

Environmental Risk Assessment – Oil Pipelines

- What is the legal situation?
- What was the European Directive saying?
- What are the main risks to the environment?
- What does the pipeline operator need to do?
- How much does it cost?

Water pollution – Legal Requirements

What are the Groundwater Regulations?

The Groundwater Regulations control the disposal of List I and List II substances to groundwater.

List I substances are the most damaging and toxic, and must be prevented from directly or indirectly entering groundwater. They include:

- many pesticides and herbicides
- many solvents
- mineral oils and hydrocarbons
- cadmium and mercury.

Groundwater Regulations 1998

Application of provisions of water pollution legislation

14. - (1) A person shall be treated as contravening section 85 of the Water Resources Act 1991 or, as the case may be, section 30F[12] of the Control of Pollution Act 1974 (water pollution offences) if-

(a) he causes or knowingly permits-

(i) the disposal or tipping for the purposes of disposal of any substance in list I or II in circumstances which might lead to an indirect discharge of that substance into groundwater unless it is carried on under and in accordance with an authorisation granted under regulation 18

Water Resources Act 1991

Section 85 Offences of polluting controlled waters

(1) A person contravenes this section if he causes or knowingly permits any poisonous, noxious or polluting matter or any solid waste matter to enter any controlled waters.

(6) Subject to the following provisions of this Chapter, a person who contravenes this section or the conditions of any consent given under this Chapter for the purposes of this section shall be guilty of an offence and liable—

(a) on summary conviction, to imprisonment for a term not exceeding three months or to a fine not exceeding £20,000 or to both;

(b) on conviction on indictment, to imprisonment for a term not exceeding two years or to a fine or to both.

BUT:-

Water Resources Act 1991

Section 89 states:-

(1) A person shall not be guilty of an offence under section 85 above in respect of the entry of any matter into any waters or any discharge if—

(b) that person takes all such steps as are reasonably practicable in the circumstances for minimising the extent of the entry or discharge and of its polluting effects;

Regulatory Benchmark for the control of major-accident hazards involving pipelines (Pipelines Safety Instrument) 1999

Pipelines Safety Instrument

- Oil pipelines included because of pollution potential

Article 9

Emergency planning

1. Member States shall ensure that, for all pipelines covered by this Instrument:
 - (a) the operator draws up an emergency plan containing the information set out in Annex IV,
 - (b) the operator supplies to the authorities

2. The emergency plans must be established with the objectives of:
 -
 - implementing the measures necessary to protect man and the environment from the effects of major accidents,
 - providing for the restoration and clean-up of the environment following a major accident.

Article 10

Information to be supplied by the operator following a major accident

Member States shall ensure that, as soon as practicable following a major accident, the operator shall be required, using the most appropriate means:

- (a) to inform the competent authorities;
- (b) to provide them with the following information as soon as it becomes available:

-,
-,
- the data available for assessing the effects of the accident on man and the environment, and
-
- (c) to inform them of the steps envisaged:
 - to alleviate the medium- and long-term effects of the accident,

Article 15

Information to persons liable to be affected by a major accident

1. Member States shall ensure that information on safety measures and on the requisite behaviour in the event of an accident **is supplied, without their having to request it, to persons liable to be affected** by a major accident originating from a pipeline covered by this Instrument.

Risk to the Environment

If a leak occurs, for effective Emergency Response, need to know:-

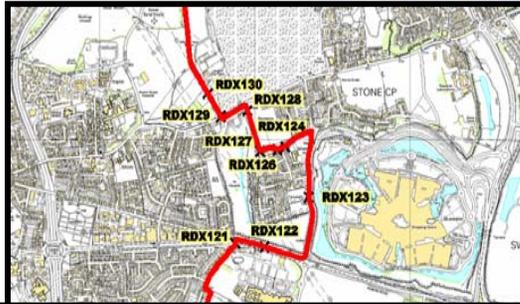
- Where along the pipeline does it occur?
- How much could leak out?
- What is the leak rate?
- Would it reduce the amount if the remotely operated cross country valves were closed?
- Is it worth sending someone to close the manually operated valves?
- What effect will the leak have?
 - What sort of soil? Will the oil soak in or stay on the surface?
 - Will it flow into a watercourse or river? Can it be clamped?
- Socio-economic effects – towns, villages, road closures, drinking water, SSSIs, other agencies

Esso Emergency Response GIS (Will Jeffries)

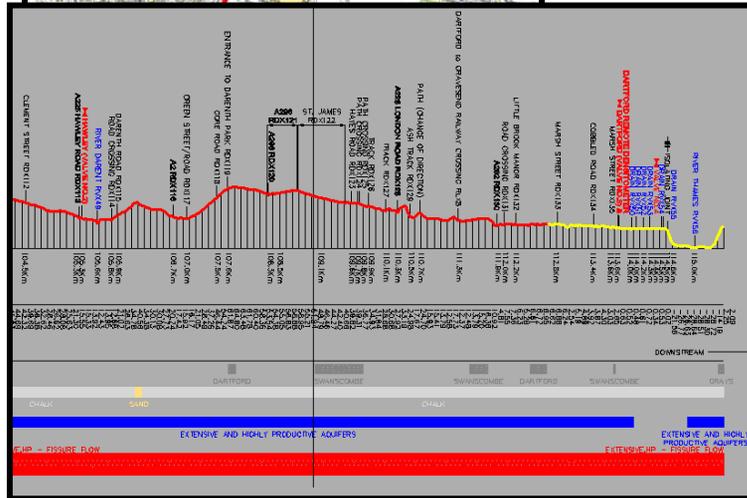
Aim: To Provide **Industry Best Practice** through Updated Functionality and Application:

- Web-based system – global access & easy to use
- Initial Emergency Response
- Incident logging and info distribution
- Risk Assessment
- Block Valve Positioning
- PIMS application
- Roll out Q2 2009

Initial Emergency Response & Info Distribution



Incident at
RDX123...



Pipeline
Profile
at leak
location
(vertical
line)

Drain Down
volume at leak
location (without
closing Hawley
CCV = 203m³,
when CCV
closed = 12m³!!)

Alton to Purfleet Pipeline		
Leak Distance from Alton	108.80	km
Total Drain-Down with CCVs Open	203	m ³
Total Drain-Down CCVs Closed	12	m ³
Recommend closing Upstream CCV because it could reduce drain down by	V2 Hawley 191	m ³

1. Locating the incident
 - From leak detection system, public call in, SCADA
 - Pipeline chainage, street name, town name, grid ref, co-ordinates (lat-long)
2. View the Pipeline Profile
 - Block Valves, Road, River Rail crossings
 - Batch Track (shows product type)
3. Drain Down Calculator
 - Tailor Made for each pipeline using profile drawings
 - Provides info on drain down (any location) & appropriate block valves to close
4. Incident Log & Distribution Facility
 - One touch creation of key info report
 - One touch email to on-call personnel (24/7 access provided through Blackberry devices)

