MAKUSHIN HAZARD + EXPOSURE ANALYSIS

HAZARDS FACTORS

1 **Volcano Type**
> If volcano type is cinder cone, basaltic field, small shield, or fissure vents:
Score = 0
> If volcano type is stratocone, lava domes, complex volcano, maar or caldera:
Score = 1

2 **Maximum Volcano Explosivity Index (VEI)**
> If maximum known VEI ≤ 2
Score = 0
> If maximum known VEI = 3 or 4
Score = 1
> If maximum known VEI = 5 or 6
Score = 2
> If maximum known VEI ≥ 7
Score = 3
> If no maximum VEI is listed by GVP and if volcano type = 0
Score = 0
> If no maximum VEI is listed by GVP but volcano type = 1
Score = 1
> If no known Holocene eruptions and the volcano is not a silicic caldera system
Score = 0

1 **Eruption recurrence**
> If eruption interval is 1-99 years
Score = 4
> 100 – 1,000 years
Score = 3
> 1,000 - 4,999 years
Score =2
> 5,000-10,000 years, or if no Holocene eruptions but it is a large-volume restless silicic system that has erupted in the last 100,000 years
Score = 1
> If no known Holocene eruption
Score = 0

1 **Explosive activity**
> If explosive activity (VEI ≥ 3) within the last 500 years
Score = 1

4 **Major explosive activity**
> If major explosive activity (VEI ≥ 4) within last 5,000 years
Score = 1

1 **Holocene pyroclastic flows**
> If yes
Score = 1

1 **Holocene lahars**
> If Holocene lahars have traveled beyond the flanks and reached populated areas
Score =1

0 **Holocene lava flows**
> If Holocene lava flows have traveled beyond the immediate eruption site or flanks and reached populated areas
Score =1

0 **Holocene tsunami(s)**
> Has it produced a tsunami within the Holocene? If yes
Score = 1

0 **Hydrothermal explosion potential**
> If the volcano had Holocene phreatic explosive activity, and/or has thermal features that are extensive enough to pose a potential for explosive activity
Score =1

1 **Sector collapse potential**
> If the volcano has produced a sector collapse in Quaternary-Holocene time and has re-built its edifice, or, has high relief, steep flanks and demonstrated or inferred alteration
Score = 1

1 **Primary lahar source**
> If volcano has a source of permanent water/ice on edifice, water volume > 106 m3: Score = 1

MAKUSHIN HAZARD + EXPOSURE ANALYSIS

HISTORICAL UNREST FACTORS

1 **Observed seismic unrest**
> Since the last eruption, in the absence of eruptive activity, within 20 km of the volcanic edifice? If yes
Score = 1

1 **Observed ground deformation**
> Since the last eruption, in the absence of eruptive activity, inflation or other evidence of magma injection? If yes
Score = 1

1 **Observed fumarolic or magmatic degassing**
> Since the last eruption, in the absence of eruptive activity, either heat source or magmatic gases? If yes
Score = 1

16 **TOTAL OF HAZARD FACTORS + HISTORICAL UNREST FACTORS**

EXPOSURE FACTORS

3.19 **Log10 of Volcano Population Index (VPI) at 30 km**
> Calculated with LandScan population database. Visitor statistics for volcanoes in National Parks and other destination recreation areas are added to the VPI factor where available.

0.00 **Log10 of approximate population downstream or downslope**
> Population outside the 30 km VPI circle included within the extent of Holocene flow deposits or reasonable inundation modeling.This factor only used with volcanoes with a lahar hazard (e.g. Cascade stratovolcanoes) or significant lava flow hazard (e.g. Mauna Loa).

0 **Historical fatalities**
> If yes, and a permanent population is still present
Score = 1

0 **Historical evacuations**
> If yes, and a permanent population is still present
Score = 1

0 **Local aviation exposure**
> If any type volcano is within 50 km of a jet-service airport
Score = 1
> If a Type 1 volcano is within 300 km of a jet-service airport
Score = 1
> If a Type 1 volcano is within 300 km of a major international airport
Score = 2
> If none of these criteria are met
Score = 0

4.3 **Regional aviation exposure**
> This score is based on the log10 of approximate daily passenger traffic in each region. At present, in the U.S., this score ranges from 4 to 5.15. The regional risk code is applied only to type 1 volcanoes and those type 0 volcanoes that have produced explosive eruptions.

0 **Power infrastructure**
> Is there power infrastructure (e.g., power generation/transmission/distribution for electricity, oil, or gas) within flow hazard zones, or in an area frequently downwind of the volcano and close enough to considered at some risk? If yes
Score =1

1 **Transportation infrastructure**
> Is there transportation infrastructure (e.g. port facilities, rail lines, major roads) within flowage hazard zones, or in an area frequently downwind of the volcano and close enough to considered at some risk? If yes
Score = 1

MAKUSHIN HAZARD + EXPOSURE ANALYSIS

1	**Major development or sensitive areas** > Are there major developments or sensitive areas threatened (e.g., National Park facilities, flood control projects, government facilities, developed tourist/ recreation facilities, manufacturing or other significant economic activity)? If yes Score = 1
0	**Volcano is a significant part of a populated island** > Holocene volcanic deposits cover >25% of land mass. If yes Score = 1
9.5	**TOTAL OF EXPOSURE FACTORS**

First total x second total = Relative Threat Ranking

16	x	9.5	=	152

GLACIER PK HAZARD + EXPOSURE ANALYSIS

HAZARDS FACTORS

1 **Volcano Type**
> If volcano type is cinder cone, basaltic field, small shield, or fissure vents:
Score = 0
> If volcano type is stratocone, lava domes, complex volcano, maar or caldera:
Score = 1

1 **Maximum Volcano Explosivity Index (VEI)**
> If maximum known VEI ≤ 2
Score = 0
> If maximum known VEI = 3 or 4
Score = 1
> If maximum known VEI = 5 or 6
Score = 2
> If maximum known VEI ≥ 7
Score = 3
> If no maximum VEI is listed by GVP and if volcano type = 0
Score = 0
> If no maximum VEI is listed by GVP but volcano type = 1
Score = 1
> If no known Holocene eruptions and the volcano is not a silicic caldera system
Score = 0

3 **Eruption recurrence**
> If eruption interval is 1-99 years
Score = 4
> 100 – 1,000 years
Score = 3
> 1,000 - 4,999 years
Score =2
> 5,000-10,000 years, or if no Holocene eruptions but it is a large-volume restless silicic system that has erupted in the last 100,000 years
Score = 1
> If no known Holocene eruption
Score = 0

0 **Explosive activity**
> If explosive activity (VEI ≥ 3) within the last 500 years
Score = 1

1 **Major explosive activity**
> If major explosive activity (VEI ≥ 4) within last 5,000 years
Score = 1

1 **Holocene pyroclastic flows**
> If yes
Score = 1

1 **Holocene lahars**
> If Holocene lahars have traveled beyond the flanks and reached populated areas
Score =1

0 **Holocene lava flows**
> If Holocene lava flows have traveled beyond the immediate eruption site or flanks and reached populated areas
Score =1

0 **Holocene tsunami(s)**
> Has it produced a tsunami within the Holocene? If yes
Score = 1

0 **Hydrothermal explosion potential**
> If the volcano had Holocene phreatic explosive activity, and/or has thermal features that are extensive enough to pose a potential for explosive activity
Score =1

1 **Sector collapse potential**
> If the volcano has produced a sector collapse in Quaternary-Holocene time and has re-built its edifice, or, has high relief, steep flanks and demonstrated or inferred alteration
Score = 1

1 **Primary lahar source**
> If volcano has a source of permanent water/ice on edifice, water volume > 106 m3: Score = 1

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GLACIER PK HAZARD + EXPOSURE ANALYSIS

HISTORICAL UNREST FACTORS

0 **Observed seismic unrest**
> Since the last eruption, in the absence of eruptive activity, within 20 km of the volcanic edifice? If yes
Score = 1

0 **Observed ground deformation**
> Since the last eruption, in the absence of eruptive activity, inflation or other evidence of magma injection? If yes
Score = 1

1 **Observed fumarolic or magmatic degassing**
> Since the last eruption, in the absence of eruptive activity, either heat source or magmatic gases? If yes
Score = 1

11 **TOTAL OF HAZARD FACTORS + HISTORICAL UNREST FACTORS**

EXPOSURE FACTORS

2.42 **Log10 of Volcano Population Index (VPI) at 30 km**
> Calculated with LandScan population database. Visitor statistics for volcanoes in National Parks and other destination recreation areas are added to the VPI factor where available.

