LES RECONNAISSANCES GÉOTECHNIQUES ET DIAGNOSTICS

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Fugro Water Services

Les digues fluviales et maritimes

Journee technique commune CFGI-CFMS-CFMR
Paris, 27 Janvier 2011

CONTENTS

Flood Risk Management – Multi layer strategy

- *mitigation / evacuation*
- *spatial planning*
- ***prevention***

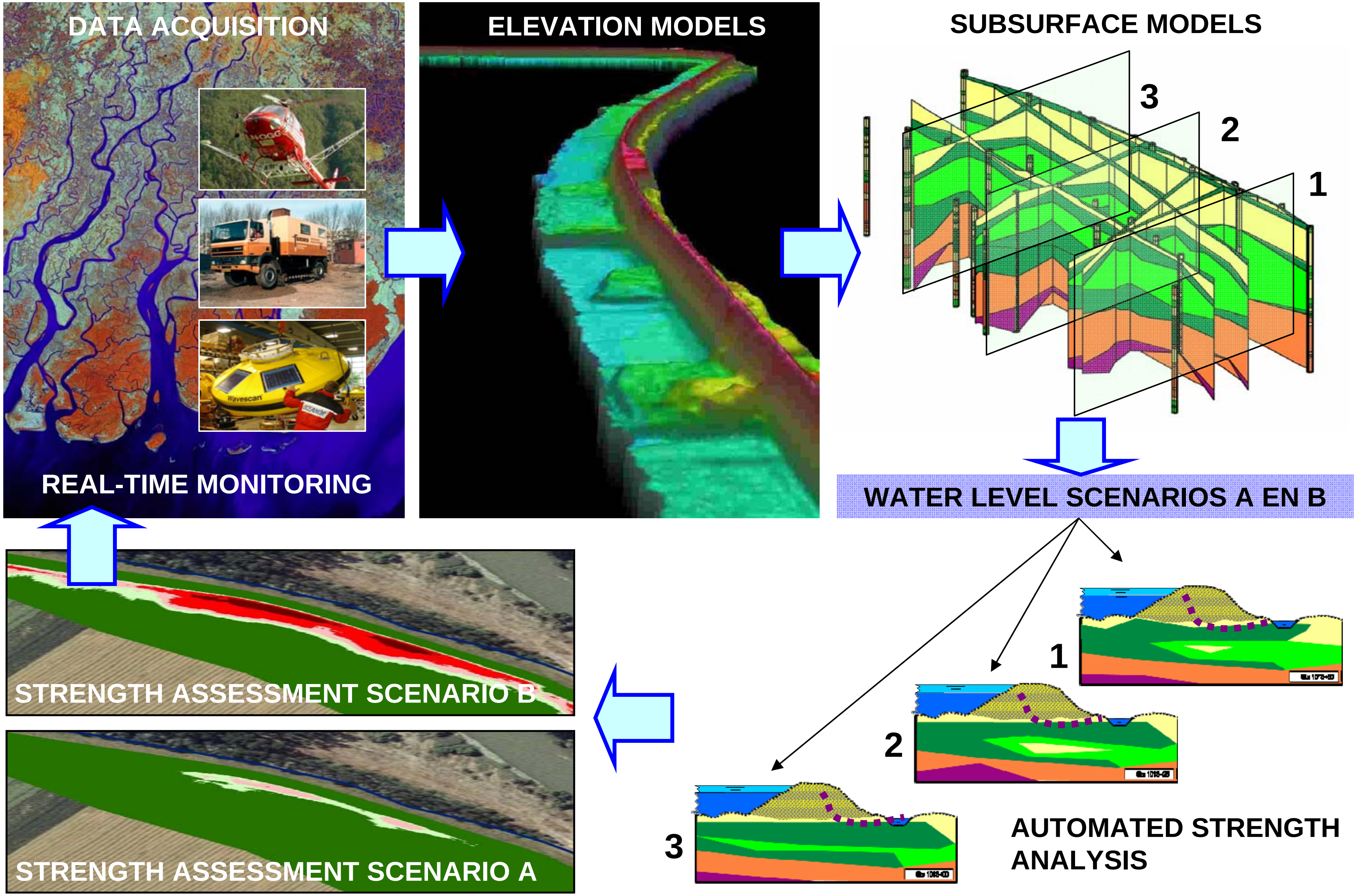
Knowledge Transfer Floods NL vs USA

Geo Hazard	*Prevention*	*Spatial Planning*	*Mitigation & Emergency Management*
Floods	EU ⟷		USA
Earthquakes			
Landslides			
Mudflows			
Etc.			
Etc.			


Flood Control
2015
SOLUTIONS FOR *SMART* FLOOD CONTROL
Stichting IJkdijk
0,235
0,217
0,199
0,181
mNAP
ITC
TNO
FUGRO
IBM
Deltares
ROYAL HASKONING
consultants architecten ingenieurs
HKV LIJN IN WATER
ARCADIS
Infrastructure, environment, buildings
> LOADS
> STRENGTH
> DECISIONS
WWW.FLOODCONTROL2015.COM >

CONTENTS

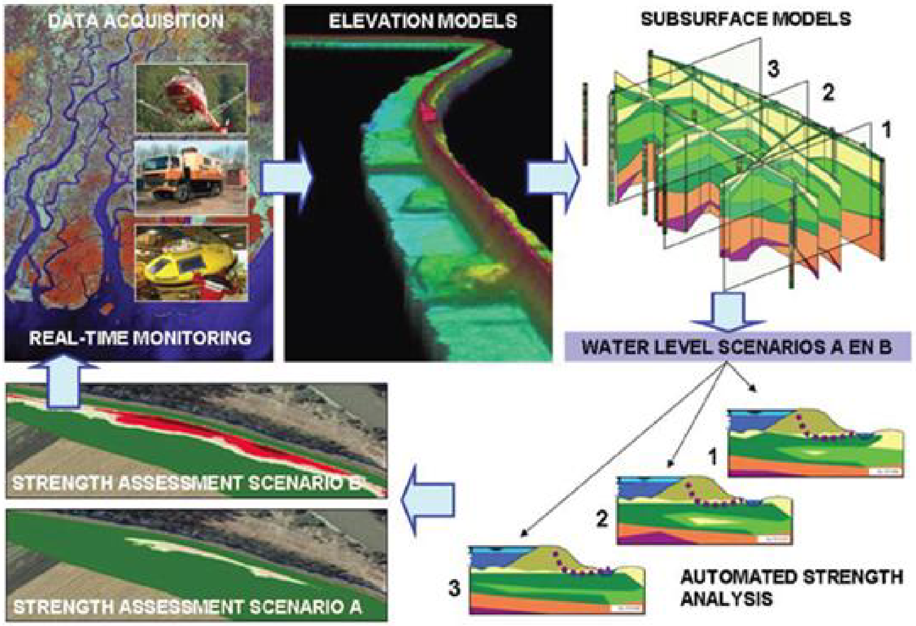
REAL® Rapid Engineering Assessment of Levees



Innovations

- MotionMap
- REAL
- Trees on levees

REAL TM Levee Control



Flood prevention managers base decisions and policies - along with other matters - on river forecast systems and identified risks. Most assessment programs however do not address the geotechnical levee failure mechanisms. The REAL™ (Rapid Engineering Assessment of Levees) method incorporates the levee's geotechnical failure mechanisms to get a clear view on levee safety risks and thus improving flood risk management. REAL™ is based on the repetitive character of the evaluations for large stretches of levees and the need to perform these assessments, both efficiently and economically.

REAL™ is a GIS based automated levee assessment method which enables FAST4DMAP® grid analyses and batch processing (developed by Deltares) of different failure mechanisms using sophisticated algorithms, surface and subsurface models. The models consist of different types of data (LiDAR, HEM, boreholes, CPT's and water levels).

REAL™ enables:

- Systematic consistency in studying the different levee failure mechanisms
- Multi water level analyses, such as high event scenarios
- Quick insight in altered assumptions and insights in physical phenomena

Contacts

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Downloads

- Brochure Pilot FAST4DMAP
- Article CrossSection Real Thing
- Article Flood Protection River Elbe
- Presentation Comparison Dikes Dutch USA
- Article Risk assessment of dikes
- Article Comparison of Dutch and American Levee Safety Approach
- Poster FAST4DMAP Hungary
- REAL General Brochure

Dike ring 10 'Mastenbroek', NL

Dike ring 10 ‘Mastenbroek’, NL

Dike ring 10 'Mastenbroek', NL

- *total dike length 48 km*
- *decomposed to 70 sections*
- *consulting safety maps?*

Base Data

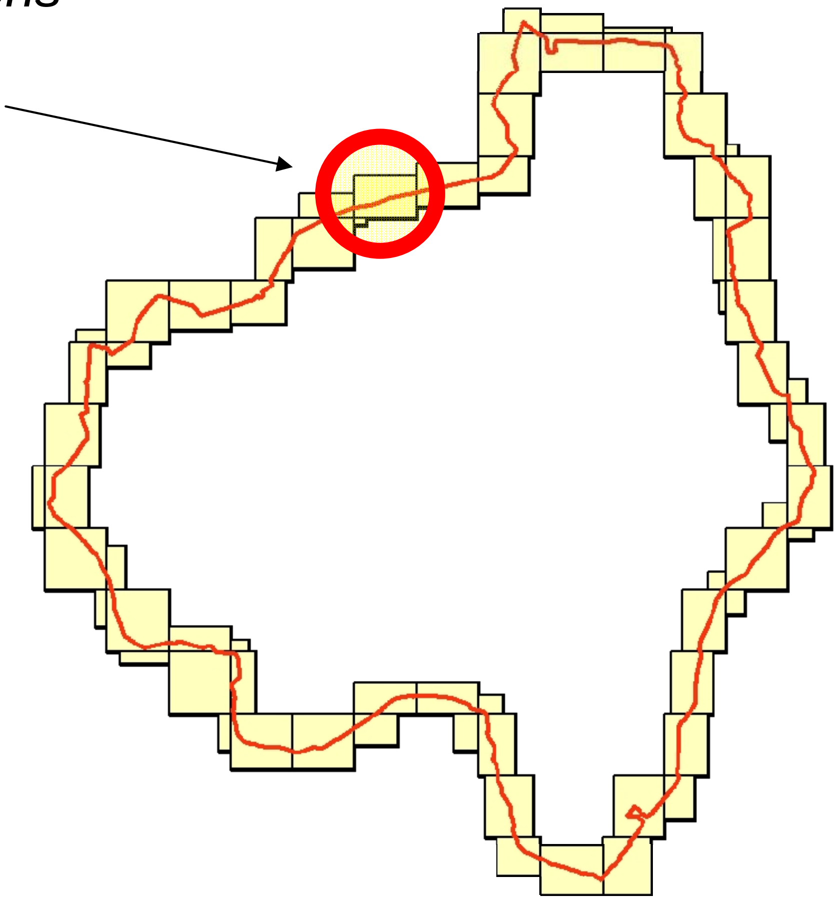
- ❑ *Dike DTM & Geo data*
- ❑ *Subsoil model*
- ❑ *Hydro geological model*

Mechanisms & models

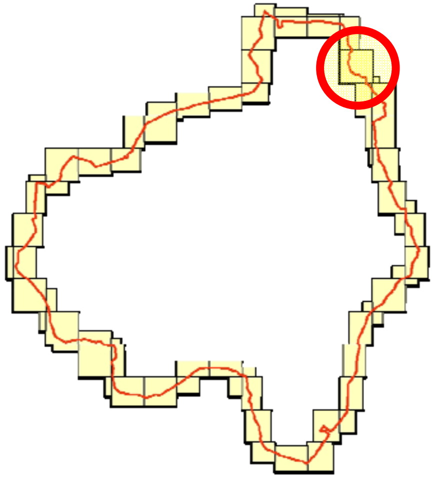
- ❑ *Uplift / heave*
- ❑ *Underseepage / piping*
- ❑ *Slope stability*
- ❑ *(…)*

Conditions

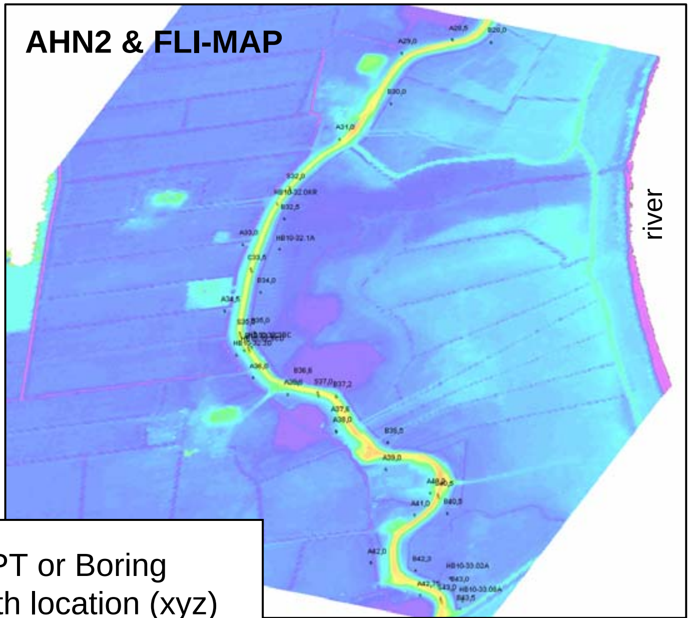
- ❑ *Fixed water level*
- ❑ *Rising water level*
- ❑ *(…)*



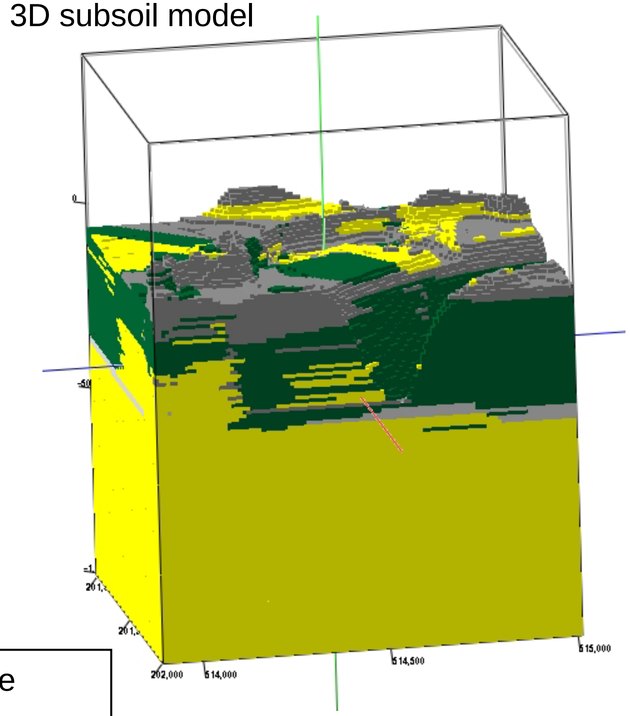
Data & Subsoil Model



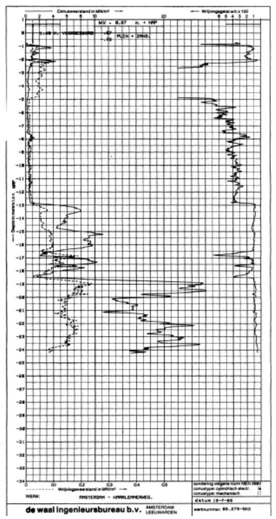
AHN2 & FLI-MAP



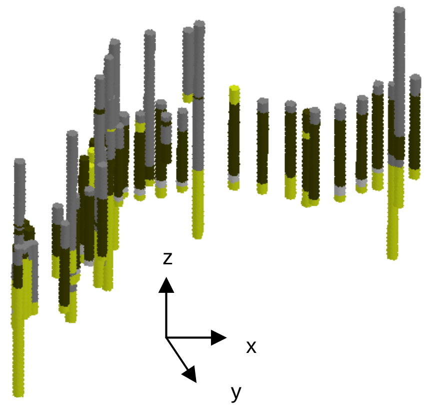
3D subsoil model



CPT or Boring
with location (xyz)



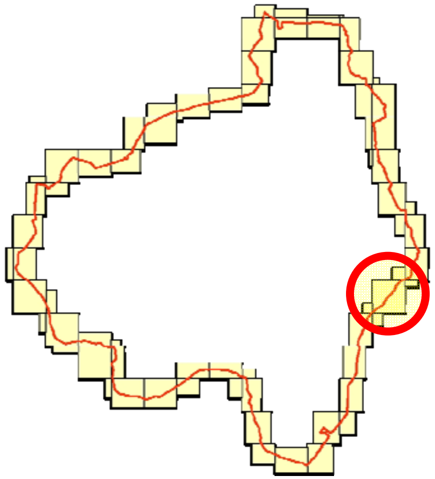
Model of de cpt/ borings in place



Lithology

- klei
- leem
- veen
- zand

Piping / Specifications

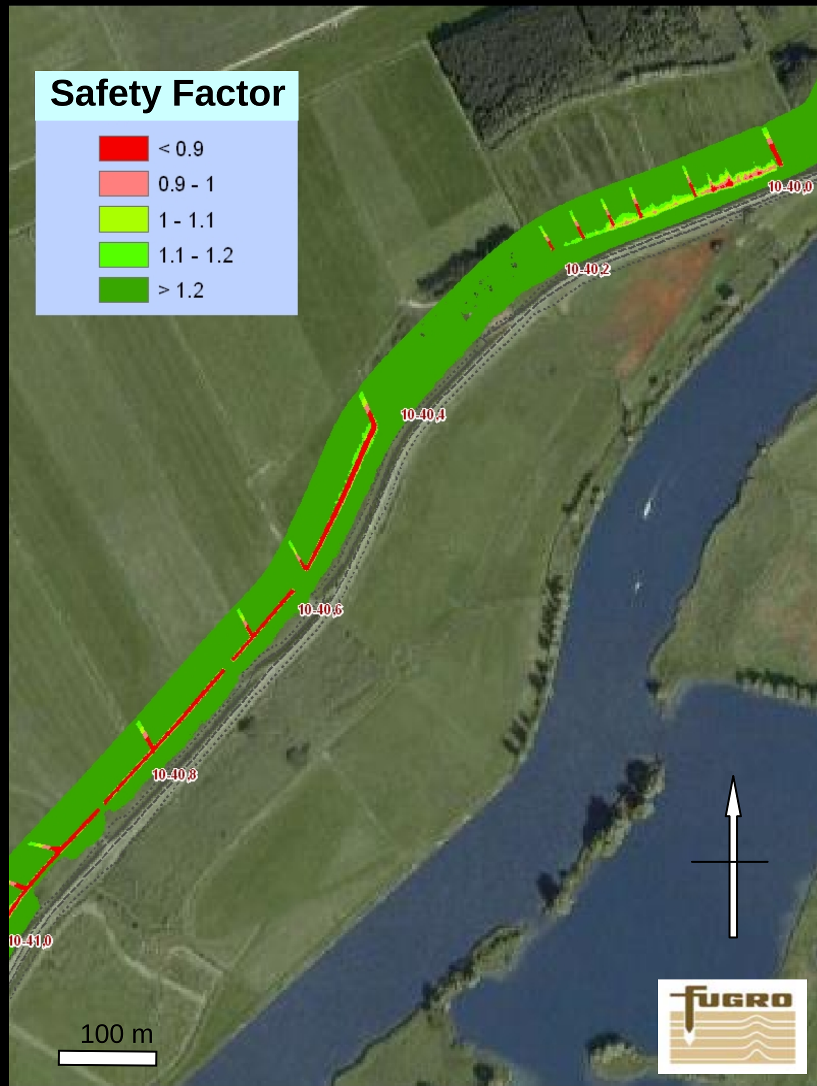


Mechanism & model

- ☐ Uplift
- ■ Piping / Bligh
- ☐ Piping / Sellmeijer old
- ☐ Piping / New model NL
- ☐ Slope Stability / simple
- ☐ Overtopping / simple
- ☐ ...

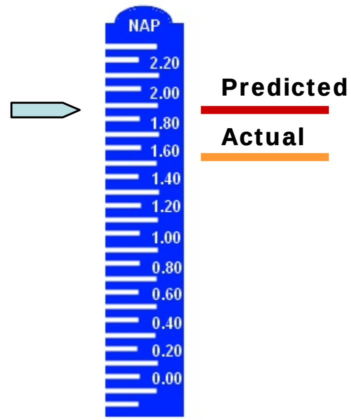
Settings

Creep factor Bligh	:	15
Entrance line	:	outer toe
Seepage length margin	:	0 m
Top layer heave factor	:	0,6
Top layer margin	:	0 m
Hydraulic Response	:	70%
Ditch level	:	NAP -1,3m
Traffic load	:	-



Water Level

- ☐ Free selection
- ■ Predicted
- ☐ Actual...



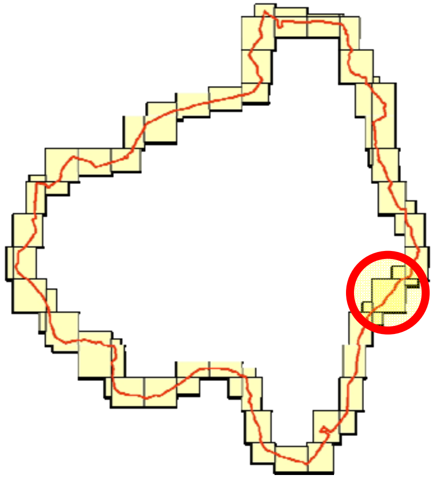
Present as ...

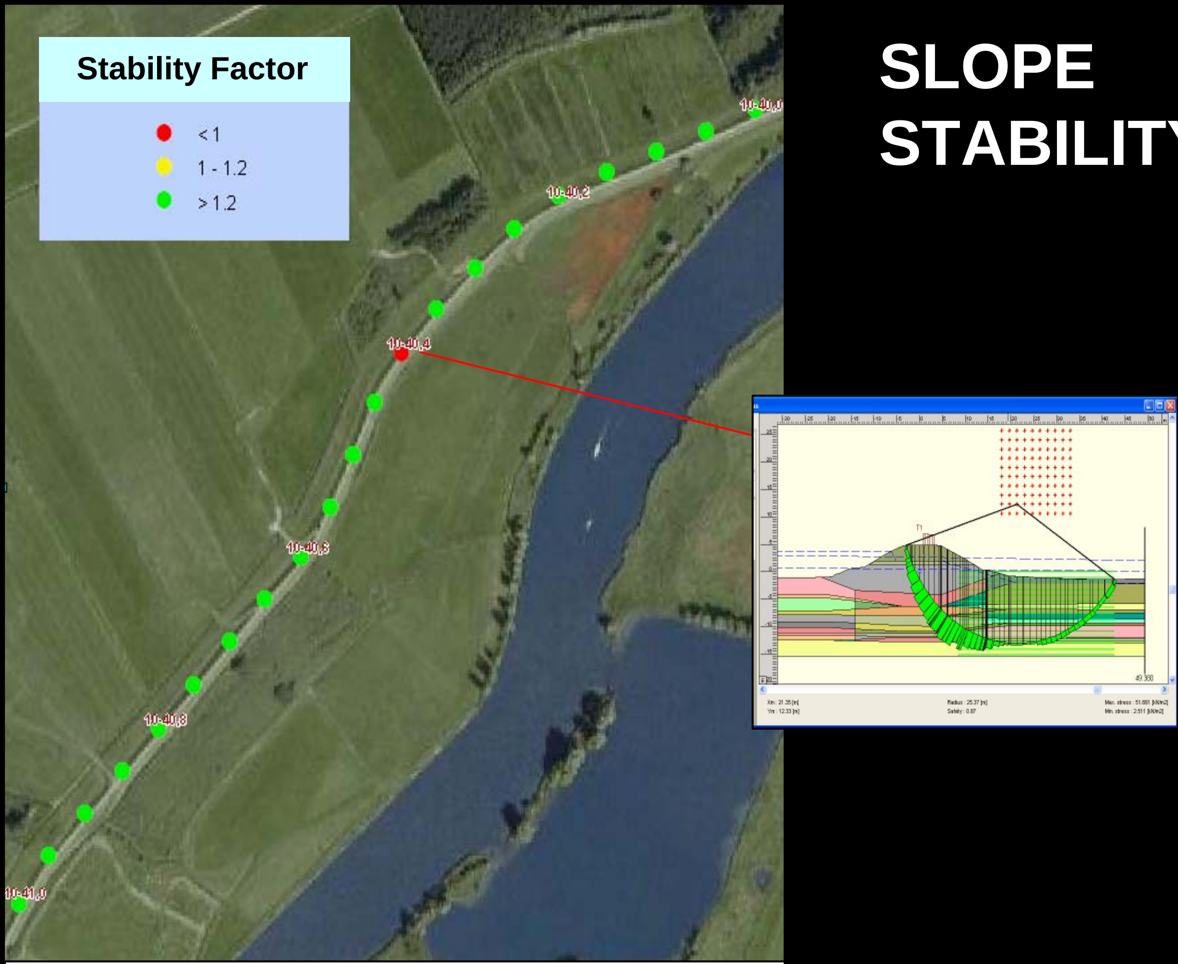
- ■ Safety Factor (-)
- ☐ Surface Deficit (m)
- ☐ Failure Probability (1/y)
- ☐ ...

Show also ...

- ☐ Flooded foreland
- ☐ Safety Report
- ☐ Inspection Results
- ☐ DAM calculations

Slope Stability / Fixed water level





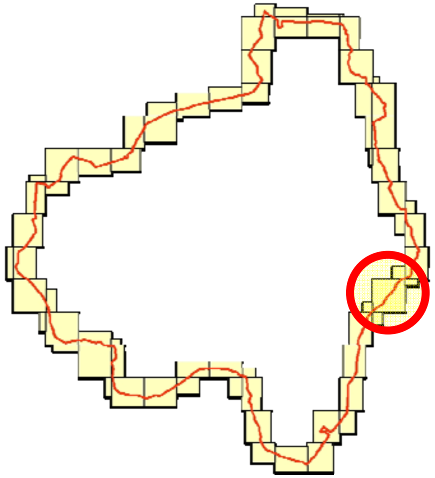
SLOPE STABILITY

DAM module

Automated MStab Slope Stability Calculations

Deltares
Enabling Delta Life

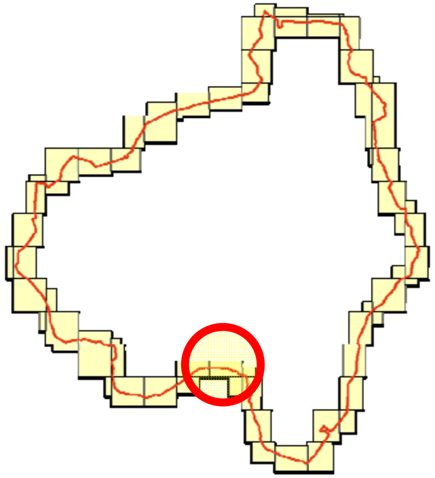
Uplift & Piping / Rising water level



UPLIFT

PIPING

Piping / Sensitivity Analysis



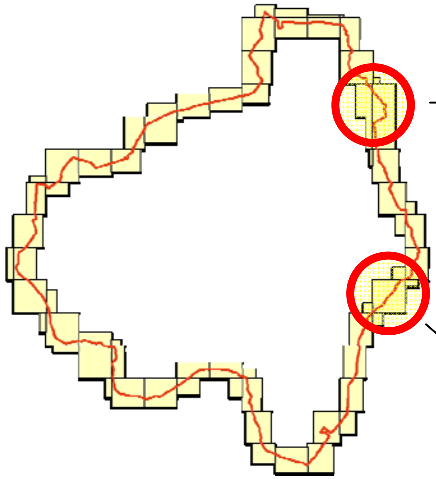
Worst case

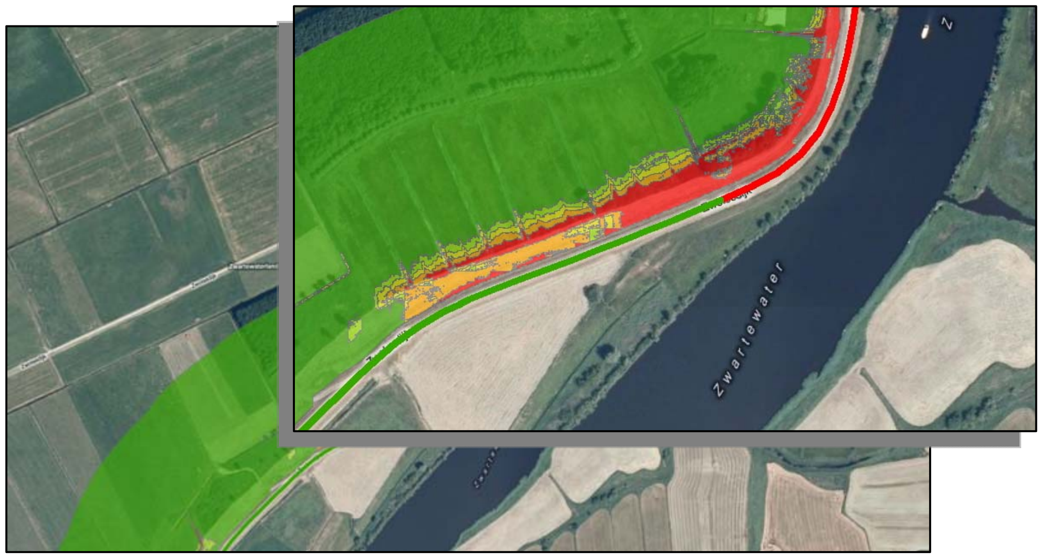
1 / 10,000 water level	+0.3m
Thickness cover layer margin	-0.5m
Creep factor Bligh	21
Response factor groundwater	1.0
Seepage length margin	-5m

Best case

1 / 2,000 water level	0
Thickness cover layer margin	+0.5m
Creep factor Bligh	15
Response factor groundwater	0.6
Seepage length margin	+5m

Piping / Fixed water level / Safety Report

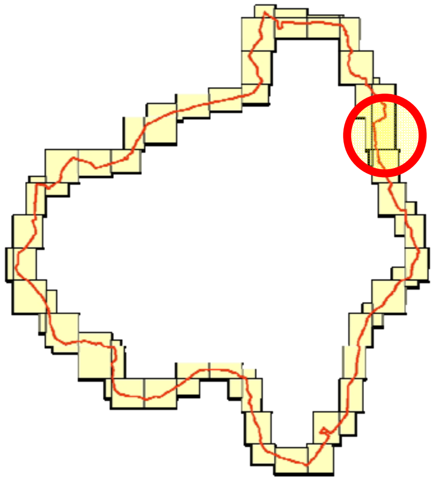




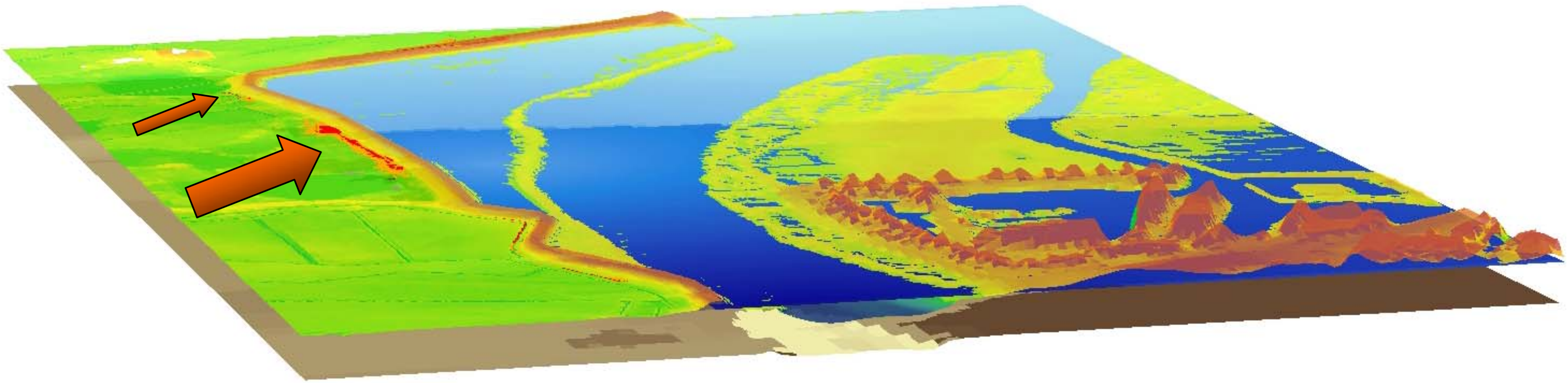
Settings

1/2,000 water level	0
Thickness cover layer margin	0
Creep factor Bligh	15
Response factor groundwater	0.7
Seepage length margin	0

Piping / Fixed water level / Flooded foreland



Model of high water conditions



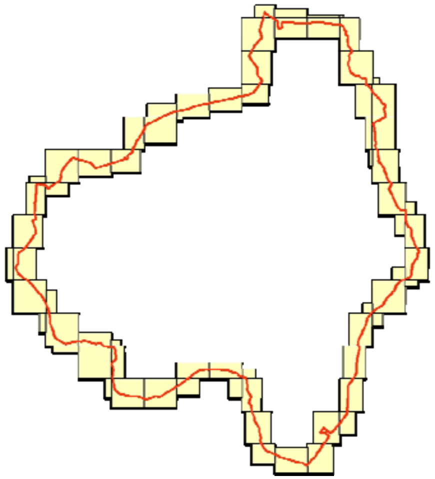
CONCLUSIONS

- ***Integrated Flood Risk Management (prevention, spatial planning and mitigation) needs solid data***
- ***High quality data sets provide added 'users value' when combined and used for REAL® solutions***
- ***See also presentation FLI-MAP & Geo data Rhône river dikes (Sylvain)***

Merci

Back-up slides

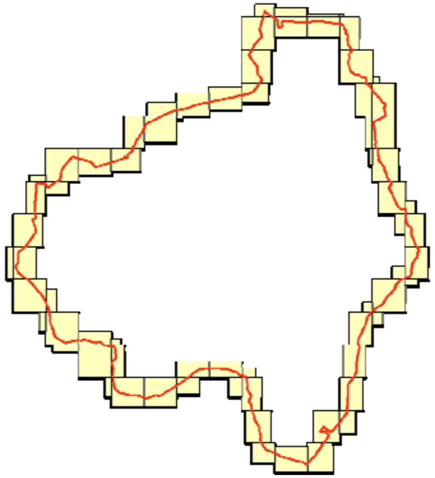
Uplift / Fixed water level / Inspection



Inspection data?

- below / at / above	fixed water level?
- worse / same / better	dike conditions?

GeODin

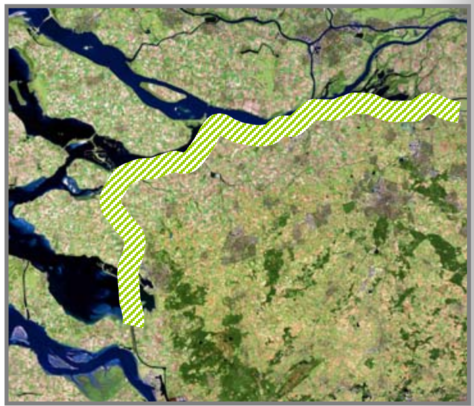


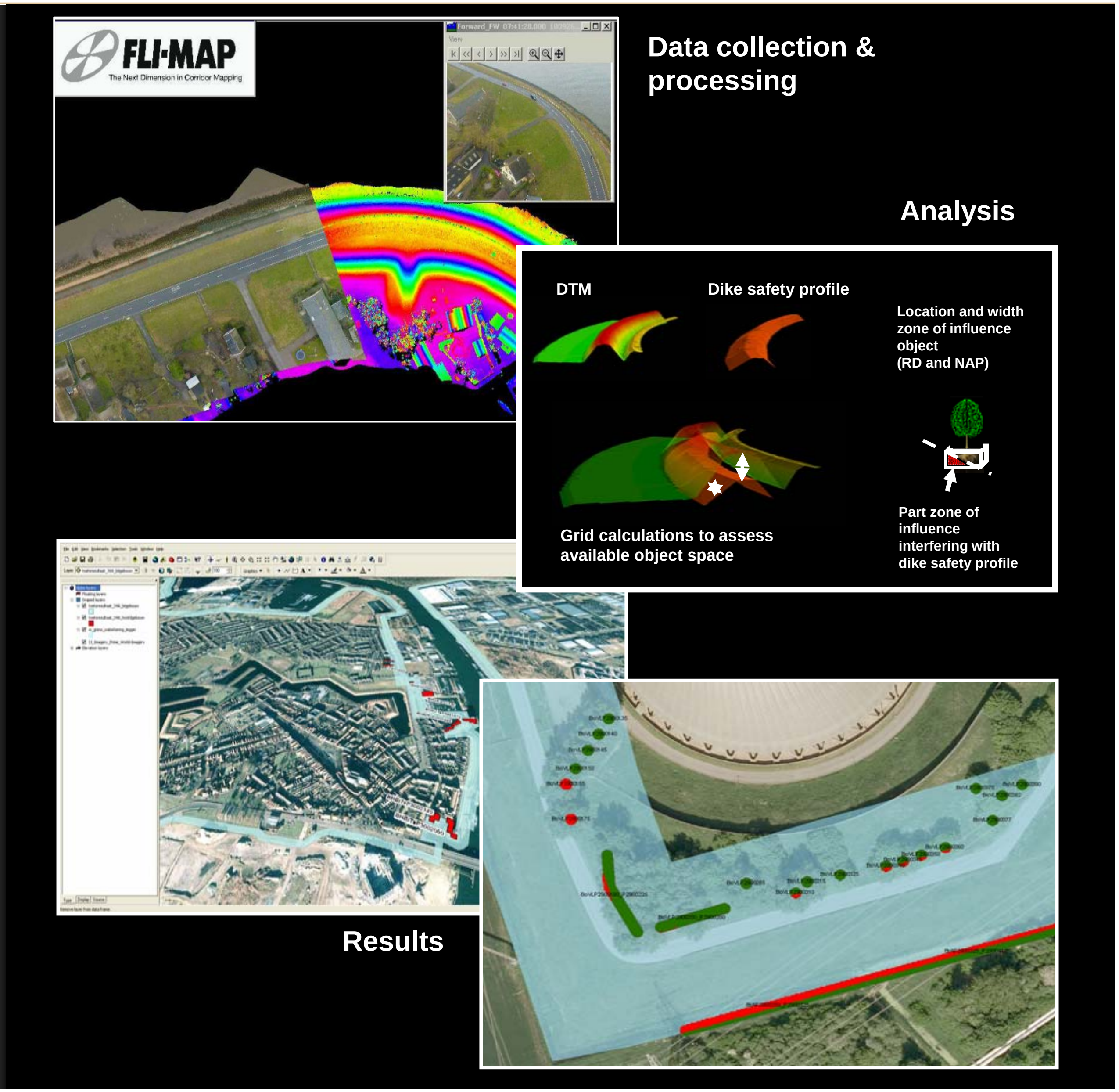
Data?

- bla

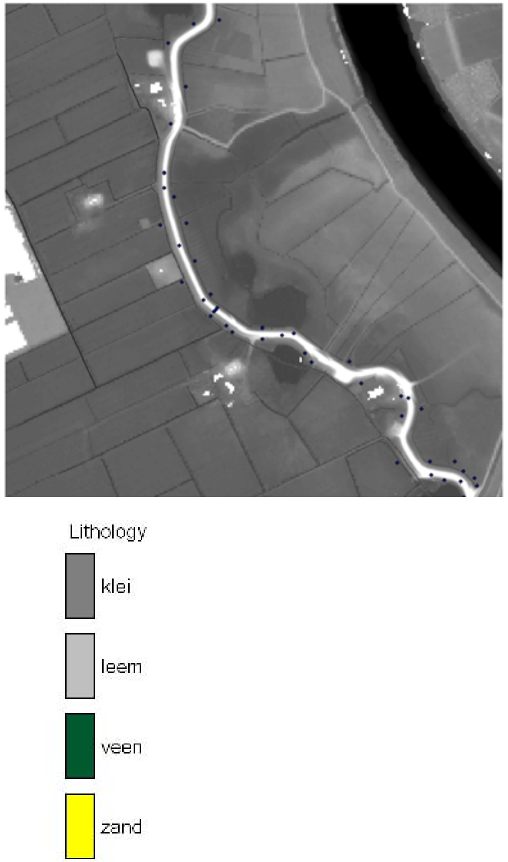
- bla

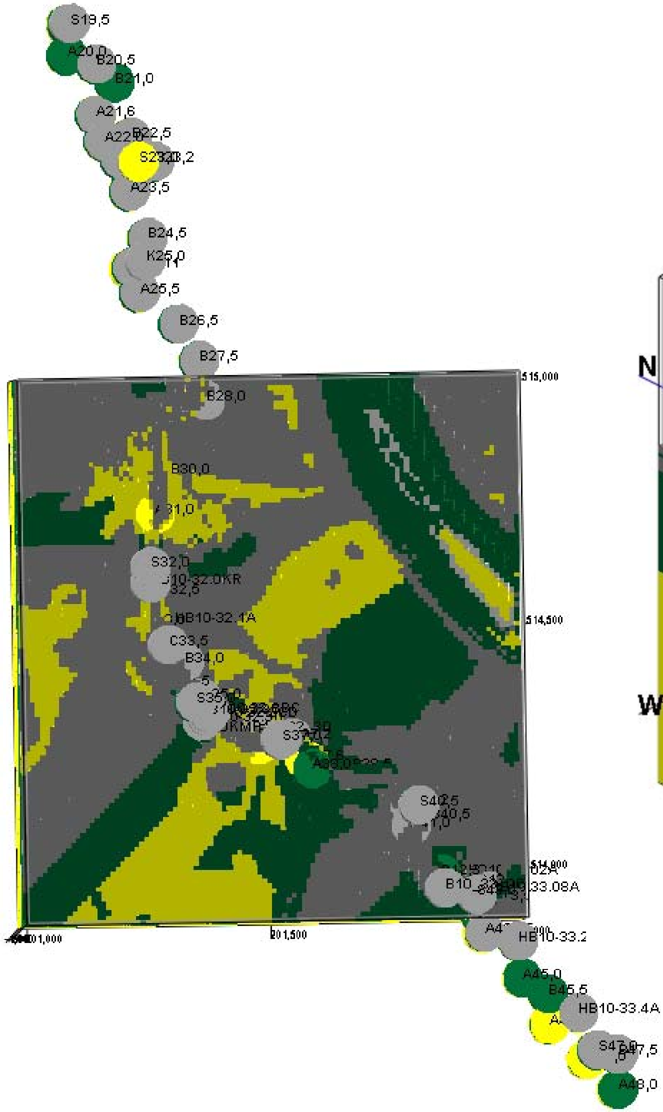
Objects / Tree Risk Mapping

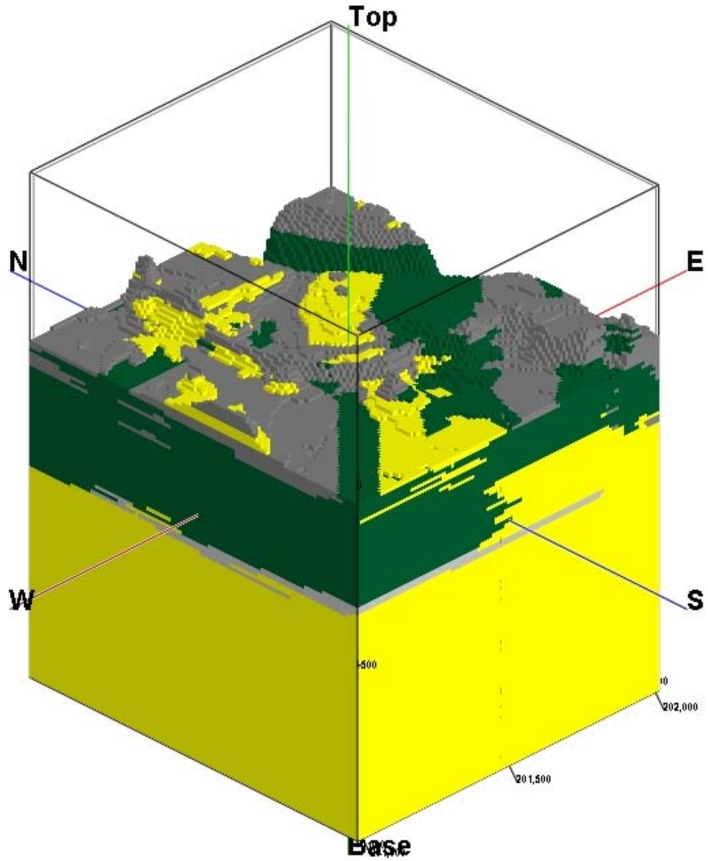




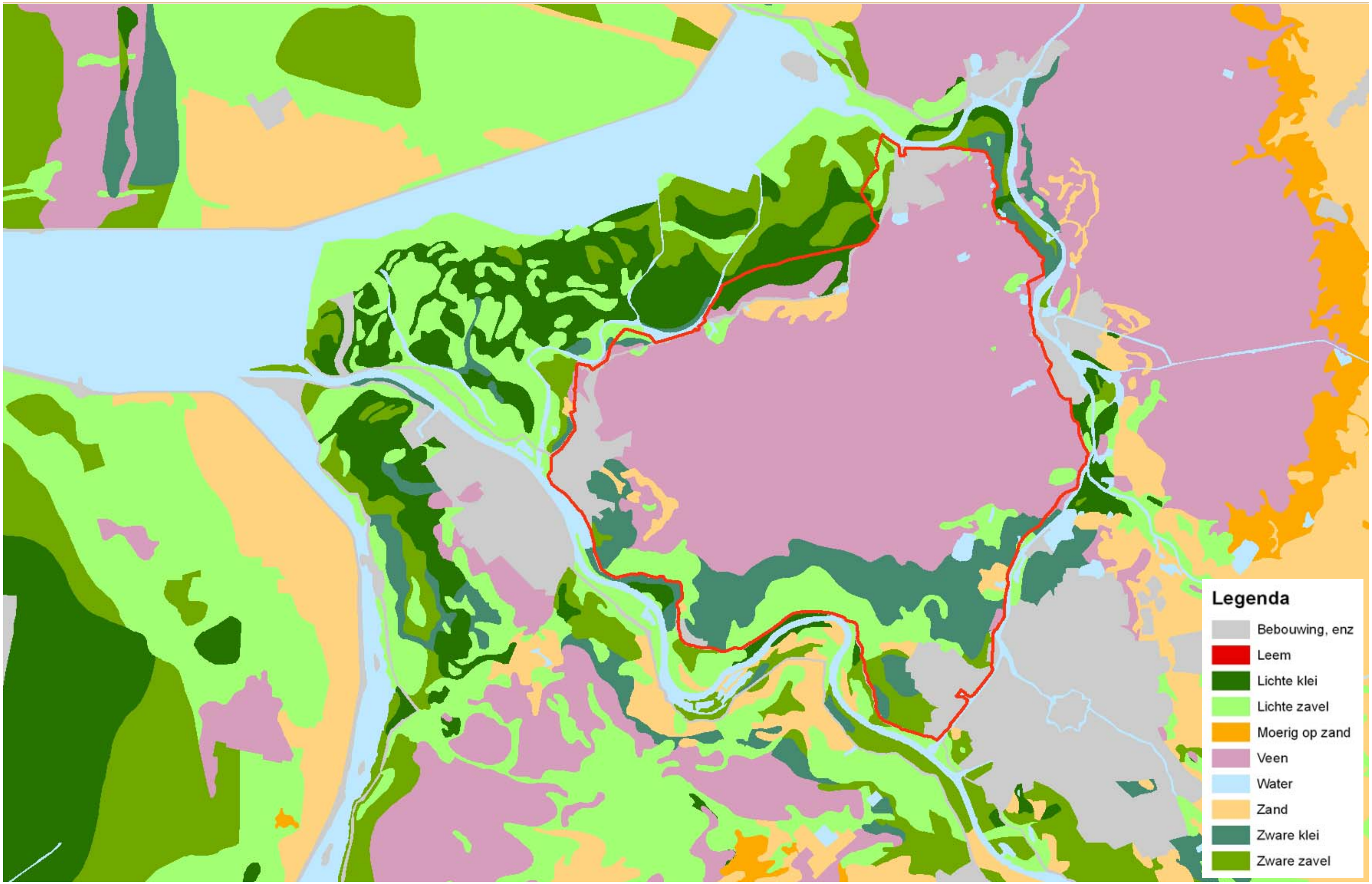
3D subsoil model - validation



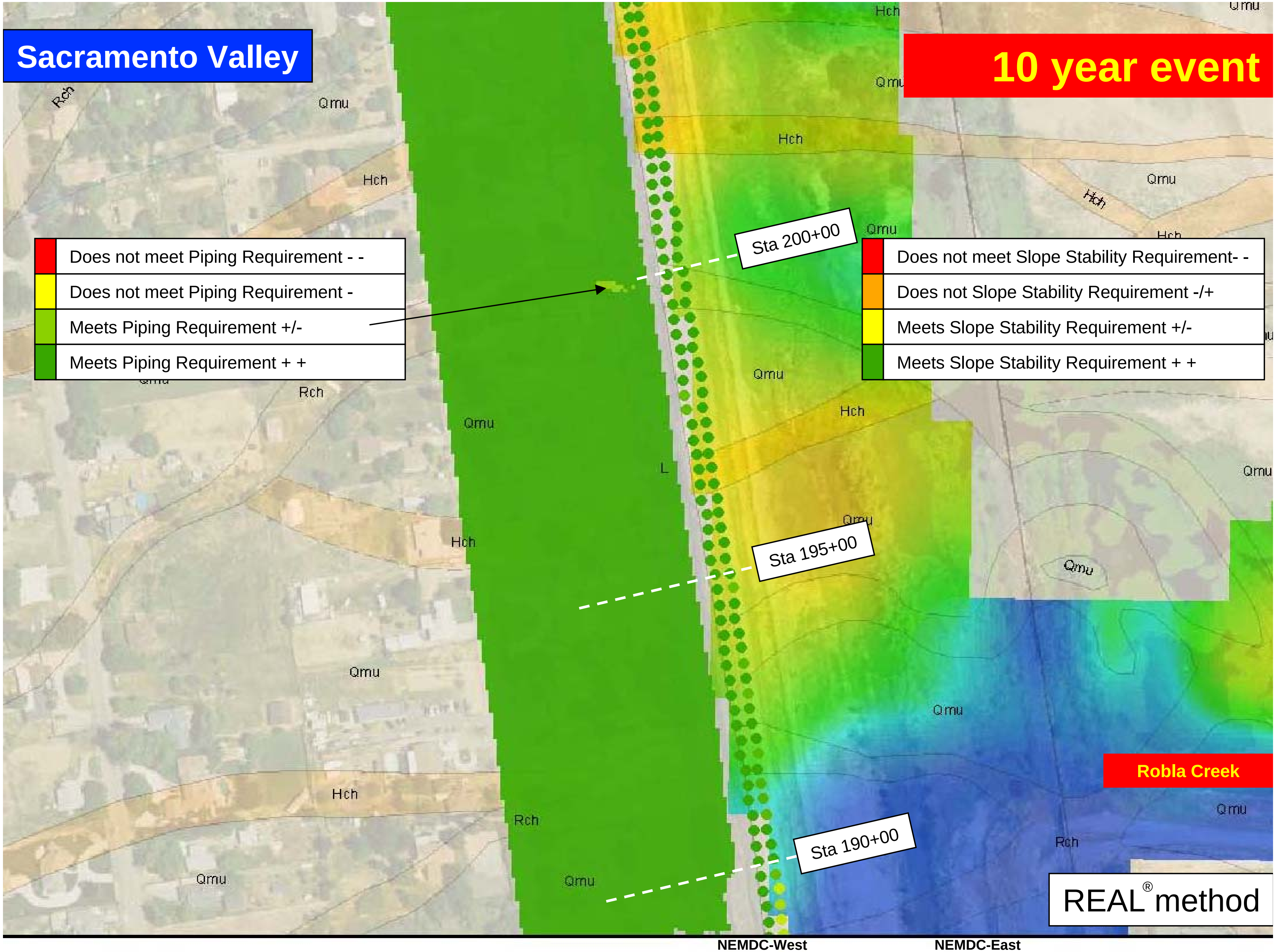


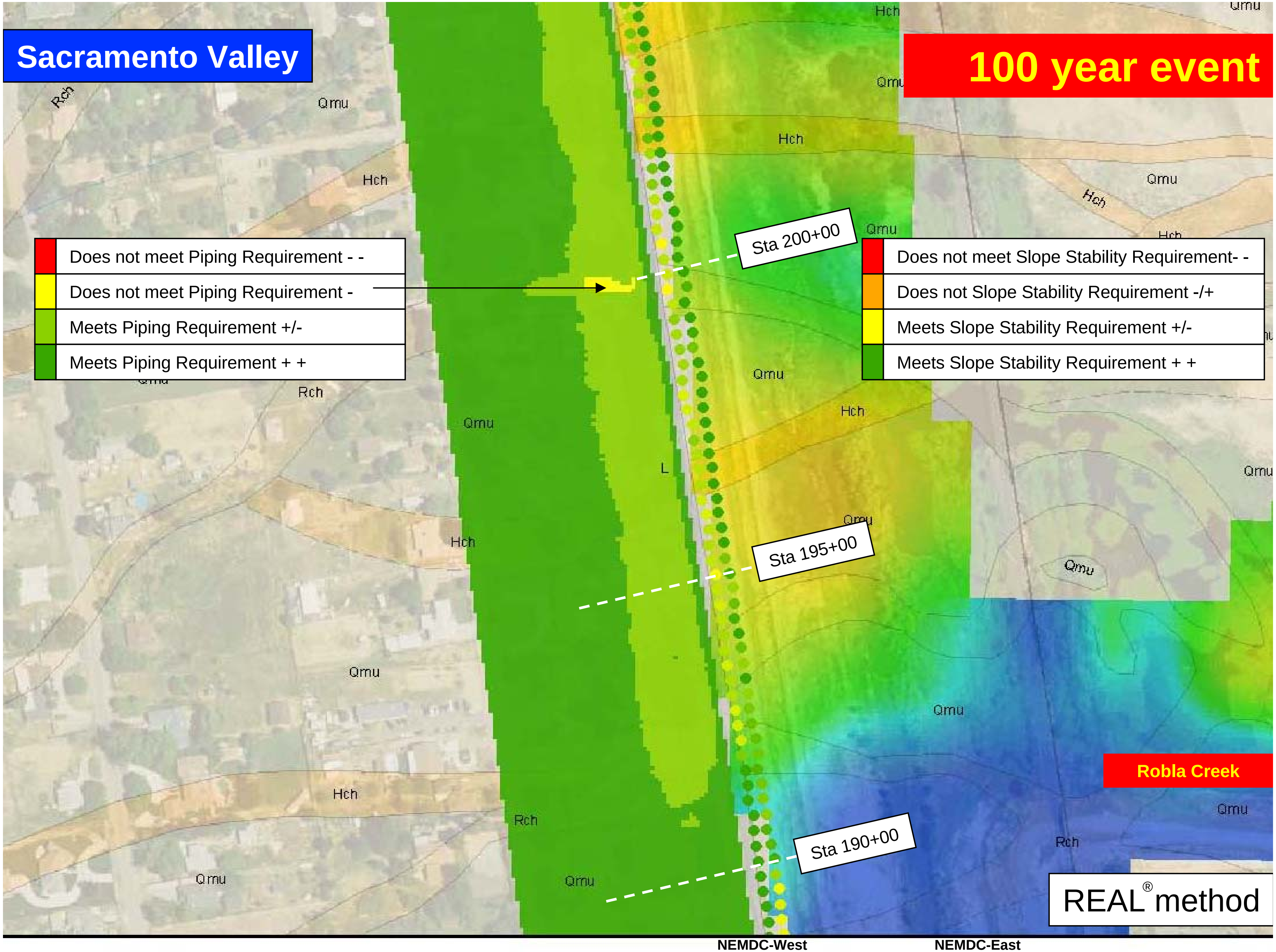


Geological Map - Top layer

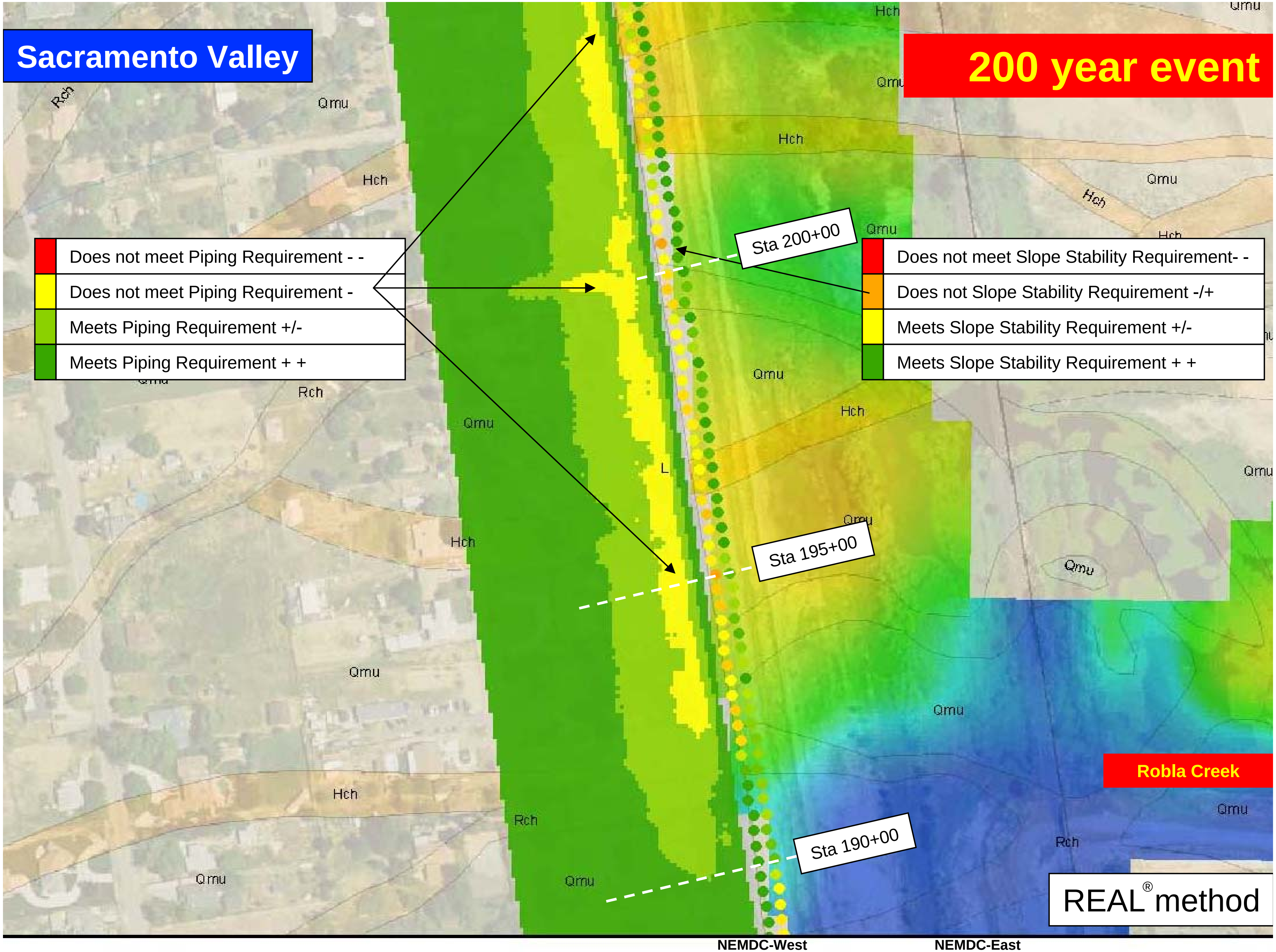


NEMDC-West NEMDC-East


Sacramento Valley
10 year event
Does not meet Piping Requirement - -
Does not meet Piping Requirement -
Meets Piping Requirement +/-
Meets Piping Requirement + +
Does not meet Slope Stability Requirement- -
Does not Slope Stability Requirement -/+
Meets Slope Stability Requirement +/-
Meets Slope Stability Requirement + +
Sta 200+00
Sta 195+00
Sta 190+00
Robla Creek
REAL® method
Qmu
Hch
Rch
L
NEMDC-West
NEMDC-East



Sacramento Valley
100 year event
Does not meet Piping Requirement - -
Does not meet Piping Requirement -
Meets Piping Requirement +/-
Meets Piping Requirement + +
Does not meet Slope Stability Requirement- -
Does not Slope Stability Requirement -/+
Meets Slope Stability Requirement +/-
Meets Slope Stability Requirement + +
Sta 200+00
Sta 195+00
Sta 190+00
Robla Creek
REAL® method
NEMDC-West
NEMDC-East



Sacramento Valley
200 year event
Does not meet Piping Requirement - -
Does not meet Piping Requirement -
Meets Piping Requirement +/-
Meets Piping Requirement + +
Does not meet Slope Stability Requirement- -
Does not Slope Stability Requirement -/+
Meets Slope Stability Requirement +/-
Meets Slope Stability Requirement + +
Sta 200+00
Sta 195+00
Sta 190+00
Robla Creek
REAL® method
Qmu
Hch
Rch
NEMDC-West
NEMDC-East

Geo Risk Management – Leading countries

Geo Hazard	*Prevention*	*Spatial Planning*	*Mitigation & Emergency Management*
Floods	NL		USA
Earthquakes		USA	
Landslides	HK	FR	
Mudflows			
Etc.			
Etc.			