



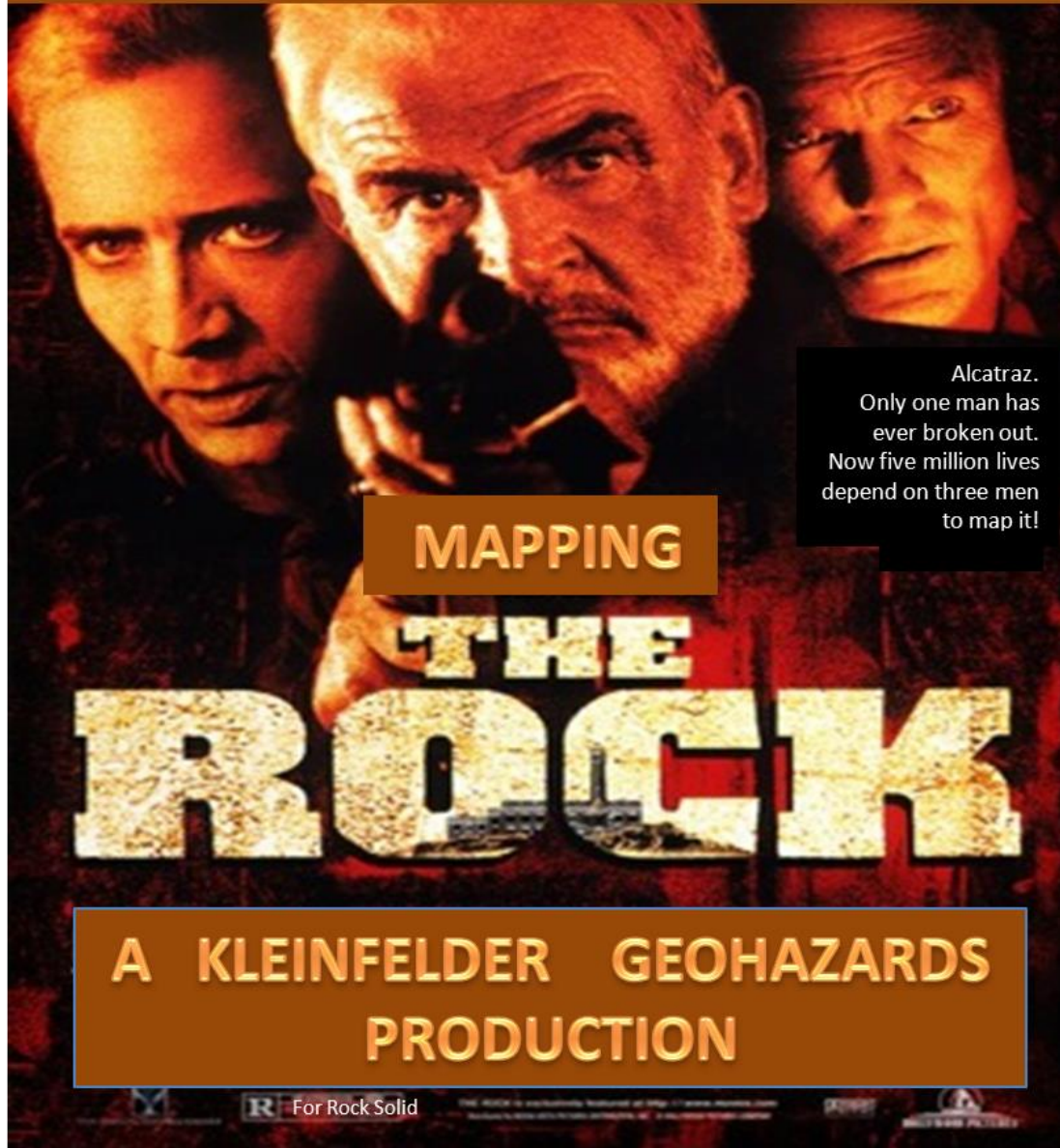
Alcatraz Island Geotechnical Evaluation and Shoreline Erosion Study

William V. McCormick, CEG
Santa Rosa, CA

**JEFF
RICHMOND**

**BILL
McCORMICK**

**CRAIG
HALL**



Alcatraz.
Only one man has
ever broken out.
Now five million lives
depend on three men
to map it!

MAPPING

THE ROCK

**A KLEINFELDER GEOHAZARDS
PRODUCTION**



R For Rock Solid

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KLEINFELDER GEOHAZARDS

PURPOSE

- Identify Geologic and Geotechnical Hazards on Island
- Assess Historical Shoreline Erosion Rates/Characteristics
- Assess Relative Risk to Cultural Resources and Public Safety

SCOPE

- Historical Document Review (maps, photos, reports)
- Geologic and Geomorphic Mapping on Island
- Perimeter Coastal Bluff Mapping by Boat
- Preparation of Relative Risk Assessment-Zonation Map
- Wave Run-up and Sea Level Rise Effects

- 1769-1775 SF Bay and Alcatraz Explored by Spanish
- 1852-1867 Initial Military Fortifications (Civil War)
- 1868- 1933 Military Prison

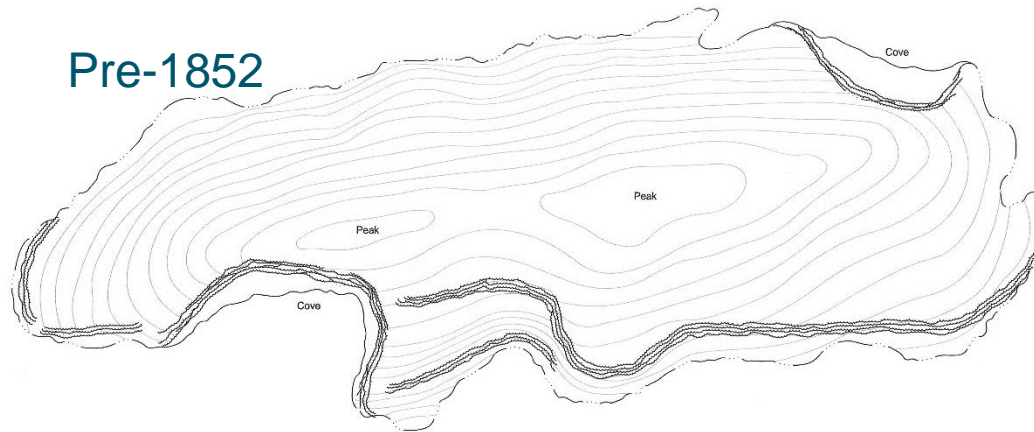


Figure 2 - 9. South Battery, note its masonry construction (c 1864); (source: NARA)

- 1934-1963 Federal Penitentiary
- 1969-1971 Indian Occupation
- 1974-Present National Park

SITE HISTORY

Pre-1852



Legend

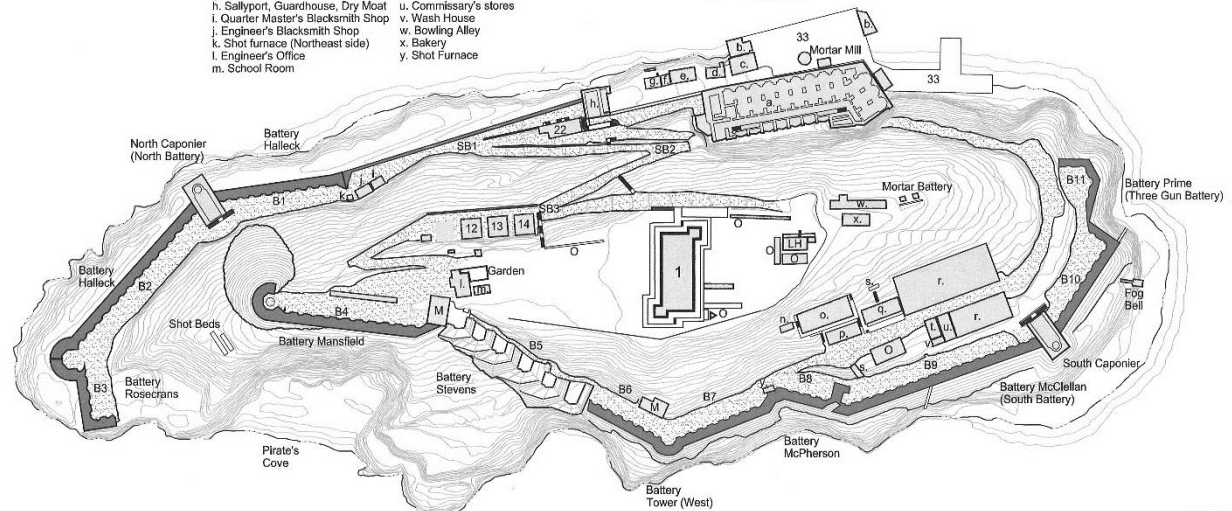
1. Citadel - Defensive Barracks
12. Non-Com Officers' Quarters
13. Non-Com Officers' Quarters
14. Non-Com Officers' Quarters
22. Prison
33. Wharf

- a. Casemates
- b. Boathouse
- c. Engineer's Storehouse
- d. Water Tank
- e. Quartermaster's storehouse
- f. Coal Shed
- g. Sullers Store
- h. Sallyport, Guardhouse, Dry Moot
- i. Quarter Master's Blacksmith Shop
- j. Engineer's Blacksmith Shop
- k. Shot furnace (Northeast side)
- l. Engineer's Office
- m. School Room

- n. Wash House
- o. Engineer's Quarters
- p. Stable
- q. Laundress' Quarters
- r. Temporary Barrack
- s. Privy
- t. Carpenter's Shop
- u. Commissary's stores
- v. Wash House
- w. Bowling Alley
- x. Bakery
- y. Shot Furnace

- LH Light House
- SB1 Switchbacks on Main Road
- O Ordnance
- M Magazine
- B Battery