4.66 **Log10 of approximate population downstream or downslope**
> Population outside the 30 km VPI circle included within the extent of Holocene flow deposits or reasonable inundation modeling.This factor only used with volcanoes with a lahar hazard (e.g. Cascade stratovolcanoes) or significant lava flow hazard (e.g. Mauna Loa).

0 **Historical fatalities**
> If yes, and a permanent population is still present
Score = 1

0 **Historical evacuations**
> If yes, and a permanent population is still present
Score = 1

2 **Local aviation exposure**
> If any type volcano is within 50 km of a jet-service airport
Score = 1
> If a Type 1 volcano is within 300 km of a jet-service airport
Score = 1
> If a Type 1 volcano is within 300 km of a major international airport
Score = 2
> If none of these criteria are met
Score = 0

5.04 **Regional aviation exposure**
> This score is based on the log10 of approximate daily passenger traffic in each region. At present, in the U.S., this score ranges from 4 to 5.15. The regional risk code is applied only to type 1 volcanoes and those type 0 volcanoes that have produced explosive eruptions.

0 **Power infrastructure**
> Is there power infrastructure (e.g., power generation/transmission/distribution for electricity, oil, or gas) within flow hazard zones, or in an area frequently downwind of the volcano and close enough to considered at some risk? If yes
Score =1

0 **Transportation infrastructure**
> Is there transportation infrastructure (e.g. port facilities, rail lines, major roads) within flowage hazard zones, or in an area frequently downwind of the volcano and close enough to considered at some risk? If yes
Score = 1

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URBAN DESIGN & PLANNING

GLACIER PK HAZARD + EXPOSURE ANALYSIS

0	**Major development or sensitive areas** > Are there major developments or sensitive areas threatened (e.g., National Park facilities, flood control projects, government facilities, developed tourist/ recreation facilities, manufacturing or other significant economic activity)? If yes Score = 1
0	**Volcano is a significant part of a populated island** > Holocene volcanic deposits cover >25% of land mass. If yes Score = 1
14.12	**TOTAL OF EXPOSURE FACTORS**

First total x second total = Relative Threat Ranking

11	x	14.1	=	155.1

MT. ST. HELENS HAZARD + EXPOSURE ANALYSIS

HAZARDS FACTORS

1 **Volcano Type**
> If volcano type is cinder cone, basaltic field, small shield, or fissure vents:
Score = 0
> If volcano type is stratocone, lava domes, complex volcano, maar or caldera:
Score = 1

2 **Maximum Volcano Explosivity Index (VEI)**
> If maximum known VEI ≤ 2
Score = 0
> If maximum known VEI = 3 or 4
Score = 1
> If maximum known VEI = 5 or 6
Score = 2
> If maximum known VEI ≥ 7
Score = 3
> If no maximum VEI is listed by GVP and if volcano type = 0
Score = 0
> If no maximum VEI is listed by GVP but volcano type = 1
Score = 1
> If no known Holocene eruptions and the volcano is not a silicic caldera system
Score = 0

1 **Eruption recurrence**
> If eruption interval is 1-99 years
Score = 4
> 100 – 1,000 years
Score = 3
> 1,000 - 4,999 years
Score =2
> 5,000-10,000 years, or if no Holocene eruptions but it is a large-volume restless silicic system that has erupted in the last 100,000 years
Score = 1
> If no known Holocene eruption
Score = 0

1 **Explosive activity**
> If explosive activity (VEI ≥ 3) within the last 500 years
Score = 1

4 **Major explosive activity**
> If major explosive activity (VEI ≥ 4) within last 5,000 years
Score = 1

1 **Holocene pyroclastic flows**
> If yes
Score = 1

1 **Holocene lahars**
> If Holocene lahars have traveled beyond the flanks and reached populated areas
Score =1

0 **Holocene lava flows**
> If Holocene lava flows have traveled beyond the immediate eruption site or flanks and reached populated areas
Score =1

0 **Holocene tsunami(s)**
> Has it produced a tsunami within the Holocene? If yes
Score = 1

0 **Hydrothermal explosion potential**
> If the volcano had Holocene phreatic explosive activity, and/or has thermal features that are extensive enough to pose a potential for explosive activity
Score =1

0 **Sector collapse potential**
> If the volcano has produced a sector collapse in Quaternary-Holocene time and has re-built its edifice, or, has high relief, steep flanks and demonstrated or inferred alteration
Score = 1

1 **Primary lahar source**
> If volcano has a source of permanent water/ice on edifice, water volume > 106 m3: Score = 1

MT. ST. HELENS HAZARD + EXPOSURE ANALYSIS

HISTORICAL UNREST FACTORS

1 **Observed seismic unrest**
> Since the last eruption, in the absence of eruptive activity, within 20 km of the volcanic edifice? If yes
Score = 1

1 **Observed ground deformation**
> Since the last eruption, in the absence of eruptive activity, inflation or other evidence of magma injection? If yes
Score = 1

1 **Observed fumarolic or magmatic degassing**
> Since the last eruption, in the absence of eruptive activity, either heat source or magmatic gases? If yes
Score = 1

15 **TOTAL OF HAZARD FACTORS + HISTORICAL UNREST FACTORS**

EXPOSURE FACTORS

2.84 **Log10 of Volcano Population Index (VPI) at 30 km**
> Calculated with LandScan population database. Visitor statistics for volcanoes in National Parks and other destination recreation areas are added to the VPI factor where available.

3.93 **Log10 of approximate population downstream or downslope**
> Population outside the 30 km VPI circle included within the extent of Holocene flow deposits or reasonable inundation modeling.This factor only used with volcanoes with a lahar hazard (e.g. Cascade stratovolcanoes) or significant lava flow hazard (e.g. Mauna Loa).

1 **Historical fatalities**
> If yes, and a permanent population is still present
Score = 1

1 **Historical evacuations**
> If yes, and a permanent population is still present
Score = 1

2 **Local aviation exposure**
> If any type volcano is within 50 km of a jet-service airport
Score = 1
> If a Type 1 volcano is within 300 km of a jet-service airport
Score = 1
> If a Type 1 volcano is within 300 km of a major international airport
Score = 2
> If none of these criteria are met
Score = 0

5.04 **Regional aviation exposure**
> This score is based on the log10 of approximate daily passenger traffic in each region. At present, in the U.S., this score ranges from 4 to 5.15. The regional risk code is applied only to type 1 volcanoes and those type 0 volcanoes that have produced explosive eruptions.

0 **Power infrastructure**
> Is there power infrastructure (e.g., power generation/transmission/distribution for electricity, oil, or gas) within flow hazard zones, or in an area frequently downwind of the volcano and close enough to considered at some risk? If yes
Score =1

1 **Transportation infrastructure**
> Is there transportation infrastructure (e.g. port facilities, rail lines, major roads) within flowage hazard zones, or in an area frequently downwind of the volcano and close enough to considered at some risk? If yes
Score = 1

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MT. ST. HELENS HAZARD + EXPOSURE ANALYSIS

1	**Major development or sensitive areas** > Are there major developments or sensitive areas threatened (e.g., National Park facilities, flood control projects, government facilities, developed tourist/ recreation facilities, manufacturing or other significant economic activity)? If yes Score = 1
0	**Volcano is a significant part of a populated island** > Holocene volcanic deposits cover >25% of land mass. If yes Score = 1
17.8	**TOTAL OF EXPOSURE FACTORS**

First total x second total = Relative Threat Ranking

15	x	17.8	=	267

MT. BAKER HAZARD + EXPOSURE ANALYSIS

HAZARDS FACTORS

1 **Volcano Type**
> If volcano type is cinder cone, basaltic field, small shield, or fissure vents:
Score = 0
> If volcano type is stratocone, lava domes, complex volcano, maar or caldera:
Score = 1

1 **Maximum Volcano Explosivity Index (VEI)**
> If maximum known VEI ≤ 2
Score = 0
> If maximum known VEI = 3 or 4
Score = 1
> If maximum known VEI = 5 or 6
Score = 2
> If maximum known VEI ≥ 7
Score = 3
> If no maximum VEI is listed by GVP and if volcano type = 0
Score = 0
> If no maximum VEI is listed by GVP but volcano type = 1
Score = 1
> If no known Holocene eruptions and the volcano is not a silicic caldera system
Score = 0

0 **Eruption recurrence**
> If eruption interval is 1-99 years
Score = 4
> 100 – 1,000 years
Score = 3
> 1,000 - 4,999 years
Score =2
> 5,000-10,000 years, or if no Holocene eruptions but it is a large-volume restless silicic system that has erupted in the last 100,000 years
Score = 1
> If no known Holocene eruption
Score = 0

0 **Explosive activity**
> If explosive activity (VEI ≥ 3) within the last 500 years
Score = 1