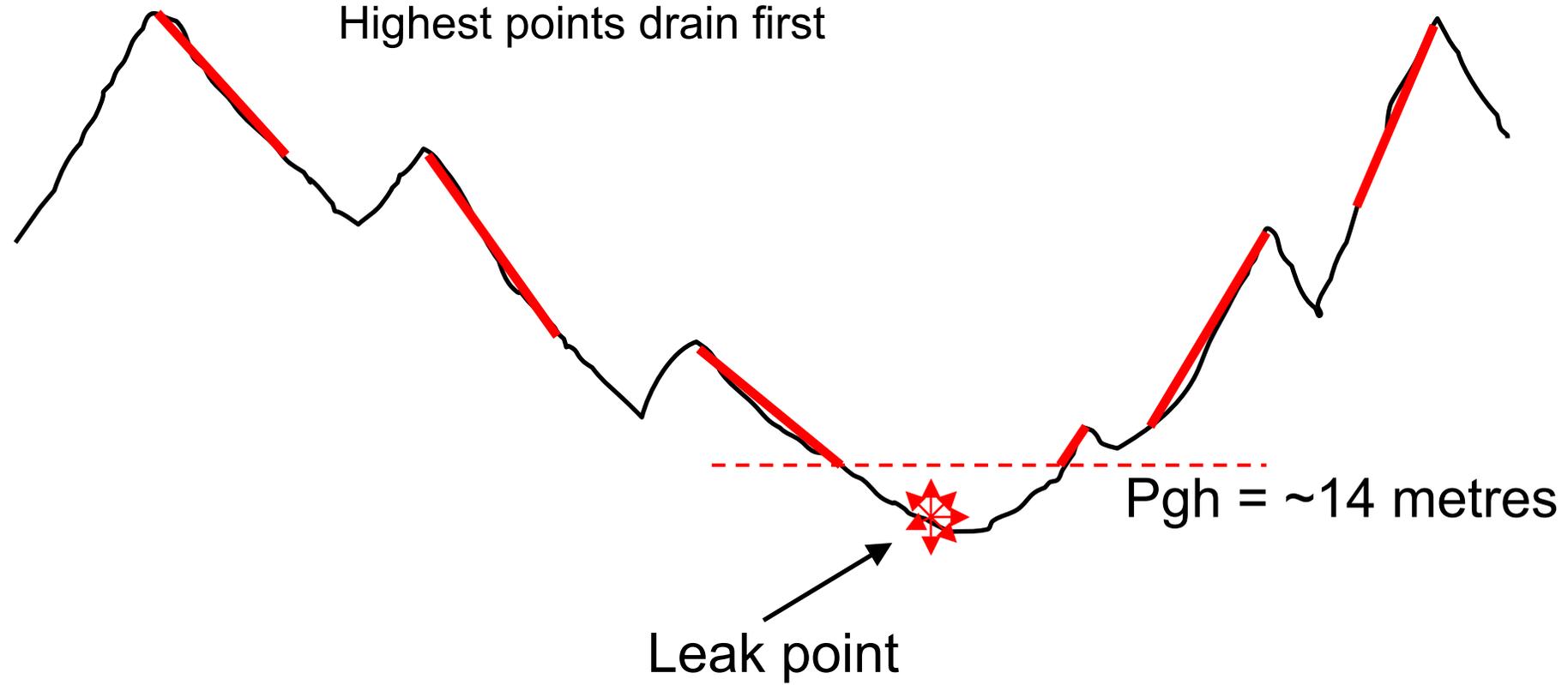
Risk to the Environment

Following a release from a pipeline, the amount released depends on:-

- 1 Time taken to switch off the pumps
e.g. 3 minutes at 150 m³/hour = 7.5 m³
- 2 Expansion of liquid as it de-pressurises
e.g. expansion of 2500 m³ at ~ 50 bar = ~ 9 m³
- 3 Drain-down from high points in pipeline as vacuum forms
depends of height profile above leak point
- 4 Gravity drain-down local to the leak point
slow draining as air ingress occurs

