Establishing and quantifying the causal linkage between drainage and earthworks performance for Highways England

Matt Lane

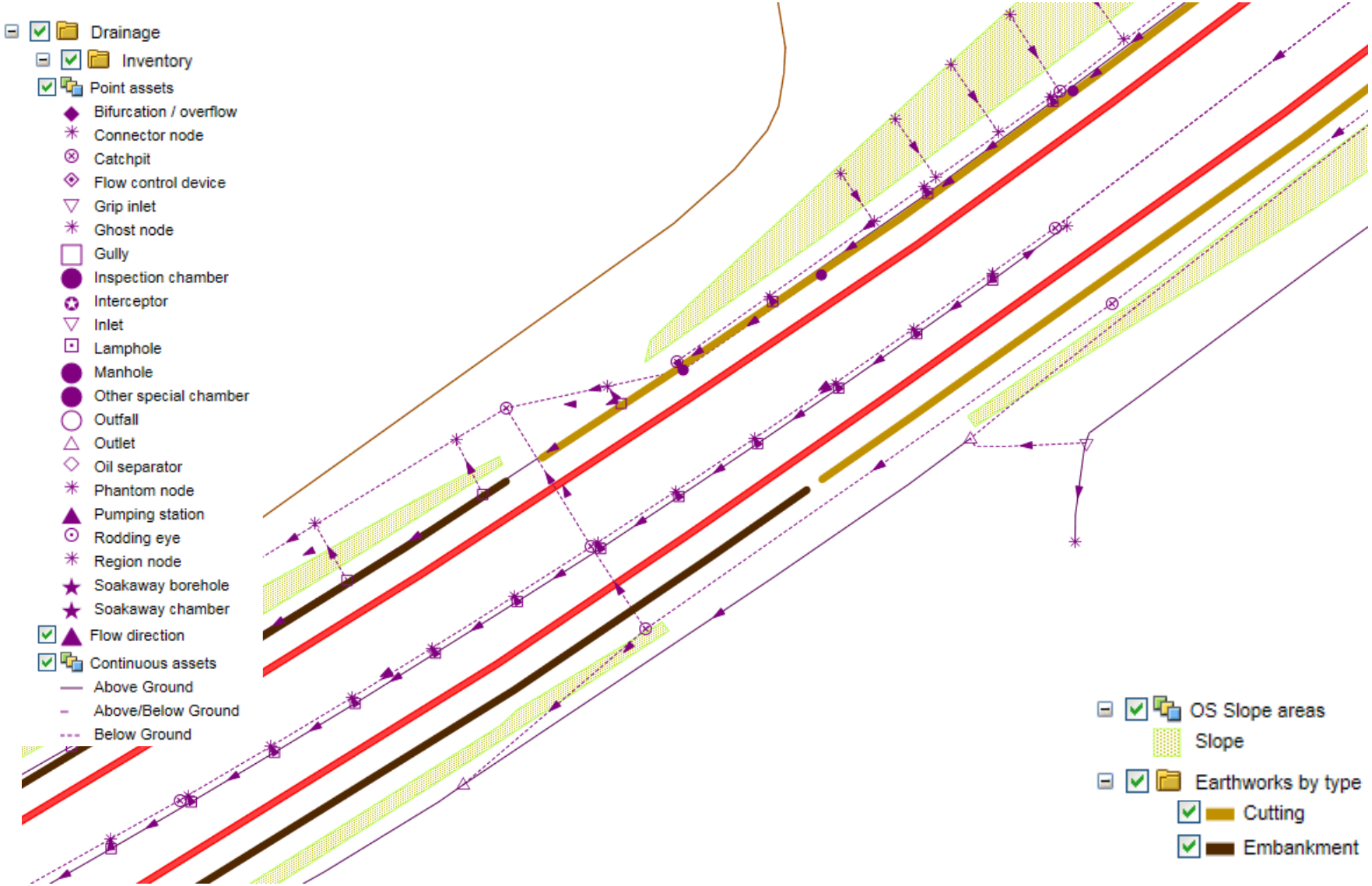
Ground related risk to transportation infrastructure

The Geological Society

26 October 2017

Earthwork and drainage assets

HA GDMS
Developed by Mott MacDonald in association with *Keynetix* v5.12.0
Terms & Conditions



Data sources

Data	Data source
HE National earthworks inventory and condition	HAGDMS (HE / Mott MacDonald)
HE National drainage inventory and condition	HADDMS (HE / Mott MacDonald)
HE National records of earthwork failures and defects	Geotechnical Asset Database (GAD) and Geotechnical Maintenance Forms (GMFs) of HAGDMS (HE / Mott MacDonald)
HE National records of earthworks repair costs	Geotechnical Maintenance Forms (GMFs) of HAGDMS (HE / Mott MacDonald)
Earthwork outlines	Ordnance Survey Mastermap Slope Areas

HAGDMS – Earthwork inventory and condition

HAGDMS – Earthwork failure records and repair costs

Geotechnical Maintenance Form: Part A

Initial Proposals
Status: Area Manager Approved

Area:	3	Road:	M4
Unique defect ID:	3_M4_206_385244		

Initial Assessment	Now	Assessed deterioration in 5 years	5 Years
Defect Class	1A		1A
Location Index	C		C
Feature Grade	4		3

Nature and Likely cause of defect:	Large slip over entire slope height, 17m wide. Backscarp 5m from safety fence. Deep seated failure.
Comments:	
Emergency works:	(•) Unspecified ( ) Carried Out ( ) Proposed
Emergency works details:	none
Emergency works Costs:	£0
Proposed investigation:	3 window sample holes and 1 trial pit, topographic survey.
Proposed investigation date:	17 Nov 03
Proposed investigation estimated costs:	£4,000
Proposed remedial or preventative works:	granular replacement of failed material
Proposed remedial or preventative works estimated costs:	£50,000

Ian Duncan			
Date Part A sent:	06 Apr 04	Date Agreement required by:	16 Apr 04

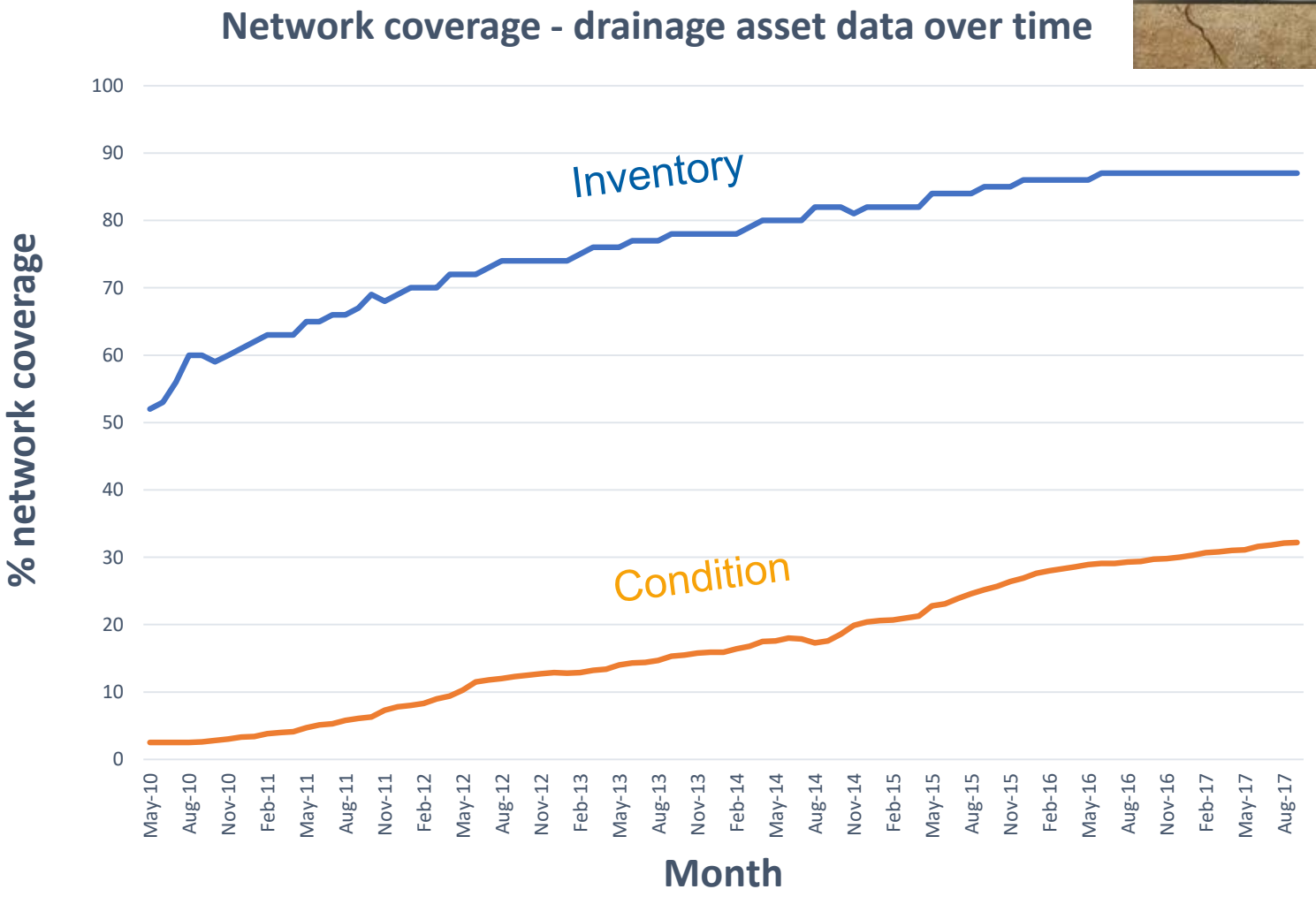
OO Geotechnical Advisor technical agreement in principal: (•) Agreed ( ) Not Agreed