- B1 Battery No. 1
- B2 Battery No. 2
- B3 Battery No. 3
- B4 Battery No. 4
- B5 Battery No. 5
- B6 Battery No. 6
- B7 Battery No. 7
- B8 Battery No. 8
- B9 Battery No. 9
- B10 Battery No. 10
- B11 Battery No. 11



1852-
1858



<p>FIGURE 2-3</p> <p>UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE GOLDEN GATE NATIONAL RECREATION AREA</p>	<p>TITLE OF PROJECT CULTURAL LANDSCAPE REPORT</p> <p>HARBOR FORT INITIAL MILITARY FORTIFICATIONS AND AIDS TO NAVIGATION 1852 - 1868 MAGE FORT ALCATRAZ ISLAND NATIONAL HISTORIC LANDMARK</p> <p>REGION COUNTY STATE</p>
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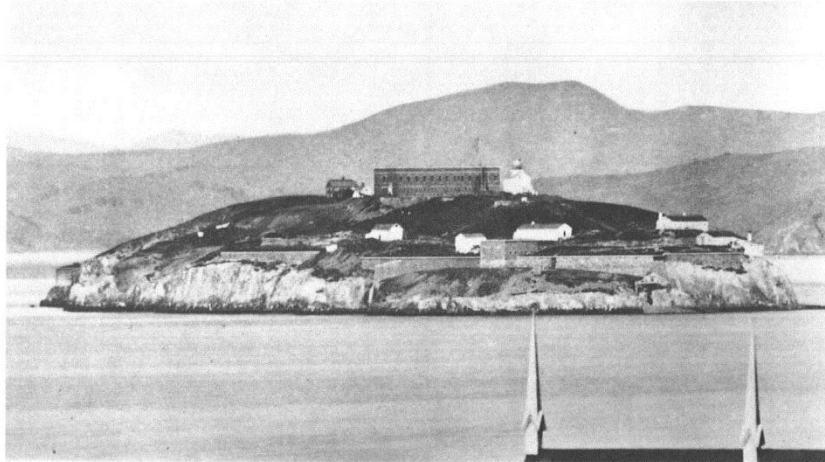


Figure 2 - 6. View to Alcatraz Island from Telegraph Hill (c 1860 ?); (source: CSL Watkins)

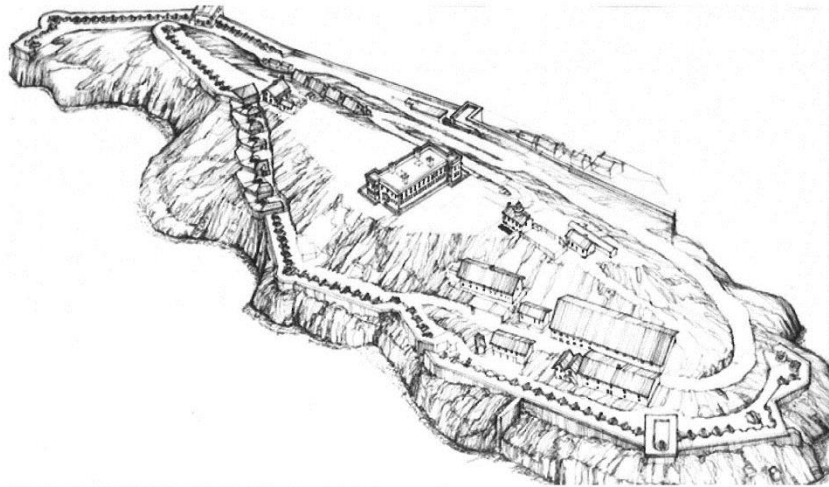


Figure 2 - 7. 1864 Aerial Graphic (no date); (source:)

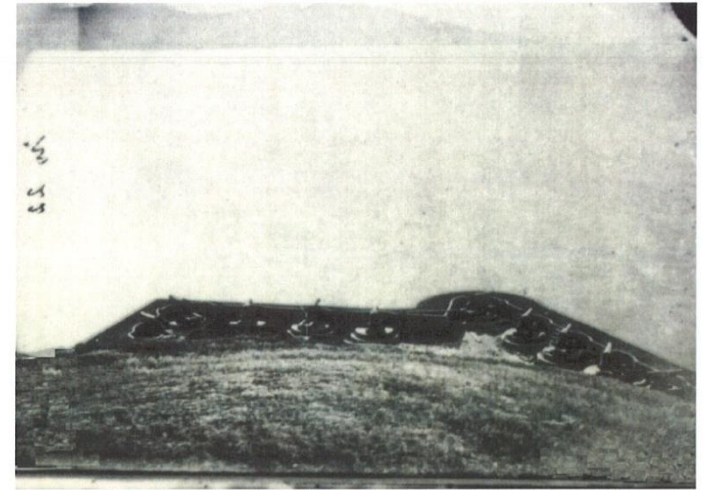


Figure 2 - 10. North Battery (c 1864) Note the vegetated slope above the battery; (source: NARA)

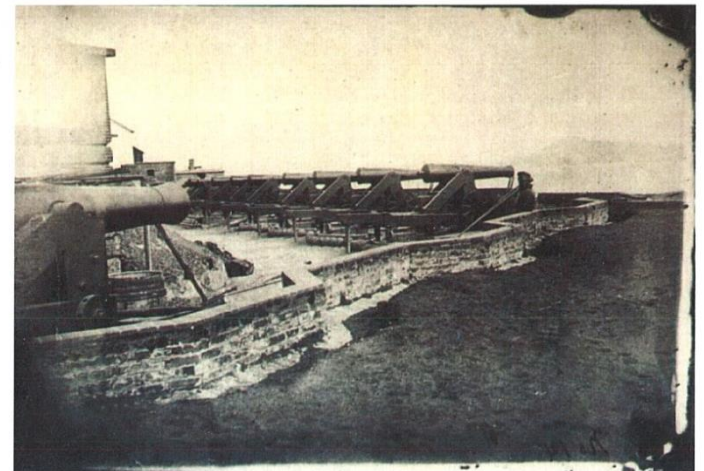


Figure 2 - 11. West Battery (c 1864); (source: NARA.)

Previous Slope Repairs

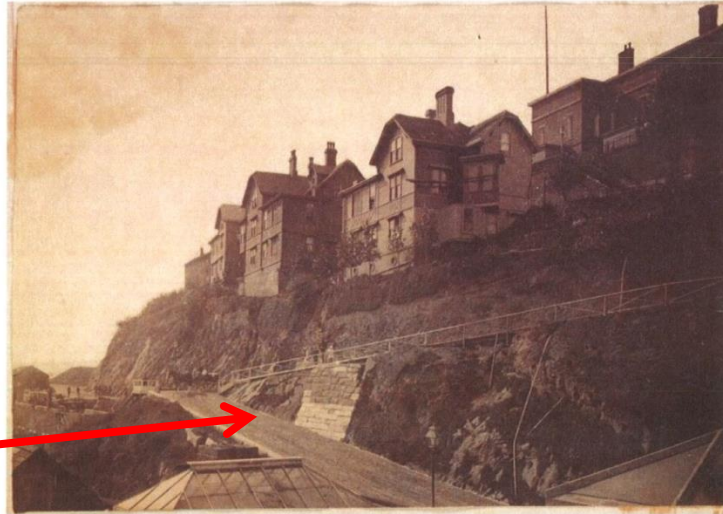


Figure 2-27. Main Road, Switchback 2, and Officers' Row (c 1869); (source: Hubbell)



Figure 2-28. Main Road, Switchback 3, Officers' Row; right (c 1882); (source: BANC, Hubbell)

Legend

1. Citadel, Officer's Quarters
2. Adjutant's Office/Post Headquarters
3. Conservatory
4. Conservatory
5. Carriage House
6. Q.M. Stable
7. Officers' Quarters 7
8. Officers' Quarters 8
9. Officers' Quarters 9
10. Hospital
11. Gymnasium
12. Non-commissioned Officers' Quarters
13. Non-commissioned Officers' Quarters
14. Non-commissioned Officers' Quarters
15. Gun Shed
16. Battery Kitchen & Post Library
17. Barracks
18. Battery Office
19. Battery Office
20. Post Exchange
21. Barber and Shoe Shop
22. Prisons
23. Prison Mess Room, Kitchen
24. Blacksmith Shop
25. Tool House
26. Hose House
27. Carpenter Shop
28. Officers' Storehouse
29. Boat House
30. Coal Shed
31. Coal Shed
32. Prison Wash House, Bath Rooms
33. Wharf
34. Sink
35. Engine House Storm Pump
36. Bakery
37. Hospital Steward's Quarters