Vacuum Drain-down

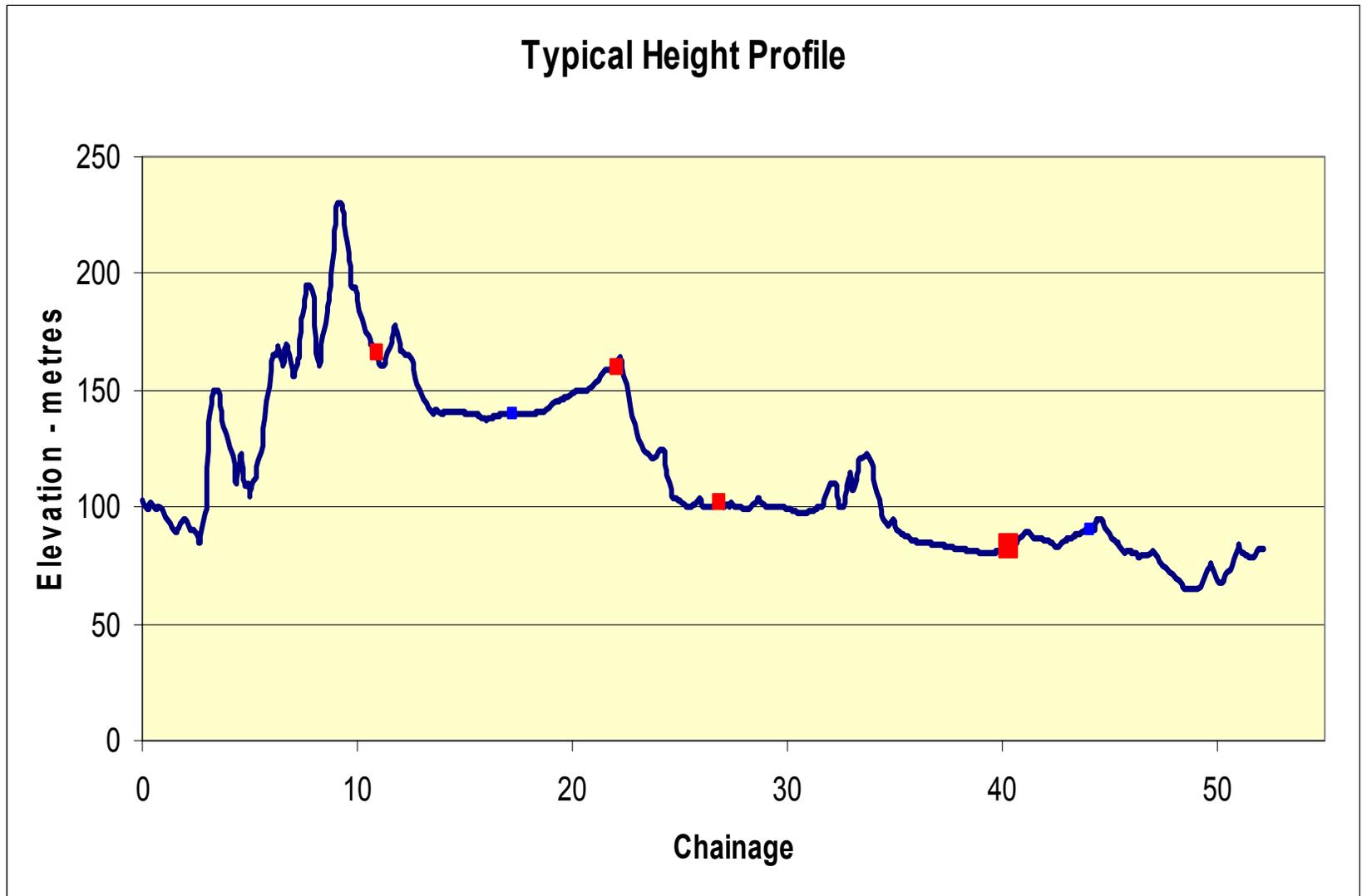
Highest points drain first



$P_{gh} = \sim 14$ metres

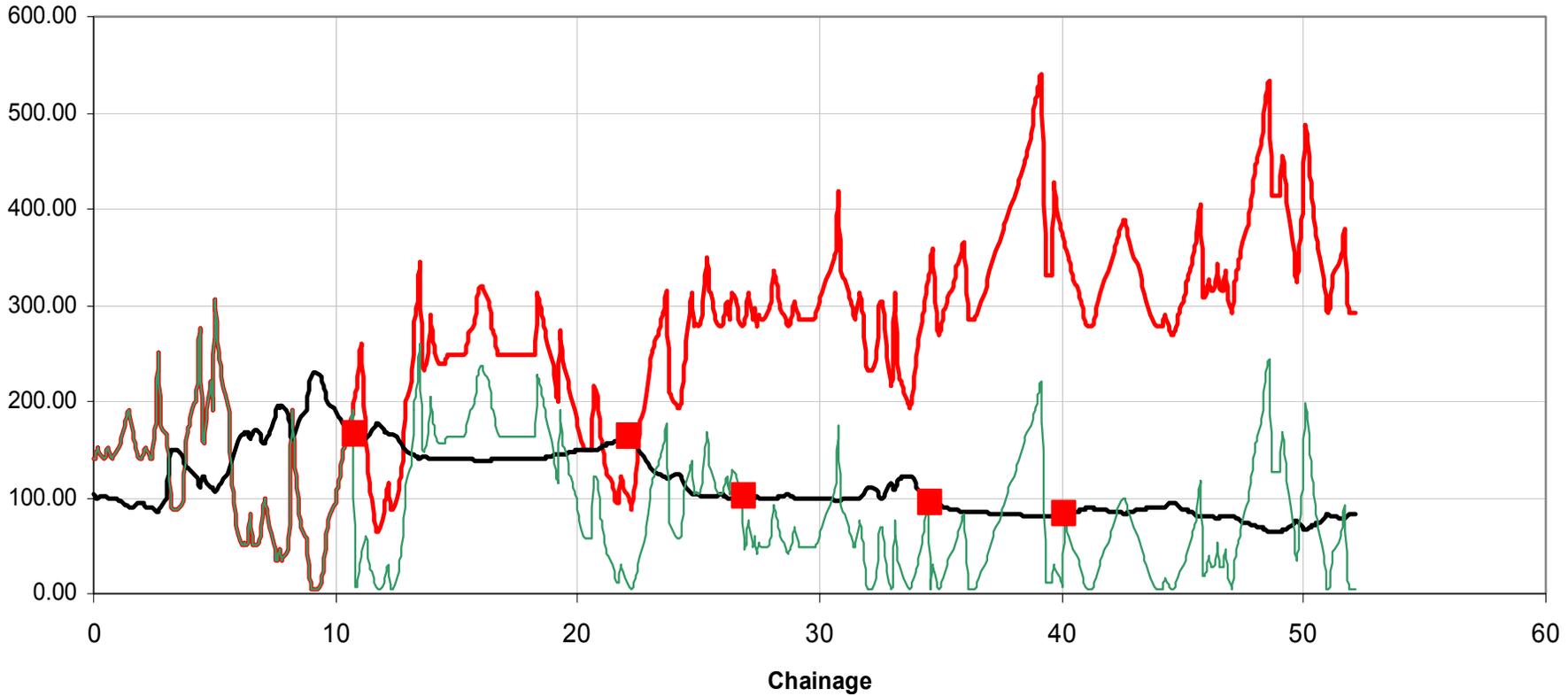
Leak point

Rate of drain down depends on hole size
- except ruptures – then rate depends on pressure drop



Red squares – location of remotely operated valves

Typical Drain Down Results



— Total Drain Down RSOVs open — Elevation ■ Location of RSOVs — RSOVs closed

Immediate Information from GIS for Control Operator

Typical Pipeline		
Leak Distance from Start	20.00	km
Total Drain-Down with CCVs Open	184	m3
Total Drain-Down CCVs Closed	86	m3
Recommend closing Upstream CCV because it could reduce drain down by	Valve BV02	m3
	84	
Recommend closing Downstream CCV because it could reduce drain down by	Valve BV04	m3
	15	
Consider getting Upstream Manual Valve closed because it could reduce drain down by an additional	Valve MV03	m3
	61	

Leak Detection System should identify Leak Location and Rate

Typical Pipeline Drain Down Rate Calculator

Input data

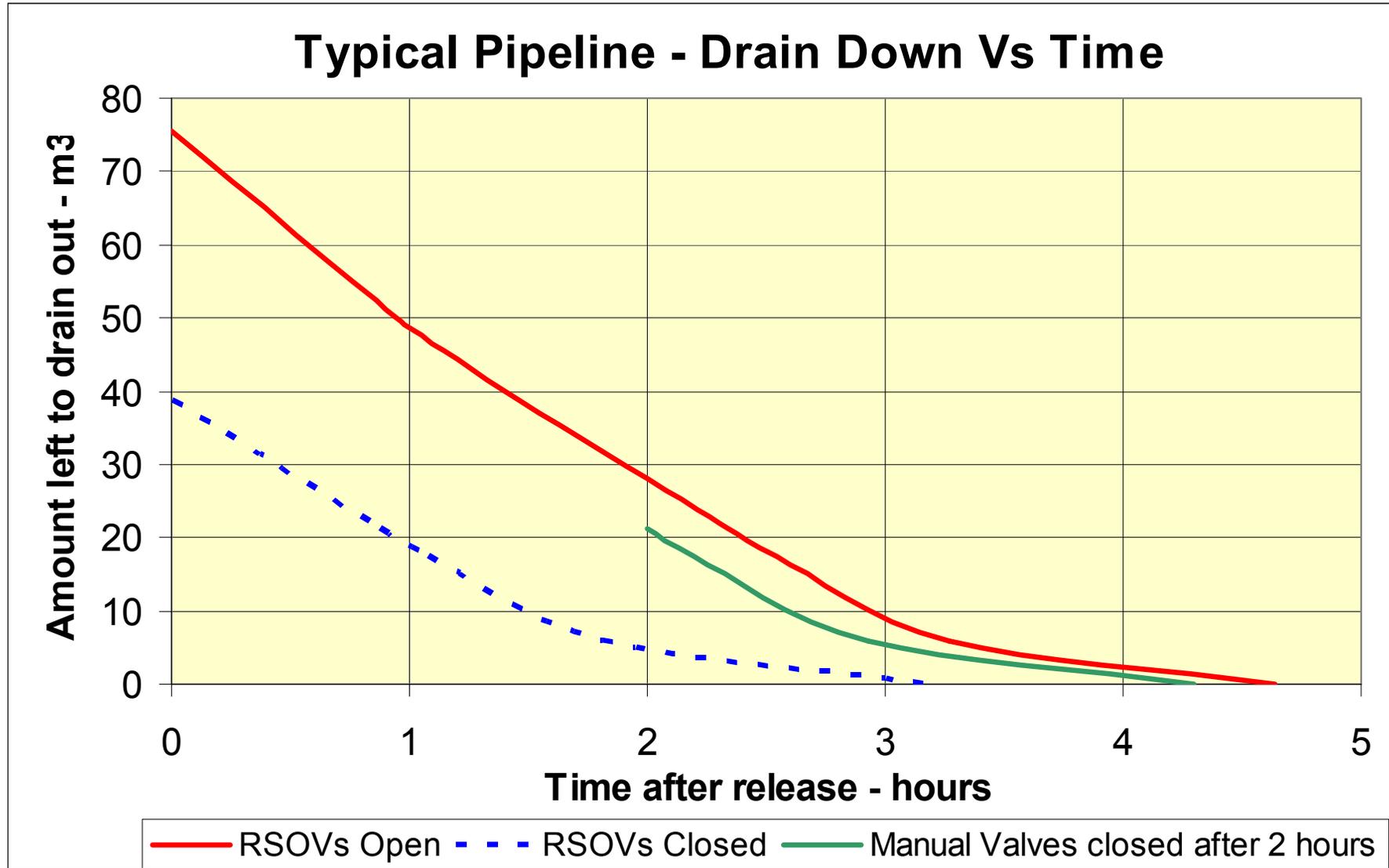
Location of leak - km from Start	125
Estimated Leak Rate m ³ /hour	25
Pipeline Pressure at Fawley bar	100
Pipeline Pressure at Avonmouth bar	5