David Patterson			
Date Part A sent:	08 Apr 04	Comments	Ensure budget agreed with OO and that all remedial solutions explored.

OO Agreement proceed with investigation: (•) Agreed ( ) Not Agreed

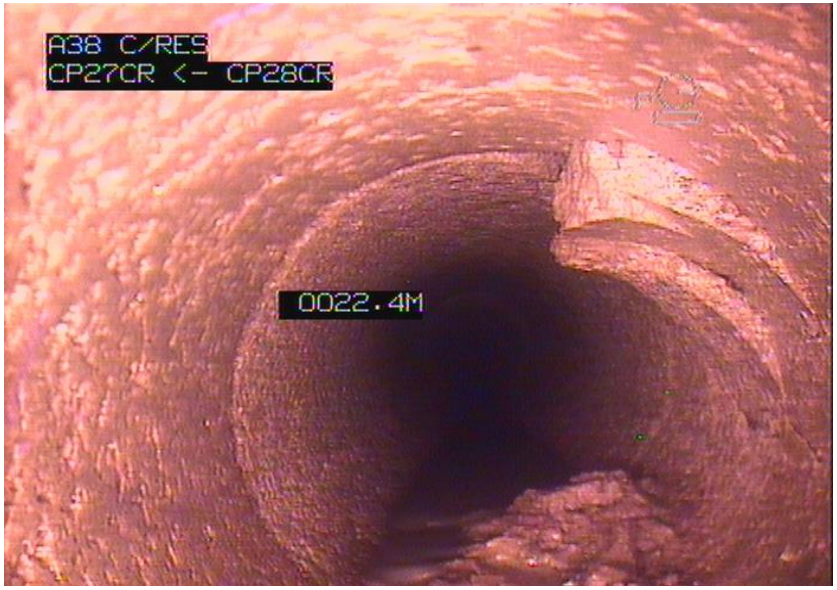
Peter Scott			
Date Part A sent:	08 Apr 04	Comments	

HADDMS – Drainage inventory and condition



Drainage Condition - Structural

1	No defects	**Good**
2	Superficial defects	
3	Minor defects	
4	Major defects	**Poor**
5	Not fit for purpose or unsafe	



Drainage Condition – Service

1	Clear	**Good**
2	No capacity loss	
3	Slight capacity loss	
4	Severe capacity loss	**Poor**
5	Blocked or unsafe	

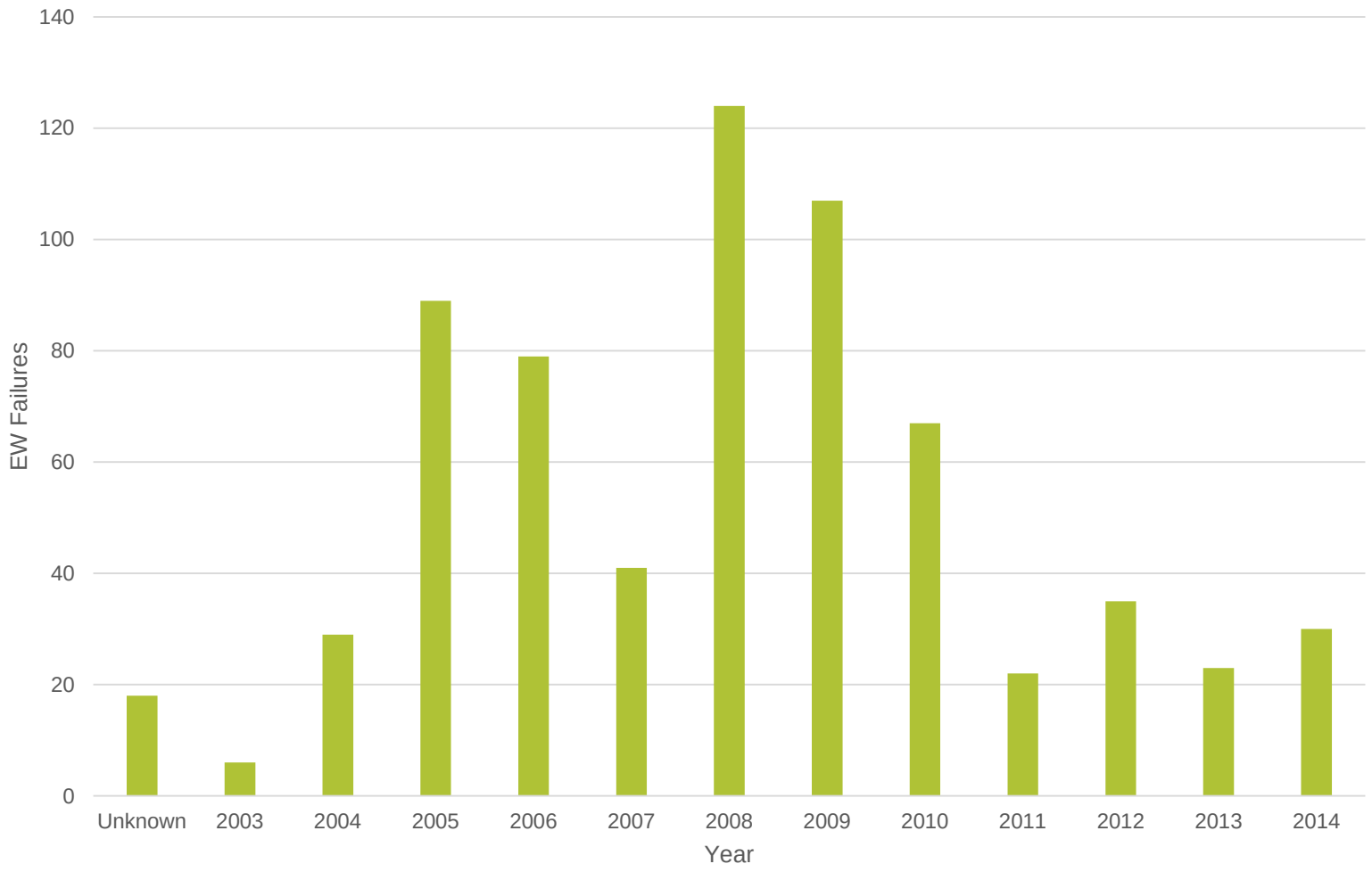
Drainage condition

		Service condition				
		1	**2**	**3**	**4**	**5**
Structural condition		Clear	No capacity loss	Slight capacity loss	Severe capacity loss	Blocked or unsafe
1	No defects	**Good**			**Poor**	
2	Superficial defects					
3	Minor defects					
4	Major defects	**Poor**				
5	Not fit for purpose or unsafe					