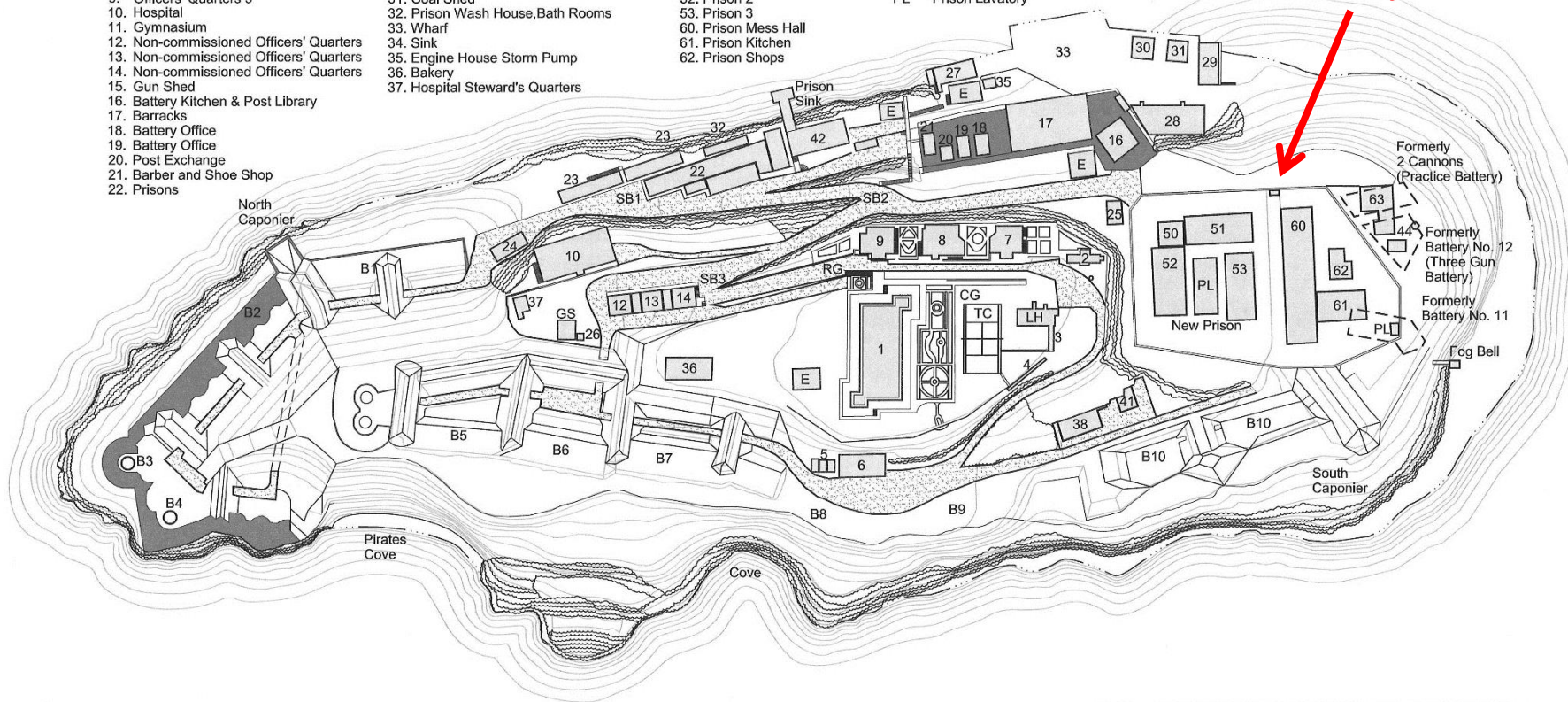
38. Ordnance Store House
39. Base Line Houses
40. Base Line Houses
41. Married Soldiers Quarters
42. Prison Chapel/Library
43. Prison Barber Shop
50. Prison Library
51. Prison 1
52. Prison 2
53. Prison 3
60. Prison Mess Hall
61. Prison Kitchen
62. Prison Shops

- E Engineer Buildings
- LH Lighthouse
- SB1 Switchbacks
- B Battery
- TC Tennis Court
- GS Gun Shed
- RG Rose Garden
- CG Citadel Garden
- PL Prison Lavatory

- B1 Battery No. 1
- B2 Battery No. 2
- B3 Battery No. 3
- B4 Battery No. 4
- B5 Battery No. 5
- B6 Battery No. 6
- B7 Battery No. 7

- B8 Battery No. 8
- B9 Battery No. 9
- B10 Battery No. 10

Military Prison



1869-1907

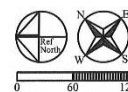
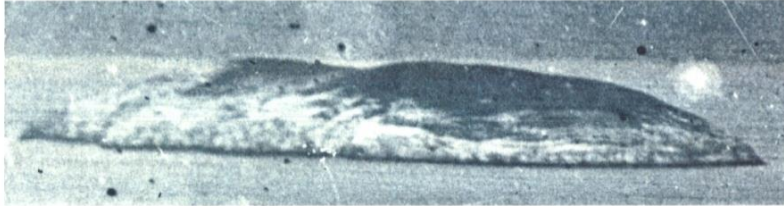


FIGURE 2 - 13

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
GOLDEN GATE NATIONAL RECREATION AREA

TITLE OF PROJECT
CULTURAL LANDSCAPE REPORT
HISTORIC PERIOD
EARTHEN FORTIFICATIONS / EARLY MILITARY PRISON
1869 - 1907
NAME OF PARK
ALCATRAZ ISLAND NATIONAL HISTORIC LANDMARK
REGION: PACIFIC COUNTY: SAN FRANCISCO STATE: CALIFORNIA

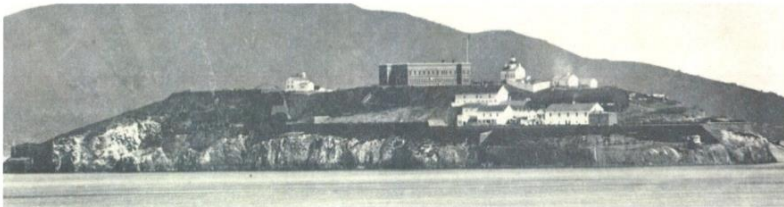


Images are views to the Island from San Francisco

1852 , Source: Golden Gate National Recreation Area
(1852c from Nob Hill (GOGA-3363)_cropped.jpg)



18607 , Source: California State Library
(1860c Alcatraz from Telegraph Hill (CSL Watkins).jpg)



1865 , Source: California State Library
(1865c profile (CSL).jpg)



1882 , Source: Bancroft Library UC Berkeley
(Alcatraz from North Point c1882 (BANC, Hubbell)_cropped.jpg)

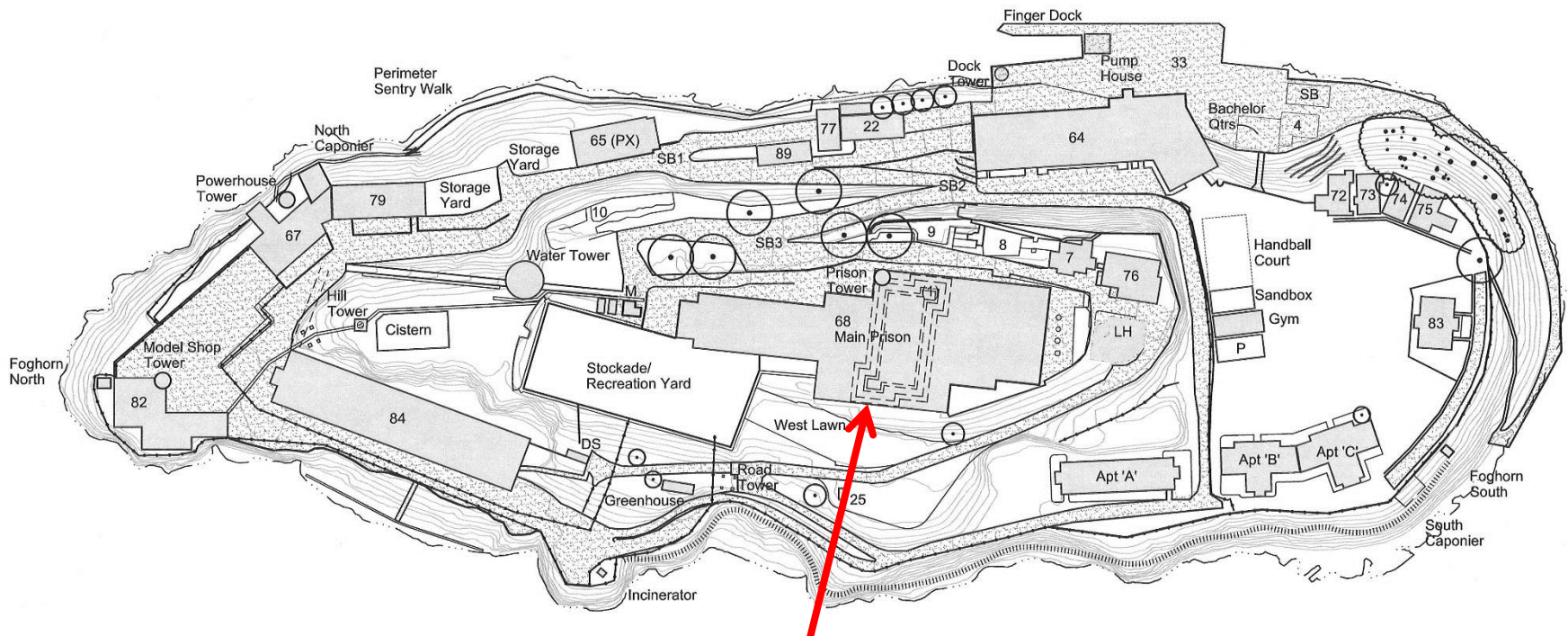


1917 , Source: ()
(1917c partial walkway pc (JAM).jpg)

FIGURE 4-2		TITLE OF PROJECT			
UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE GOLDEN GATE NATIONAL RECREATION AREA		CULTURAL LANDSCAPE REPORT			
		LOCATION WITHIN PARK			
		SPATIAL ORGANIZATION & TOPOGRAPHIC ANALYSIS			
		NAME OF PARK			
		ALCATRAZ ISLAND NATIONAL HISTORIC LANDMARK			
		REGION	COUNTY	STATE	
		PACIFIC	SAN FRANCISCO	CALIFORNIA	

Legend

1. Citadel	22. Guardhouse	72. Officers' Quarters 72	82. Model Industries	DS	Metal Detector Shed
7. Officers' Quarters 7	25. Toolhouse (new location)	73. Officers' Quarters 73	83. Officers' Quarters-Duplex	Gym	Gymnasium
8. Officers' Quarters 8 (Garden)	33. Wharf	74. Officers' Quarters 74	84. New Industries	LH	Lighthouse
9. Officers' Quarters 9 (Garden)	64. Bombproof Barracks	75. Officers' Quarters 75	89. Prison Site/Electric Shop	M	Morgue
10. Hospital (non-extant)	65. Post Exchange	76. Warden's House		P	Playground
	67. Powerhouse	77. Sallyport and Guardhouse		SB1	Switbacks on Main Road
	68. Main Prison	79. Stores/QM Warehouse		SP	Sandbox