Results

Leak Elevation above Sea Level m	20.0
Pressure at Leak Point bar	10.2
Estimated Leak Hole Circular Diameter mm	17

STOP THE PUMPS!
PRESS to calculate drain down

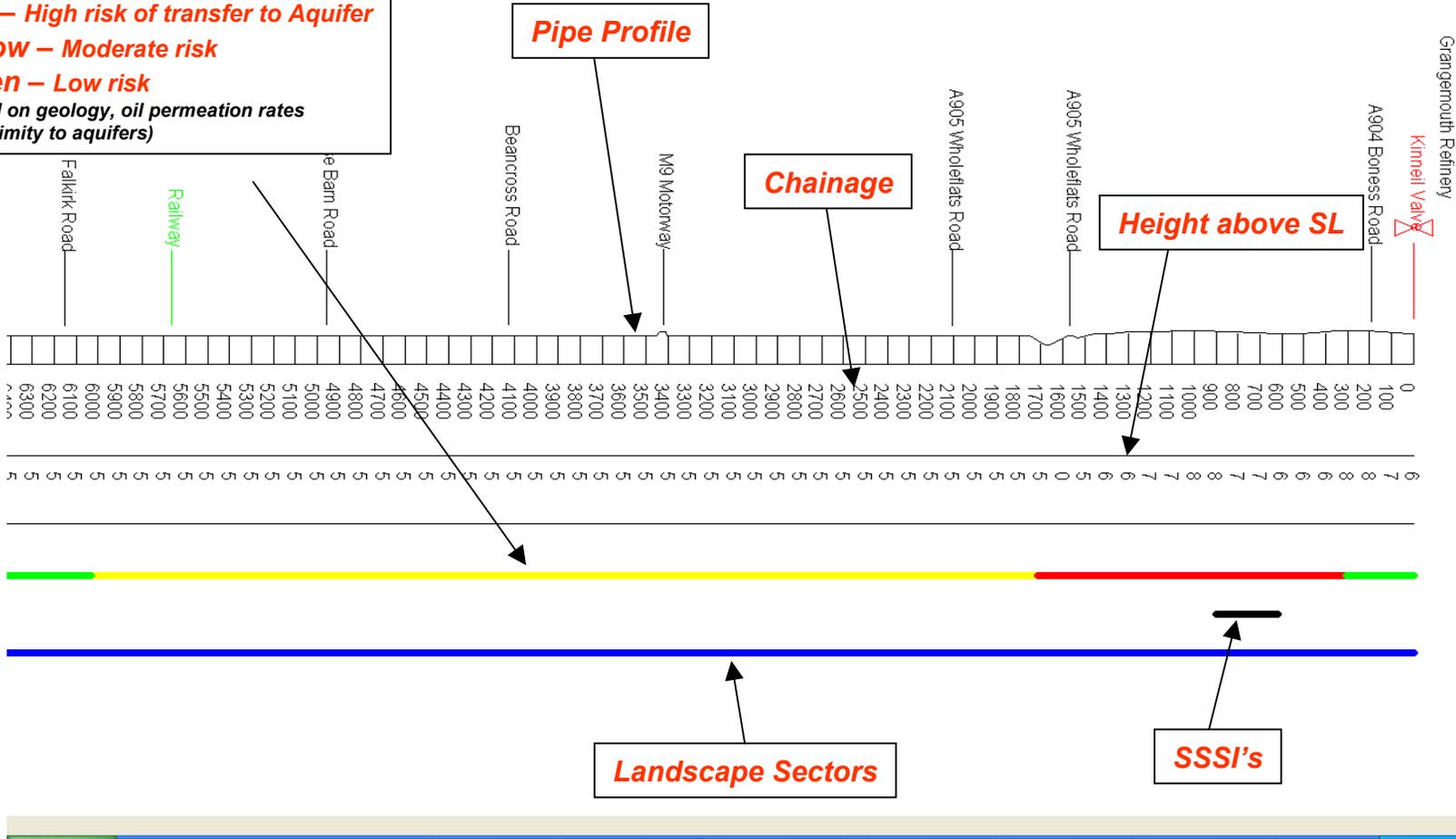
Release time shown graphically



Finnart Pipelines GIS – Profile Layer Information

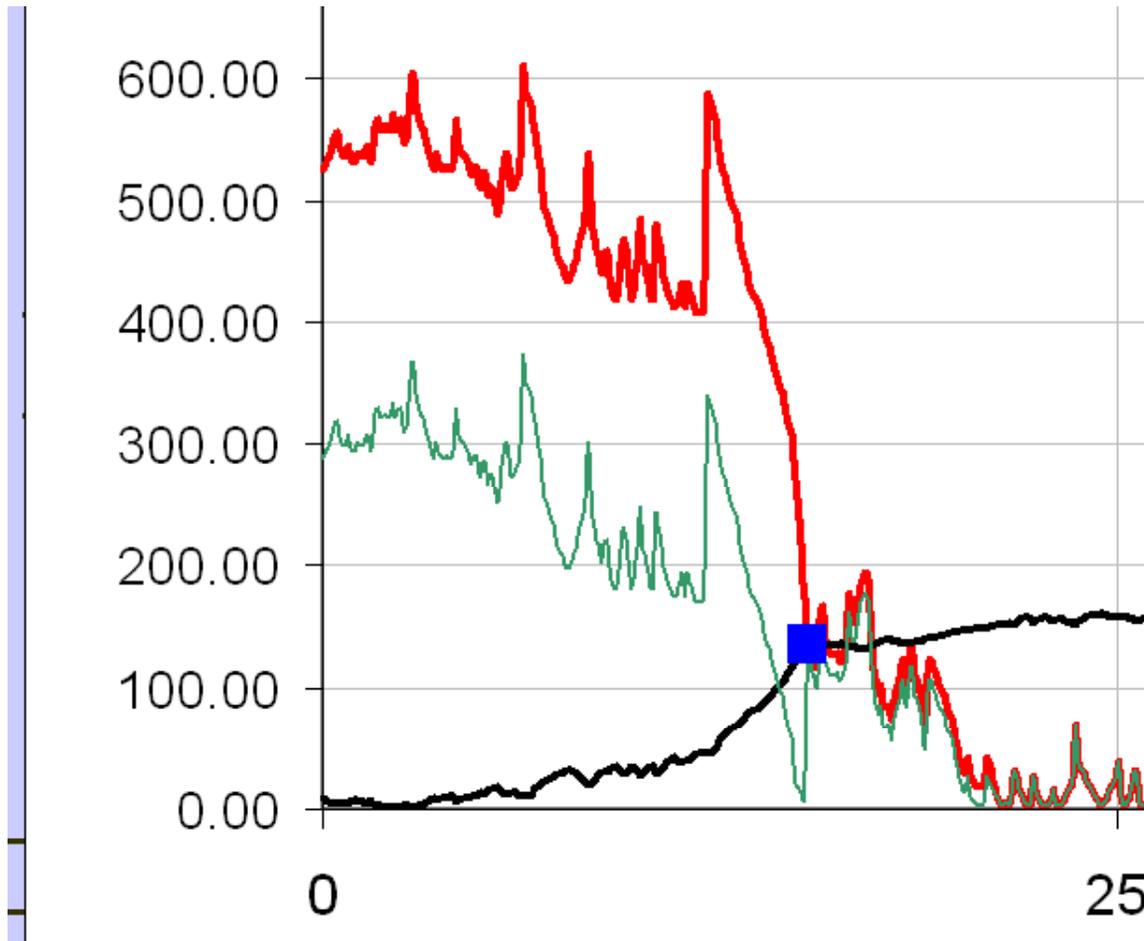


Risk Zones
Red – High risk of transfer to Aquifer
Yellow – Moderate risk
Green – Low risk
 (Based on geology, oil permeation rates & proximity to aquifers)



