



AWWA PNWS Tacoma Conference

April 27, 2022

Wildfire and Winter Storm Risk Management Examples

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2020 Labor Day Fires

- WA in the day: 80+ Fires, 330,000 acres, 2 cities destroyed
- OR: Expanded and new fires => 1M acres burned total, 4 cities substantial destroyed





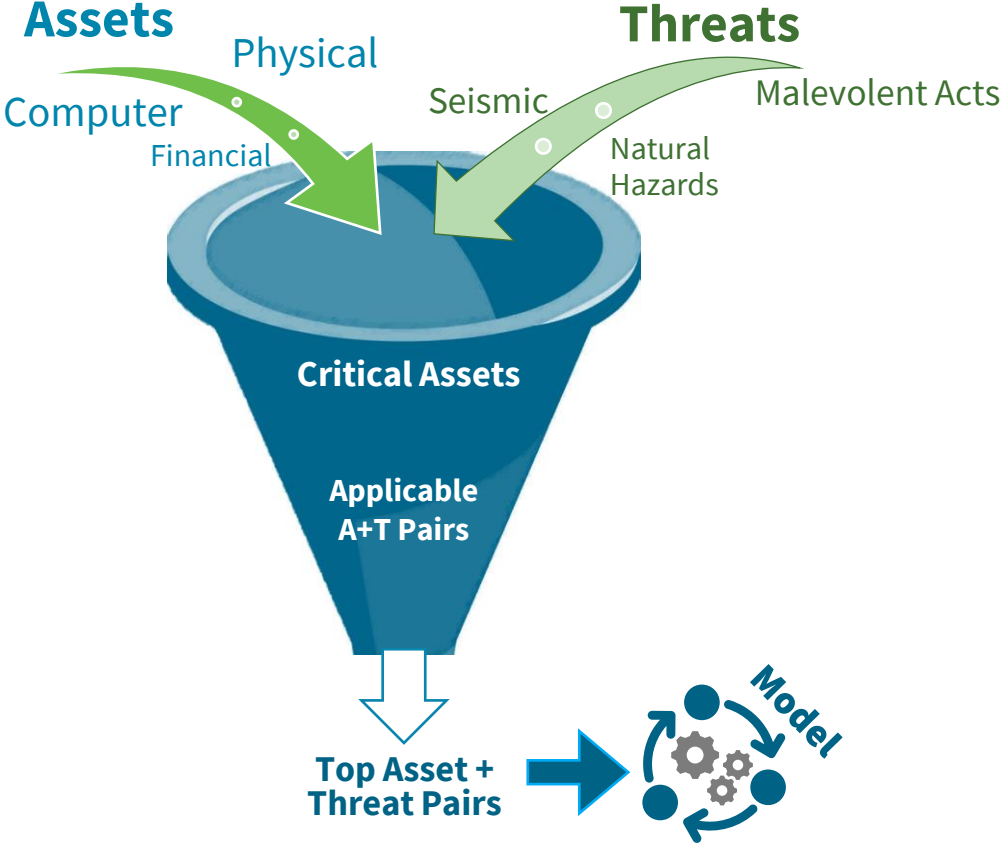
February 2021 Winter Storm

- February 11th-14th
- Seattle: 11” snow
- Portland: 9” snow, 270k w/o power
- Up to 1.5” ice south of Portland
- Oregon: 730k w/o power

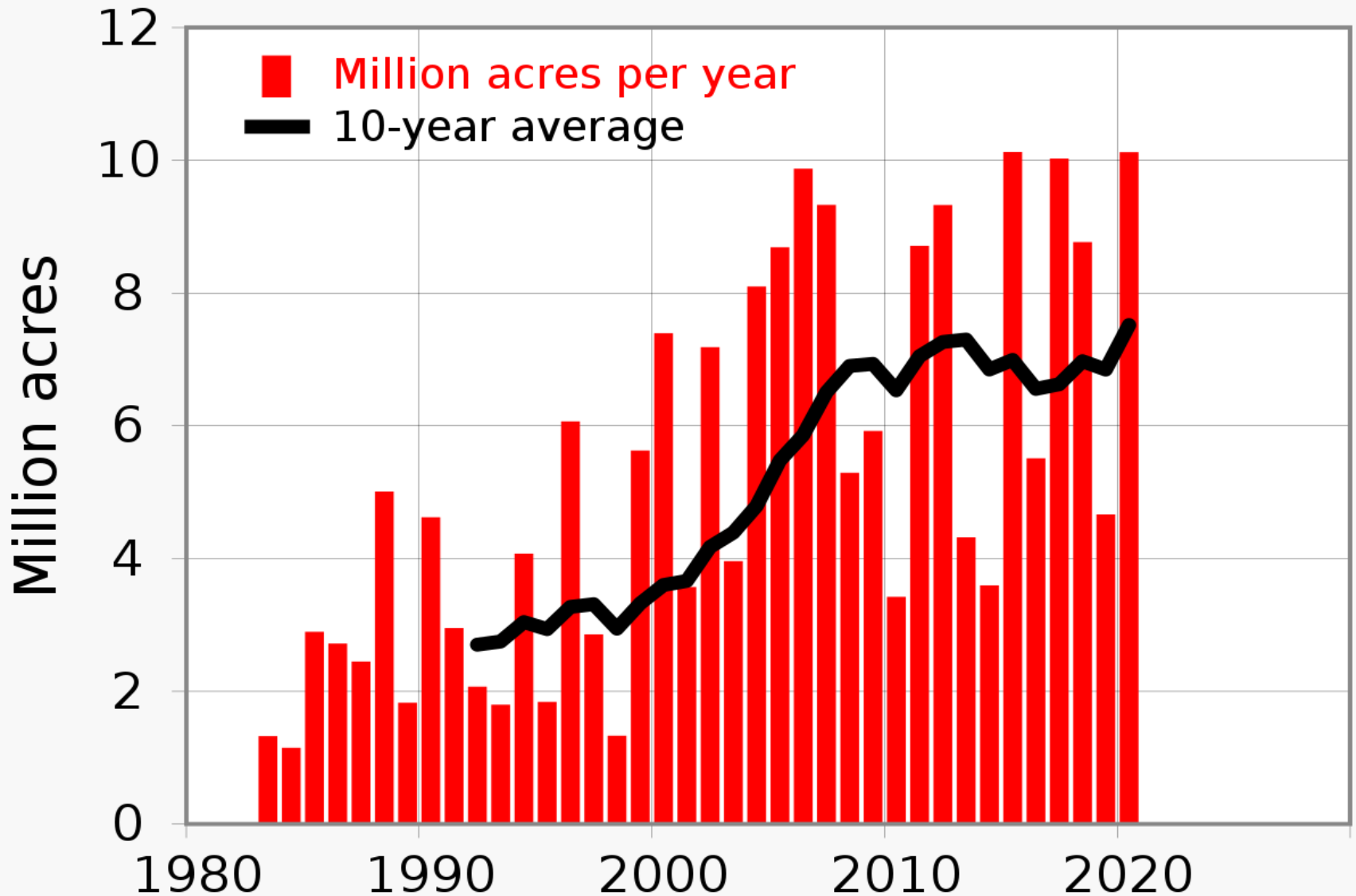


Photo Credit: Pamplin Media Group

Black Box/Funnel?