1 **Major explosive activity**
> If major explosive activity (VEI ≥ 4) within last 5,000 years
Score = 1

1 **Holocene pyroclastic flows**
> If yes
Score = 1

1 **Holocene lahars**
> If Holocene lahars have traveled beyond the flanks and reached populated areas
Score =1

0 **Holocene lava flows**
> If Holocene lava flows have traveled beyond the immediate eruption site or flanks and reached populated areas
Score =1

0 **Holocene tsunami(s)**
> Has it produced a tsunami within the Holocene? If yes
Score = 1

1 **Hydrothermal explosion potential**
> If the volcano had Holocene phreatic explosive activity, and/or has thermal features that are extensive enough to pose a potential for explosive activity
Score =1

1 **Sector collapse potential**
> If the volcano has produced a sector collapse in Quaternary-Holocene time and has re-built its edifice, or, has high relief, steep flanks and demonstrated or inferred alteration
Score = 1

1 **Primary lahar source**
> If volcano has a source of permanent water/ice on edifice, water volume > 106 m3: Score = 1

MT. BAKER HAZARD + EXPOSURE ANALYSIS

HISTORICAL UNREST FACTORS

0 **Observed seismic unrest**
> Since the last eruption, in the absence of eruptive activity, within 20 km of the volcanic edifice? If yes
Score = 1

0 **Observed ground deformation**
> Since the last eruption, in the absence of eruptive activity, inflation or other evidence of magma injection? If yes
Score = 1

1 **Observed fumarolic or magmatic degassing**
> Since the last eruption, in the absence of eruptive activity, either heat source or magmatic gases? If yes
Score = 1

9 **TOTAL OF HAZARD FACTORS + HISTORICAL UNREST FACTORS**

EXPOSURE FACTORS

3.65 **Log10 of Volcano Population Index (VPI) at 30 km**
> Calculated with LandScan population database. Visitor statistics for volcanoes in National Parks and other destination recreation areas are added to the VPI factor where available.

4.69 **Log10 of approximate population downstream or downslope**
> Population outside the 30 km VPI circle included within the extent of Holocene flow deposits or reasonable inundation modeling.This factor only used with volcanoes with a lahar hazard (e.g. Cascade stratovolcanoes) or significant lava flow hazard (e.g. Mauna Loa).

0 **Historical fatalities**
> If yes, and a permanent population is still present
Score = 1

0 **Historical evacuations**
> If yes, and a permanent population is still present
Score = 1

2 **Local aviation exposure**
> If any type volcano is within 50 km of a jet-service airport
Score = 1
> If a Type 1 volcano is within 300 km of a jet-service airport
Score = 1
> If a Type 1 volcano is within 300 km of a major international airport
Score = 2
> If none of these criteria are met
Score = 0

5.04 **Regional aviation exposure**
> This score is based on the log10 of approximate daily passenger traffic in each region. At present, in the U.S., this score ranges from 4 to 5.15. The regional risk code is applied only to type 1 volcanoes and those type 0 volcanoes that have produced explosive eruptions.

1 **Power infrastructure**
> Is there power infrastructure (e.g., power generation/transmission/distribution for electricity, oil, or gas) within flow hazard zones, or in an area frequently downwind of the volcano and close enough to considered at some risk? If yes
Score =1

1 **Transportation infrastructure**
> Is there transportation infrastructure (e.g. port facilities, rail lines, major roads) within flowage hazard zones, or in an area frequently downwind of the volcano and close enough to considered at some risk? If yes
Score = 1

MT. BAKER HAZARD + EXPOSURE ANALYSIS

0	**Major development or sensitive areas** > Are there major developments or sensitive areas threatened (e.g., National Park facilities, flood control projects, government facilities, developed tourist/ recreation facilities, manufacturing or other significant economic activity)? If yes Score = 1
0	**Volcano is a significant part of a populated island** > Holocene volcanic deposits cover >25% of land mass. If yes Score = 1
14.12	**TOTAL OF EXPOSURE FACTORS**

First total x second total = Relative Threat Ranking

0	x	17.4	=	155.6

MT. RAINIER HAZARD + EXPOSURE ANALYSIS

HAZARDS FACTORS

1 **Volcano Type**
> If volcano type is cinder cone, basaltic field, small shield, or fissure vents:
Score = 0
> If volcano type is stratocone, lava domes, complex volcano, maar or caldera:
Score = 1

1 **Maximum Volcano Explosivity Index (VEI)**
> If maximum known VEI ≤ 2
Score = 0
> If maximum known VEI = 3 or 4
Score = 1
> If maximum known VEI = 5 or 6
Score = 2
> If maximum known VEI ≥ 7
Score = 3
> If no maximum VEI is listed by GVP and if volcano type = 0
Score = 0
> If no maximum VEI is listed by GVP but volcano type = 1
Score = 1
> If no known Holocene eruptions and the volcano is not a silicic caldera system
Score = 0

0 **Eruption recurrence**
> If eruption interval is 1-99 years
Score = 4
> 100 – 1,000 years
Score = 3
> 1,000 - 4,999 years
Score =2
> 5,000-10,000 years, or if no Holocene eruptions but it is a large-volume restless silicic system that has erupted in the last 100,000 years
Score = 1
> If no known Holocene eruption
Score = 0

1 **Explosive activity**
> If explosive activity (VEI ≥ 3) within the last 500 years
Score = 1

3 **Major explosive activity**
> If major explosive activity (VEI ≥ 4) within last 5,000 years
Score = 1

1 **Holocene pyroclastic flows**
> If yes
Score = 1

1 **Holocene lahars**
> If Holocene lahars have traveled beyond the flanks and reached populated areas
Score =1

0 **Holocene lava flows**
> If Holocene lava flows have traveled beyond the immediate eruption site or flanks and reached populated areas
Score =1

0 **Holocene tsunami(s)**
> Has it produced a tsunami within the Holocene? If yes
Score = 1

1 **Hydrothermal explosion potential**
> If the volcano had Holocene phreatic explosive activity, and/or has thermal features that are extensive enough to pose a potential for explosive activity
Score =1

1 **Sector collapse potential**
> If the volcano has produced a sector collapse in Quaternary-Holocene time and has re-built its edifice, or, has high relief, steep flanks and demonstrated or inferred alteration
Score = 1

1 **Primary lahar source**
> If volcano has a source of permanent water/ice on edifice, water volume > 106 m3: Score = 1

MT. RAINIER HAZARD + EXPOSURE ANALYSIS

HISTORICAL UNREST FACTORS

1 **Observed seismic unrest**
> Since the last eruption, in the absence of eruptive activity, within 20 km of the volcanic edifice? If yes
Score = 1

0 **Observed ground deformation**
> Since the last eruption, in the absence of eruptive activity, inflation or other evidence of magma injection? If yes
Score = 1

1 **Observed fumarolic or magmatic degassing**
> Since the last eruption, in the absence of eruptive activity, either heat source or magmatic gases? If yes
Score = 1

13 **TOTAL OF HAZARD FACTORS + HISTORICAL UNREST FACTORS**

EXPOSURE FACTORS

3.69 **Log10 of Volcano Population Index (VPI) at 30 km**
> Calculated with LandScan population database. Visitor statistics for volcanoes in National Parks and other destination recreation areas are added to the VPI factor where available.

5.07 **Log10 of approximate population downstream or downslope**
> Population outside the 30 km VPI circle included within the extent of Holocene flow deposits or reasonable inundation modeling.This factor only used with volcanoes with a lahar hazard (e.g. Cascade stratovolcanoes) or significant lava flow hazard (e.g. Mauna Loa).

0 **Historical fatalities**
> If yes, and a permanent population is still present
Score = 1

0 **Historical evacuations**
> If yes, and a permanent population is still present
Score = 1

2 **Local aviation exposure**
> If any type volcano is within 50 km of a jet-service airport
Score = 1
> If a Type 1 volcano is within 300 km of a jet-service airport
Score = 1
> If a Type 1 volcano is within 300 km of a major international airport
Score = 2
> If none of these criteria are met
Score = 0

5.04 **Regional aviation exposure**
> This score is based on the log10 of approximate daily passenger traffic in each region. At present, in the U.S., this score ranges from 4 to 5.15. The regional risk code is applied only to type 1 volcanoes and those type 0 volcanoes that have produced explosive eruptions.

