Rockfall in New Jersey:
A proactive and collaborative approach

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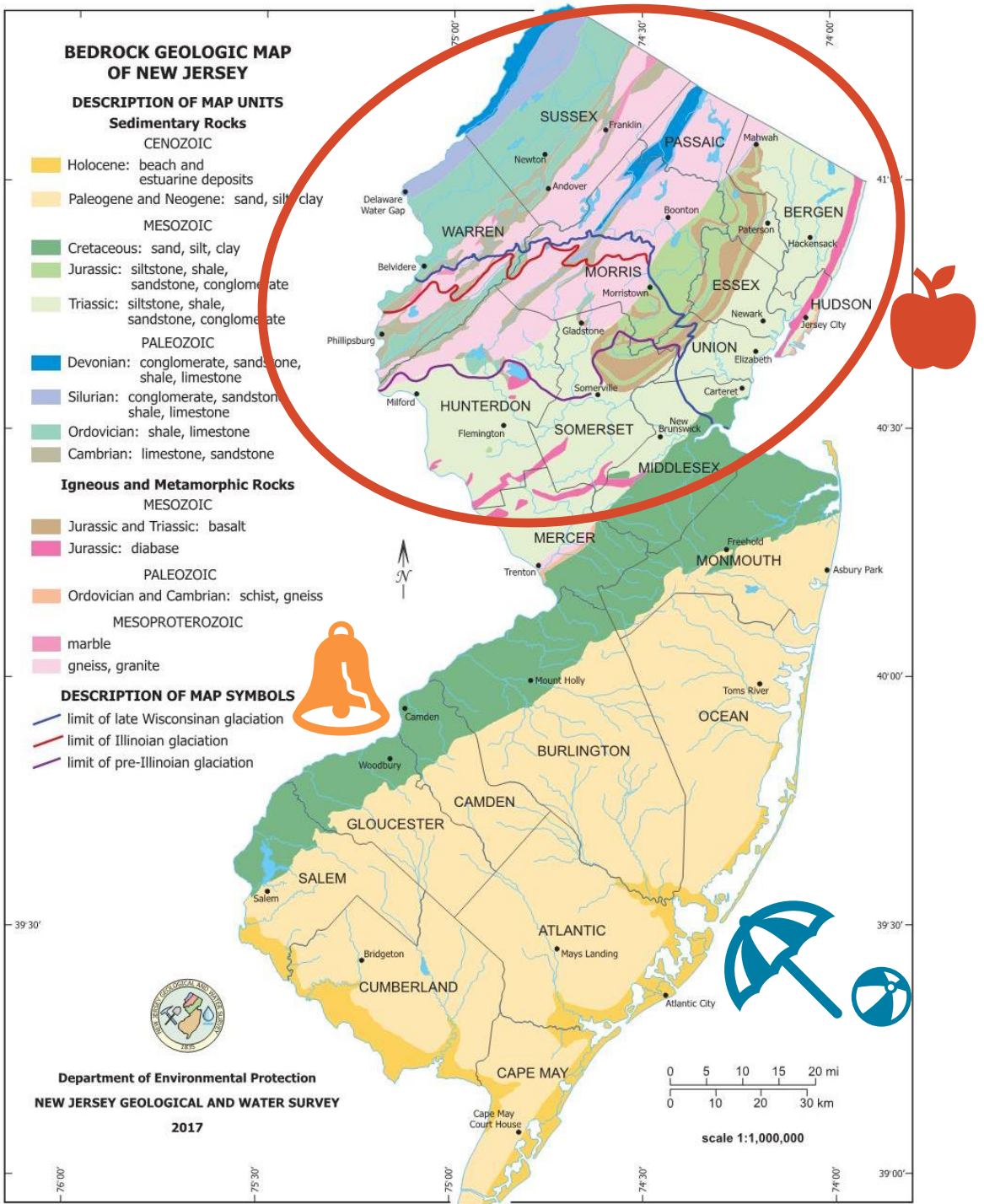
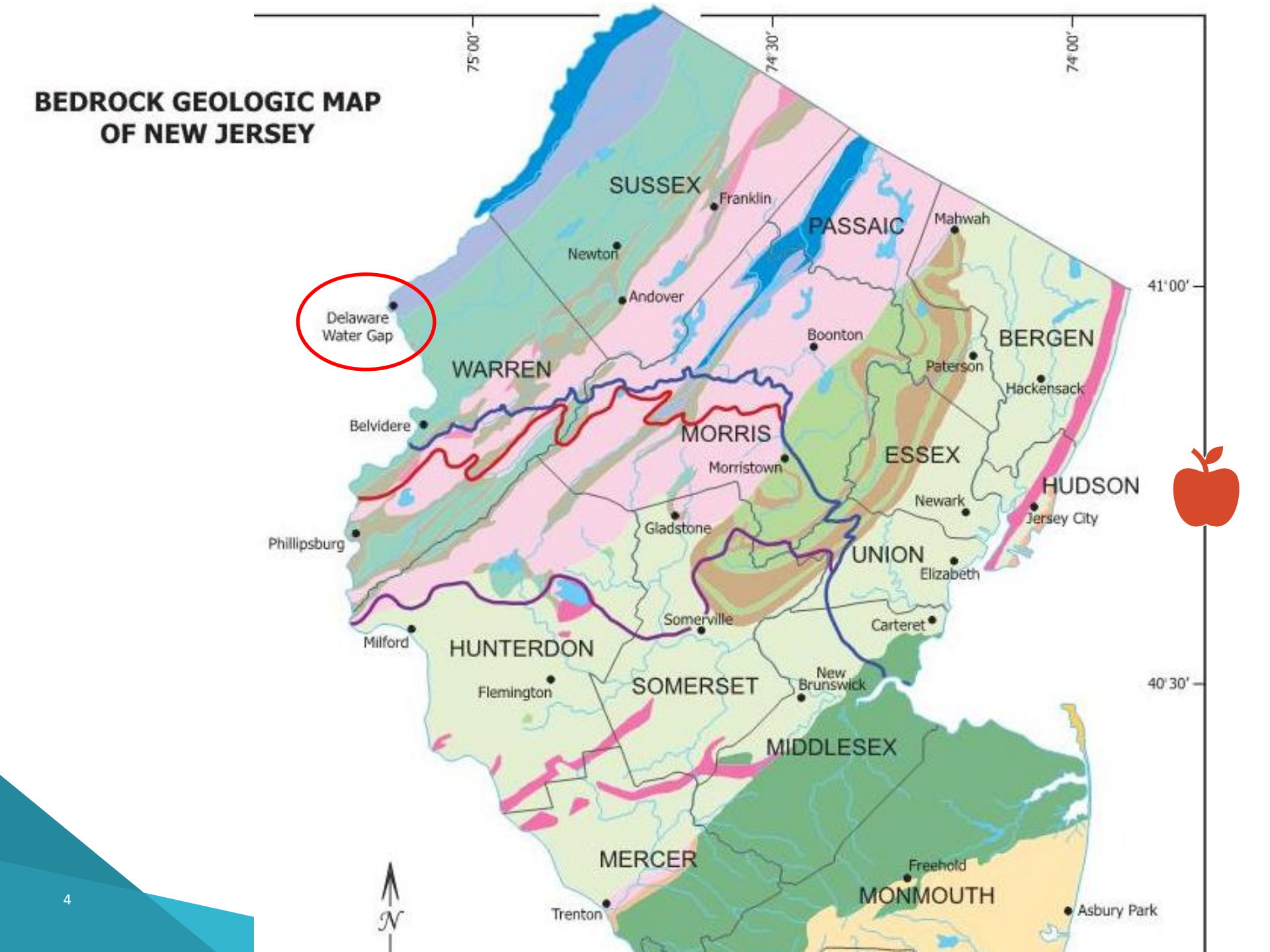
Presentation overview