Acres burned by wildfire (U.S.)



Similar Storms

Feburary 2021
December 2016
January 2004
December 1996
January 1979
































































































RH2 Introduction

- Founded in 1978
- Employee-owned, client focused
- 130 employees in 9 offices



Related Assessment Work

- Cascade Water Alliance 
- City of Ashland, OR 
- City of Arlington  
- City of Beaverton, OR  
- City of Bellevue 
- City of Bonney Lake       
- City of Everett 
- City of Ferndale   
- City of Kelso  
- City of Kent   
- City of Kirkland  
- City of Lynden  
- City of Marysville  
- City of Phoenix, OR   
- City of Port Angeles  
- City of Richland  
- City of Snohomish  
- City of Snoqualmie  
- City of Stanwood       
- City of Sultan  
- City of Talent, OR   
- City of Woodland  
- Crystal Mountain  
- Lakewood Water District   
- Manchester Water District     
- Mt. View-Edgewood Water Company 
- Nob Hill Water Association  
- North City Water District     
- NE Sammamish S&W District       
- Port of Vancouver 
- Snoqualmie Pass Utility District     
- Tacoma Water 
- Union Hill Water Association      
- Woodinville Water District 

Legend

-  Water System Planning
-  Hydraulic Modeling
-  Seismic Performance Vulnerability Assessment
-  Vulnerability Analysis
-  Hazard Mitigation Planning
-  Emergency Response Planning
-  Cybersecurity

Overview

1. What is the Risk?
2. How Do We Manage the Risk?
3. Application Ideas



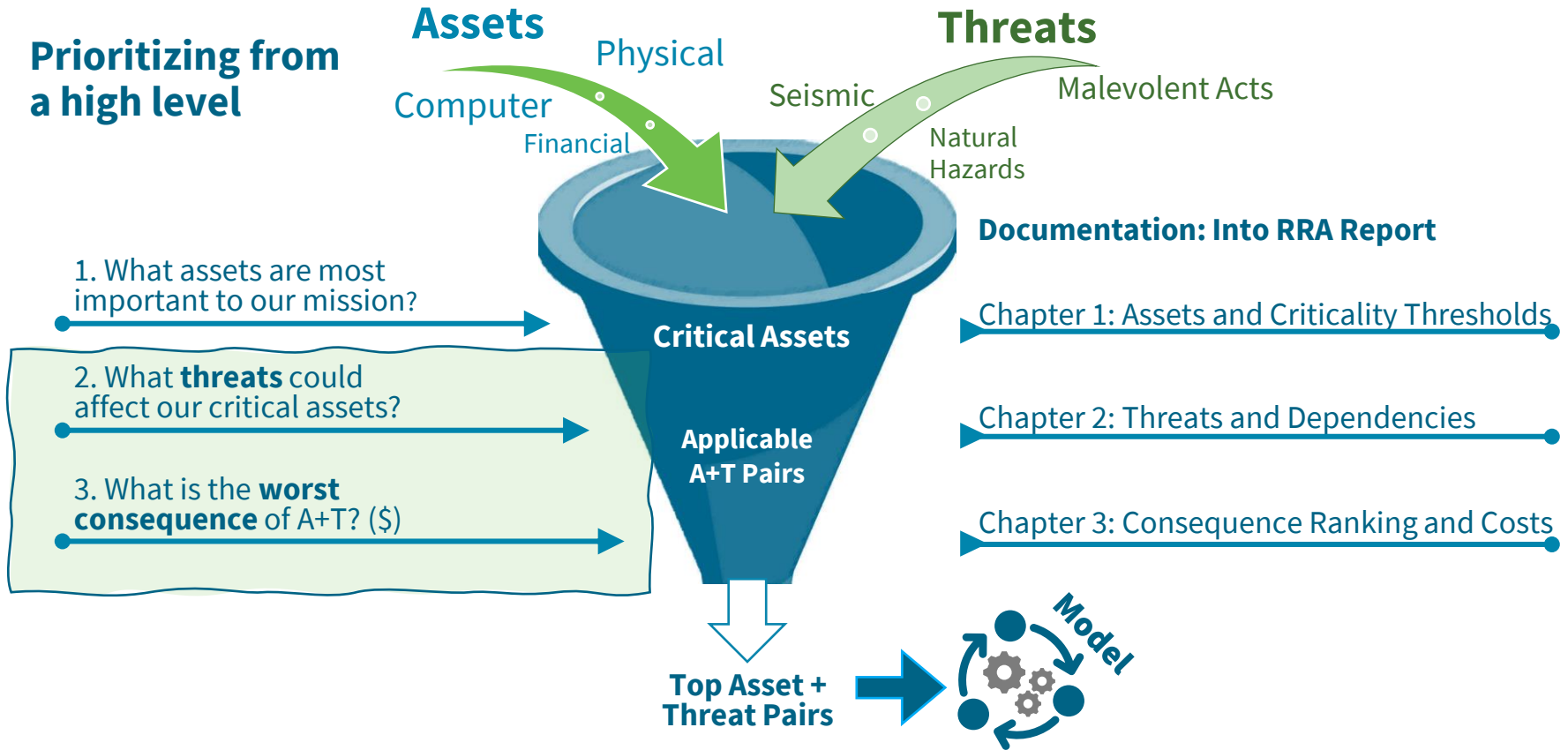
...Questions

1. What is the Risk?

- Risk Assessment Process Overview
- Risk Assessment Calculation
- Fire and Ice Examples



RA Process Overview



Assets
Redacted

ASSETS	THREATS	Malevolent Acts								Natural Hazards							
		Contam. of Source Water - Accidental	Contam. of Source Water - Intentional	Contam. of Finished Water - Accidental	Contam. of Finished Water - Intentional	Theft or Diversion (Physical)	Assault on Utility - Physical	Sabotage - Physical (insider or outsider)	Cyber Attack (insider or outsider) - BES	Cyber Attack (insider or outsider) - SCADA	Earthquake - MCE (Portland Hills Crustal)	Earthquake - CSZ (Full or partial rupture)	Landslide (earthquake or precipitation)	Winter Storm	Windstorm	Wildfire / Facility Fire	Drought or Hydrologic Change
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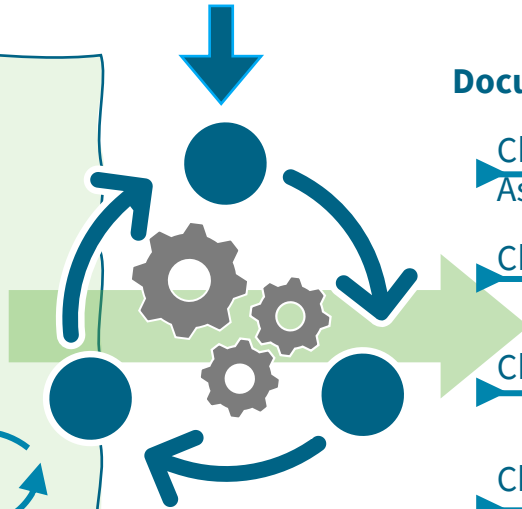