- Nationally 25% of linear drainage assets (mainly pipes) are Poor

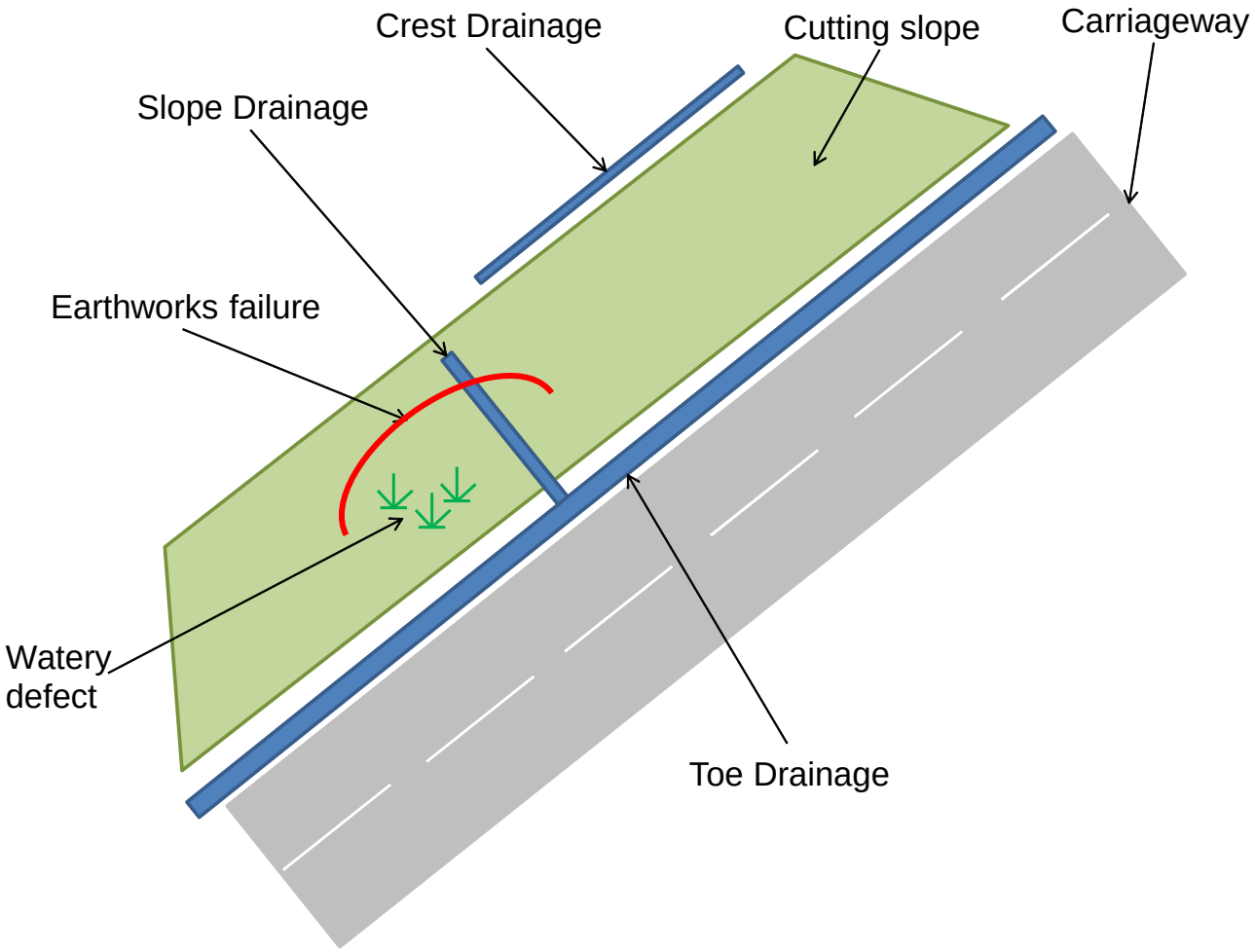
Earthwork failure summary

- 670 earthwork failure records were identified over the 11 year recording period.