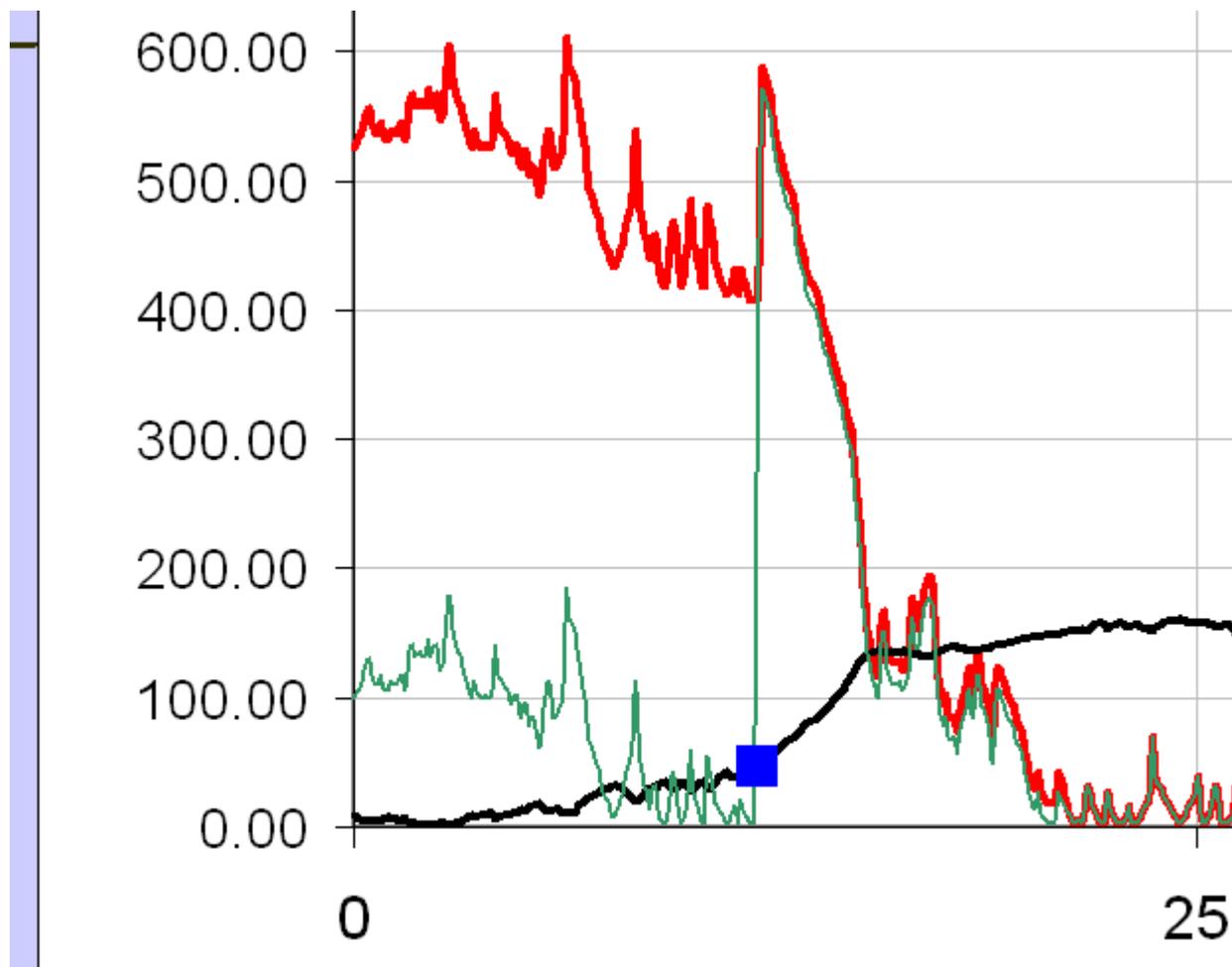
Reducing Drain-down – Design Considerations

Optimum location for Remotely Operated Valves



Higher risk areas
for 3rd party
interference
usually in lower
areas along pipeline
route.....

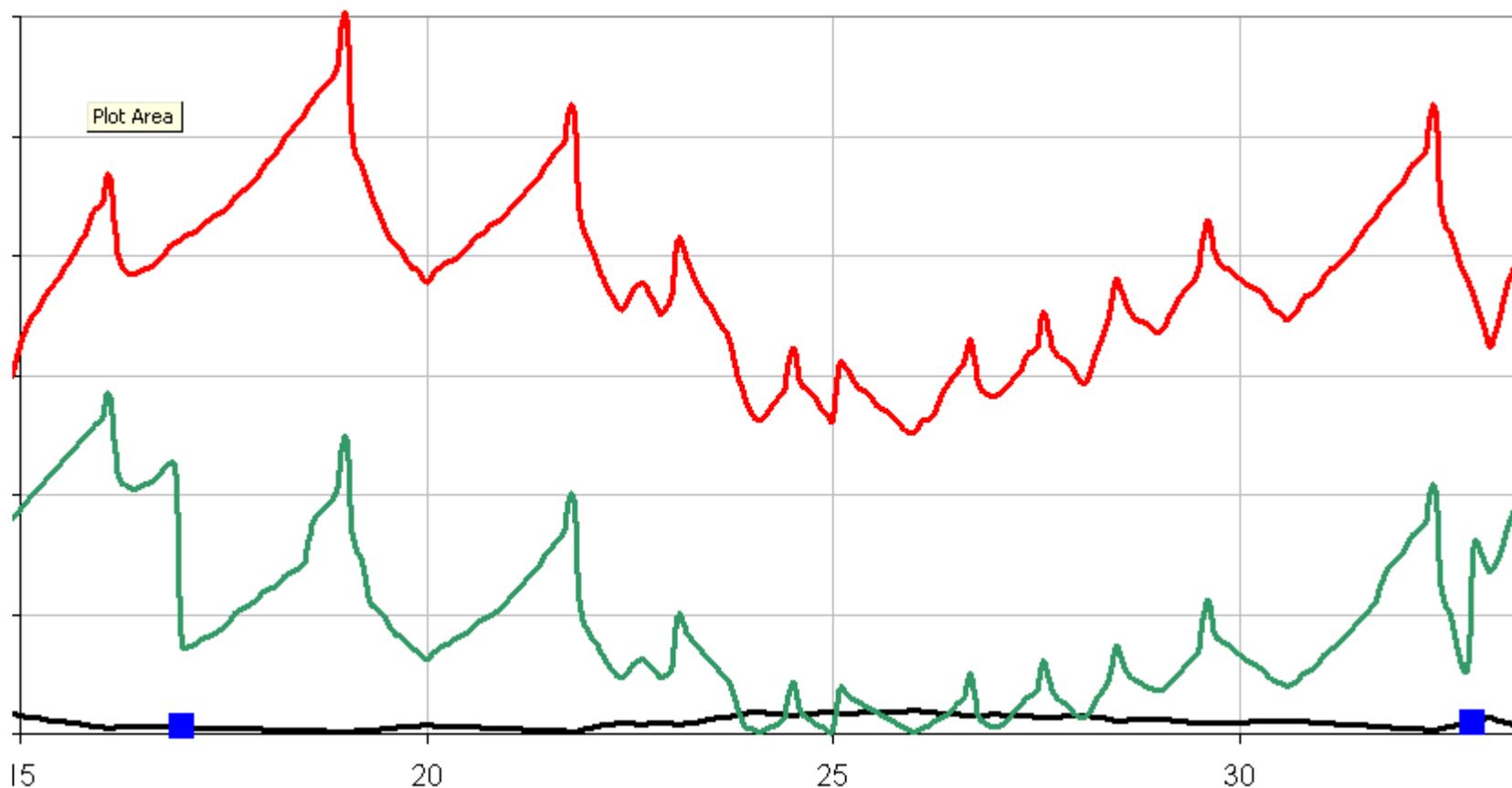
.....move the valve 3 km down the slope ...