1 **Power infrastructure**
> Is there power infrastructure (e.g., power generation/transmission/distribution for electricity, oil, or gas) within flow hazard zones, or in an area frequently downwind of the volcano and close enough to considered at some risk? If yes
Score =1

1 **Transportation infrastructure**
> Is there transportation infrastructure (e.g. port facilities, rail lines, major roads) within flowage hazard zones, or in an area frequently downwind of the volcano and close enough to considered at some risk? If yes
Score = 1

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MT. RAINIER HAZARD + EXPOSURE ANALYSIS

1	**Major development or sensitive areas** > Are there major developments or sensitive areas threatened (e.g., National Park facilities, flood control projects, government facilities, developed tourist/ recreation facilities, manufacturing or other significant economic activity)? If yes Score = 1
0	**Volcano is a significant part of a populated island** > Holocene volcanic deposits cover >25% of land mass. If yes Score = 1
18.8	**TOTAL OF EXPOSURE FACTORS**

First total x second total = Relative Threat Ranking

13	x	18.8	=	244.4

MT. HOOD HAZARD + EXPOSURE ANALYSIS

HAZARDS FACTORS

1 **Volcano Type**
> If volcano type is cinder cone, basaltic field, small shield, or fissure vents:
Score = 0
> If volcano type is stratocone, lava domes, complex volcano, maar or caldera:
Score = 1

1 **Maximum Volcano Explosivity Index (VEI)**
> If maximum known VEI ≤ 2
Score = 0
> If maximum known VEI = 3 or 4
Score = 1
> If maximum known VEI = 5 or 6
Score = 2
> If maximum known VEI ≥ 7
Score = 3
> If no maximum VEI is listed by GVP and if volcano type = 0
Score = 0
> If no maximum VEI is listed by GVP but volcano type = 1
Score = 1
> If no known Holocene eruptions and the volcano is not a silicic caldera system
Score = 0

0 **Eruption recurrence**
> If eruption interval is 1-99 years
Score = 4
> 100 – 1,000 years
Score = 3
> 1,000 - 4,999 years
Score =2
> 5,000-10,000 years, or if no Holocene eruptions but it is a large-volume restless silicic system that has erupted in the last 100,000 years
Score = 1
> If no known Holocene eruption
Score = 0

0 **Explosive activity**
> If explosive activity (VEI ≥ 3) within the last 500 years
Score = 1

3 **Major explosive activity**
> If major explosive activity (VEI ≥ 4) within last 5,000 years
Score = 1

1 **Holocene pyroclastic flows**
> If yes
Score = 1

1 **Holocene lahars**
> If Holocene lahars have traveled beyond the flanks and reached populated areas
Score =1

0 **Holocene lava flows**
> If Holocene lava flows have traveled beyond the immediate eruption site or flanks and reached populated areas
Score =1

0 **Holocene tsunami(s)**
> Has it produced a tsunami within the Holocene? If yes
Score = 1

1 **Hydrothermal explosion potential**
> If the volcano had Holocene phreatic explosive activity, and/or has thermal features that are extensive enough to pose a potential for explosive activity
Score =1

1 **Sector collapse potential**
> If the volcano has produced a sector collapse in Quaternary-Holocene time and has re-built its edifice, or, has high relief, steep flanks and demonstrated or inferred alteration
Score = 1

1 **Primary lahar source**
> If volcano has a source of permanent water/ice on edifice, water volume > 106 m3: Score = 1

MT. HOOD HAZARD + EXPOSURE ANALYSIS

HISTORICAL UNREST FACTORS

1 **Observed seismic unrest**
> Since the last eruption, in the absence of eruptive activity, within 20 km of the volcanic edifice? If yes
Score = 1

0 **Observed ground deformation**
> Since the last eruption, in the absence of eruptive activity, inflation or other evidence of magma injection? If yes
Score = 1

1 **Observed fumarolic or magmatic degassing**
> Since the last eruption, in the absence of eruptive activity, either heat source or magmatic gases? If yes
Score = 1

12 **TOTAL OF HAZARD FACTORS + HISTORICAL UNREST FACTORS**

EXPOSURE FACTORS

3.75 **Log10 of Volcano Population Index (VPI) at 30 km**
> Calculated with LandScan population database. Visitor statistics for volcanoes in National Parks and other destination recreation areas are added to the VPI factor where available.

3.98 **Log10 of approximate population downstream or downslope**
> Population outside the 30 km VPI circle included within the extent of Holocene flow deposits or reasonable inundation modeling.This factor only used with volcanoes with a lahar hazard (e.g. Cascade stratovolcanoes) or significant lava flow hazard (e.g. Mauna Loa).

0 **Historical fatalities**
> If yes, and a permanent population is still present
Score = 1

0 **Historical evacuations**
> If yes, and a permanent population is still present
Score = 1

2 **Local aviation exposure**
> If any type volcano is within 50 km of a jet-service airport
Score = 1
> If a Type 1 volcano is within 300 km of a jet-service airport
Score = 1
> If a Type 1 volcano is within 300 km of a major international airport
Score = 2
> If none of these criteria are met
Score = 0

5.04 **Regional aviation exposure**
> This score is based on the log10 of approximate daily passenger traffic in each region. At present, in the U.S., this score ranges from 4 to 5.15. The regional risk code is applied only to type 1 volcanoes and those type 0 volcanoes that have produced explosive eruptions.

1 **Power infrastructure**
> Is there power infrastructure (e.g., power generation/transmission/distribution for electricity, oil, or gas) within flow hazard zones, or in an area frequently downwind of the volcano and close enough to considered at some risk? If yes
Score =1

1 **Transportation infrastructure**
> Is there transportation infrastructure (e.g. port facilities, rail lines, major roads) within flowage hazard zones, or in an area frequently downwind of the volcano and close enough to considered at some risk? If yes
Score = 1

MT. HOOD HAZARD + EXPOSURE ANALYSIS

1	**Major development or sensitive areas** > Are there major developments or sensitive areas threatened (e.g., National Park facilities, flood control projects, government facilities, developed tourist/ recreation facilities, manufacturing or other significant economic activity)? If yes Score = 1
0	**Volcano is a significant part of a populated island** > Holocene volcanic deposits cover >25% of land mass. If yes Score = 1
17.8	**TOTAL OF EXPOSURE FACTORS**

First total x second total = Relative Threat Ranking

12	x	17.8	=	213.6

CRATER LAKE HAZARD + EXPOSURE ANALYSIS

HAZARDS FACTORS

1 **Volcano Type**
> If volcano type is cinder cone, basaltic field, small shield, or fissure vents:
Score = 0
> If volcano type is stratocone, lava domes, complex volcano, maar or caldera:
Score = 1

3 **Maximum Volcano Explosivity Index (VEI)**
> If maximum known VEI ≤ 2
Score = 0
> If maximum known VEI = 3 or 4
Score = 1
> If maximum known VEI = 5 or 6
Score = 2
> If maximum known VEI ≥ 7
Score = 3
> If no maximum VEI is listed by GVP and if volcano type = 0
Score = 0
> If no maximum VEI is listed by GVP but volcano type = 1
Score = 1
> If no known Holocene eruptions and the volcano is not a silicic caldera system
Score = 0

0 **Eruption recurrence**
> If eruption interval is 1-99 years
Score = 4
> 100 – 1,000 years
Score = 3
> 1,000 - 4,999 years
Score =2
> 5,000-10,000 years, or if no Holocene eruptions but it is a large-volume restless silicic system that has erupted in the last 100,000 years
Score = 1
> If no known Holocene eruption
Score = 0

0 **Explosive activity**
> If explosive activity (VEI ≥ 3) within the last 500 years
Score = 1

2 **Major explosive activity**
> If major explosive activity (VEI ≥ 4) within last 5,000 years
Score = 1

1 **Holocene pyroclastic flows**
> If yes
Score = 1

1 **Holocene lahars**
> If Holocene lahars have traveled beyond the flanks and reached populated areas
Score =1

0 **Holocene lava flows**
> If Holocene lava flows have traveled beyond the immediate eruption site or flanks and reached populated areas
Score =1

0 **Holocene tsunami(s)**
> Has it produced a tsunami within the Holocene? If yes
Score = 1

0 **Hydrothermal explosion potential**
> If the volcano had Holocene phreatic explosive activity, and/or has thermal features that are extensive enough to pose a potential for explosive activity
Score =1

0 **Sector collapse potential**
> If the volcano has produced a sector collapse in Quaternary-Holocene time and has re-built its edifice, or, has high relief, steep flanks and demonstrated or inferred alteration
Score = 1

1 **Primary lahar source**
> If volcano has a source of permanent water/ice on edifice, water volume > 106 m3: Score = 1

CRATER LAKE HAZARD + EXPOSURE ANALYSIS

HISTORICAL UNREST FACTORS

nd **Observed seismic unrest**
> Since the last eruption, in the absence of eruptive activity, within 20 km of the volcanic edifice? If yes
Score = 1

nd **Observed ground deformation**
> Since the last eruption, in the absence of eruptive activity, inflation or other evidence of magma injection? If yes
Score = 1

1 **Observed fumarolic or magmatic degassing**
> Since the last eruption, in the absence of eruptive activity, either heat source or magmatic gases? If yes
Score = 1

10 **TOTAL OF HAZARD FACTORS + HISTORICAL UNREST FACTORS**

EXPOSURE FACTORS

3.36 **Log10 of Volcano Population Index (VPI) at 30 km**
> Calculated with LandScan population database. Visitor statistics for volcanoes in National Parks and other destination recreation areas are added to the VPI factor where available.