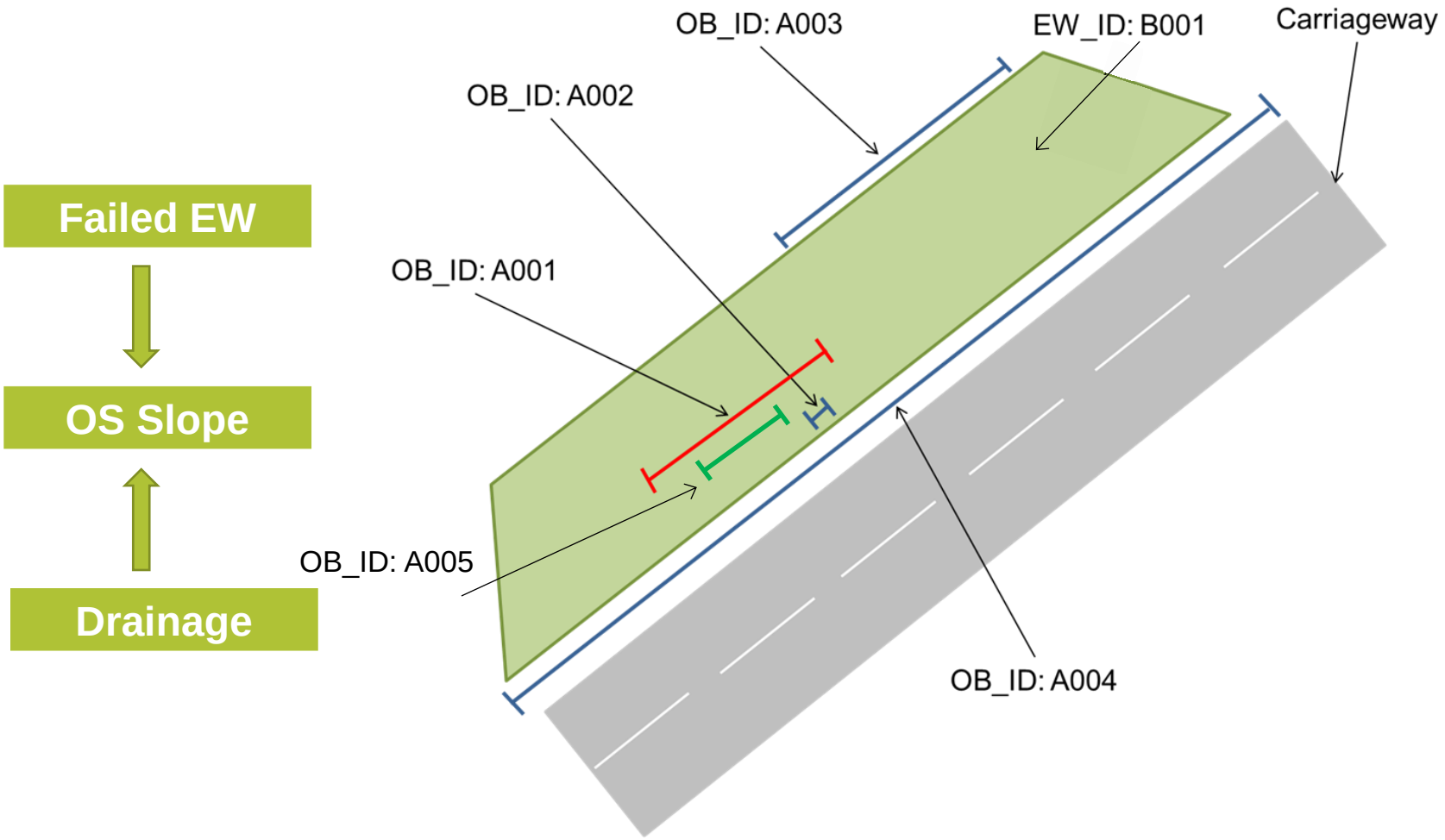


Earthwork failure – Watery defect

Earthwork – drainage analysis



Earthwork – drainage analysis

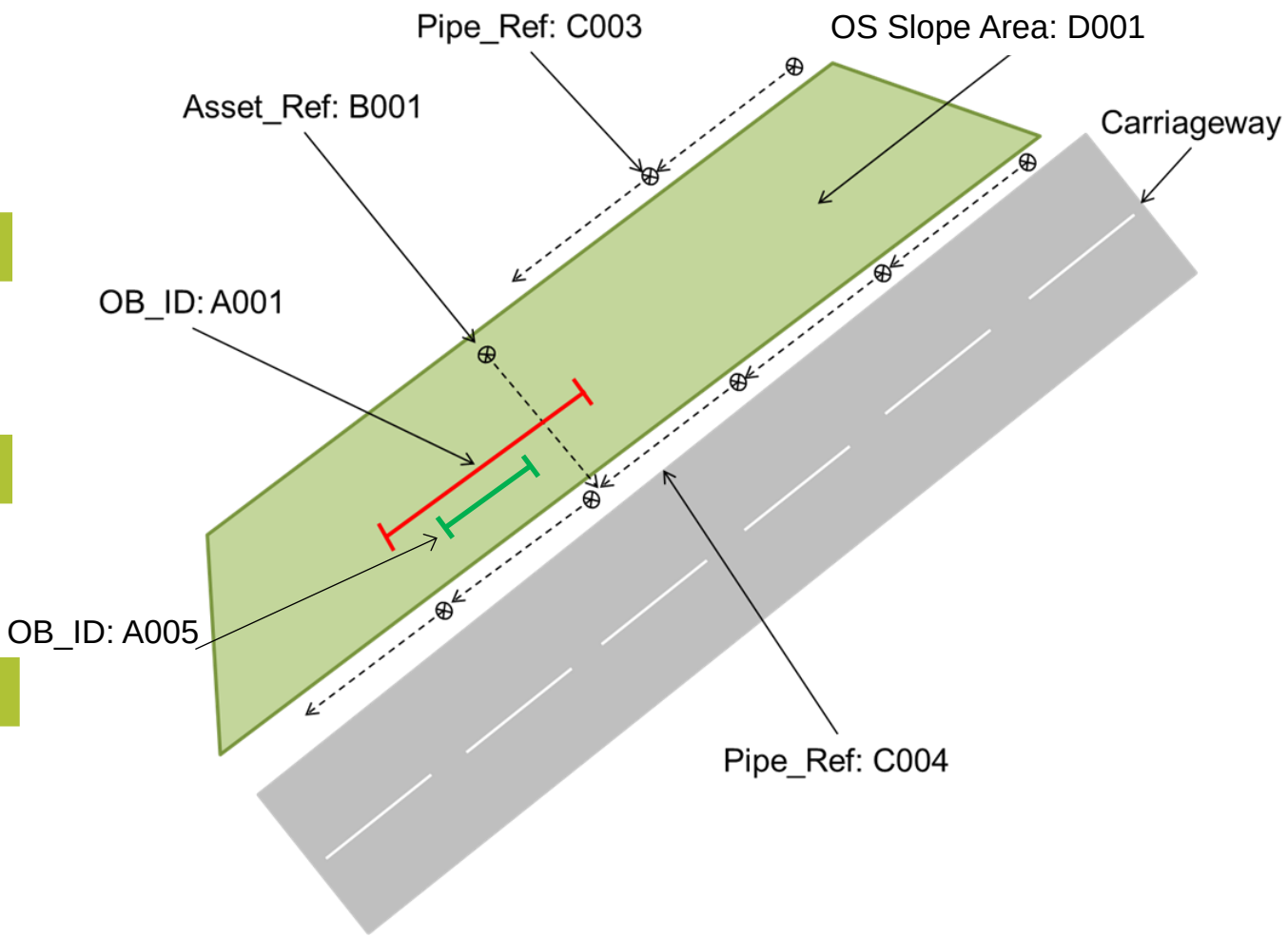


Earthwork – drainage analysis

Failed EW

OS Slope

Drainage