1. New Jersey geology and rockfall
2. NJDOT Rockfall Hazard Management System
3. Concept Development for rockfall projects
4. Conclusion

New Jersey geology




BEDROCK GEOLOGIC MAP
OF NEW JERSEY
75°00'
74°30'
74°00'
41°00'
40°30'
SUSSEX
Franklin
Newton
Andover
PASSAIC
Mahwah
Delaware
Water Gap
WARREN
Belvidere
Boonton
BERGEN
Paterson
Hackensack
MORRIS
Morristown
ESSEX
Newark
HUDSON
Jersey City
Phillipsburg
Gladstone
UNION
Elizabeth
Somerville
Carteret
Milford
HUNTERDON
Flemington
SOMERSET
New
Brunswick
MIDDLESEX
MERCER
Trenton
Freehold
MONMOUTH
Asbury Park
N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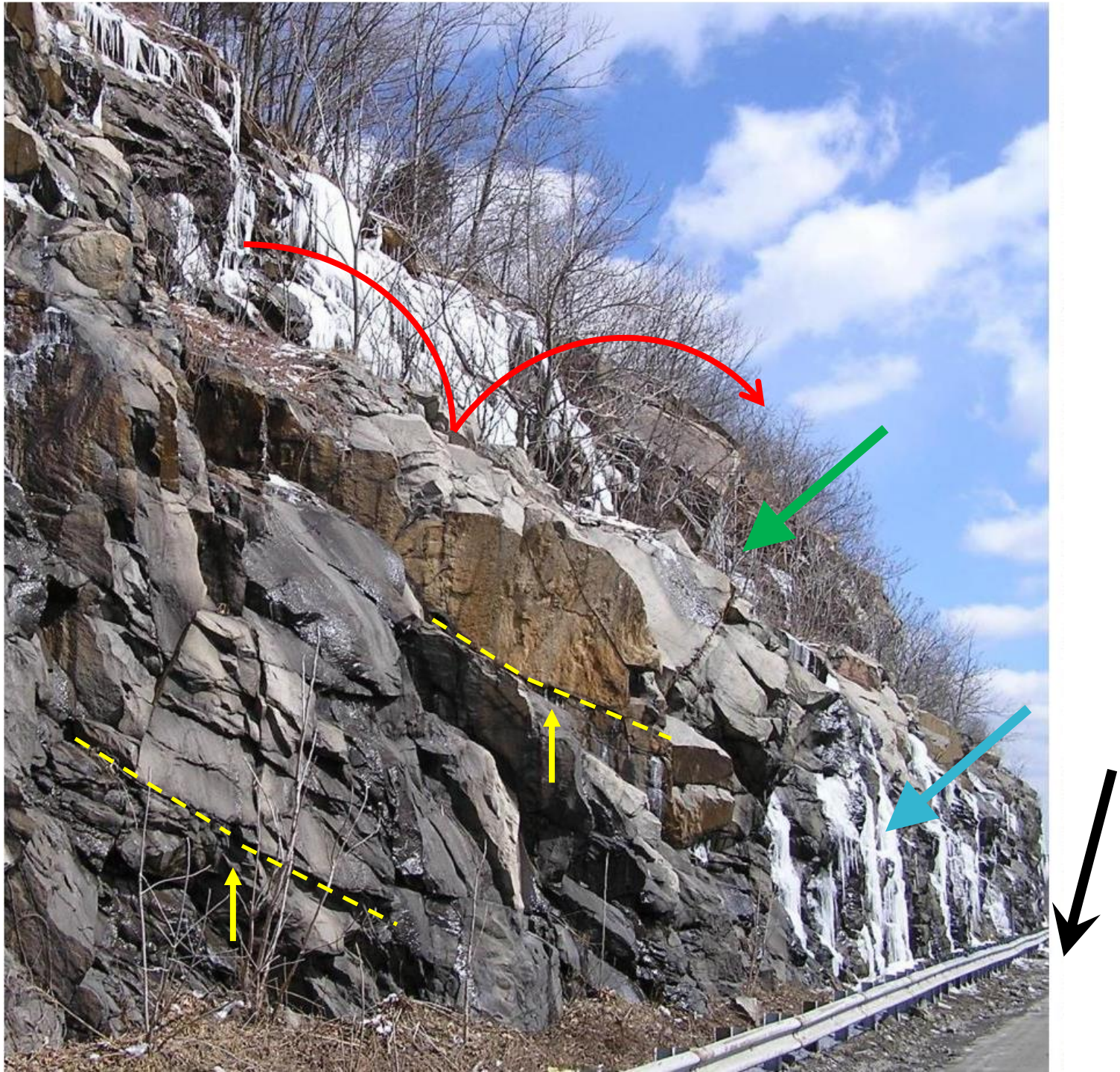
Rockfall hazards and risks