3.70 **Log10 of approximate population downstream or downslope**
> Population outside the 30 km VPI circle included within the extent of Holocene flow deposits or reasonable inundation modeling.This factor only used with volcanoes with a lahar hazard (e.g. Cascade stratovolcanoes) or significant lava flow hazard (e.g. Mauna Loa).

0 **Historical fatalities**
> If yes, and a permanent population is still present
Score = 1

0 **Historical evacuations**
> If yes, and a permanent population is still present
Score = 1

2 **Local aviation exposure**
> If any type volcano is within 50 km of a jet-service airport
Score = 1
> If a Type 1 volcano is within 300 km of a jet-service airport
Score = 1
> If a Type 1 volcano is within 300 km of a major international airport
Score = 2
> If none of these criteria are met
Score = 0

5.04 **Regional aviation exposure**
> This score is based on the log10 of approximate daily passenger traffic in each region. At present, in the U.S., this score ranges from 4 to 5.15. The regional risk code is applied only to type 1 volcanoes and those type 0 volcanoes that have produced explosive eruptions.

1 **Power infrastructure**
> Is there power infrastructure (e.g., power generation/transmission/distribution for electricity, oil, or gas) within flow hazard zones, or in an area frequently downwind of the volcano and close enough to considered at some risk? If yes
Score =1

0 **Transportation infrastructure**
> Is there transportation infrastructure (e.g. port facilities, rail lines, major roads) within flowage hazard zones, or in an area frequently downwind of the volcano and close enough to considered at some risk? If yes
Score = 1

FEMA URBAN DESIGN & PLANNING

CRATER LAKE HAZARD + EXPOSURE ANALYSIS

1	**Major development or sensitive areas** > Are there major developments or sensitive areas threatened (e.g., National Park facilities, flood control projects, government facilities, developed tourist/ recreation facilities, manufacturing or other significant economic activity)? If yes Score = 1
0	**Volcano is a significant part of a populated island** > Holocene volcanic deposits cover >25% of land mass. If yes Score = 1
16.1	**TOTAL OF EXPOSURE FACTORS**

First total x second total = Relative Threat Ranking

10	x	16.1	=	161

SOUTH SISTER HAZARD + EXPOSURE ANALYSIS

HAZARDS FACTORS

1 **Volcano Type**
> If volcano type is cinder cone, basaltic field, small shield, or fissure vents:
Score = 0
> If volcano type is stratocone, lava domes, complex volcano, maar or caldera:
Score = 1

1 **Maximum Volcano Explosivity Index (VEI)**
> If maximum known VEI ≤ 2
Score = 0
> If maximum known VEI = 3 or 4
Score = 1
> If maximum known VEI = 5 or 6
Score = 2
> If maximum known VEI ≥ 7
Score = 3
> If no maximum VEI is listed by GVP and if volcano type = 0
Score = 0
> If no maximum VEI is listed by GVP but volcano type = 1
Score = 1
> If no known Holocene eruptions and the volcano is not a silicic caldera system
Score = 0

0 **Eruption recurrence**
> If eruption interval is 1-99 years
Score = 4
> 100 – 1,000 years
Score = 3
> 1,000 - 4,999 years
Score =2
> 5,000-10,000 years, or if no Holocene eruptions but it is a large-volume restless silicic system that has erupted in the last 100,000 years
Score = 1
> If no known Holocene eruption
Score = 0

1 **Explosive activity**
> If explosive activity (VEI ≥ 3) within the last 500 years
Score = 1

2 **Major explosive activity**
> If major explosive activity (VEI ≥ 4) within last 5,000 years
Score = 1

1 **Holocene pyroclastic flows**
> If yes
Score = 1

1 **Holocene lahars**
> If Holocene lahars have traveled beyond the flanks and reached populated areas
Score =1

0 **Holocene lava flows**
> If Holocene lava flows have traveled beyond the immediate eruption site or flanks and reached populated areas
Score =1

0 **Holocene tsunami(s)**
> Has it produced a tsunami within the Holocene? If yes
Score = 1

0 **Hydrothermal explosion potential**
> If the volcano had Holocene phreatic explosive activity, and/or has thermal features that are extensive enough to pose a potential for explosive activity
Score =1

1 **Sector collapse potential**
> If the volcano has produced a sector collapse in Quaternary-Holocene time and has re-built its edifice, or, has high relief, steep flanks and demonstrated or inferred alteration
Score = 1

1 **Primary lahar source**
> If volcano has a source of permanent water/ice on edifice, water volume > 106 m3: Score = 1

SOUTH SISTER HAZARD + EXPOSURE ANALYSIS

HISTORICAL UNREST FACTORS

1 **Observed seismic unrest**
> Since the last eruption, in the absence of eruptive activity, within 20 km of the volcanic edifice? If yes
Score = 1

1 **Observed ground deformation**
> Since the last eruption, in the absence of eruptive activity, inflation or other evidence of magma injection? If yes
Score = 1

1 **Observed fumarolic or magmatic degassing**
> Since the last eruption, in the absence of eruptive activity, either heat source or magmatic gases? If yes
Score = 1

12 **TOTAL OF HAZARD FACTORS + HISTORICAL UNREST FACTORS**

EXPOSURE FACTORS

3.32 **Log10 of Volcano Population Index (VPI) at 30 km**
> Calculated with LandScan population database. Visitor statistics for volcanoes in National Parks and other destination recreation areas are added to the VPI factor where available.

3.83 **Log10 of approximate population downstream or downslope**
> Population outside the 30 km VPI circle included within the extent of Holocene flow deposits or reasonable inundation modeling.This factor only used with volcanoes with a lahar hazard (e.g. Cascade stratovolcanoes) or significant lava flow hazard (e.g. Mauna Loa).

0 **Historical fatalities**
> If yes, and a permanent population is still present
Score = 1

0 **Historical evacuations**
> If yes, and a permanent population is still present
Score = 1

2 **Local aviation exposure**
> If any type volcano is within 50 km of a jet-service airport
Score = 1
> If a Type 1 volcano is within 300 km of a jet-service airport
Score = 1
> If a Type 1 volcano is within 300 km of a major international airport
Score = 2
> If none of these criteria are met
Score = 0

5.04 **Regional aviation exposure**
> This score is based on the log10 of approximate daily passenger traffic in each region. At present, in the U.S., this score ranges from 4 to 5.15. The regional risk code is applied only to type 1 volcanoes and those type 0 volcanoes that have produced explosive eruptions.

1 **Power infrastructure**
> Is there power infrastructure (e.g., power generation/transmission/distribution for electricity, oil, or gas) within flow hazard zones, or in an area frequently downwind of the volcano and close enough to considered at some risk? If yes
Score =1

0 **Transportation infrastructure**
> Is there transportation infrastructure (e.g. port facilities, rail lines, major roads) within flowage hazard zones, or in an area frequently downwind of the volcano and close enough to considered at some risk? If yes
Score = 1

SOUTH SISTER HAZARD + EXPOSURE ANALYSIS

1	**Major development or sensitive areas** > Are there major developments or sensitive areas threatened (e.g., National Park facilities, flood control projects, government facilities, developed tourist/ recreation facilities, manufacturing or other significant economic activity)? If yes Score = 1
0	**Volcano is a significant part of a populated island** > Holocene volcanic deposits cover >25% of land mass. If yes Score = 1
16.2	**TOTAL OF EXPOSURE FACTORS**

First total x second total = Relative Threat Ranking

12	x	16.2	=	194.4

NEWBERRY HAZARD + EXPOSURE ANALYSIS

HAZARDS FACTORS

1 **Volcano Type**
> If volcano type is cinder cone, basaltic field, small shield, or fissure vents:
Score = 0
> If volcano type is stratocone, lava domes, complex volcano, maar or caldera:
Score = 1

1 **Maximum Volcano Explosivity Index (VEI)**
> If maximum known VEI ≤ 2
Score = 0
> If maximum known VEI = 3 or 4
Score = 1
> If maximum known VEI = 5 or 6
Score = 2
> If maximum known VEI ≥ 7
Score = 3
> If no maximum VEI is listed by GVP and if volcano type = 0
Score = 0
> If no maximum VEI is listed by GVP but volcano type = 1
Score = 1
> If no known Holocene eruptions and the volcano is not a silicic caldera system
Score = 0