RA Process Overview

Calculating risk and making actionable mitigation plans

- 4. If A+T, what is the **likelihood** that the consequence occurs? (%) →
- 5. **Probability** of A+T, (%/yr) →
- 6. **Risk** (\$/yr) = Consequence*%*%/yr →
- 7. How can we reduce our risk w/ operational/capital changes? ↻

Top Asset + Threat Pairs



Documentation: Into RRA Report

- ▶ Chapter 4: Vulnerability Assessment
- ▶ Chapter 5: Threat Likelihood
- ▶ Chapter 6: Baseline Risk and Resilience
- ▶ Chapter 7: Risk and Resilience Management



Asset	Threat	Calculated Risk	Vulnerability	Threat Likelihood	Consequence - Total
		(\$/year)	(0 to 1)	(0 to 1/year)	(\$ rounded)
	Winter Storm	\$ 128,000	0.5	0.16	\$ 1,600,000
	Sabotage - Physical (insider or outsider)	\$ 107,250	0.7	0.05	\$ 3,300,000
	Power and Fuel - Earthquake	\$ 62,333	1.0	0.0033	\$ 18,700,000
	Earthquake - CSZ (Full or partial rupture)	\$ 49,667	1.0	0.0033	\$ 14,900,000
	Contam. of Finished Water - Accidental	\$ 37,600	0.1	0.02	\$ 18,800,000
	Contam. of Finished Water - Accidental	\$ 36,400	0.1	0.02	\$ 18,200,000
	Earthquake - CSZ (Full or partial rupture)	\$ 26,750	0.8	0.003	\$ 10,700,000
	Cyber Attack (insider or outsider) - SCADA	\$ 22,680	0.1	0.1	\$ 2,100,000
	Contam. of Finished Water - Accidental	\$ 18,600	0.1	0.02	\$ 9,300,000
	Landslide (earthquake or precipitation)	\$ 13,750	0.5	0.0083	\$ 3,300,000
	Scoggins Dam (Flooding from breach)	\$ 12,567	0.7	0.0033	\$ 5,800,000
	Power and Fuel - Earthquake	\$ 12,000	1.0	0.0033	\$ 3,600,000
	Cyber Attack (insider or outsider) - BES	\$ 7,200	0.03	0.3	\$ 800,000
	Earthquake - MCF	\$ 2,810	0.7	0.0004	\$ 10,700,000

Assets Redacted

Risk Assessment Calculation

$$\text{Risk (\$/Year)} = C * T * V$$

C = Worst Consequence of Threat (\$)

T = Threat Likelihood (#/year)

V = Vulnerability = Probability of
Threat Actually Causing the
Consequence (%)





C = Worst Consequence of Impact (\$)

Components of Cost and Sources

- Asset Replacement Cost
 - Capital improvement plans
 - Multiple for emergency project
- Other Utility Costs*
 - Lost sales (% out*days*ADD*Ave. daily revenue)
 - Liability, workaround cost (ballpark)
- Regional Economic Costs*
 - Outage/curtailment (\$114/person/day, FEMA 2020)
 - Other costs

*Include death, injury costs (\$8M, \$0.8M statistical value, FEMA 2020)

T = Threat Likelihood (#/year)



Likelihood Sources:

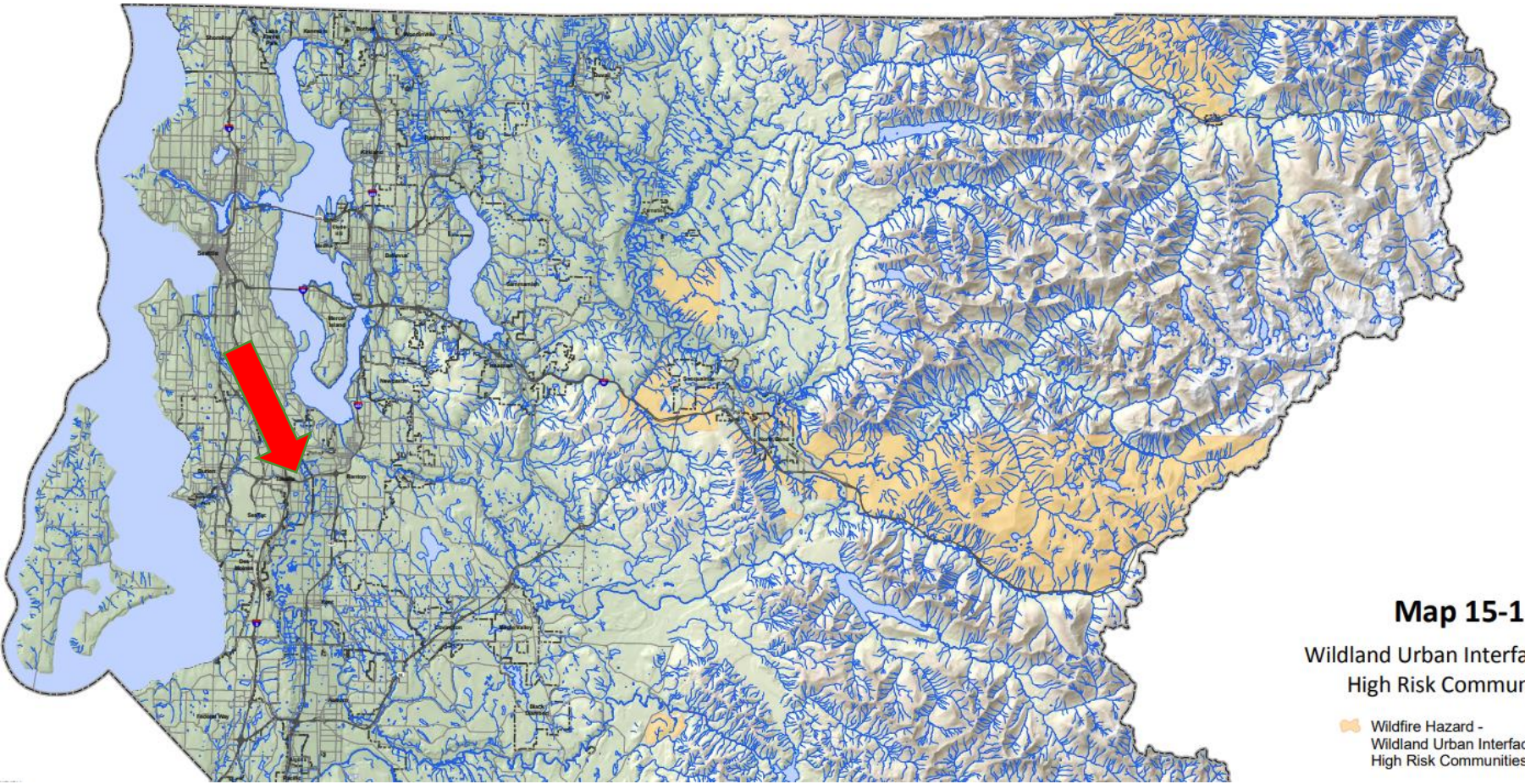
How often?