Main Prison Over Citadel Foundation

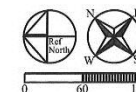


FIGURE 2 - 85	TITLE OF PROJECT CULTURAL LANDSCAPE REPORT
UNITED STATES DEPARTMENT OF THE INTERIOR	HISTORIC PERIOD FEDERAL PENITENTIARY / GSA 1934 - 1989
NATIONAL PARK SERVICE GOLDEN GATE NATIONAL RECREATION AREA	NAME OF PARK ALCATRAZ ISLAND NATIONAL HISTORIC LANDMARK
REGION STATE	COUNTY CITY



880
881
882

Figure 2-57. Alcatraz Island from west (c 1921) (source:)



883
884

Figure 2-58. Alcatraz Island from west (c 1925) (source:)



Figure 2-84. Sentry Catwalk around south and west sides of Island (c. 1920) (source: NPS GGNRA Archives)

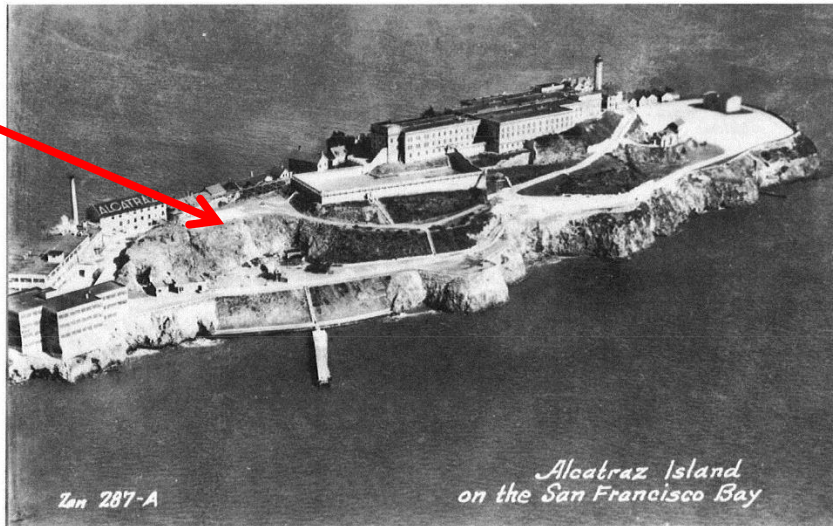


Figure 2 -90. 1934 Alcatraz Island Aerial from south (source:)

Federal Prison

Quarry
and Dock

1180
1181
1182



1183
1184

Figure 2 -91. 1935 Alcatraz Island Postcard (source:)



1401

1402

1403

1404

Figure 2 -133. Indian Tipi and View to Golden Gate Bridge (c Indian Occupation 1969-1971) (Courtesy of GOGA Denevi)







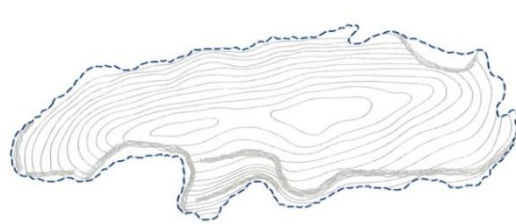
1405

1406

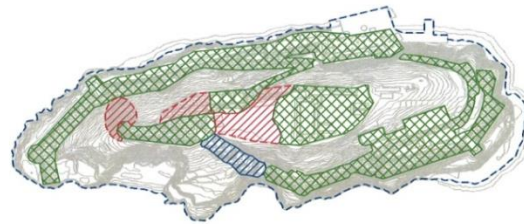
Figure 2 -134.: Indian Symbols at Wharf (Indian Symbols.JPG)

Legend

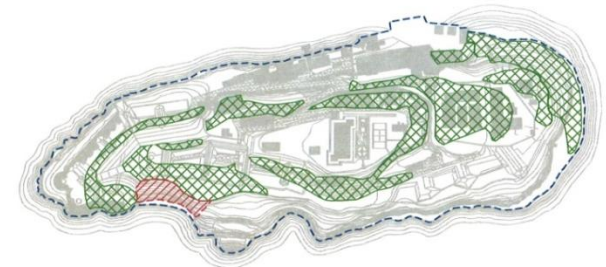
Fill Areas	
Shoreline (Info only)	
Cut Areas	
Interspersed Cut & Fill	



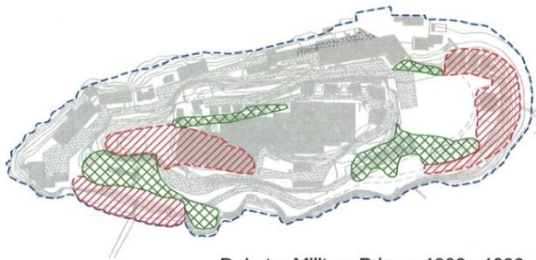
A. Pre-settlement: 1851 and Before



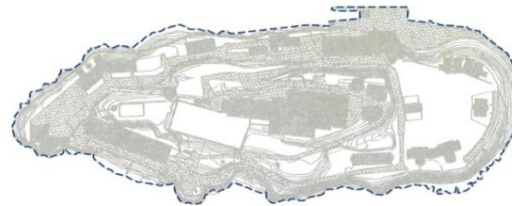
B. Initial Military Fortifications / Aid to Navigation: 1852 - 1868



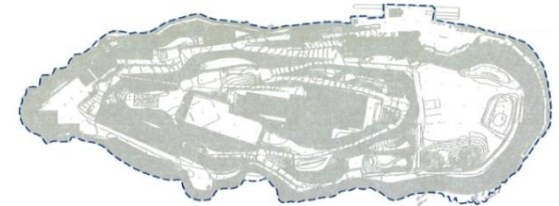
C. Earthen Fortifications / Early Military Prison: 1869 - 1907



D. Later Military Prison: 1908 - 1933



E. Federal Penitentiary / GSA: 1934 - 1973



F. NPS/GGNRA: 1974-Present



FIGURE 4-3

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
GOLDEN GATE NATIONAL RECREATION AREA

TITLE OF PROJECT
CULTURAL LANDSCAPE REPORT

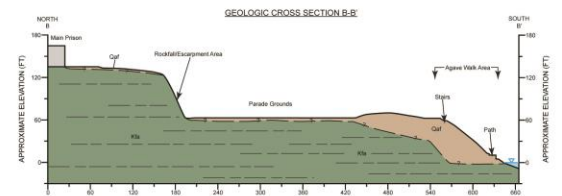
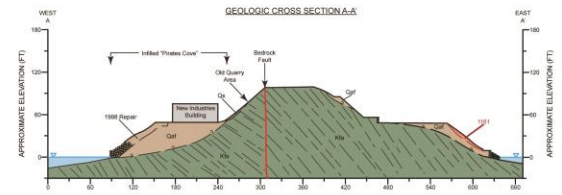
TITLE OF DRAWING
MAJOR TOPOGRAPHIC CHANGES

NAME OF PARK
ALCATRAZ ISLAND NATIONAL HISTORIC LANDMARK
REGION: PACIFIC COUNTY: SAN FRANCISCO STATE: CALIFORNIA

DRAFT

EXPLANATION	
	Concrete Hardscape
	Stone Walls or Slope Protection
	Rock Slope Protection (rip-rap)
	Artificial Fill
	Talus
	Beach Deposits
	Terrace Deposits (Pleistocene)
	Franciscan Complex (Alcatraz Terrace)
	Geologic Contact: dashed where approximate, dotted where uncertain
	Landslide Contact: dashed where approximate
	Bedrock Fault: dotted where concealed
	Bedding Orientation
	Horizontal Bedding Orientation
	Bedrock Shear Orientation
	Landslide: hatching indicate steep area, arrows indicate direction of movement
	Landslide Identification Number: referenced Landslide Identification Chart, below
	SC Small Sea Cave Location
	LC Large Sea Cave Location
	RF Rock Fall Location
	U Undermining
	SC Creep, Raveling
	Cross Section Location

SPECIFIC CULTURAL FEATURES	
A	Model Industries Building
B	New Industries Building
C	Incinerator
D	Main Prison
E	Lighthouse
F	Warden's House
G	Boatproof Barracks
H	Dock Tower
I	Sallyport
J	Post Exchange/Officers Club
K	Water Tower
L	Shops/Warehouse
M	Power House
N	Cistern



LANDSLIDE IDENTIFICATION CHART	
1	STATE OF ACTIVITY
1-1	Active or Recently Active (areas of unstable ground with relatively recent "fresh" geomorphic features such as ground cracks, hummocky topography, exposed soils, abrupt gradient breaks and/or denuded vegetation, typically recent to 50 years old)
2	Dormant (areas of unstable ground, with eroded and subdued geomorphic features, no exposed soils, somewhat re-vegetated but typically with different type or density, typically >50 to several hundreds of years old)
3	Stable (areas of relatively stable ground, typically characterized by large, forest and steep landforms with highly eroded and subdued geomorphic features, re-vegetated with similar type and density, typically several hundreds to several thousands of years old)
4	CERTAINTY OF IDENTIFICATION
1	Definite
2	Probable
3	Questionable
4	DOMINANT TYPE OF MOVEMENT
1	Slump/Flow Complex
2	Debris Slide
3	Debris Flow
4	Earth Flow
5	Slump
6	Translational
7	THICKNESS OF DEPOSIT
1	Less Than 2 Feet
2	2 to 10 Feet
3	10 to 50 Feet
4	Greater Than 50 Feet