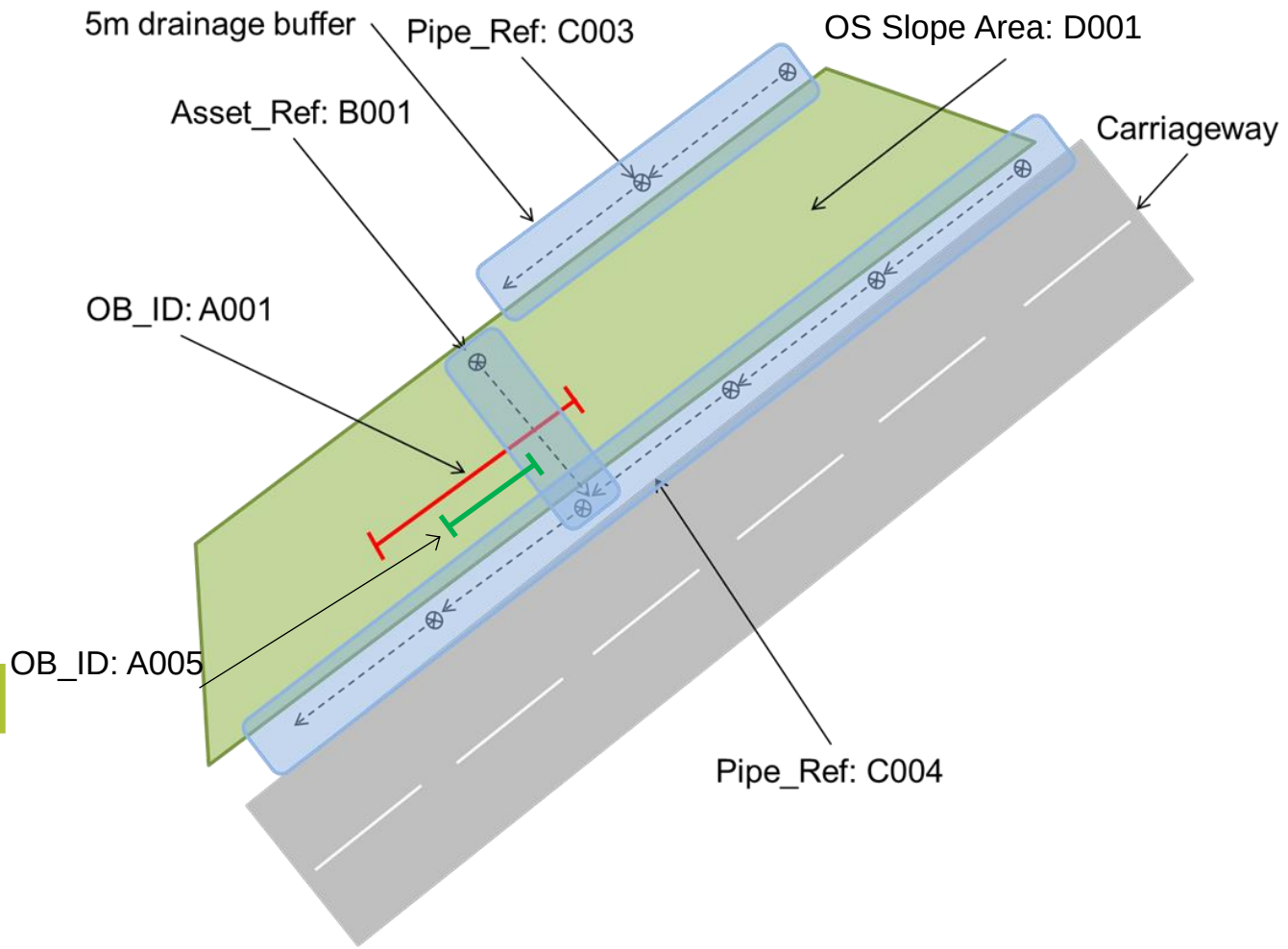


Earthwork – drainage analysis

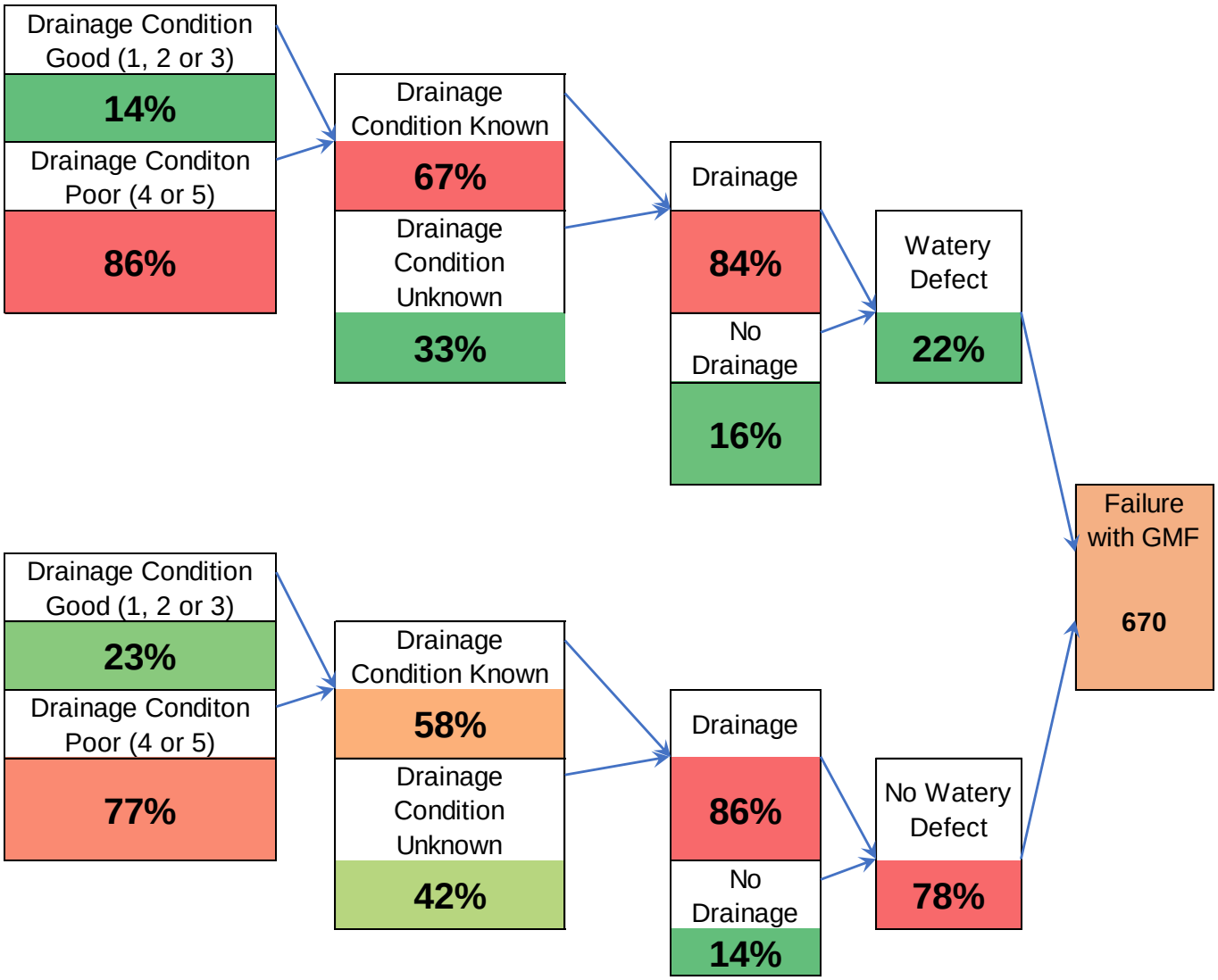
Failed EW

OS Slope

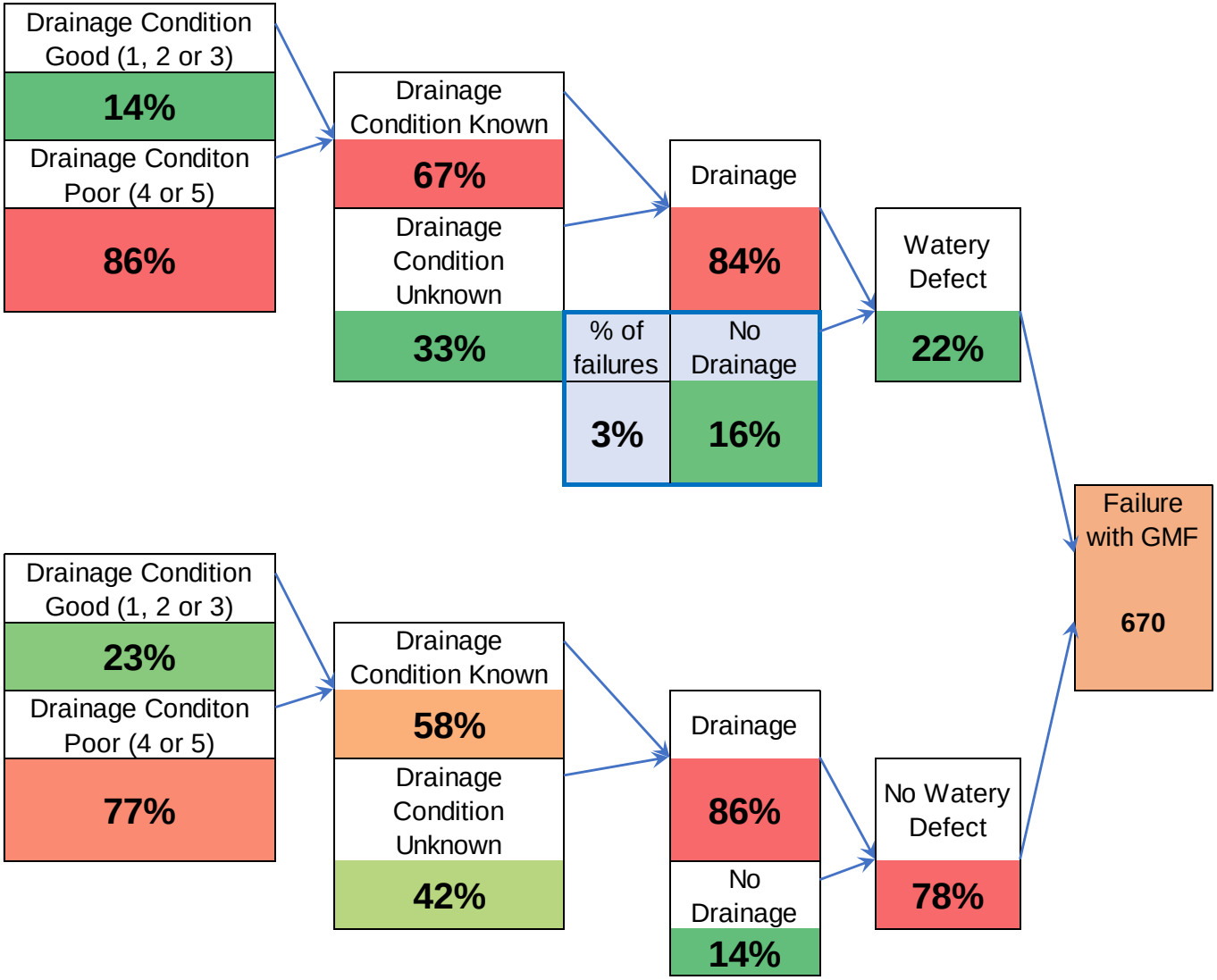
Drainage



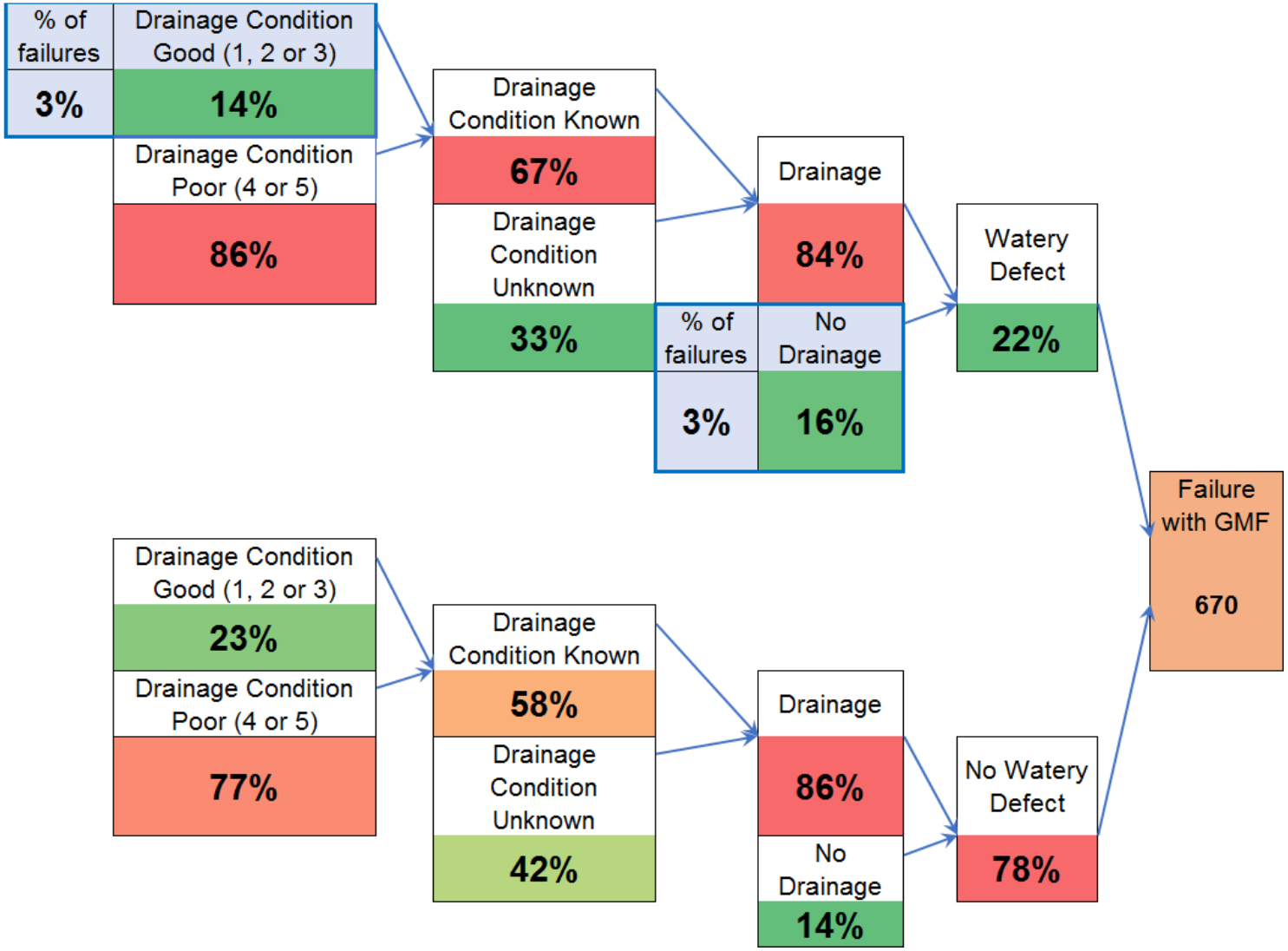
Earthwork – drainage analysis results