- National: Fire Return Interval (data from BPS layer of LandFire) Consider shortening interval since DNR study says they are occurring more frequently (WA DNR, 2019)*
- OR: Advanced Oregon Wildfire Risk Explorer (ODF, 2022) “Burn Probability” layer.* Also search layer “local fires.”
- County natural hazard mitigation plans (storms and fires)

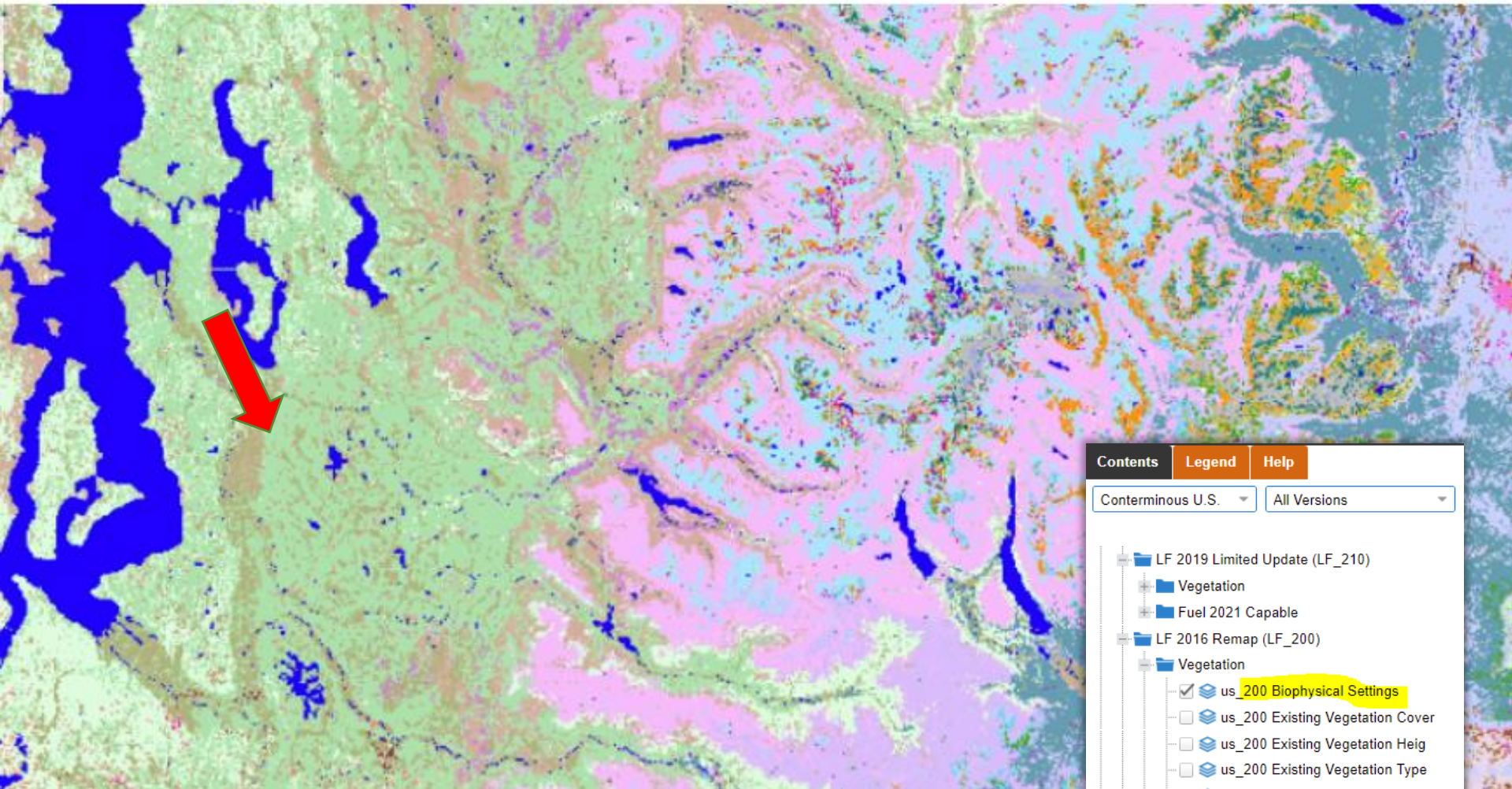
Near an interface?

- WA: Wildland Urban Interface High Risk Communities map (WA DNR, 2010)*
- OR: Advanced Oregon Wildfire Risk Explorer “WUI” layer

*Example maps on next slides



(WA DNR, 2010)



(LandFire, 2022)