Reduces drain down by ~ 2/3rds

Reducing Drain-down – Design Considerations

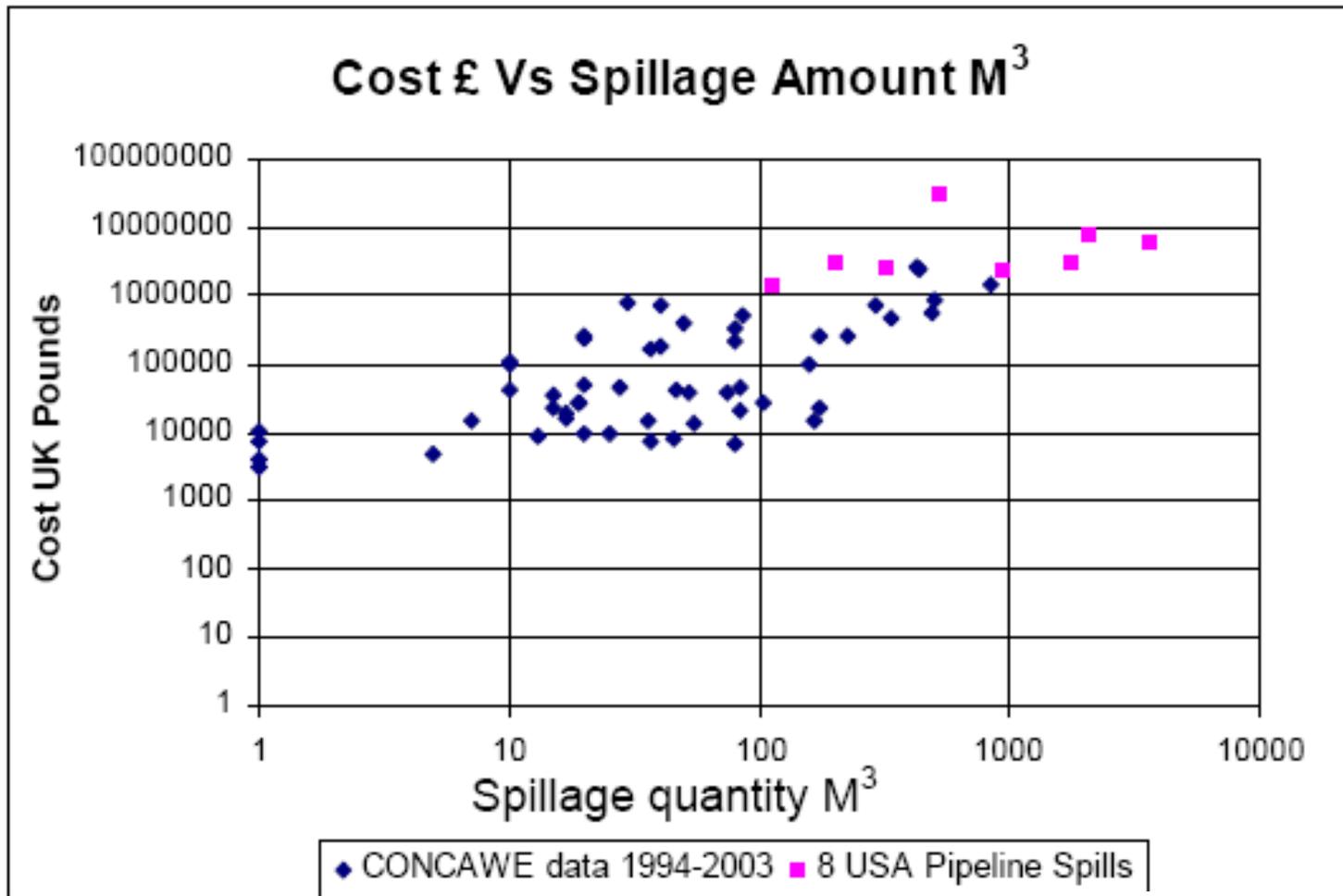
Converting Manual Valves to Remotely Operated Valves



Red - valves open, green – valves shut

Converting Manual Valves to Remotely Operated Valves

- 1 Frequency analysis – pipeline leak or rupture in sensitive area
- 2 Spillage reduction – assuming remote valves closed in 3 minutes instead of ~ 1.5 hours
- 3 Cost of spillage = clean-up + cost of compensation + loss of use
- 4 Also account for containment factor of soil and local sensitivity
- 5 Cost benefit analysis to assess whether cost of automating valves is justified
- 6 Decision made on loss of reputation / local –national reaction