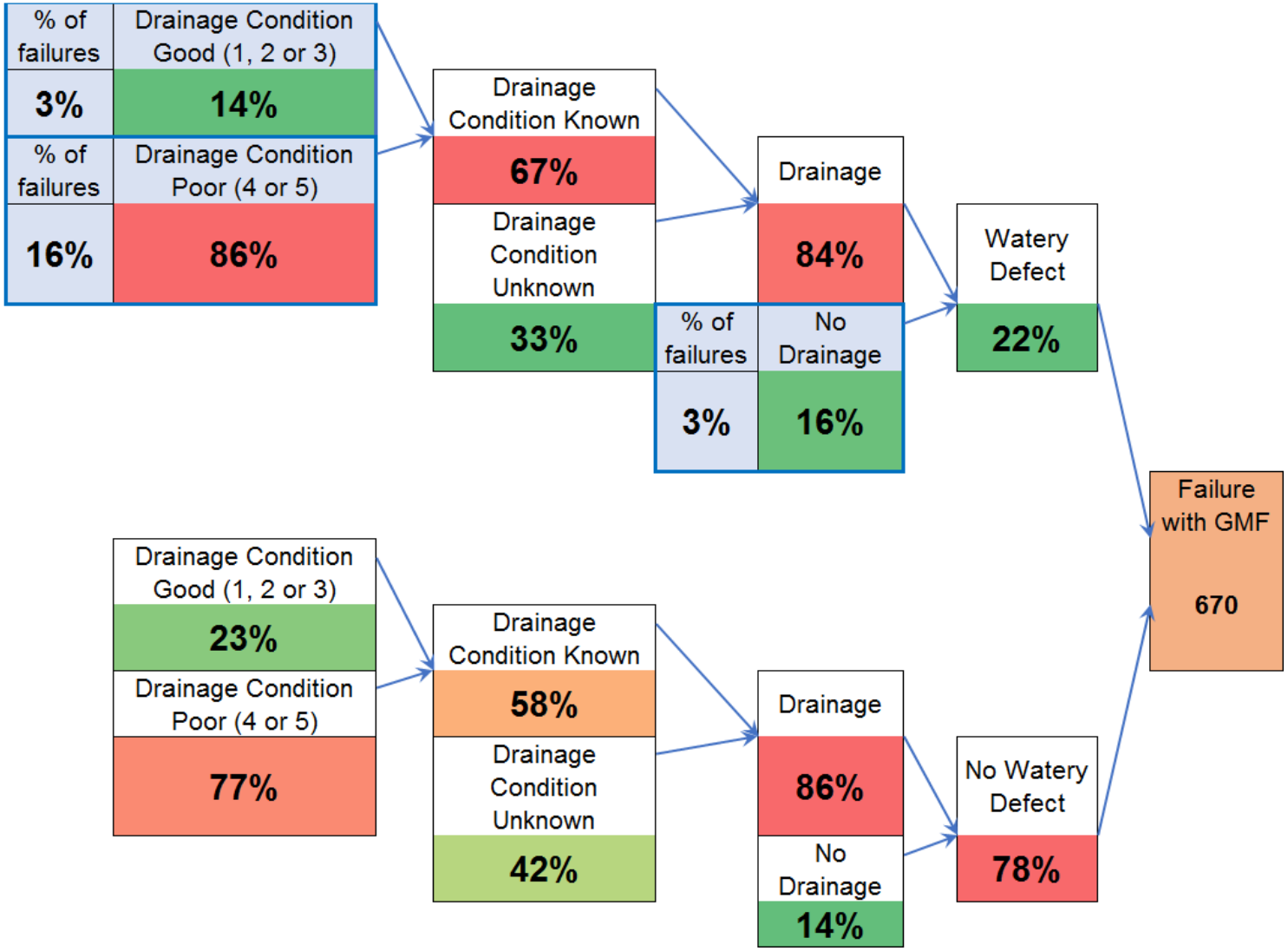
Earthwork – drainage analysis results



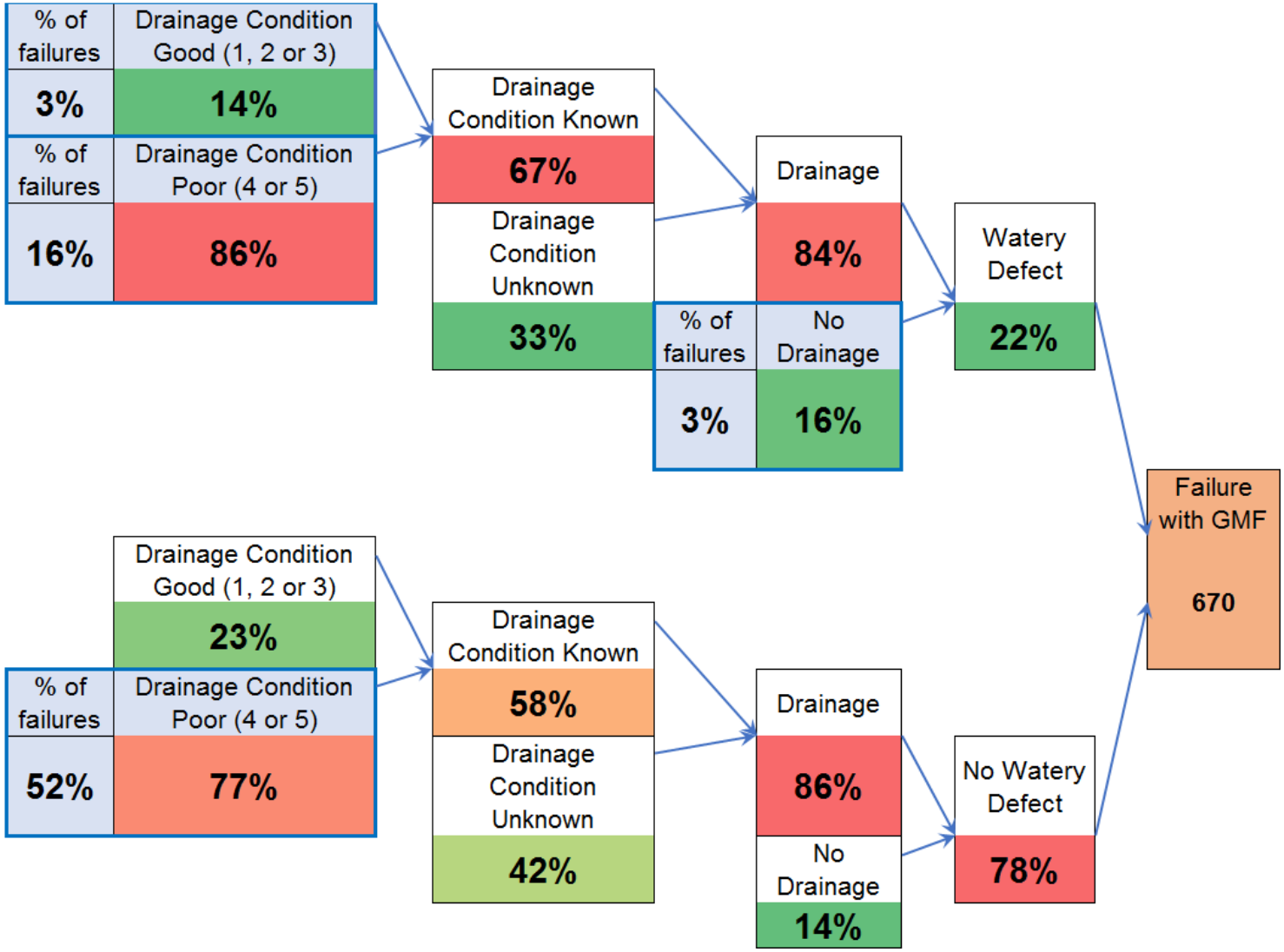
Earthwork – drainage analysis results



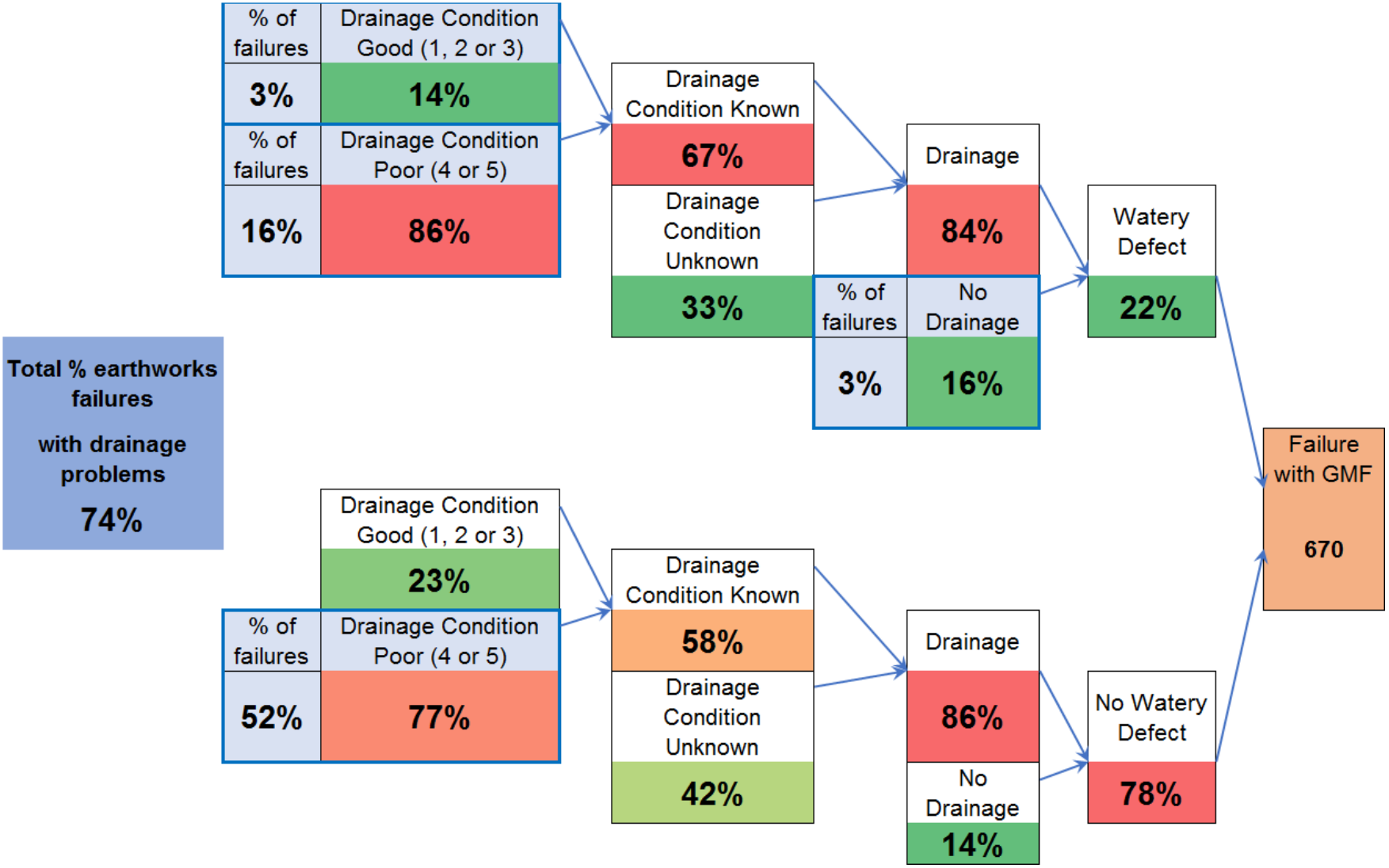
Earthwork – drainage analysis results