Contents Legend Help

Conterminous U.S. All Versions

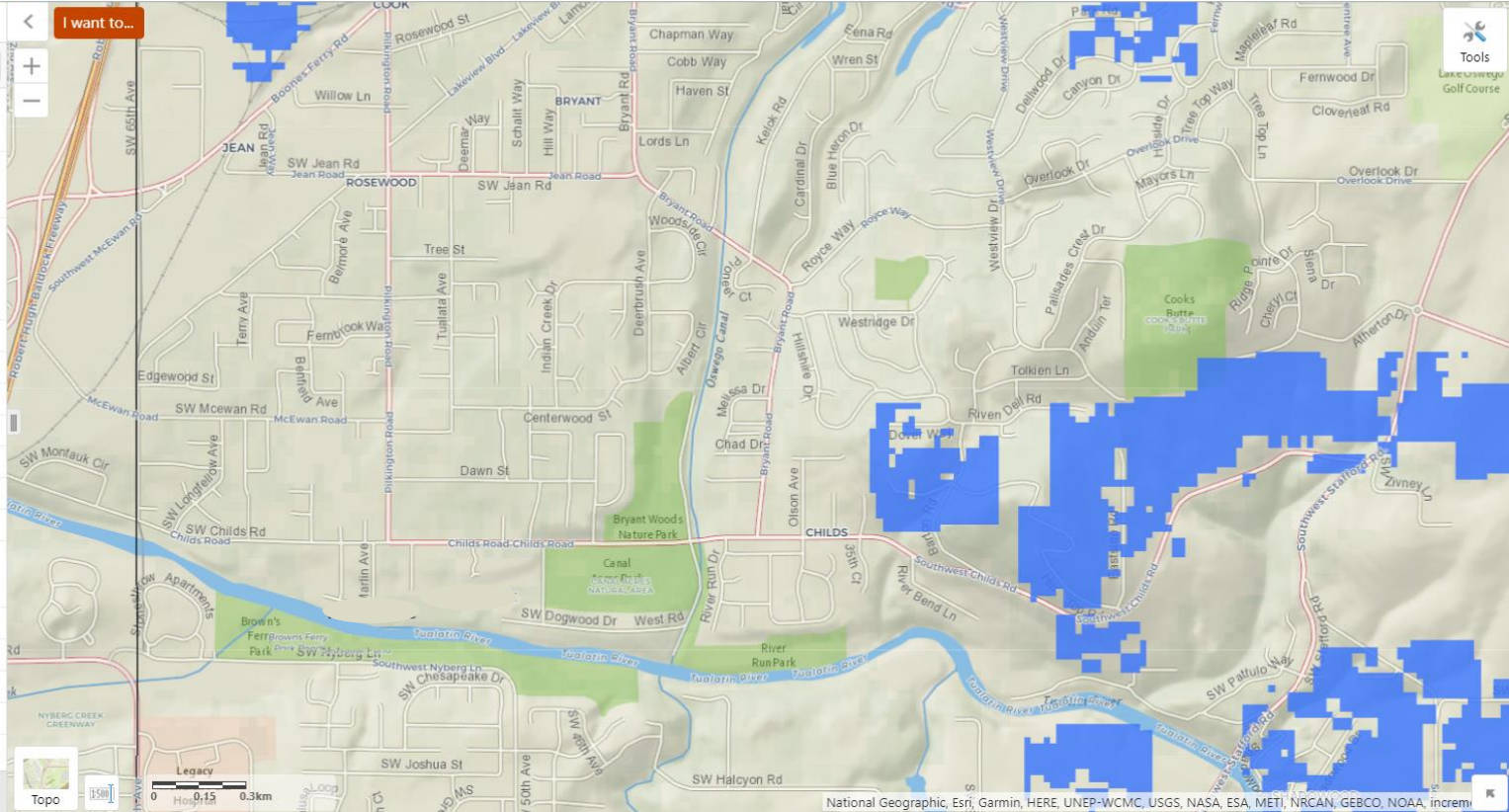
- [-] LF 2019 Limited Update (LF_210)
 - [+] Vegetation
 - [+] Fuel 2021 Capable
- [-] LF 2016 Remap (LF_200)
 - [+] Vegetation
 - us_200 Biophysical Settings
 - us_200 Existing Vegetation Cover
 - us_200 Existing Vegetation Heig
 - us_200 Existing Vegetation Type
 - us_200 National Vegetation Clas
 - [+] Fuel 2019 Capable
 - [+] Fuel 2020 Capable



Legend

Filter Swatches... Filter

- Roads
 - Signed Routes (2015)
- Supporting Layers
 - County Boundaries (2015)
- Wildfire Threat
 - Burn probability
 - 0
 - Low (<= 1-in-10,000)
 - Low - Moderate (1-in-10,000 to 1-in-5,000)
 - Moderate (1-in-5,000 to 1-in-1,000)
 - Moderate - High (1-in-1,000 to 1-in-500)
 - High (1-in-500 to 1-in-100)
 - High - Very High (1-in-100 to 1-in-50)
 - Very High (1-in-50 to 1-in-25)
 - Average flame length ft
 - 0
 - > 0 - 4 ft
 - 4 - 8 ft
 - 8 - 11 ft
 - > 11 ft



(ODF, 2022)



V = Vulnerability (%)

Probability that if the threat strikes the consequence occurs.

Threats and factors

Ice Storms:

- **Trees and other obstacles**
- Power (single power feed, remoteness, lack of backup power)
- Access (isolation, steepness of road grade)

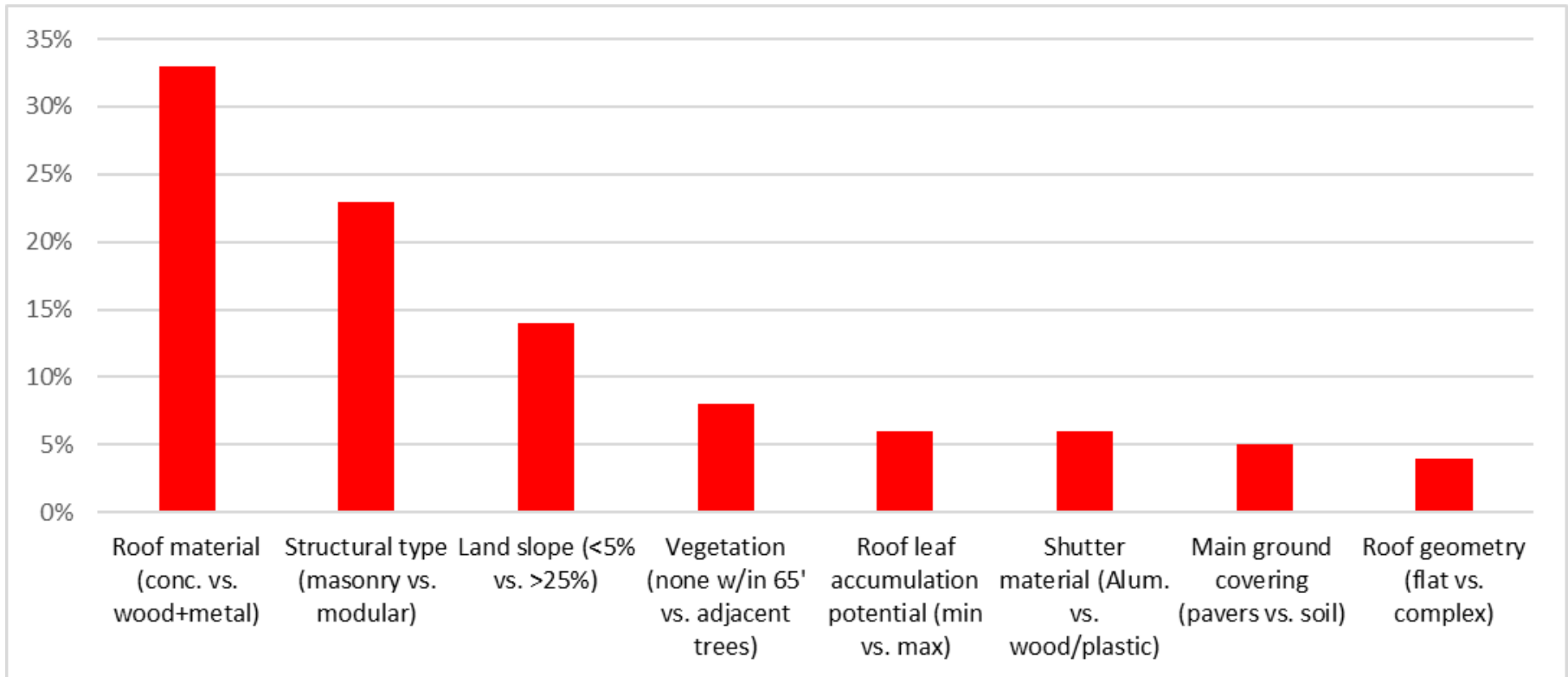
Fire – General Building Guidance (FEMA, 2008):