0 **Eruption recurrence**
> If eruption interval is 1-99 years
Score = 4
> 100 – 1,000 years
Score = 3
> 1,000 - 4,999 years
Score =2
> 5,000-10,000 years, or if no Holocene eruptions but it is a large-volume restless silicic system that has erupted in the last 100,000 years
Score = 1
> If no known Holocene eruption
Score = 0

1 **Explosive activity**
> If explosive activity (VEI ≥ 3) within the last 500 years
Score = 1

2 **Major explosive activity**
> If major explosive activity (VEI ≥ 4) within last 5,000 years
Score = 1

1 **Holocene pyroclastic flows**
> If yes
Score = 1

1 **Holocene lahars**
> If Holocene lahars have traveled beyond the flanks and reached populated areas
Score =1

1 **Holocene lava flows**
> If Holocene lava flows have traveled beyond the immediate eruption site or flanks and reached populated areas
Score =1

0 **Holocene tsunami(s)**
> Has it produced a tsunami within the Holocene? If yes
Score = 1

0 **Hydrothermal explosion potential**
> If the volcano had Holocene phreatic explosive activity, and/or has thermal features that are extensive enough to pose a potential for explosive activity
Score =1

0 **Sector collapse potential**
> If the volcano has produced a sector collapse in Quaternary-Holocene time and has re-built its edifice, or, has high relief, steep flanks and demonstrated or inferred alteration
Score = 1

0 **Primary lahar source**
> If volcano has a source of permanent water/ice on edifice, water volume > 106 m3: Score = 1

NEWBERRY HAZARD + EXPOSURE ANALYSIS

HISTORICAL UNREST FACTORS

0 **Observed seismic unrest**
> Since the last eruption, in the absence of eruptive activity, within 20 km of the volcanic edifice? If yes
Score = 1

0 **Observed ground deformation**
> Since the last eruption, in the absence of eruptive activity, inflation or other evidence of magma injection? If yes
Score = 1

1 **Observed fumarolic or magmatic degassing**
> Since the last eruption, in the absence of eruptive activity, either heat source or magmatic gases? If yes
Score = 1

9 **TOTAL OF HAZARD FACTORS + HISTORICAL UNREST FACTORS**

EXPOSURE FACTORS

3.67 **Log10 of Volcano Population Index (VPI) at 30 km**
> Calculated with LandScan population database. Visitor statistics for volcanoes in National Parks and other destination recreation areas are added to the VPI factor where available.

0 **Log10 of approximate population downstream or downslope**
> Population outside the 30 km VPI circle included within the extent of Holocene flow deposits or reasonable inundation modeling.This factor only used with volcanoes with a lahar hazard (e.g. Cascade stratovolcanoes) or significant lava flow hazard (e.g. Mauna Loa).

0 **Historical fatalities**
> If yes, and a permanent population is still present
Score = 1

0 **Historical evacuations**
> If yes, and a permanent population is still present
Score = 1

2 **Local aviation exposure**
> If any type volcano is within 50 km of a jet-service airport
Score = 1
> If a Type 1 volcano is within 300 km of a jet-service airport
Score = 1
> If a Type 1 volcano is within 300 km of a major international airport
Score = 2
> If none of these criteria are met
Score = 0

5.04 **Regional aviation exposure**
> This score is based on the log10 of approximate daily passenger traffic in each region. At present, in the U.S., this score ranges from 4 to 5.15. The regional risk code is applied only to type 1 volcanoes and those type 0 volcanoes that have produced explosive eruptions.

1 **Power infrastructure**
> Is there power infrastructure (e.g., power generation/transmission/distribution for electricity, oil, or gas) within flow hazard zones, or in an area frequently downwind of the volcano and close enough to considered at some risk? If yes
Score =1

1 **Transportation infrastructure**
> Is there transportation infrastructure (e.g. port facilities, rail lines, major roads) within flowage hazard zones, or in an area frequently downwind of the volcano and close enough to considered at some risk? If yes
Score = 1

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NEWBERRY HAZARD + EXPOSURE ANALYSIS

1	**Major development or sensitive areas** > Are there major developments or sensitive areas threatened (e.g., National Park facilities, flood control projects, government facilities, developed tourist/ recreation facilities, manufacturing or other significant economic activity)? If yes Score = 1
0	**Volcano is a significant part of a populated island** > Holocene volcanic deposits cover >25% of land mass. If yes Score = 1
14.0	**TOTAL OF EXPOSURE FACTORS**

First total x second total = Relative Threat Ranking

9	x	14.0	=	126

AKUTAN HAZARD + EXPOSURE ANALYSIS

HAZARDS FACTORS

1 **Volcano Type**
> If volcano type is cinder cone, basaltic field, small shield, or fissure vents:
Score = 0
> If volcano type is stratocone, lava domes, complex volcano, maar or caldera:
Score = 1

2 **Maximum Volcano Explosivity Index (VEI)**
> If maximum known VEI ≤ 2
Score = 0
> If maximum known VEI = 3 or 4
Score = 1
> If maximum known VEI = 5 or 6
Score = 2
> If maximum known VEI ≥ 7
Score = 3
> If no maximum VEI is listed by GVP and if volcano type = 0
Score = 0
> If no maximum VEI is listed by GVP but volcano type = 1
Score = 1
> If no known Holocene eruptions and the volcano is not a silicic caldera system
Score = 0

1 **Eruption recurrence**
> If eruption interval is 1-99 years
Score = 4
> 100 – 1,000 years
Score = 3
> 1,000 - 4,999 years
Score =2
> 5,000-10,000 years, or if no Holocene eruptions but it is a large-volume restless silicic system that has erupted in the last 100,000 years
Score = 1
> If no known Holocene eruption
Score = 0

1 **Explosive activity**
> If explosive activity (VEI ≥ 3) within the last 500 years
Score = 1

4 **Major explosive activity**
> If major explosive activity (VEI ≥ 4) within last 5,000 years
Score = 1

1 **Holocene pyroclastic flows**
> If yes
Score = 1

1 **Holocene lahars**
> If Holocene lahars have traveled beyond the flanks and reached populated areas
Score =1

0 **Holocene lava flows**
> If Holocene lava flows have traveled beyond the immediate eruption site or flanks and reached populated areas
Score =1

0 **Holocene tsunami(s)**
> Has it produced a tsunami within the Holocene? If yes
Score = 1

0 **Hydrothermal explosion potential**
> If the volcano had Holocene phreatic explosive activity, and/or has thermal features that are extensive enough to pose a potential for explosive activity
Score =1

1 **Sector collapse potential**
> If the volcano has produced a sector collapse in Quaternary-Holocene time and has re-built its edifice, or, has high relief, steep flanks and demonstrated or inferred alteration
Score = 1

1 **Primary lahar source**
> If volcano has a source of permanent water/ice on edifice, water volume > 106 m3: Score = 1

AKUTAN HAZARD + EXPOSURE ANALYSIS

HISTORICAL UNREST FACTORS

1 **Observed seismic unrest**
> Since the last eruption, in the absence of eruptive activity, within 20 km of the volcanic edifice? If yes
Score = 1

1 **Observed ground deformation**
> Since the last eruption, in the absence of eruptive activity, inflation or other evidence of magma injection? If yes
Score = 1

1 **Observed fumarolic or magmatic degassing**
> Since the last eruption, in the absence of eruptive activity, either heat source or magmatic gases? If yes
Score = 1

16 **TOTAL OF HAZARD FACTORS + HISTORICAL UNREST FACTORS**

EXPOSURE FACTORS

1.46 **Log10 of Volcano Population Index (VPI) at 30 km**
> Calculated with LandScan population database. Visitor statistics for volcanoes in National Parks and other destination recreation areas are added to the VPI factor where available.

0 **Log10 of approximate population downstream or downslope**
> Population outside the 30 km VPI circle included within the extent of Holocene flow deposits or reasonable inundation modeling.This factor only used with volcanoes with a lahar hazard (e.g. Cascade stratovolcanoes) or significant lava flow hazard (e.g. Mauna Loa).

0 **Historical fatalities**
> If yes, and a permanent population is still present
Score = 1

0 **Historical evacuations**
> If yes, and a permanent population is still present
Score = 1

1 **Local aviation exposure**
> If any type volcano is within 50 km of a jet-service airport
Score = 1
> If a Type 1 volcano is within 300 km of a jet-service airport
Score = 1
> If a Type 1 volcano is within 300 km of a major international airport
Score = 2
> If none of these criteria are met
Score = 0

4.3 **Regional aviation exposure**
> This score is based on the log10 of approximate daily passenger traffic in each region. At present, in the U.S., this score ranges from 4 to 5.15. The regional risk code is applied only to type 1 volcanoes and those type 0 volcanoes that have produced explosive eruptions.