 Kleinfelder Bright People. Right Solutions. 2140 Harwood Parkway San Jose, CA 95128-1033 www.kleinfelder.com TEL 707-571-1882 FAX 707-571-7813	PROJECT NO. 113904	SITE GEOLOGY ALCATRAZ ISLAND SAN FRANCISCO, CALIFORNIA	PLATE 2
	DESIGNED BY: JAC		
	CHECKED BY: WMM		
	FILE NAME: 04a_Plan and Geologic Maps		

SITE GEOLOGY

EXPLANATION

	Concrete Hardscape
	Stone Walls or Slope Protection
	Rock Slope Protection (rip-rap)
	Artificial Fill
	Talus
	Beach Deposits
	Terrace Deposits (Pleistocene)
	Franciscan Complex (Alcatraz Terrane): graywacke sandstone with shale interbeds
	Geologic Contact: dashed where approximate; queried where uncertain
	Landslide Contact: dashed where approximate
	Bedrock Fault: dotted where concealed
	Bedding Orientation
	Horizontal Bedding Orientation
	Bedrock Shear Orientation
	Landslide: hatchures indicate scarp area; arrows indicate direction of movement
1161	Landslide Identification Number: reference Landslide Identification Chart, below
SC	Small Sea Cave Location
LC	Large Sea Cave Location
RF	Rock Fall Location
U	Undermining
	Soil Creep, Ravelling
	Cross Section Location

LANDSLIDE IDENTIFICATION CHART

STATE OF ACTIVITY

- 1=Active or Recently Active
(areas of unstable ground with relatively recent/"fresh" geomorphic features such as ground cracks, hummocky topography, exposed soils, abrupt gradient breaks and/or disrupted vegetation, typically recent to 50 years old)
- 2=Dormant
(areas of quasi-stable ground, with eroded and subdued geomorphic features, no exposed soils, somewhat re-vegetated but typically with different type or density, typically >50 to several hundreds of years old)
- 3=Ancient
(areas of relatively stable ground, typically characterized by large, broad and deep landslides with highly eroded and subdued geomorphic features, re-vegetated with similar type and density, typically several hundreds to several thousands of years old)

CERTAINTY OF IDENTIFICATION

- 1=Definite
- 2=Probable
- 3=Questionable

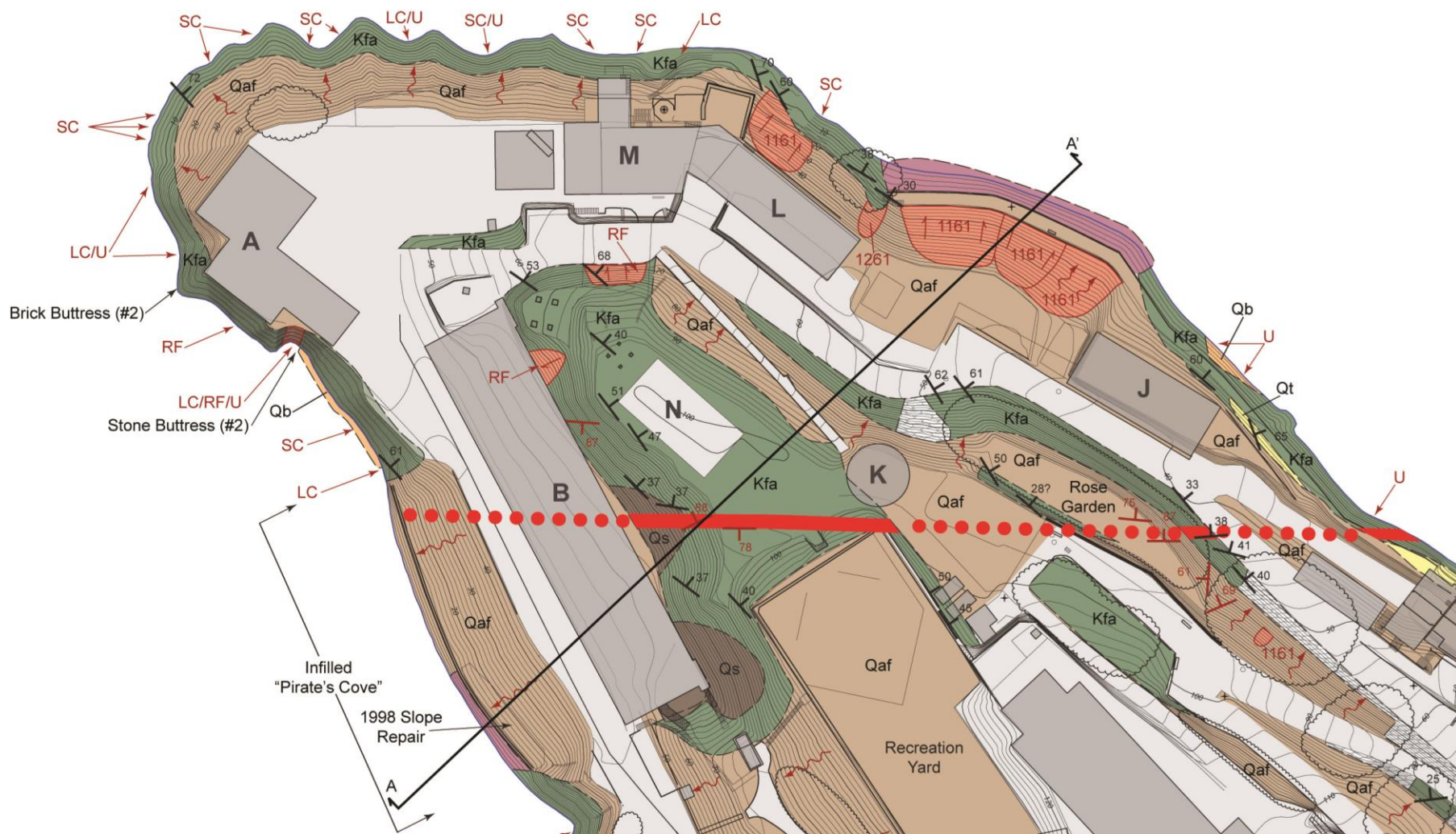
DOMINANT TYPE OF MOVEMENT

- 1=Slump Flow Complex
- 2=Debris Slide
- 3=Debris Flow
- 4=Earth Flow
- 5=Slump
- 6=Translational

