:

- Extreme weather events
- Sea level rise
- Soluble rocks
- Long term change
- Ground chemistry

Hazards:

- Erosion
- Flooding
- Landslips
- Rockfalls
- Earthflows
- Collapse/settlement

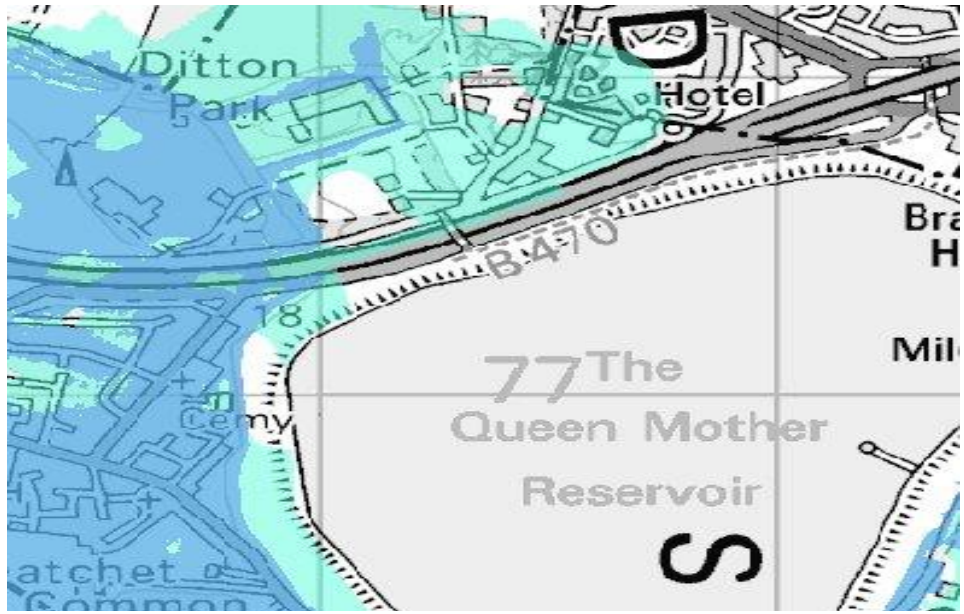
Asssessing the consequences of new or potential future Risks: EXAMPLE: RIVER FLOODING

Cause

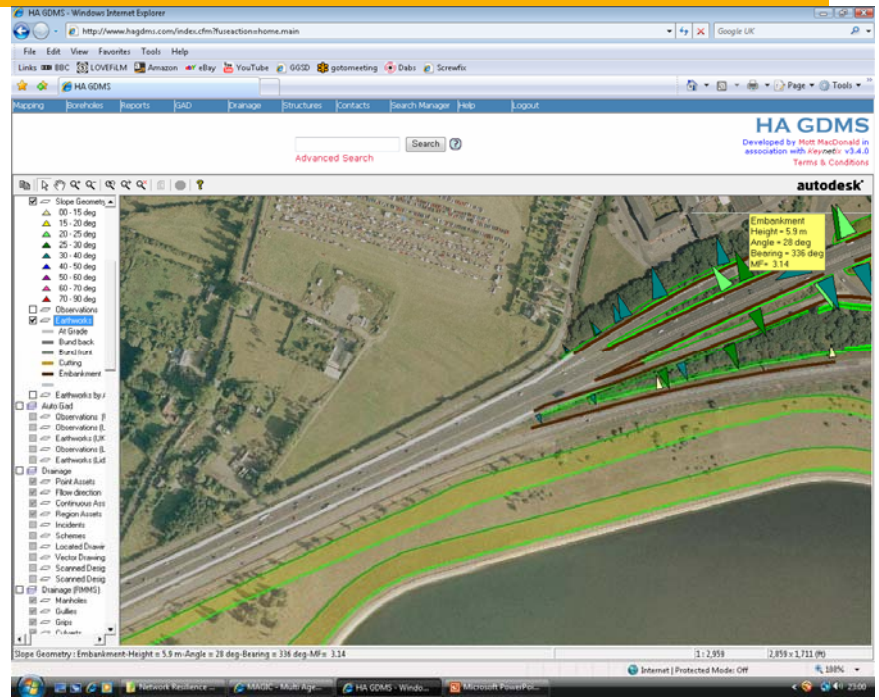
- Extreme weather events
- Inadequate drainage

Hazards

- Carriageway flooding
- Earthworks erosion / failure



Asssessing the consequences of new or potential future Risks: Risk= Hazard x consequence: EXAMPLE: RIVER FLOOD



Flooding Assessment:

- Assessed flood risk based on historical or prediction analysis
- Carriageway level
- Derived relative level >> At risk hot-spots
- Aerial photography
- Geology
- Earthworks Type & Condition
- Drainage Type, location & condition

Hence >> Capacity Risk
= Relative level x Earthworks x Drainage

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Summary

- Definition of the Geotechnical Asset
- Asset Management Framework
- Risk based assessment options
- Data management tools
- Application of Performance Indicators and SMART data