0 **Power infrastructure**
> Is there power infrastructure (e.g., power generation/transmission/distribution for electricity, oil, or gas) within flow hazard zones, or in an area frequently downwind of the volcano and close enough to considered at some risk? If yes
Score =1

0 **Transportation infrastructure**
> Is there transportation infrastructure (e.g. port facilities, rail lines, major roads) within flowage hazard zones, or in an area frequently downwind of the volcano and close enough to considered at some risk? If yes
Score = 1

AKUTAN HAZARD + EXPOSURE ANALYSIS

1	**Major development or sensitive areas** > Are there major developments or sensitive areas threatened (e.g., National Park facilities, flood control projects, government facilities, developed tourist/ recreation facilities, manufacturing or other significant economic activity)? If yes Score = 1
1	**Volcano is a significant part of a populated island** > Holocene volcanic deposits cover >25% of land mass. If yes Score = 1
8.8	**TOTAL OF EXPOSURE FACTORS**

First total x second total = Relative Threat Ranking

16	x	8.8	=	140.8

AUGUSTINE HAZARD + EXPOSURE ANALYSIS

HAZARDS FACTORS

1 **Volcano Type**
> If volcano type is cinder cone, basaltic field, small shield, or fissure vents:
Score = 0
> If volcano type is stratocone, lava domes, complex volcano, maar or caldera:
Score = 1

1 **Maximum Volcano Explosivity Index (VEI)**
> If maximum known VEI ≤ 2
Score = 0
> If maximum known VEI = 3 or 4
Score = 1
> If maximum known VEI = 5 or 6
Score = 2
> If maximum known VEI ≥ 7
Score = 3
> If no maximum VEI is listed by GVP and if volcano type = 0
Score = 0
> If no maximum VEI is listed by GVP but volcano type = 1
Score = 1
> If no known Holocene eruptions and the volcano is not a silicic caldera system
Score = 0

1 **Eruption recurrence**
> If eruption interval is 1-99 years
Score = 4
> 100 – 1,000 years
Score = 3
> 1,000 - 4,999 years
Score =2
> 5,000-10,000 years, or if no Holocene eruptions but it is a large-volume restless silicic system that has erupted in the last 100,000 years
Score = 1
> If no known Holocene eruption
Score = 0

4 **Explosive activity**
> If explosive activity (VEI ≥ 3) within the last 500 years
Score = 1

1 **Major explosive activity**
> If major explosive activity (VEI ≥ 4) within last 5,000 years
Score = 1

1 **Holocene pyroclastic flows**
> If yes
Score = 1

1 **Holocene lahars**
> If Holocene lahars have traveled beyond the flanks and reached populated areas
Score =1

0 **Holocene lava flows**
> If Holocene lava flows have traveled beyond the immediate eruption site or flanks and reached populated areas
Score =1

1 **Holocene tsunami(s)**
> Has it produced a tsunami within the Holocene? If yes
Score = 1

0 **Hydrothermal explosion potential**
> If the volcano had Holocene phreatic explosive activity, and/or has thermal features that are extensive enough to pose a potential for explosive activity
Score =1

1 **Sector collapse potential**
> If the volcano has produced a sector collapse in Quaternary-Holocene time and has re-built its edifice, or, has high relief, steep flanks and demonstrated or inferred alteration
Score = 1

0 **Primary lahar source**
> If volcano has a source of permanent water/ice on edifice, water volume > 106 m3: Score = 1

AUGUSTINE HAZARD + EXPOSURE ANALYSIS

HISTORICAL UNREST FACTORS

1 **Observed seismic unrest**
> Since the last eruption, in the absence of eruptive activity, within 20 km of the volcanic edifice? If yes
Score = 1

nd **Observed ground deformation**
> Since the last eruption, in the absence of eruptive activity, inflation or other evidence of magma injection? If yes
Score = 1

1 **Observed fumarolic or magmatic degassing**
> Since the last eruption, in the absence of eruptive activity, either heat source or magmatic gases? If yes
Score = 1

14 **TOTAL OF HAZARD FACTORS + HISTORICAL UNREST FACTORS**

EXPOSURE FACTORS

0.48 **Log10 of Volcano Population Index (VPI) at 30 km**
> Calculated with LandScan population database. Visitor statistics for volcanoes in National Parks and other destination recreation areas are added to the VPI factor where available.

0.00 **Log10 of approximate population downstream or downslope**
> Population outside the 30 km VPI circle included within the extent of Holocene flow deposits or reasonable inundation modeling.This factor only used with volcanoes with a lahar hazard (e.g. Cascade stratovolcanoes) or significant lava flow hazard (e.g. Mauna Loa).

0 **Historical fatalities**
> If yes, and a permanent population is still present
Score = 1

0 **Historical evacuations**
> If yes, and a permanent population is still present
Score = 1

2 **Local aviation exposure**
> If any type volcano is within 50 km of a jet-service airport
Score = 1
> If a Type 1 volcano is within 300 km of a jet-service airport
Score = 1
> If a Type 1 volcano is within 300 km of a major international airport
Score = 2
> If none of these criteria are met
Score = 0

4.3 **Regional aviation exposure**
> This score is based on the log10 of approximate daily passenger traffic in each region. At present, in the U.S., this score ranges from 4 to 5.15. The regional risk code is applied only to type 1 volcanoes and those type 0 volcanoes that have produced explosive eruptions.

0 **Power infrastructure**
> Is there power infrastructure (e.g., power generation/transmission/distribution for electricity, oil, or gas) within flow hazard zones, or in an area frequently downwind of the volcano and close enough to considered at some risk? If yes
Score =1

1 **Transportation infrastructure**
> Is there transportation infrastructure (e.g. port facilities, rail lines, major roads) within flowage hazard zones, or in an area frequently downwind of the volcano and close enough to considered at some risk? If yes
Score = 1

AUGUSTINE HAZARD + EXPOSURE ANALYSIS

1	**Major development or sensitive areas** > Are there major developments or sensitive areas threatened (e.g., National Park facilities, flood control projects, government facilities, developed tourist/ recreation facilities, manufacturing or other significant economic activity)? If yes Score = 1
0	**Volcano is a significant part of a populated island** > Holocene volcanic deposits cover >25% of land mass. If yes Score = 1
8.8	**TOTAL OF EXPOSURE FACTORS**

First total x second total = Relative Threat Ranking

14	x	8.8	=	123.2

REDOUBT HAZARD + EXPOSURE ANALYSIS

HAZARDS FACTORS

1 **Volcano Type**
> If volcano type is cinder cone, basaltic field, small shield, or fissure vents:
Score = 0
> If volcano type is stratocone, lava domes, complex volcano, maar or caldera:
Score = 1

1 **Maximum Volcano Explosivity Index (VEI)**
> If maximum known VEI ≤ 2
Score = 0
> If maximum known VEI = 3 or 4
Score = 1
> If maximum known VEI = 5 or 6
Score = 2
> If maximum known VEI ≥ 7
Score = 3
> If no maximum VEI is listed by GVP and if volcano type = 0
Score = 0
> If no maximum VEI is listed by GVP but volcano type = 1
Score = 1
> If no known Holocene eruptions and the volcano is not a silicic caldera system
Score = 0

1 **Eruption recurrence**
> If eruption interval is 1-99 years
Score = 4
> 100 – 1,000 years
Score = 3
> 1,000 - 4,999 years
Score =2
> 5,000-10,000 years, or if no Holocene eruptions but it is a large-volume restless silicic system that has erupted in the last 100,000 years
Score = 1
> If no known Holocene eruption
Score = 0

1 **Explosive activity**
> If explosive activity (VEI ≥ 3) within the last 500 years
Score = 1

4 **Major explosive activity**
> If major explosive activity (VEI ≥ 4) within last 5,000 years
Score = 1

1 **Holocene pyroclastic flows**
> If yes
Score = 1

1 **Holocene lahars**
> If Holocene lahars have traveled beyond the flanks and reached populated areas
Score =1

0 **Holocene lava flows**
> If Holocene lava flows have traveled beyond the immediate eruption site or flanks and reached populated areas
Score =1

0 **Holocene tsunami(s)**
> Has it produced a tsunami within the Holocene? If yes
Score = 1

0 **Hydrothermal explosion potential**
> If the volcano had Holocene phreatic explosive activity, and/or has thermal features that are extensive enough to pose a potential for explosive activity
Score =1

1 **Sector collapse potential**
> If the volcano has produced a sector collapse in Quaternary-Holocene time and has re-built its edifice, or, has high relief, steep flanks and demonstrated or inferred alteration
Score = 1

1 **Primary lahar source**
> If volcano has a source of permanent water/ice on edifice, water volume > 106 m3: Score = 1

REDOUBT HAZARD + EXPOSURE ANALYSIS

HISTORICAL UNREST FACTORS

1 **Observed seismic unrest**
> Since the last eruption, in the absence of eruptive activity, within 20 km of the volcanic edifice? If yes
Score = 1

0 **Observed ground deformation**
> Since the last eruption, in the absence of eruptive activity, inflation or other evidence of magma injection? If yes
Score = 1

1 **Observed fumarolic or magmatic degassing**
> Since the last eruption, in the absence of eruptive activity, either heat source or magmatic gases? If yes
Score = 1

14 **TOTAL OF HAZARD FACTORS + HISTORICAL UNREST FACTORS**

EXPOSURE FACTORS

1.42 **Log10 of Volcano Population Index (VPI) at 30 km**
> Calculated with LandScan population database. Visitor statistics for volcanoes in National Parks and other destination recreation areas are added to the VPI factor where available.