- Topography
- **Building envelope**
- **Defensible space**
- **Community infrastructure**



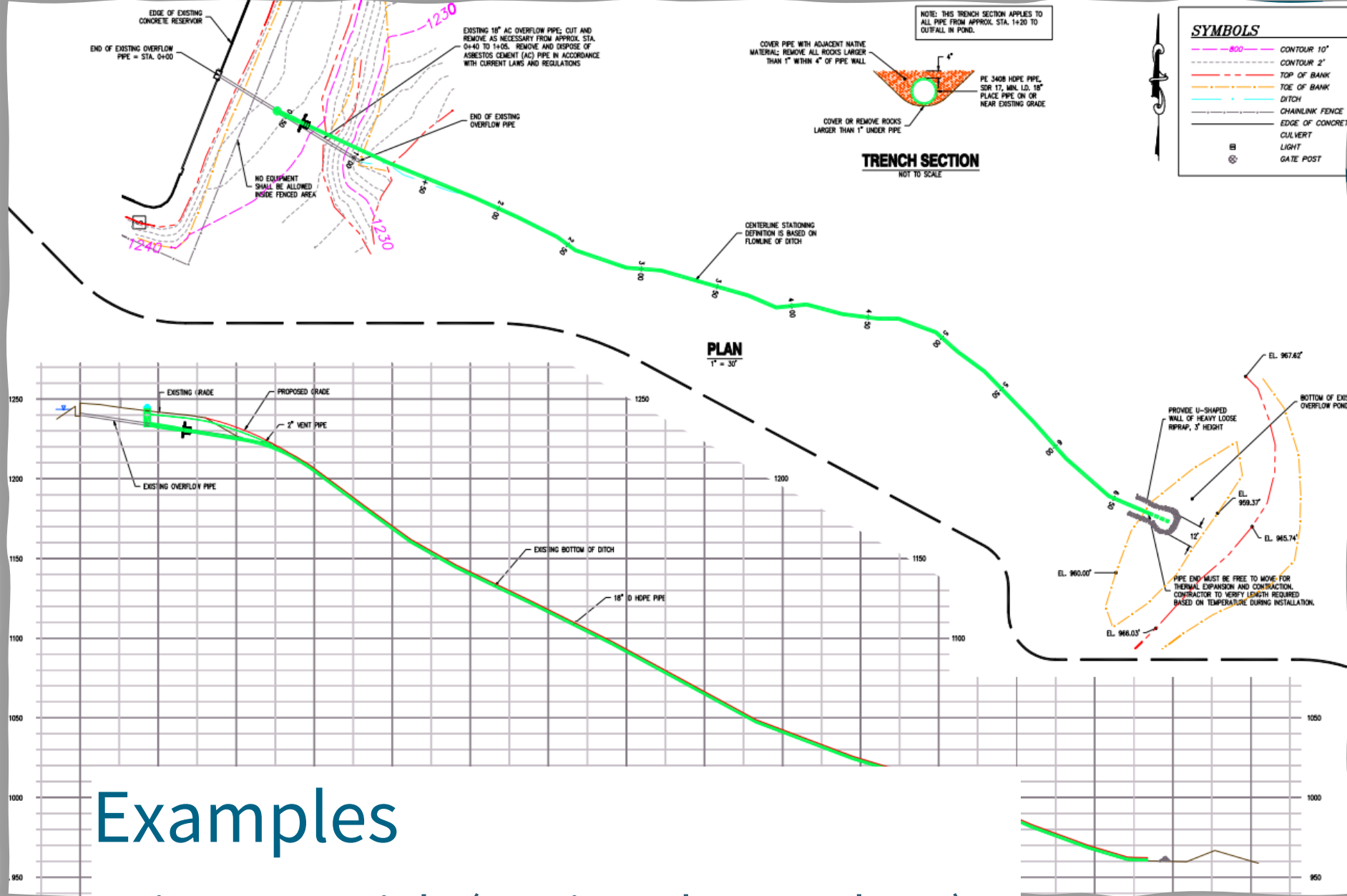
V = Vulnerability, Cont.

Study of 2018 wildfire in Greece => Index



Building Factor Relevance in Index (After Köhle, 2022)

- Not significant: ground cover, leaf accumulation in gutters, # of floors, combination of # of floors + neighboring vegetation
- Unclear significance: Proximity of neighboring buildings



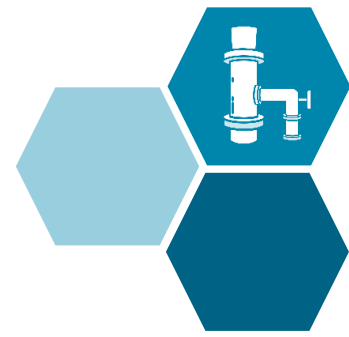
Examples

- Fire - Materials (not just the envelope)



Examples

- Fire - Materials (not just the envelope)





Examples

- Fire Cont. - Location



Examples

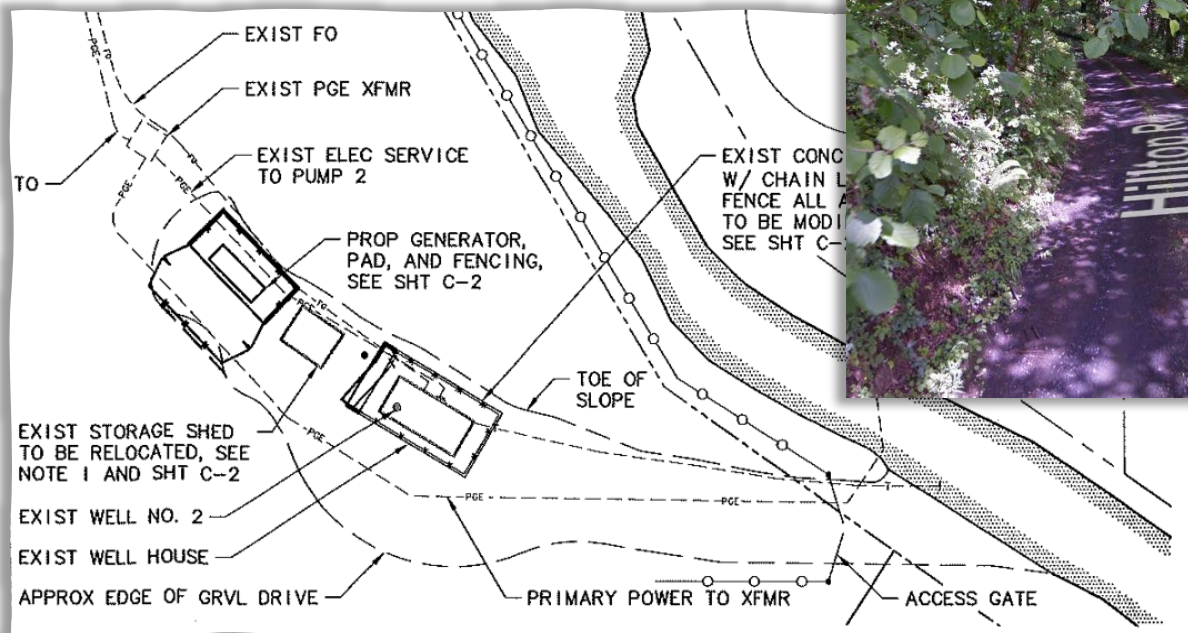
- Fire Cont. - Secondary effects





Examples

- Ice
 - Sabotage corollary
 - Fire corollary
 - The last mile



Examples – Why What Rises?