Rockfall Hazard Rating System

- Developed by ODOT, sponsored by FHWA
- Quantifies rockfall hazards and risks
- 2-phase approach
  - Preliminary rating (Class A, B and C)
  - Detailed rating score

Slope height
Ditch effectiveness
Average vehicle risk
Sight distance
Roadway width
Geologic character
Block size
Climate/water
Rockfall history

NJDOT Rockfall Hazard Management System

- >440 State and Interstate highway cut slopes
- Identify and monitor rockfall hazards and risks to traveling public
- Rockfall mitigation project prioritization and development
- Based on RHRS

NJDOT Rockfall Hazard Management System

RHRS Rating Ranking*	Non-Programmed Ranking **	Route	MP	Prelim. Rating	Detailed Rating	Notes/Comments
--		46 WB	1.4 R	C	688	Mitigation Construction Completed 2015
1^		80 WB	1.3 R	A	660	In Preliminary Design 2012
n/a		80 WB	0.5 R	A	636	Outside NJDOT jurisdiction
1^		80 WB	1.15 R	A	630	In Preliminary Design 2012
2		78 EB	10.3 R	A	592	Group 2014-1: PE/FD Assignment #1 (UPC # 153380)
3		29 NB	27.78 R	A	576	Group 2014-1: PE/FD Assignment #2 (UPC # 158020)
4		287 SB/RAMP D	53.0 R	B	573	
5		287 SB	55.6 R	B	555	
6		78 WB	10.3 R	A	515	Group 2014-1: PE/FD Assignment #1 (UPC # 153380)
1^		80 WB	1.4 R	A	512	In Preliminary Design for remediation 2012
7		287 SB	67.4 R	B	507	Catch full of debris-9/2008, mesh and fence intact
8		23 NB	18.8 R	A	503	In Concept Development Group 2016-1
9		15 NB	19.0 R	A	503	In Concept Development Group 2015-1
10		15 SB	5.2 R	A	494	In Concept Development Group 2015-1
11		80 EB	41.0 R	B	488	In Concept Development Group 2015-1
12		29 NB	17.8 R	A	485	In Concept Development Group 2015-1

Concept development for rockfall projects

- Foundation for future project phases
- Builds on RHRS rating
- Preliminary rock engineering analyses
- Approach to rockfall mitigation alternatives:
  - Removal (get rid of it)
  - Stabilization (keep it in place)
  - Protection (let it fall safely)