0.00 **Log10 of approximate population downstream or downslope**
> Population outside the 30 km VPI circle included within the extent of Holocene flow deposits or reasonable inundation modeling.This factor only used with volcanoes with a lahar hazard (e.g. Cascade stratovolcanoes) or significant lava flow hazard (e.g. Mauna Loa).

0 **Historical fatalities**
> If yes, and a permanent population is still present
Score = 1

1 **Historical evacuations**
> If yes, and a permanent population is still present
Score = 1

2 **Local aviation exposure**
> If any type volcano is within 50 km of a jet-service airport
Score = 1
> If a Type 1 volcano is within 300 km of a jet-service airport
Score = 1
> If a Type 1 volcano is within 300 km of a major international airport
Score = 2
> If none of these criteria are met
Score = 0

4.3 **Regional aviation exposure**
> This score is based on the log10 of approximate daily passenger traffic in each region. At present, in the U.S., this score ranges from 4 to 5.15. The regional risk code is applied only to type 1 volcanoes and those type 0 volcanoes that have produced explosive eruptions.

1 **Power infrastructure**
> Is there power infrastructure (e.g., power generation/transmission/distribution for electricity, oil, or gas) within flow hazard zones, or in an area frequently downwind of the volcano and close enough to considered at some risk? If yes
Score =1

1 **Transportation infrastructure**
> Is there transportation infrastructure (e.g. port facilities, rail lines, major roads) within flowage hazard zones, or in an area frequently downwind of the volcano and close enough to considered at some risk? If yes
Score = 1

REDOUBT HAZARD + EXPOSURE ANALYSIS

1	**Major development or sensitive areas** > Are there major developments or sensitive areas threatened (e.g., National Park facilities, flood control projects, government facilities, developed tourist/ recreation facilities, manufacturing or other significant economic activity)? If yes Score = 1
0	**Volcano is a significant part of a populated island** > Holocene volcanic deposits cover >25% of land mass. If yes Score = 1
11.7	**TOTAL OF EXPOSURE FACTORS**

First total x second total = Relative Threat Ranking

14	x	11.7	=	163.8

MT. SPURR HAZARD + EXPOSURE ANALYSIS

HAZARDS FACTORS

1 **Volcano Type**
> If volcano type is cinder cone, basaltic field, small shield, or fissure vents:
Score = 0
> If volcano type is stratocone, lava domes, complex volcano, maar or caldera:
Score = 1

1 **Maximum Volcano Explosivity Index (VEI)**
> If maximum known VEI ≤ 2
Score = 0
> If maximum known VEI = 3 or 4
Score = 1
> If maximum known VEI = 5 or 6
Score = 2
> If maximum known VEI ≥ 7
Score = 3
> If no maximum VEI is listed by GVP and if volcano type = 0
Score = 0
> If no maximum VEI is listed by GVP but volcano type = 1
Score = 1
> If no known Holocene eruptions and the volcano is not a silicic caldera system
Score = 0

1 **Eruption recurrence**
> If eruption interval is 1-99 years
Score = 4
> 100 – 1,000 years
Score = 3
> 1,000 - 4,999 years
Score =2
> 5,000-10,000 years, or if no Holocene eruptions but it is a large-volume restless silicic system that has erupted in the last 100,000 years
Score = 1
> If no known Holocene eruption
Score = 0

1 **Explosive activity**
> If explosive activity (VEI ≥ 3) within the last 500 years
Score = 1

4 **Major explosive activity**
> If major explosive activity (VEI ≥ 4) within last 5,000 years
Score = 1

1 **Holocene pyroclastic flows**
> If yes
Score = 1

1 **Holocene lahars**
> If Holocene lahars have traveled beyond the flanks and reached populated areas
Score =1

0 **Holocene lava flows**
> If Holocene lava flows have traveled beyond the immediate eruption site or flanks and reached populated areas
Score =1

0 **Holocene tsunami(s)**
> Has it produced a tsunami within the Holocene? If yes
Score = 1

0 **Hydrothermal explosion potential**
> If the volcano had Holocene phreatic explosive activity, and/or has thermal features that are extensive enough to pose a potential for explosive activity
Score =1

1 **Sector collapse potential**
> If the volcano has produced a sector collapse in Quaternary-Holocene time and has re-built its edifice, or, has high relief, steep flanks and demonstrated or inferred alteration
Score = 1

1 **Primary lahar source**
> If volcano has a source of permanent water/ice on edifice, water volume > 106 m3: Score = 1

MT. SPURR HAZARD + EXPOSURE ANALYSIS

HISTORICAL UNREST FACTORS

1 **Observed seismic unrest**
> Since the last eruption, in the absence of eruptive activity, within 20 km of the volcanic edifice? If yes
Score = 1

nd **Observed ground deformation**
> Since the last eruption, in the absence of eruptive activity, inflation or other evidence of magma injection? If yes
Score = 1

1 **Observed fumarolic or magmatic degassing**
> Since the last eruption, in the absence of eruptive activity, either heat source or magmatic gases? If yes
Score = 1

14 **TOTAL OF HAZARD FACTORS + HISTORICAL UNREST FACTORS**

EXPOSURE FACTORS

0.00 **Log10 of Volcano Population Index (VPI) at 30 km**
> Calculated with LandScan population database. Visitor statistics for volcanoes in National Parks and other destination recreation areas are added to the VPI factor where available.

0.00 **Log10 of approximate population downstream or downslope**
> Population outside the 30 km VPI circle included within the extent of Holocene flow deposits or reasonable inundation modeling.This factor only used with volcanoes with a lahar hazard (e.g. Cascade stratovolcanoes) or significant lava flow hazard (e.g. Mauna Loa).

0 **Historical fatalities**
> If yes, and a permanent population is still present
Score = 1

0 **Historical evacuations**
> If yes, and a permanent population is still present
Score = 1

2 **Local aviation exposure**
> If any type volcano is within 50 km of a jet-service airport
Score = 1
> If a Type 1 volcano is within 300 km of a jet-service airport
Score = 1
> If a Type 1 volcano is within 300 km of a major international airport
Score = 2
> If none of these criteria are met
Score = 0

4.3 **Regional aviation exposure**
> This score is based on the log10 of approximate daily passenger traffic in each region. At present, in the U.S., this score ranges from 4 to 5.15. The regional risk code is applied only to type 1 volcanoes and those type 0 volcanoes that have produced explosive eruptions.

1 **Power infrastructure**
> Is there power infrastructure (e.g., power generation/transmission/distribution for electricity, oil, or gas) within flow hazard zones, or in an area frequently downwind of the volcano and close enough to considered at some risk? If yes
Score =1

1 **Transportation infrastructure**
> Is there transportation infrastructure (e.g. port facilities, rail lines, major roads) within flowage hazard zones, or in an area frequently downwind of the volcano and close enough to considered at some risk? If yes
Score = 1

MT. SPURR HAZARD + EXPOSURE ANALYSIS

1	**Major development or sensitive areas** > Are there major developments or sensitive areas threatened (e.g., National Park facilities, flood control projects, government facilities, developed tourist/ recreation facilities, manufacturing or other significant economic activity)? If yes Score = 1
0	**Volcano is a significant part of a populated island** > Holocene volcanic deposits cover >25% of land mass. If yes Score = 1
9.3	**TOTAL OF EXPOSURE FACTORS**

First total x second total = Relative Threat Ranking

14	x	9.3	=	130.2