Cost of Clean-up
- Depends on ground type

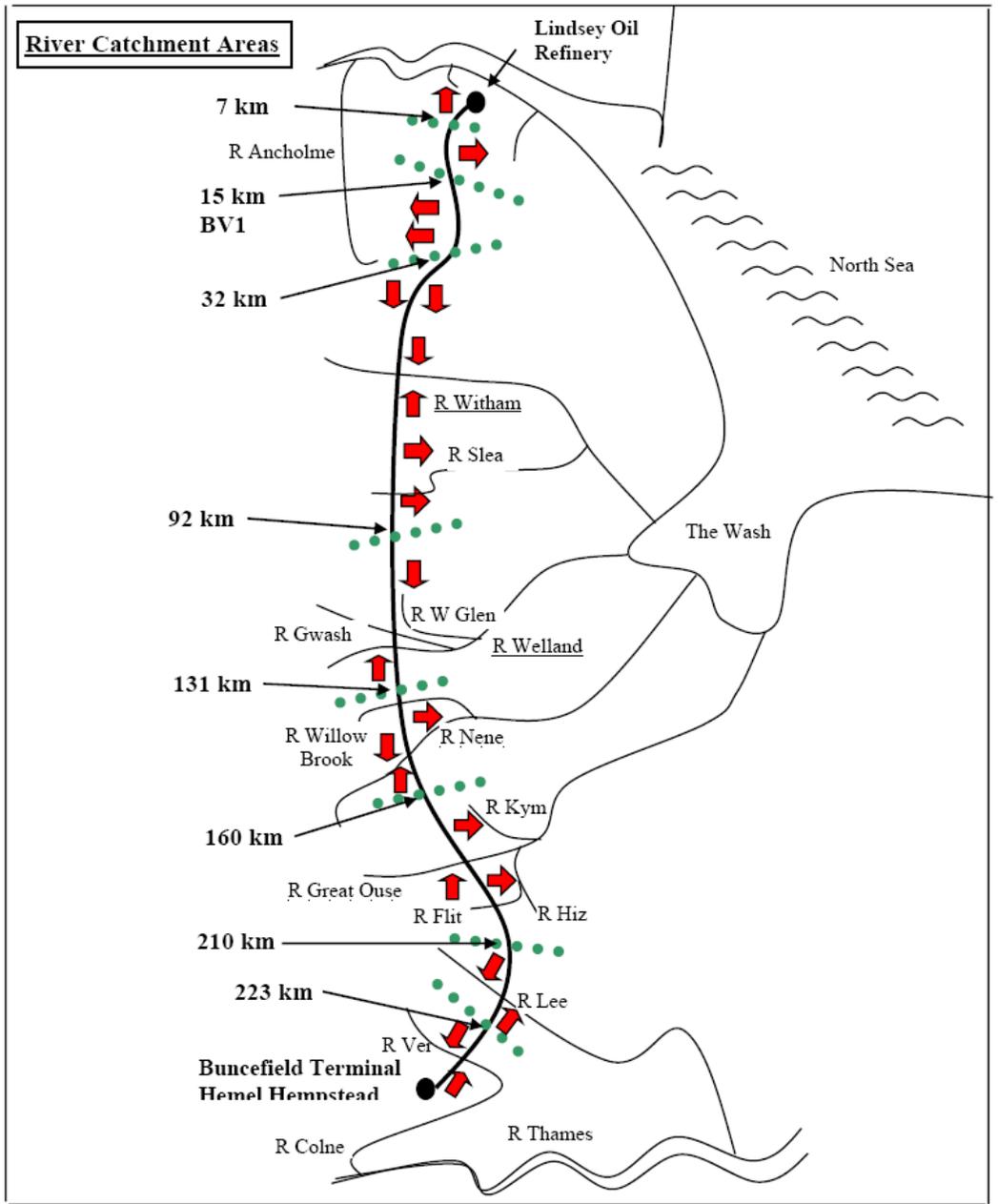
Spillage M ³	Cost £	Spillage M ³	Cost £
5	11,400	250	435,000
10	21,800	300	515,000
50	97,000	500	828,000
100	185,000	750	1,210,000
200	353,000	1000	1,580,000

Description		
Length of Vulnerable Section km	3.71	3.71
Containment Factor CF	1.8	1.8
Environmental Sensitivity Factor ESF	10	10
Rupture Failure Rate per 1000km.yrs	0.082	0.082
Rupture Frequency	3.04E-04	3.04E-04
Reduction in amount spilled for rupture m3	1031	1126
Clean-up Cost Reduction for Rupture spillage	£29,230,957	£31,728,035
Annualised Cost of Risk Reduction Rupture	£8,893	£9,652
Large Hole Failure Rate per 1000km.yrs	0.147	0.147
Large Hole Frequency	5.45E-04	5.45E-04
Reduction in amount spilled for large hole m3	600	700
Clean-up Cost Reduction for large hole spillage	£17,668,234	£20,391,710
Annualised Cost of Risk Reduction Large Hole	£9,636	£11,121
Total Annualised Cost of Risk Reduction	£18,528	£20,773
Years to discount capital	10	10
Justifiable Capital to spend	£185,284	£207,733



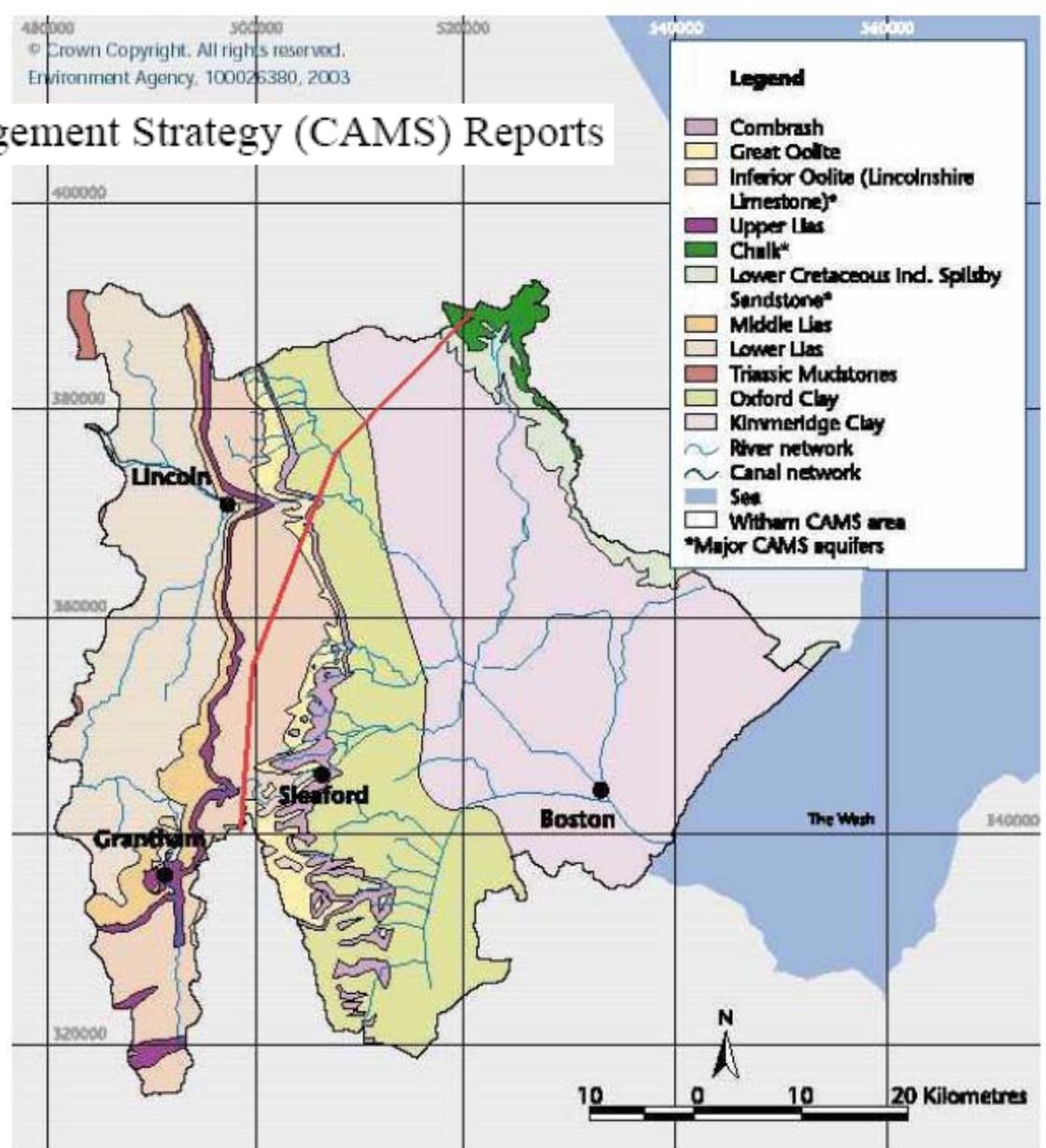
Total UK Pipeline Operations
Fina-Line Pipeline
Quantified Risk Assessment
Risks to the Environment