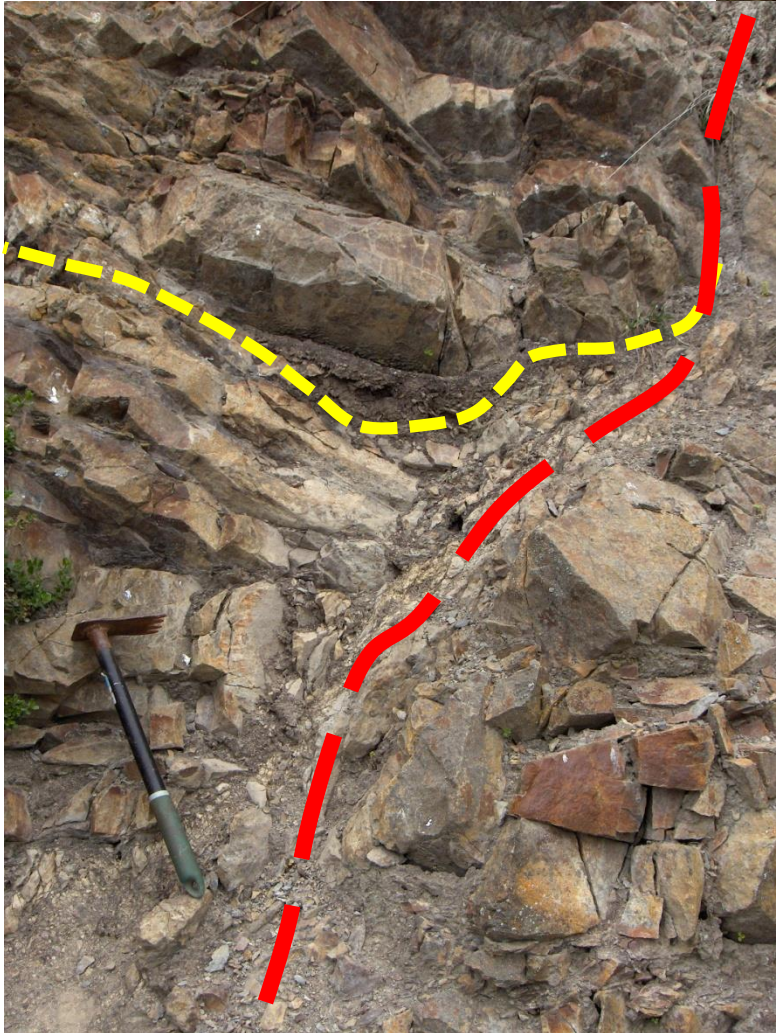
THICKNESS OF DEPOSIT

- 1=Less Than 5 Feet
- 2=5 to 15 Feet
- 3=15 to 50 Feet
- 4=Greater Than 50 Feet

1 2 3 4

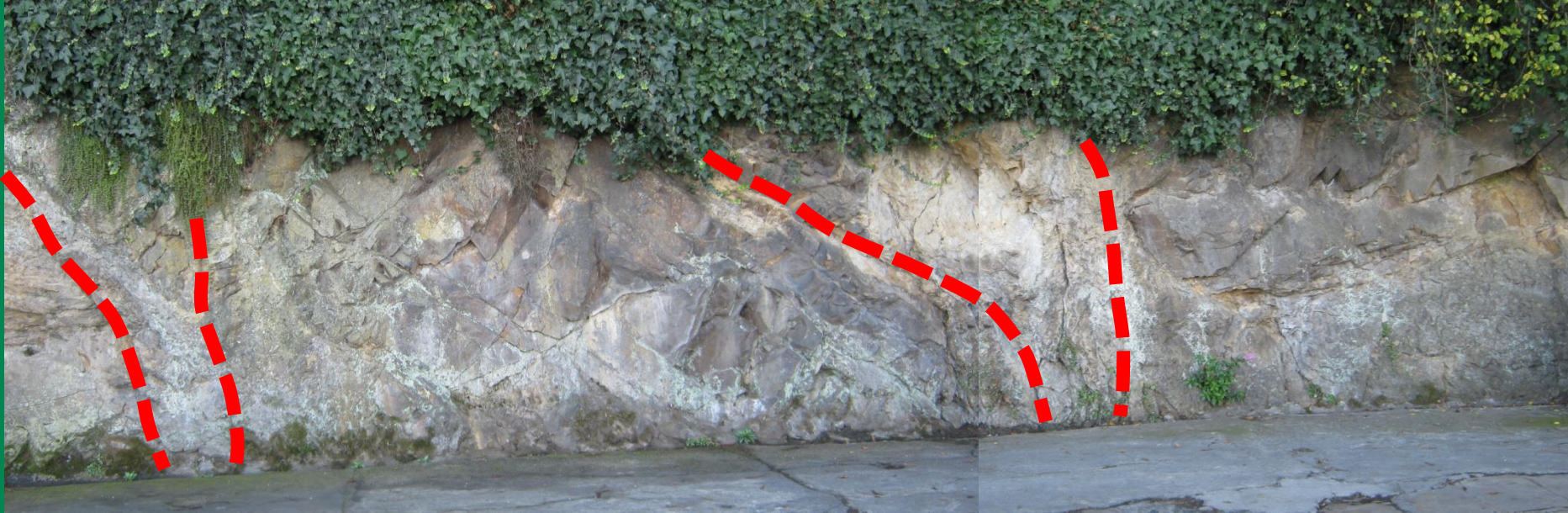


Distorted Bedding
along Main Shear



Main Fault Shears with Horizontal Striations
in Old Quarry Slopes

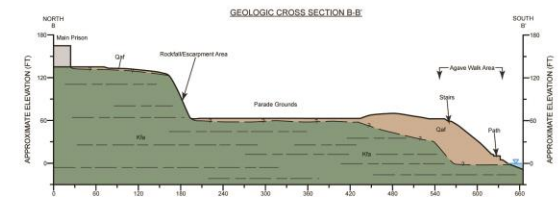
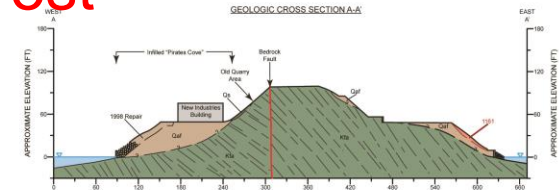
“EAST-WEST” FAULT



Fault Shear Zone with Distorted and Truncated Bedding, East Side of Island

“EAST-WEST” FAULT

East-West



EXPLANATION	
[Symbol]	Concrete Hardscape
[Symbol]	Stone Walls or Slope Protection
[Symbol]	Rock Slope Protection (rip-rap)
[Symbol]	Artificial Fill
[Symbol]	Talus
[Symbol]	Beach Deposits
[Symbol]	Terrace Deposits (Pleistocene)
[Symbol]	Franciscan Complex (Alcatraz Terrace): graywacke sandstone with shale interbeds
[Symbol]	Geologic Contact: dashed where approximate; dotted where uncertain
[Symbol]	Landslide Contact: dashed where approximate
[Symbol]	Bedrock Fault: dotted where concealed
[Symbol]	Bedding Orientation
[Symbol]	Horizontal Bedding Orientation
[Symbol]	Bedrock Shear Orientation
[Symbol]	Landslide: hatchures indicate scarp area; arrows indicate direction of movement
[Symbol]	Landslide Identification Number: reference Landslide Identification Chart, below
[Symbol]	Small Sea Cave Location
[Symbol]	Large Sea Cave Location
[Symbol]	Rock Fall Location
[Symbol]	Undermining
[Symbol]	Soil Creep, Raveling
[Symbol]	Cross Section Location

SPECIFIC CULTURAL FEATURES	
A	Model Industries Building
B	New Industries Building
C	Incinerator
D	Main Prison
E	Lighthouse
F	Warden's House
G	Bombproof Barracks
H	Dock Tower
I	Saltport
J	Post Exchange/Officers Club
K	Water Tower
L	Shops/Warehouse
M	Power House
N	Citadel

LANDSLIDE IDENTIFICATION CHART	
STATE OF ACTIVITY	1-Active or Recently Active (areas of unstable ground with relatively recent "fresh" geomorphic features such as ground cracks, hummocky topography, exposed soils, abrupt gradient breaks and/or denuded vegetation, typically recent to 50 years old)
2-Dormant	Areas of quasi-stable ground, with eroded and subdued geomorphic features, no exposed soils, somewhat re-vegetated but typically with different type or density, typically >50 to several hundreds of years old)
3-Ancient	Areas of relatively stable ground, typically characterized by well-defined and steep or terraced with highly eroded and subdued geomorphic features, re-vegetated with similar type and density, typically several hundreds to several thousands of years old)
CERTAINITY OF IDENTIFICATION	1-Definite 2-Probable 3-Questionable
DOMINANT TYPE OF MOVEMENT	1-Debris Flow 2-Debris Flow 3-Debris Flow 4-Debris Flow 5-Slide 6-Translational
THICKNESS OF DEPOSIT	1-Less Than 18 Feet 2-18 to 36 Feet 3-36 to 60 Feet 4-Greater Than 60 Feet

N10° -
25° E

N40° -50° W

	PROJECT NO. 113964	SITE GEOLOGY ALCATRAZ ISLAND SAN FRANCISCO, CALIFORNIA	2
	DRAWN: JAN 2011		
	CHECKED BY: JCB		
	FILE NAME: WMM		

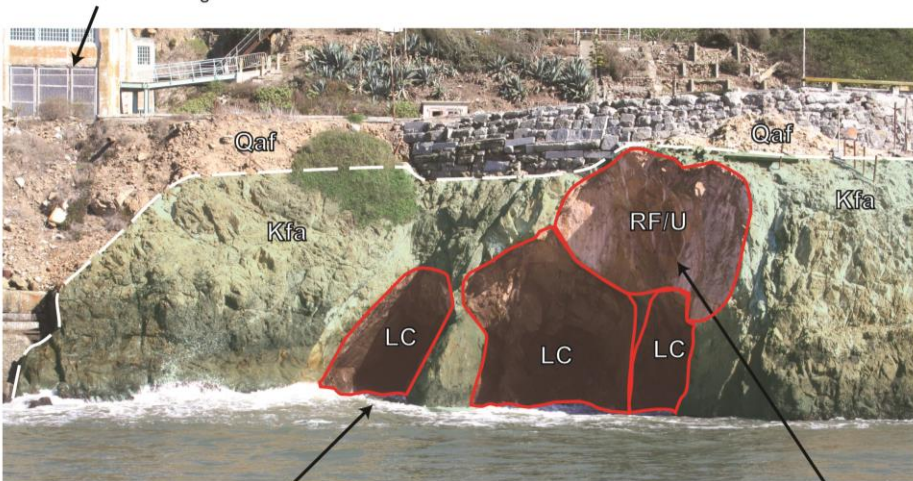


Prominent Joint Sets



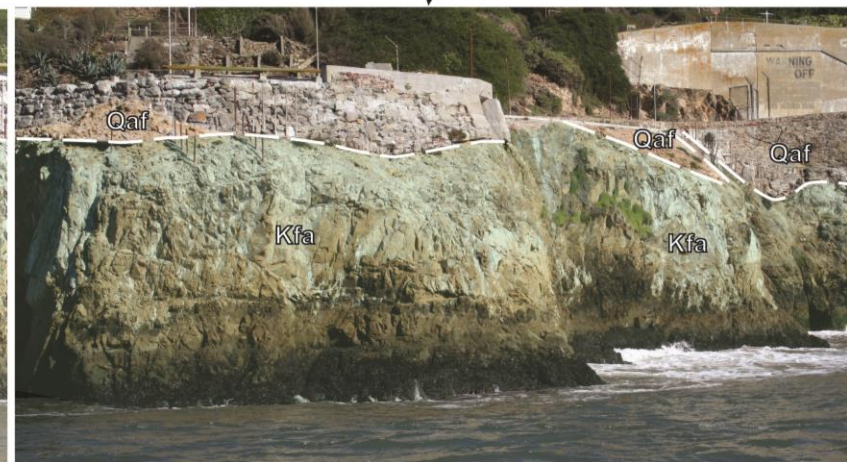
EXPLANATION			
Qaf	Artificial Fill		Landslide: hatchures indicate scarp area; arrows indicate direction of movement
Qb	Beach Deposits	1132	Landslide Identification Number: reference Landslide Identification Chart (Plate 2)
Qt	Terrace Deposits		Geologic Contact: dashed where approximate, dotted where concealed
Kfa	Franciscan Complex Bedrock: sandstone		Soil creep, ravelling
		RF	Rock Fall-Predominantly wedge failures
		U	Undermined/Overhanging portion of slope
		LC	Large Sea Cave
		SC	Small Sea Cave
		RSP	Rock Slope Protection (Rip-Rap)

New Industries Building



LC created by block and wedge failure along prominent joint sets.