Risk (\$/Year) = C*T*V

- The Top Risk: **T**hreat Likelihood, Outage and Injury **C**onsequences (\$1M/yr)
- In the Top 5: Outage **C**onsequences (\$25k/yr)
- Bottom of Top 20: Replacement **C**onsequences

Hard to change **C**onsequences

All the above had moderate to high **V**ulnerability

Cutting vulnerability in half would drop out of top 10 or out altogether

2. How Do We Manage the Risk?

- Risk Management Calcs
- Examples



Risk Management Calcs

Baseline Risk (\$/Year) = $C * T * V$

Mitigated Risk (\$/Year) = **$C_m * T_m * V_m$**

Net Benefit (Reduction in Risk)

= Baseline Risk – Mitigated Risk

Cost = Mitigation \$ divided by lifetime

Cost Benefit Ratio = Net Benefit/Cost
(positive whole numbers are good)



Risk Management Example



Springs Pump Station



\$1.7M vs. \$1.3M

Risk Management Example

Springs Pump Station – Changing the Vulnerability



		Alt 2 Risk (\$/year)	Alt 1 Risk (\$/year)	Gross Benefit (\$/year)	Mitigation Cost (\$/year)	Net Benefit (\$/year)	Benefit/Cost Ratio (-)
\$	Landslide	\$3,440	\$20,590	\$17,150	\$3,075	\$14,075	4.58
\$	Wildfire	\$260	\$7,730	\$7,470	\$3,075	\$4,395	1.43
\$	Combined Landslide/Wildfire	\$3,700	\$28,320	\$24,620	\$6,150	\$18,470	3.00

(Mitigated) points to the Alt 1 Risk column.
(Baseline) points to the Mitigation Cost column.

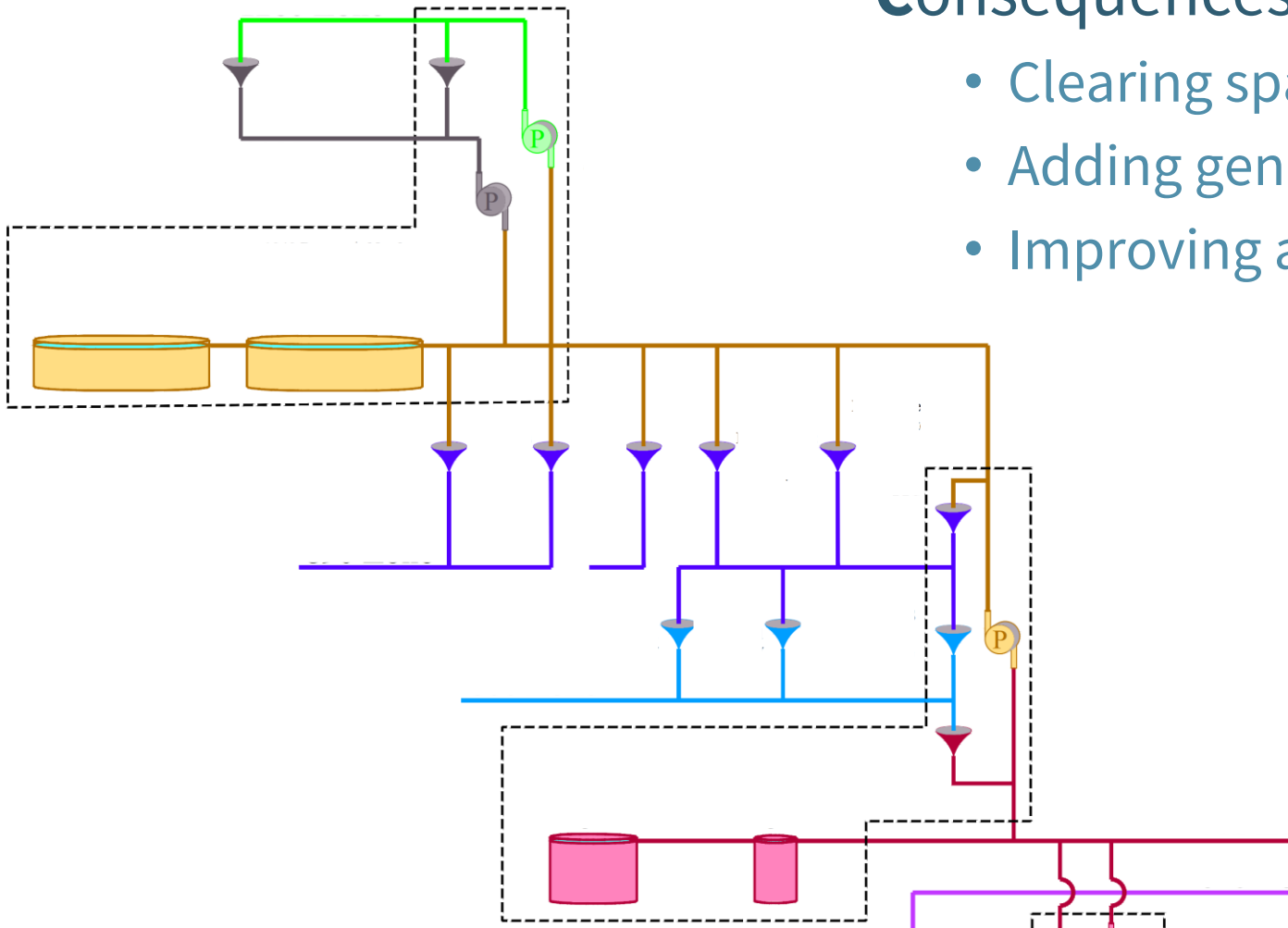
A red bracket on the left side of the table groups the three rows. A red arrow points from the Net Benefit of \$4,395 to the Benefit/Cost Ratio of 1.43.

Common Management



Reduce Outage Consequences

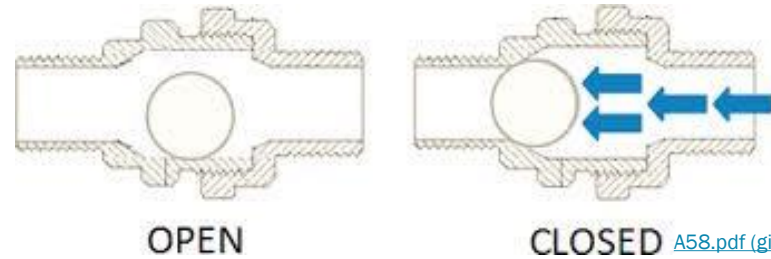
- Clearing space
- Adding generators
- Improving access



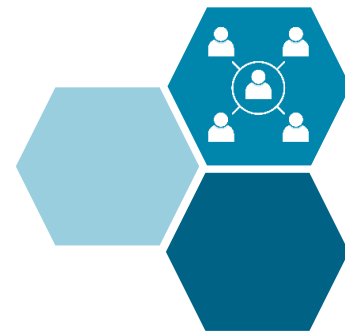
Ice Management

Learn from east-side colleagues – reduce **Consequences and Vulnerability**

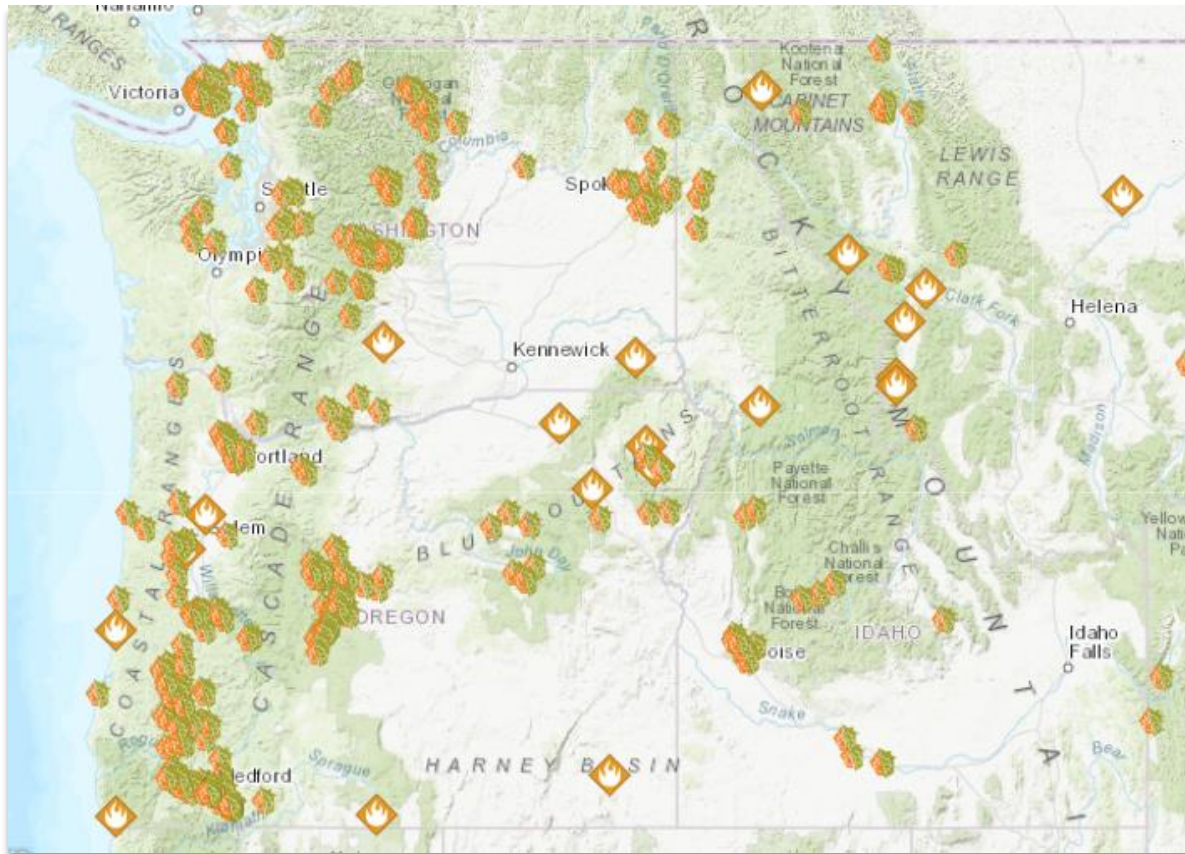
- Freeze protection through depth, drainage, etc.
- Think about slopes
- Personal traction devices



Fire Risk Management



- Promote community mitigation
 - Wildfire Community Preparedness Day: Sat. May 7th
 - Firewise USA™ Communities (NFPA, 2022)



Fire Risk Management Cont.

- Applying NFPA/FEMA Guidance – Reduce **Vulnerability**
 - Topography
 - **Building envelope**
 - **Defensible space**
 - **Community infrastructure**



Fire Risk Management Cont.



Operational Changes/Plans – Reduce **V**ulnerability

- Backbone isolation plan – aides:
 - Facility isolation figures/procedures
 - Reservoir outlet valves (think ShakeAlert™)
 - Automatic meters w/ remote shutoff
- Community distribution site planning
- Monitoring/Control
 - SCADA
 - Alerting



Monitoring Cont. – Alerting



<p>Alerts and General Info</p>	<p>Red Flag Warnings, Fire Weather Watches from NWS. (Free alerting app options: FEMA, Ping4alerts! Storm Shield Severe Weather App, The Weather Channel, WeatherSTEM, Weather Underground, Weather USA, WeatherBug, WeatherSphere)</p>
	<p>General status and links: NWCC :: Home (nifc.gov)</p>
	<p>Twitter DNR state-wide wildfire info: Washington State DNR Wildfire (@waDNR_fire) / Twitter (Don't use Twitter? Text 40404 to get DNR tweets delivered to your phone as text messages.)</p>
<p>Map-Based Info</p>	<p>InciWeb the Incident Information System (nwcg.gov)</p>
	<p>NASA LANCE FIRMS US/Canada</p>
	<p>Misc. https://gisgeography.com/wildfire-maps-real-time/</p>
<p>Local Monitoring (Not listed but can also include DOT road-cams)</p>	<p>Alert Wildfire ALERTWildfire OR-ID-WA (System still in early stages of development, more stations will be added. Could also be useful for seeing from afar other areas of the water system)</p>
	<p>PurpleAir air quality sensor map (proxy for smoke detection): https://www.purpleair.com/map?mylocation</p>

3. Application Ideas

- Revisit your risk assessment
 - Ranking of fire/ice?
 - If low/non-existent, does it need re-thinking?
- Do fire/ice specific risk assessments
 - On individual assets
 - For your whole system
- Use risk assessment to manage risk
 - Grab the low-hanging fruit
 - Add design/planning criteria (start 2 lists)
 - Get projects funded

Conclusion

1. You Can Evaluate Risk
2. You Can Take Steps to Manage Risk
3. You Can Apply Risk Management

“Where there is no vision, the people perish.”

A decorative vertical border on the left side of the slide, composed of a grid of hexagons in various shades of blue and green. Some hexagons contain white icons: a calendar, a magnifying glass, a hard hat, a lightbulb, a leaf, a road with a tree, and a document.

Thank You!

Questions?

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<https://www.fema.gov/sites/default/files/2020-08/fema_bca_toolkit_release-notes-july-2020.pdf.>

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Washington State Department of Natural Resources. (2019). Washington State Wildland Fire Protection 10-Year Strategic Plan.
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