June 2005

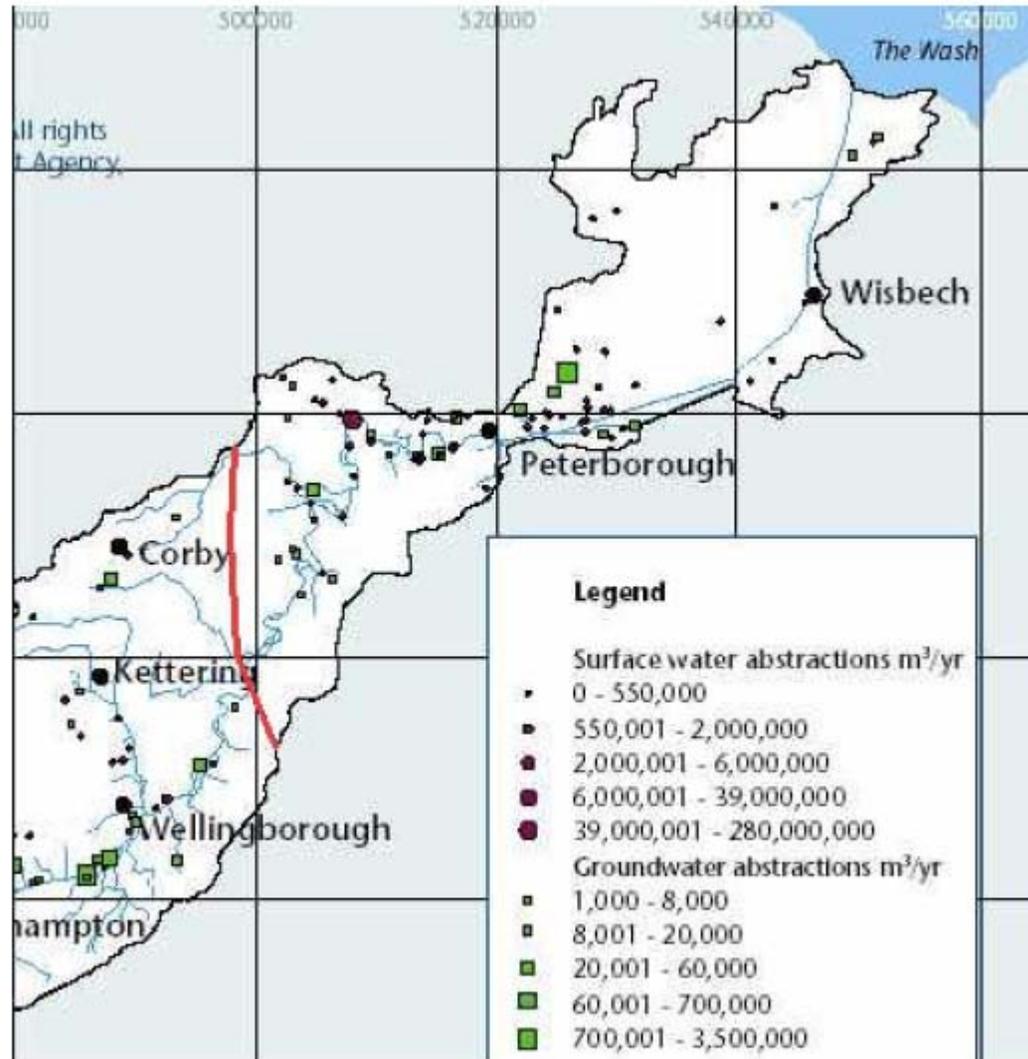


Catchment Abstraction Management Strategy (CAMS) Reports

Rock formations
from
Environment
Agency
CAMS
Reports



Water Abstraction points

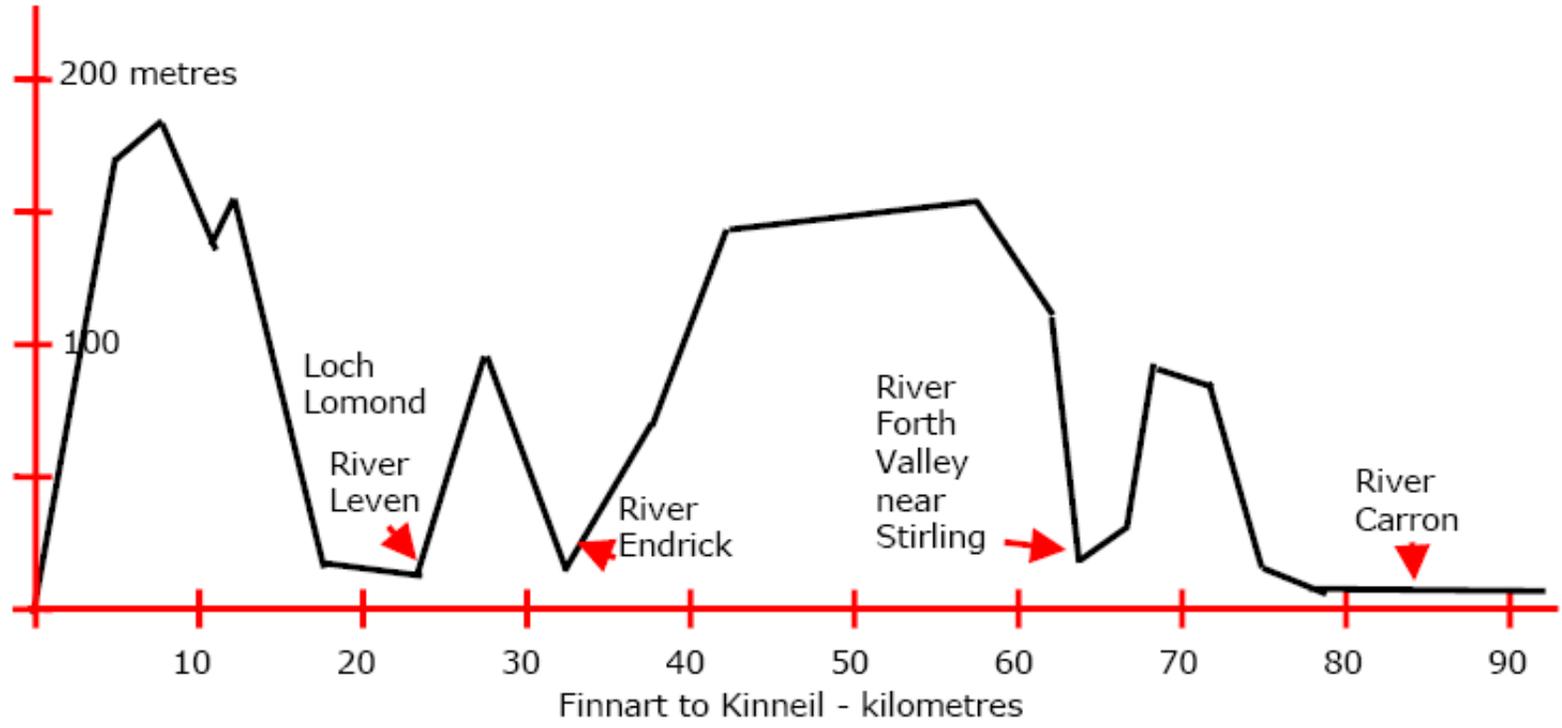


Meeting with Environment Agency 12 Dec 07

- Meeting held following re-commissioning of FinaLine
- EA are Category 1 Responder to spillages – they have 24-hour emergency response
- EA have “EasyMap” GIS system and have a “layer” for pipelines -FinaLine to be added
- update of emergency contacts and numbers
- direct contact with Total’s contractor (Adler & Allen)
- relatively small sections of the line need detailed assessment – risk classification of sections of the route
- update of emergency contacts and numbers r

FIGURE 8

Approximate Pipeline Elevation Profile



Finnart Oil Pipelines

Quantified Risk Assessment

Part 5 – Drain Down Calculator

Ineos Grangemouth

Finnart Oil Pipelines

Environmental and Emergency Response Analysis



Drain-down and Emergency Response 2007-8