Removal:
Scaling


Removal:
Blasting/ Excavation

Stabilization:
Rock dowels

Stabilization:
Anchored mesh

Stabilization

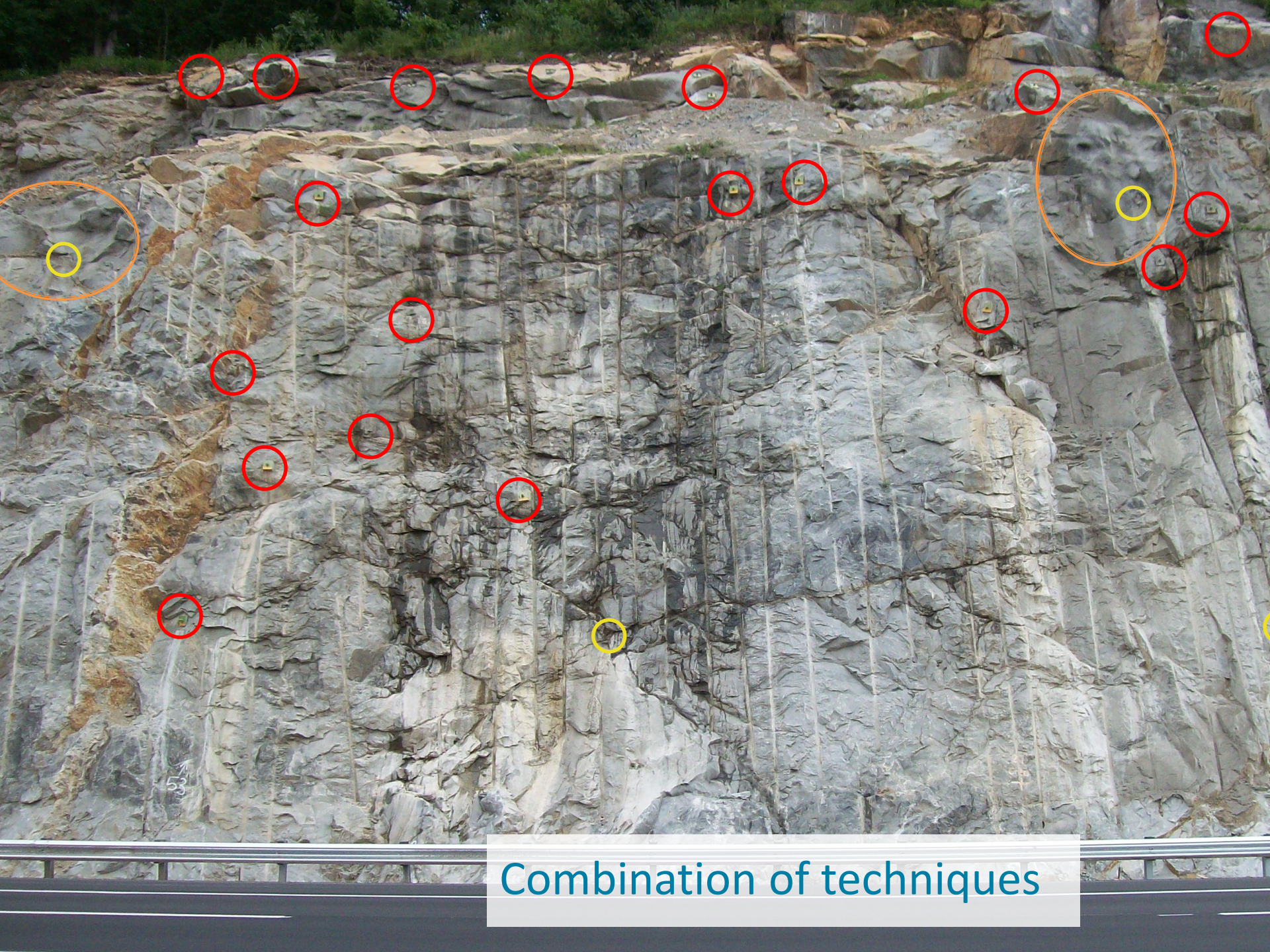
Cable lashing

Shotcrete/ concrete buttress

Protection:
Rockfall barrier fencing

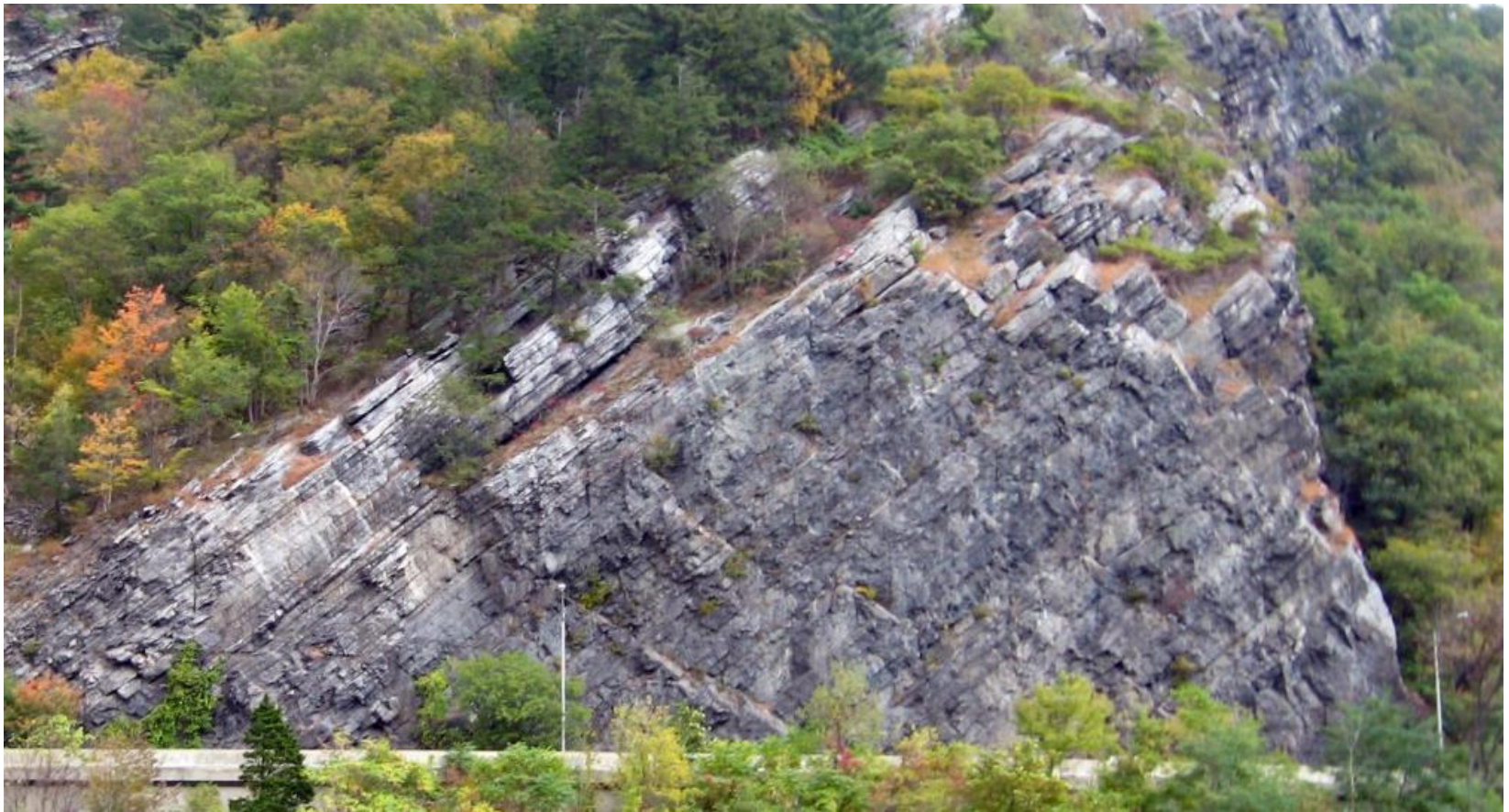
Protection:
Rockfall catchment ditch


Protection:
Draped mesh system


Combination of techniques

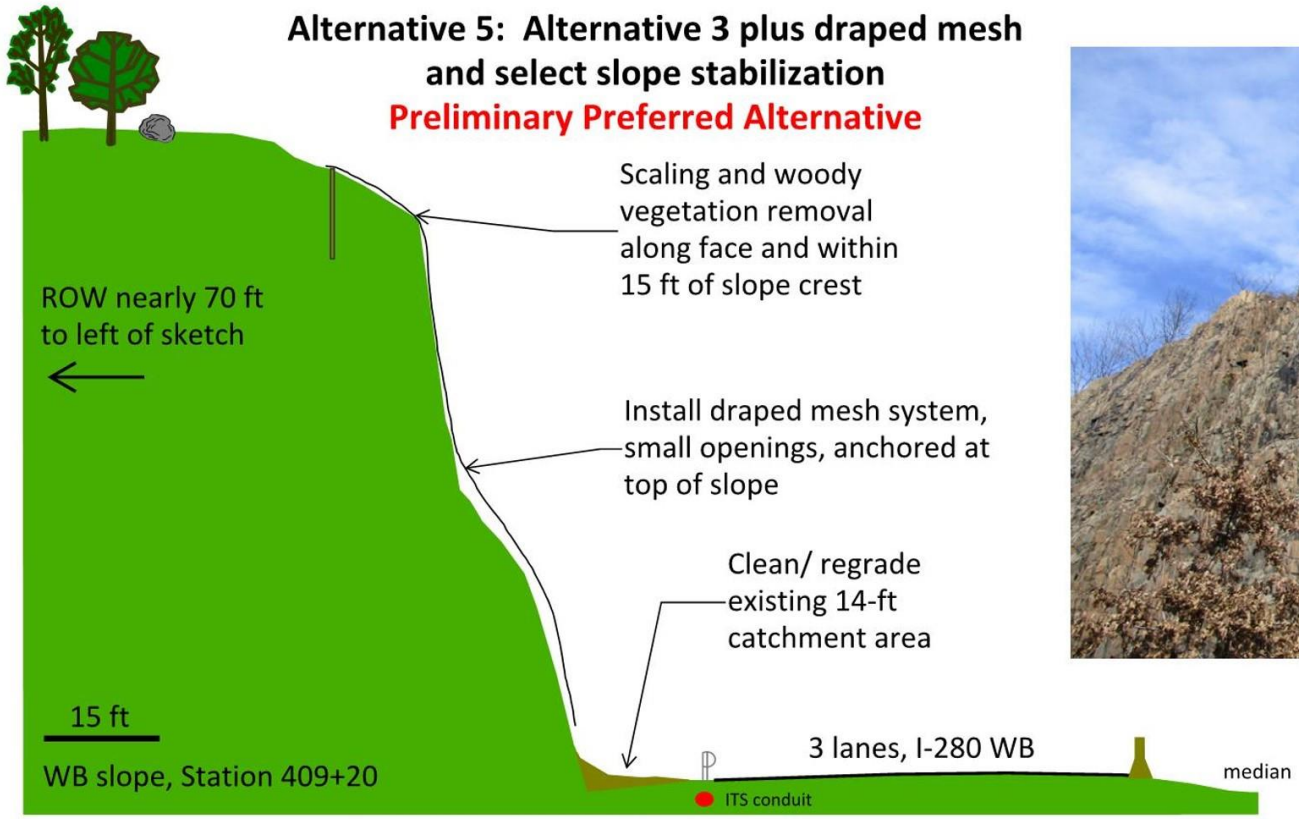
Concept Development alternatives

- Alternatives analysis
- 3 to 4 additional options
- 1st alternative is “No Build”
- Visualization is key



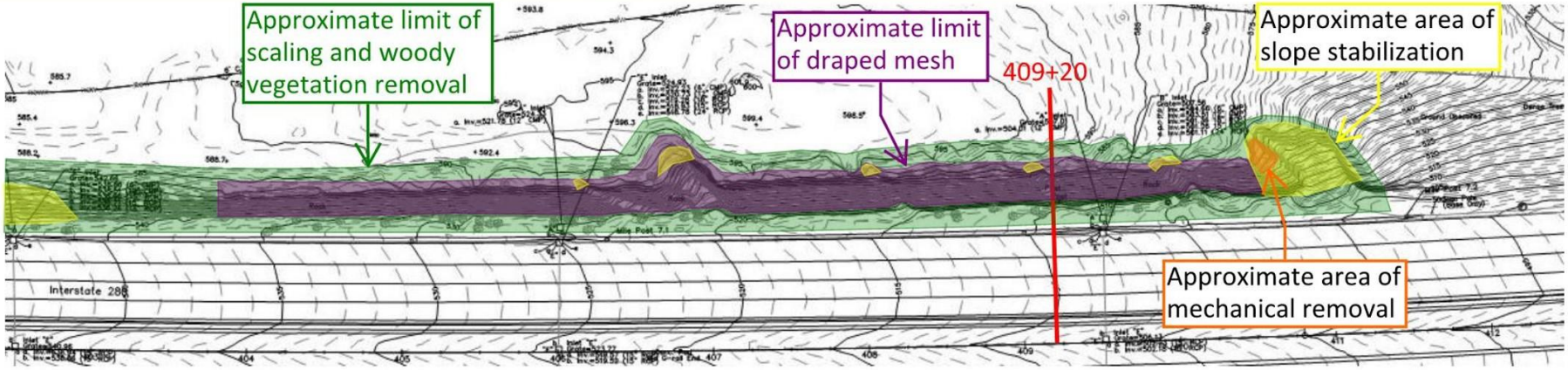
Alternative 5: Alternative 3 plus draped mesh and select slope stabilization

Preliminary Preferred Alternative



Existing Conditions

Note: alternative includes mechanical removal of pinnacle on WB slope east end and minor removal on EB slope east end, as well as slope stabilization (like secured TECCO)