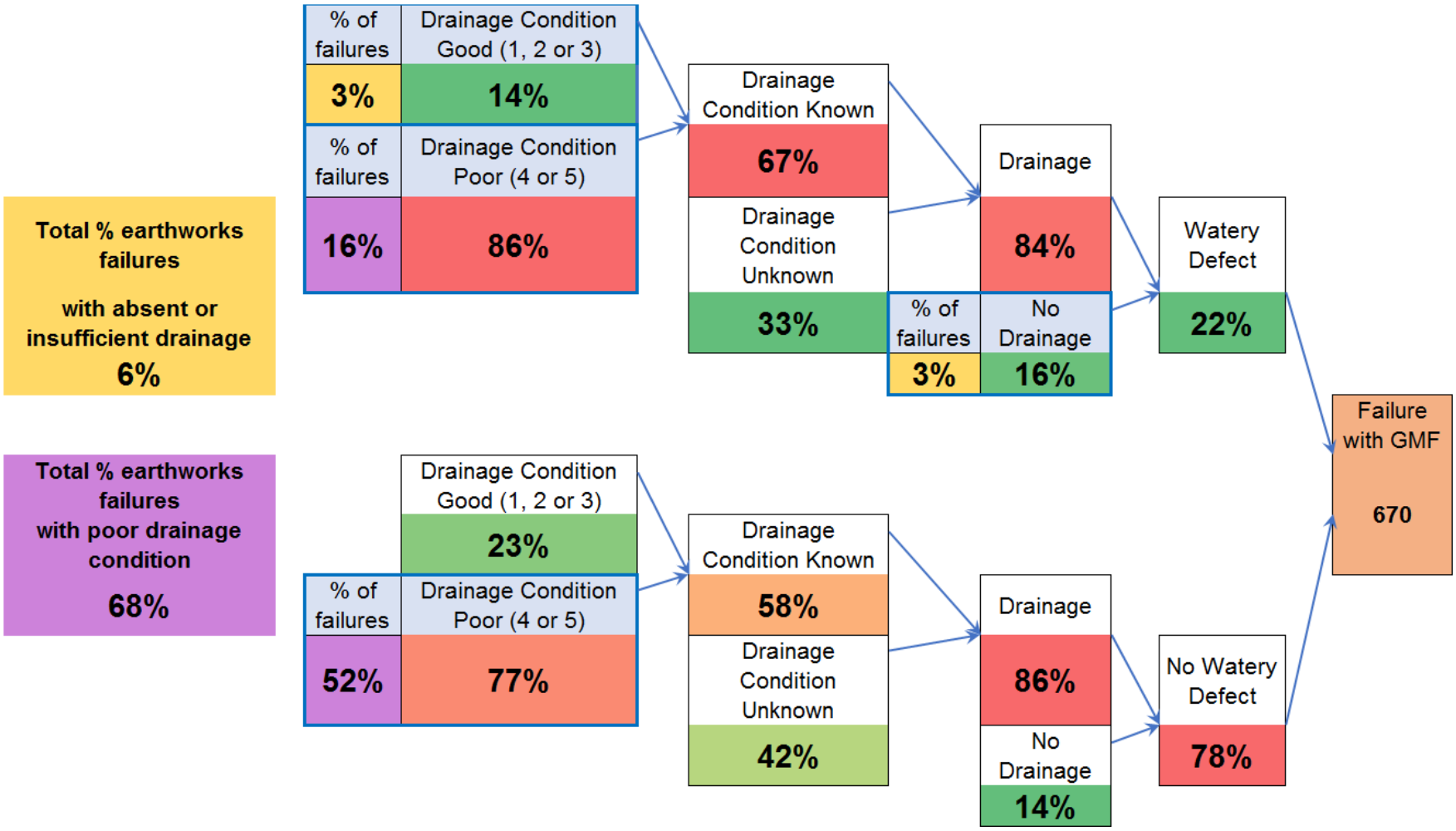
Earthwork – drainage analysis results



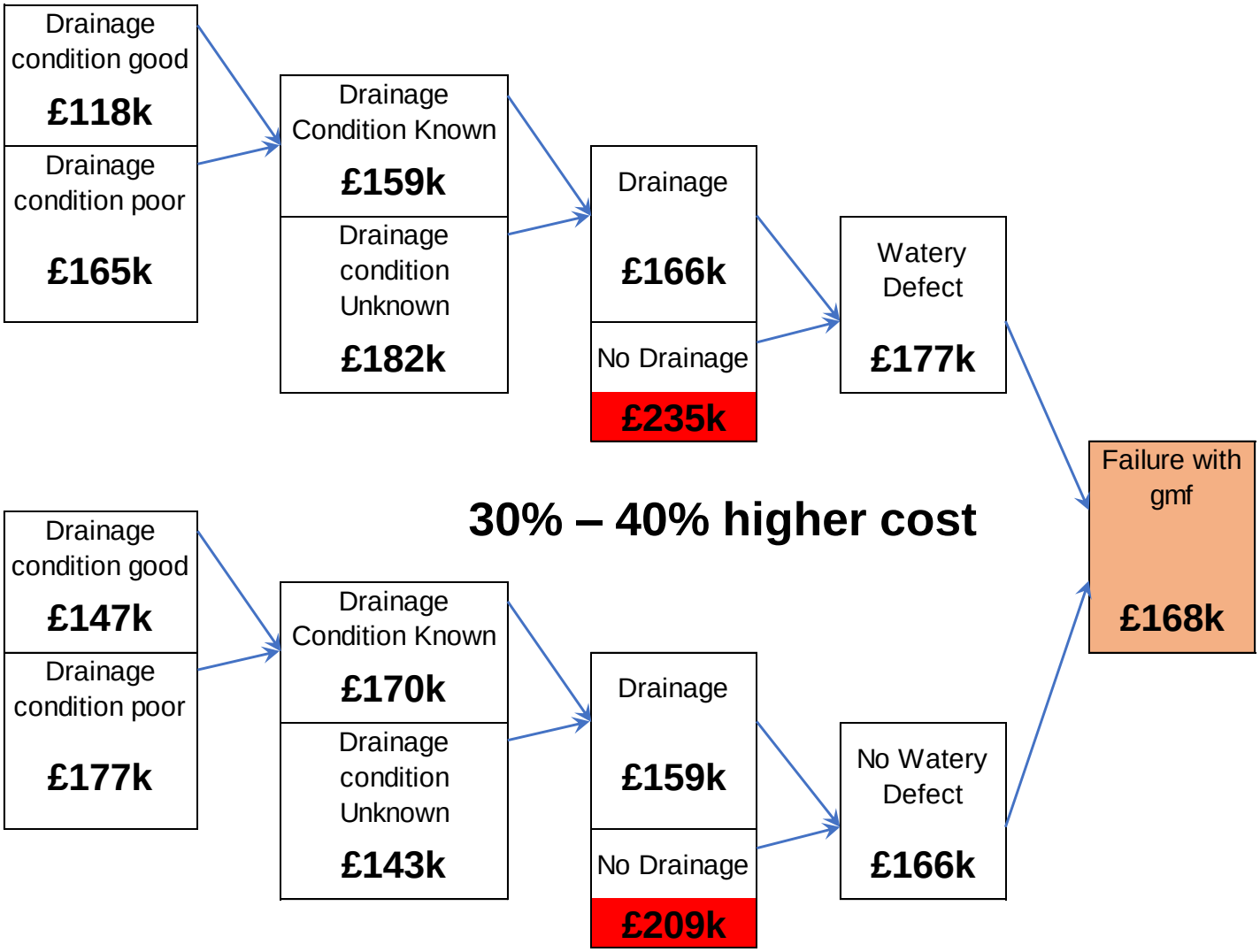
Earthwork – drainage analysis results



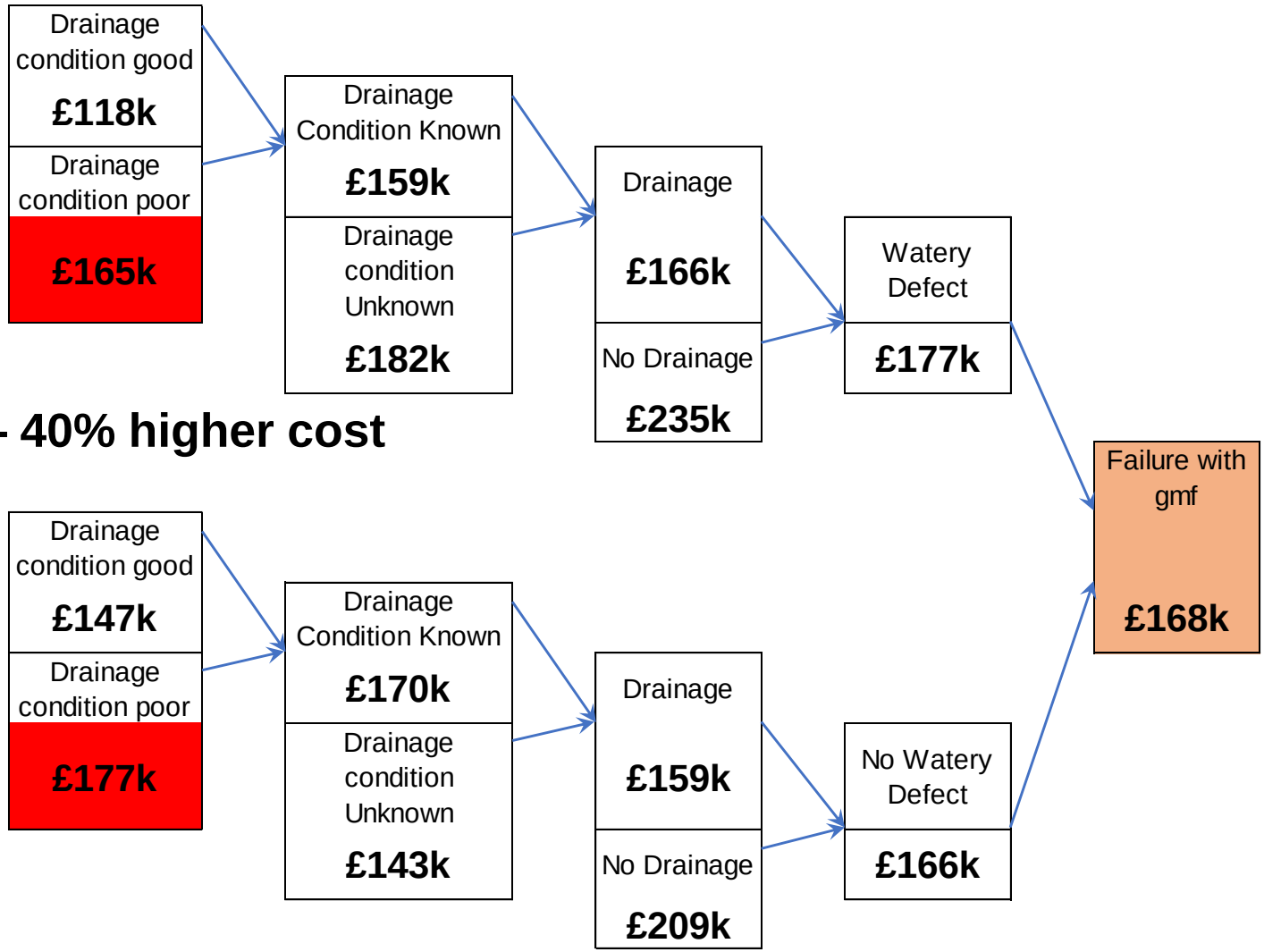
Earthwork – drainage analysis results



Average cost per earthwork failure



Average cost per earthwork failure



20% – 40% higher cost

Conclusions

- Analysis showed 74% of the failures have some drainage related problem
  - Absent/insufficient drainage (6%)
  - Poor condition drainage (68%)