DRAFT



Former Incinerator Site



Undermined Rockfall Area

WEST SIDE

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




PROJECT NO.	113964
DRAWN	JAN 2011
DRAWN BY	JG
CHECKED BY	WM
FILE NAME	1526_1529.ai

COASTAL BLUFF GEOLOGY

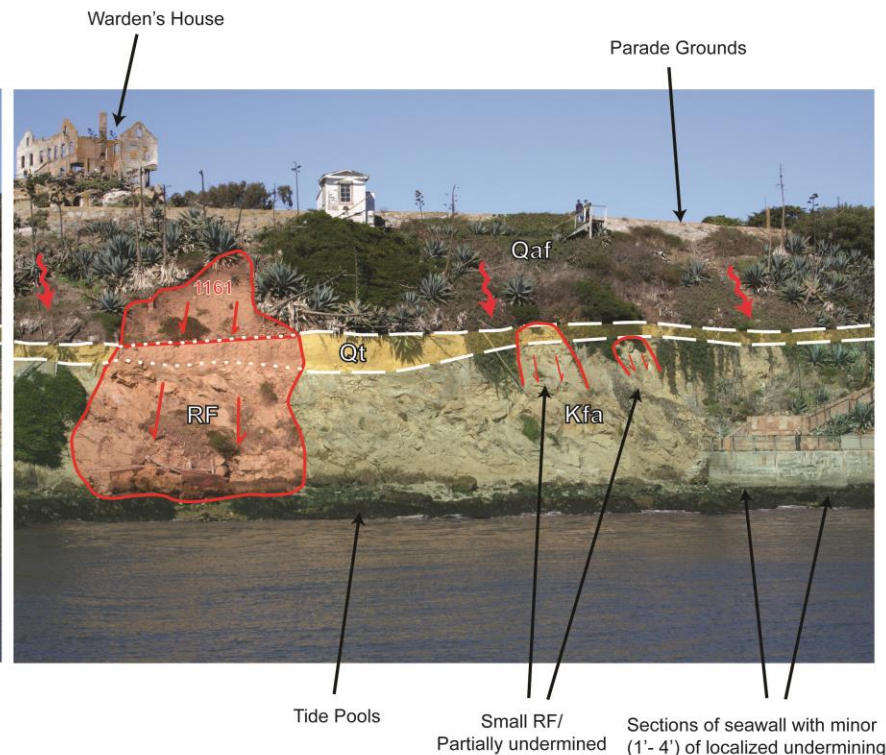
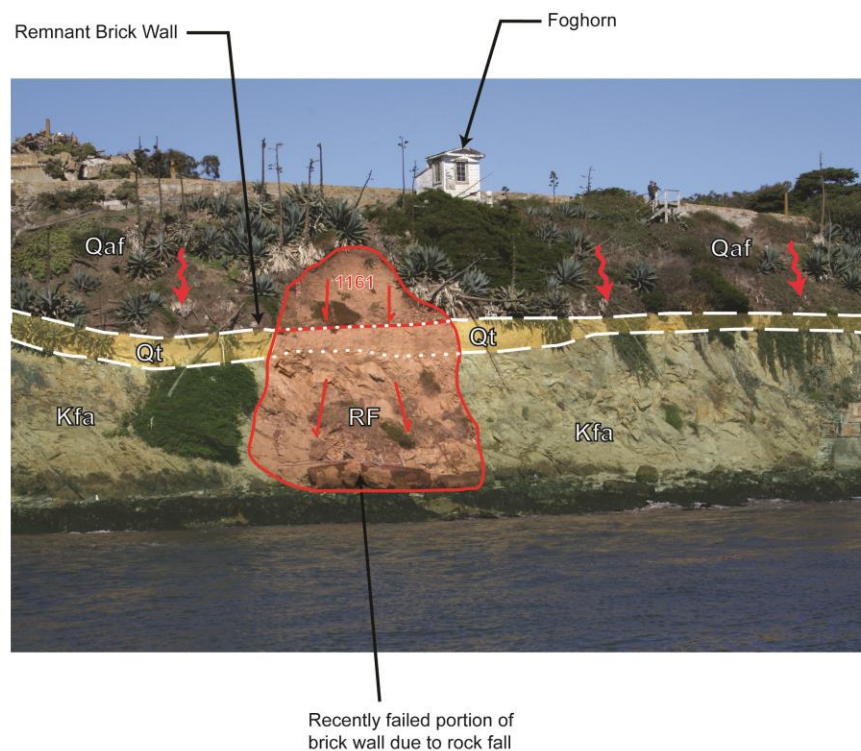
ALCATRAZ ISLAND
SAN FRANCISCO, CALIFORNIA

PLATE

8

EXPLANATION			
	Artificial Fill		Landslide: hatchures indicate scarp area; arrows indicate direction of movement
	Beach Deposits	1132	Landslide Identification Number: reference
	Terrace Deposits		Geologic Contact: dashed where approximate, dotted where concealed
	Franciscan Complex Bedrock: sandstone		Soil creep, raveling
		RF	Rock Fall-Predominantly wedge failures
		U	Undermined/Overhanging portion of slope
		LC	Large Sea Cave
		SC	Small Sea Cave
		RSP	Rock Slope Protection (Rip-Rap)

WEST SIDE



DRAFT

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PROJECT NO.	113964	COASTAL BLUFF GEOLOGY	ALCATRAZ ISLAND SAN FRANCISCO, CALIFORNIA	PLATE
DRAWN	JAN 2011			13
DRAWN BY	JG			
CHECKED BY	WM			
FILE NAME	1560_1563.ai			



Pleistocene Terrace Deposits

EXPLANATION

RELATIVE GEOLOGIC RISK:



High



Moderate



Low



Minimal



PUBLIC ACCESS BOUNDARY
(not open to public north/west of this line)

67

RISK ZONE DESIGNATION
(reference Geologic Risk Assessment Table,
right)



Existing Structure

SPECIFIC GEOLOGIC HAZARD

- G1 Bluff Collapse/Failure
(due to rockfall, sea cave collapse or landsliding)
- G2 Rockfall*
(includes areas of ravelling rock slopes and areas of potential adverse dip-slip failures with risks associated with falling rock debris)
- G3 Landsliding
(predominantly areas of existing [$<5'$ thick] instabilities within unconsolidated or semi-consolidated fill)
- G4 Creep/Accelerated Erosion
(areas of predominantly unconsolidated fill soils)
- G5 Fill Settlement
- G6 Other
(reference Geologic Risk Assessment, right)

*Does not include rockfall areas along the coastal bluff where falls occur into the bay.

Relative Geologic Risk Definitions

HIGH = Areas of existing and/or recently active geologic hazards that are considered to have a high potential for additional movement or failure under static and/or seismic conditions.

MODERATE = Areas of existing semi-stable/dormant geologic hazards or areas that are considered capable of resulting in a geologic hazard that might be activated by adverse climatic or intense seismic shaking conditions in their current physical configuration.

LOW = Areas that generally do not have an identified geologic hazard or exhibit obvious physical features that would result in a geologic hazard in a static condition but could possibly occur during intense seismic shaking.

MINIMAL = Areas that generally have no known geologic hazards other than ground shaking during an intense seismic event.

THREE-PART QUALITATIVE GEOLOGIC RISK ASSESSMENT IS A FUNCTION OF:

1. RELATIVE RISK OF GEOLOGIC HAZARD TO OCCUR AND ITS POTENTIAL AFFECT ON:
2. CULTURAL RESOURCES (existing buildings and improvements)
3. PUBLIC SAFETY

GEOLOGIC RISK ASSESSMENT[†]

LOCATION	DESCRIPTION	GEOLOGIC RISK	CULTURAL RESOURCES RISK	CURRENT* PUBLIC RISK	COMMENTS
1	Northwest bluff below Model Industries bldg.	G1-High G4-Moderate	High	Low	Large sea caves and undermined rock bluff adjacent to building foundation, thin fill locally at top of slope.
2	Northwest bluff, steep	G1-Moderate	Low	Low	Vertical rock bluff with large and small sea cave.
3A	Northwest, in-filled "Pirates Cove" slope	G3-Moderate G4-High	Moderate	Low	Semi- to unconsolidated fill retained at the toe by a low seawall that is partially rotated, potential damage to upper sidewalk, stairway and seawall.
3B	Northwest, in-filled "Pirates Cove" slope	G3-Moderate G4-Moderate	Moderate	Low	Area of previous slope repair in 1998 with horizontally stacked waste concrete piles, partially overlain by semi-consolidate fill, potential damage to upper sidewalk, seawall.
4	West bluff south of "Pirates Cove"	G1-Moderate G4-Moderate	Low	Low	Steep rock bluff with fill on top.
5	West bluff, northwest edge incinerator pad	G1-High	Moderate	Low	Steep rock bluff with large sea caves and undermining, stone wall immediately above.
6	West bluff, west and south edges of incinerator pad	G1-Low	Low	Low	Relatively stable rock on moderately steep bluff.

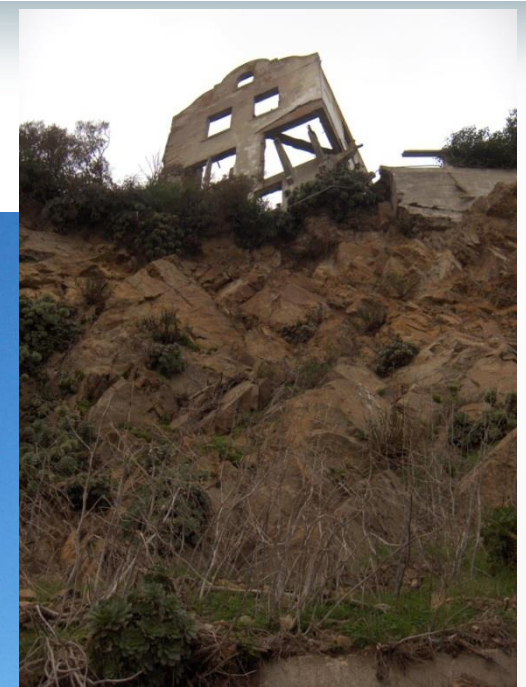


South Escarpment #53

Public Access Line

EXAMPLE OF HIGH RISK

Active Rockfalls, undermining
improvements along entire top of
cliff



Close-up
of
Undermine
d Portion
of
Warden's
House



Rockfall
Debris

Public Access to Parade Grounds at Base of
Escarpment



Vertical cuts in fractured rock, slope higher than the building

OTHER ROCKFALL HAZARDS

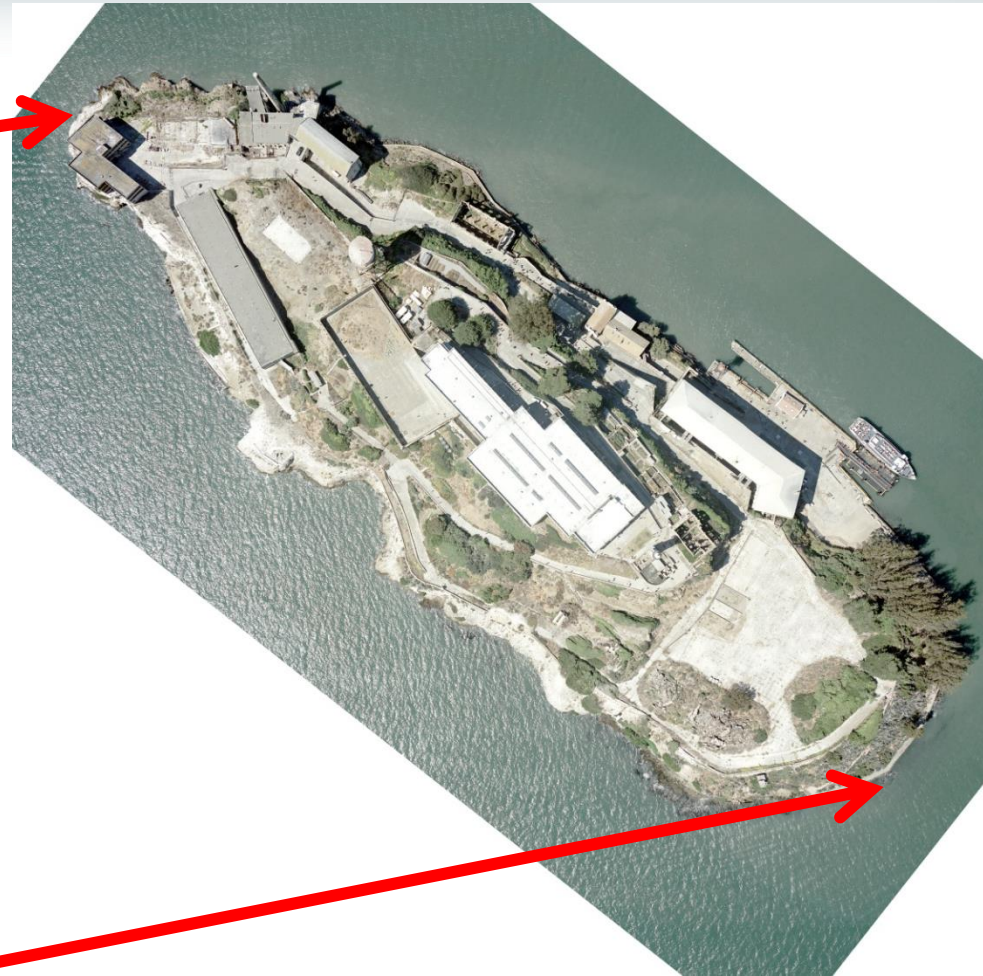


Active rockfall debris and plywood protection at windows



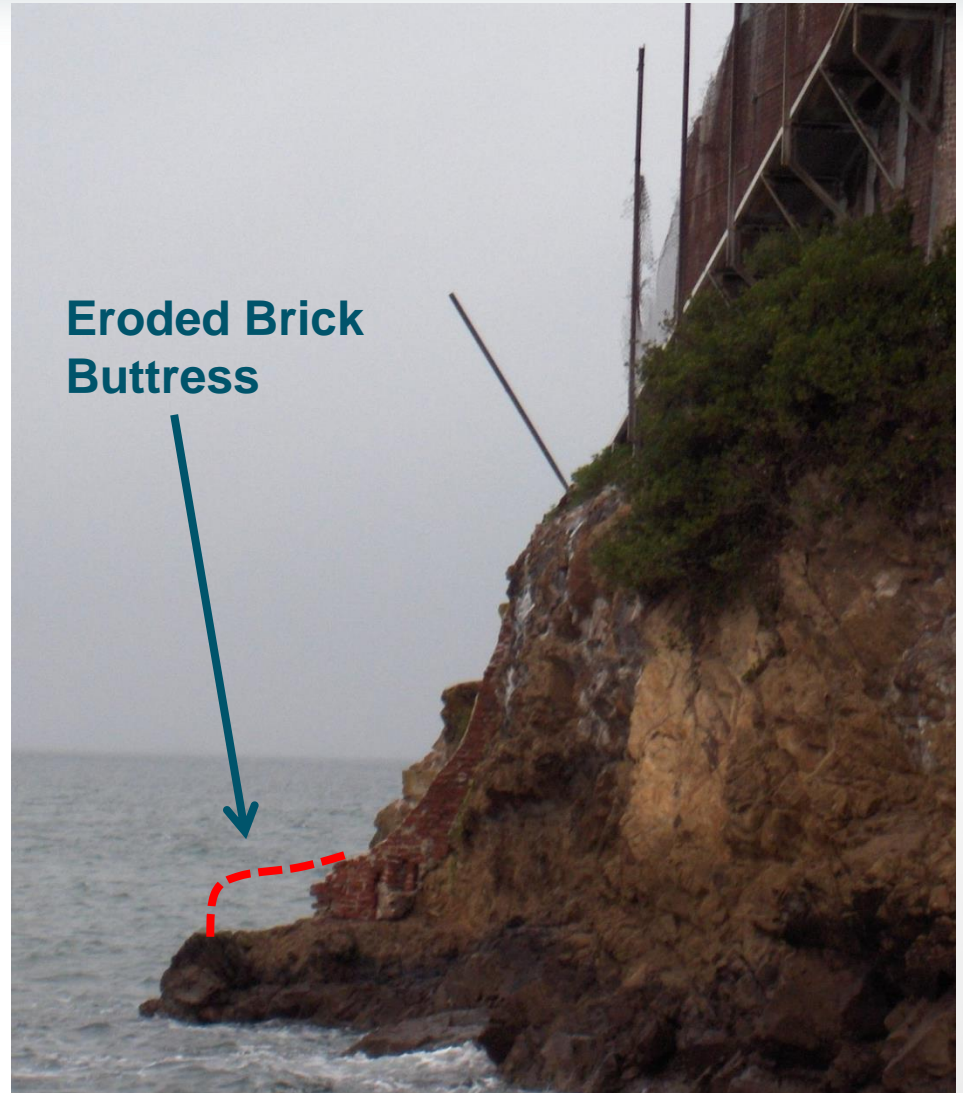


1935



2010

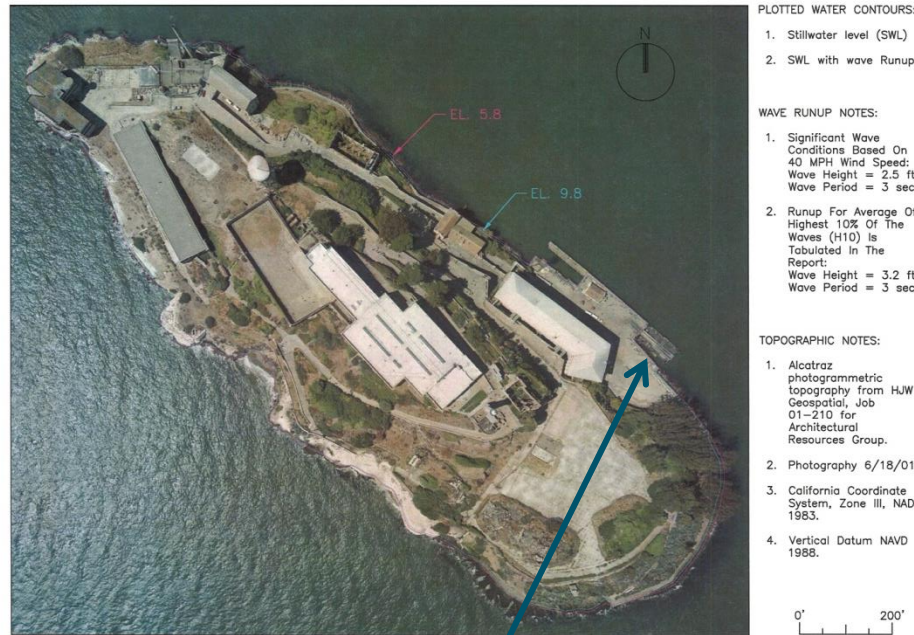
SHORELINE EROSION COMPARISON BY DIGITAL AERIAL OVERLAY



Stone and Brick Buttresses built Circa 1860

BLUFF EROSION RATE ASSESSMENT USING CULTURAL DATA

2010 Conditions



1. Stillwater level (MHHW) = 5.8 feet (MLLW)
2. Wave Runup: Year 0 (2010) & MHHW Water Level



Figure 5

Runup elevation 9.8'

2100 Conditions



1. Stillwater level (10 Year) = 12.9 feet (MLLW)
2. Wave Runup: Year 90 (2100) & 10 Year Water Level



Figure 12

Runup elevation 16.0'

2010 Conditions



Runup elevation 9.8'

2100 Conditions



Runup elevation 16.0'



Figure 9. Overview of inundation (10-yr water level=10.6 ft) and potential wave runup zones based on Sea Level Rise estimates in the year 2060 (50 yrs).

More Work to be Done.....

"No one has ever mapped Alcatraz.....and no one ever will"

KLEINFELDER

GEOLOGISTS IN:

MAPPING THE

"ROCK" 2:

ALCATRAZ



The Sequel...?





Thank You

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