Comparison matrix

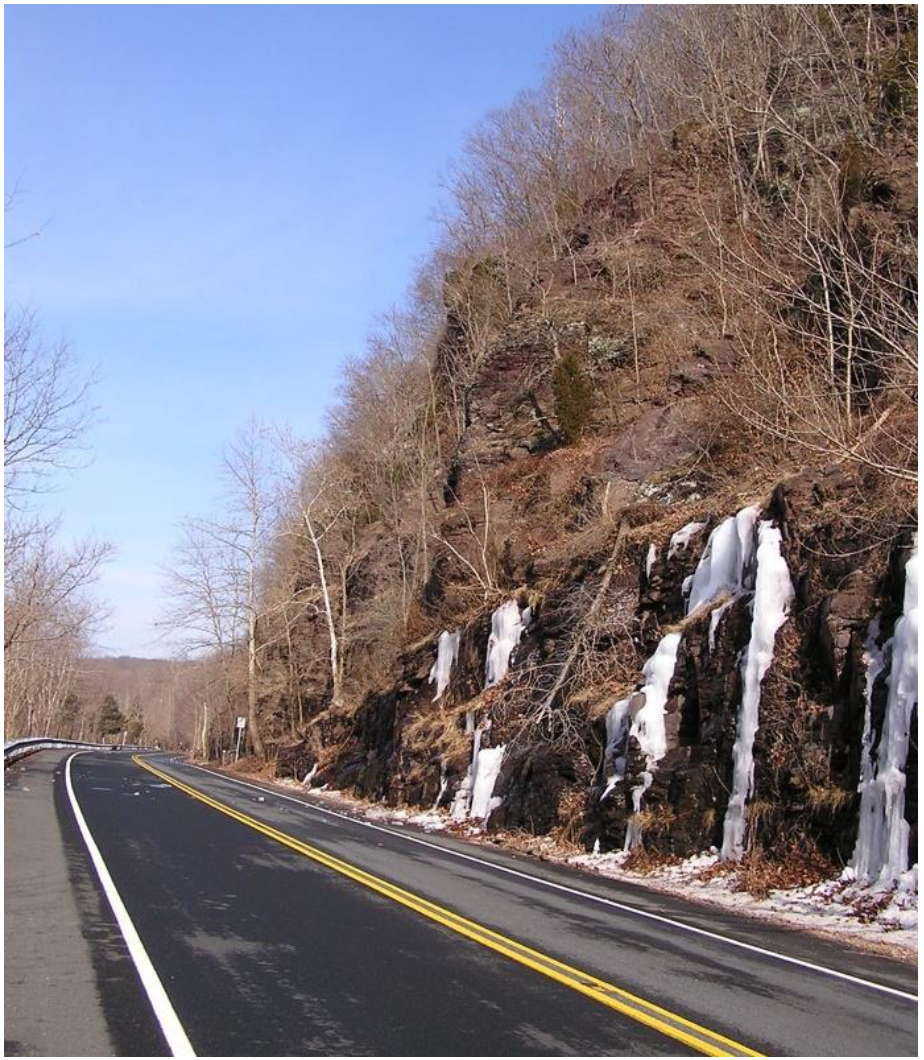
	Risk Reduction	Beyond ROW	Long Term Maintenance	Service Life	Construction Impact	Difficulty of Construction	Aesthetic Impacts	Utility Impacts	Length of Construction (days)		Range of Costs (x $1,000)	
									Low	High	Low	High
	None	No	High	N/A	N/A	N/A	N/A	N/A	0	0	0	0
	High	No	Moderate	Moderate to High	Low to Moderate	Low to Moderate	High	Yes	130	160	1,026	1,924
	Low	No	High	Low	Low	Moderate	Low	No	140	170	557	1,045
	High	No	Moderate	Moderate	Moderate	Moderate to High	Low to Moderate	No	210	250	1,173	2,199
	High	No	Low to Moderate	Moderate to High	Moderate	Moderate to High	Moderate to High	No	220	260	1,462	2,742
	High	No/Maybe	Low	High	High	High	Moderate	Yes	400	460	2,580	4,838
	Desirable				Neutral			Undesirable				

Project team collaboration

- Identify the Preliminary Preferred Alternative
- Consideration of NEPA process
- Public Involvement Action Plan

Conclusion

- Stream-lined process
- So far, 10 rockfall projects have ‘graduated’ from CD under this methodology
  - 3 Limited Scope Final Design
    (Construction in +/- 1 year)
  - 7 Standard Delivery
    (Construction in +/- 2 years)
- Anticipate 3 to 5 new project starts in 2019



Thank you! Questions?

For a copy of this paper after the conclusion of the conference: