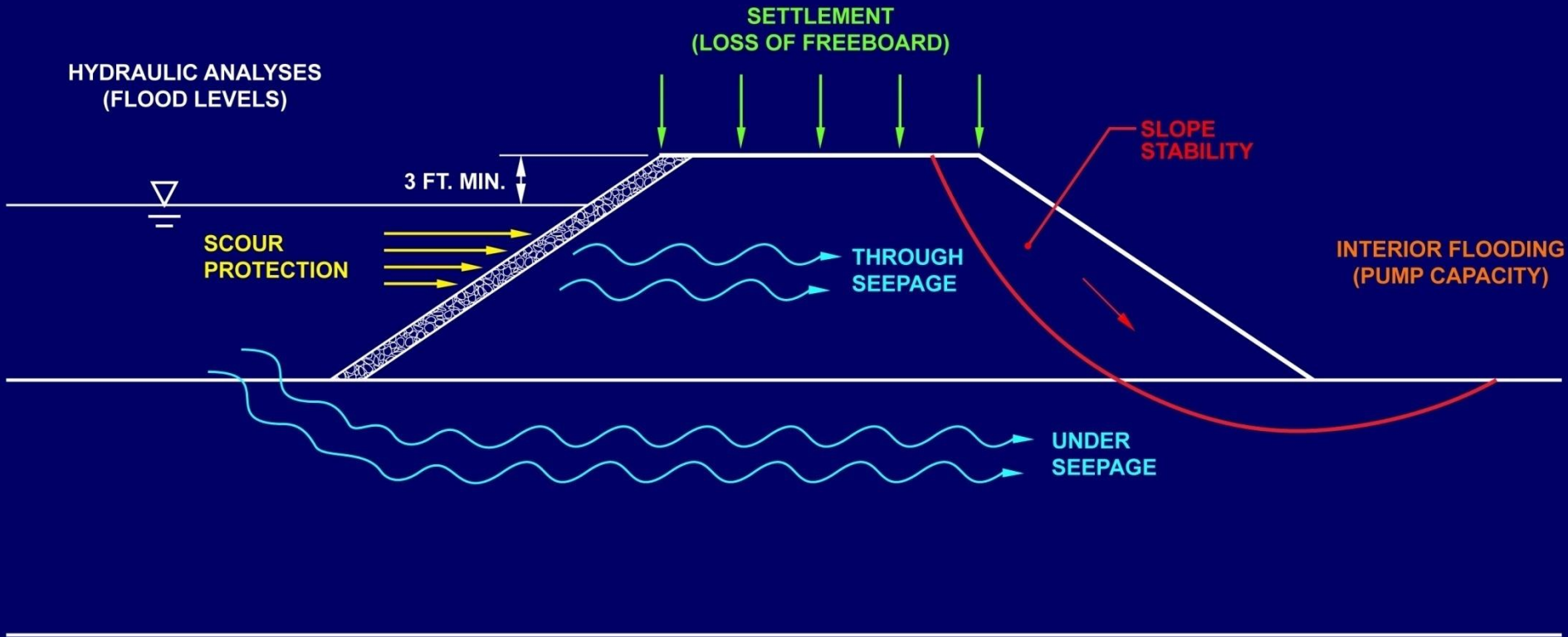


PEN 1 & PEN 2

Levee Engineering Assessment

- Following 44 CFR 65.10 (FEMA)
- Standard: US Army Corps Manuals
- Roles:
 - Cornforth: Seepage, Stability, Settlement
 - WEST: Freeboard, Scour Protection
 - MCDD: Interior Drainage
 - Group Mackenzie: As-Builts

44 CFR 65.10 CERTIFICATION REQUIREMENTS





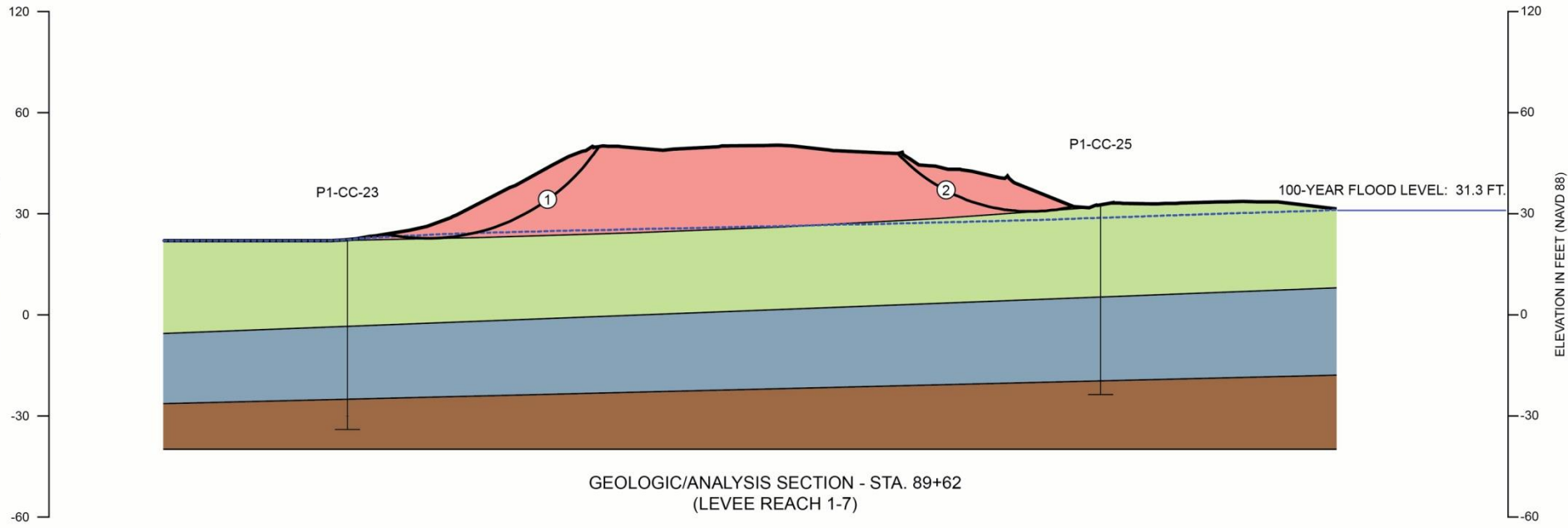
- Railroad Embankment Mixed sand and silt with timber remnants
- Fill Soft, slightly clayey to clayey SILT
- Fill Loose, silty SAND to sandy SILT
- Foundation Soft, clayey SILT (Alluvium)
- Foundation Loose, silty SAND (Alluvium)

SLIP SURFACE	CALCULATED FS	MEETS REQUIRED FS*
1	1.15	NO
2	2.04	YES

*MINIMUM ALLOWABLE FS=1.4, USACE, EM 1110-2-1913

CALCULATED EXIT GRADIENT AT TOE OF LANDWARD SLOPE = 0.2**

**RECOMMENDED MAXIMUM EXIT GRADIENT = 0.5, USACE, EM 1110-2-1913



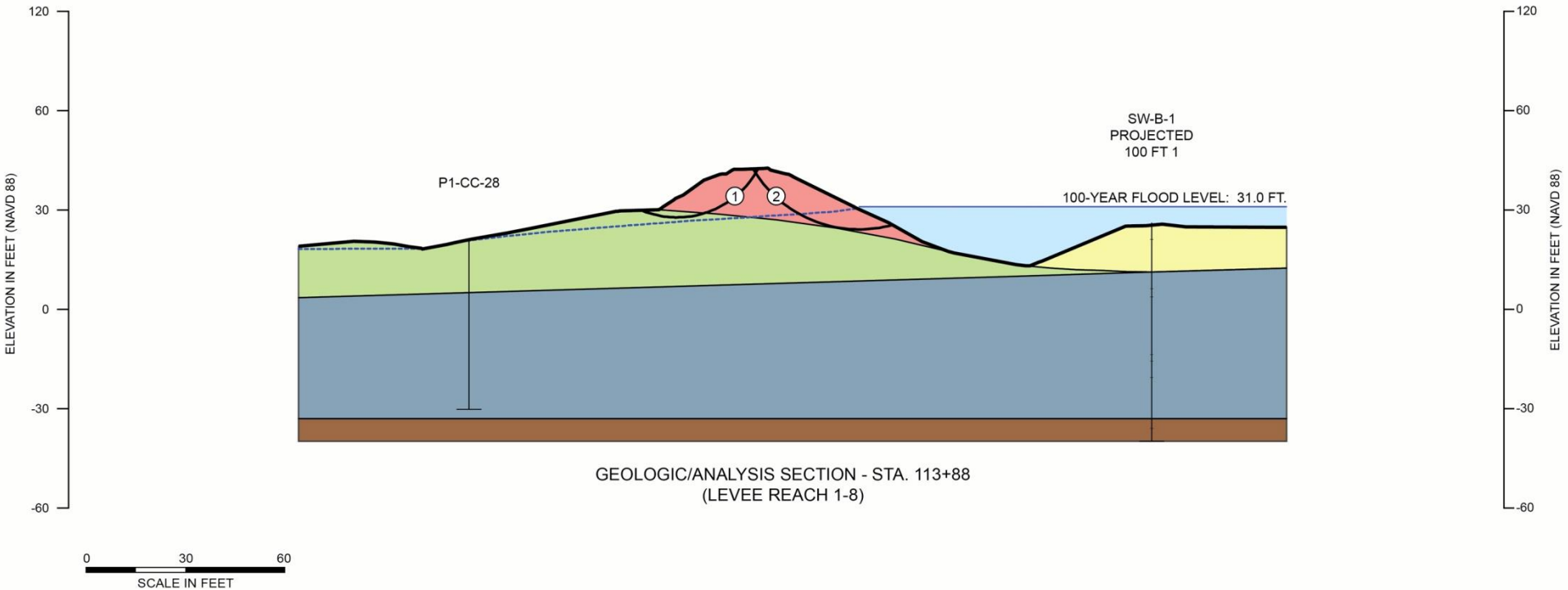
- Railroad Embankment Mixed sand and silt with timber remnants
- Fill Soft, slightly clayey to clayey SILT
- Fill Loose, silty SAND to sandy SILT
- Foundation Soft, clayey SILT (Alluvium)
- Foundation Loose, silty SAND (Alluvium)

SLIP SURFACE	CALCULATED FS	MEETS REQUIRED FS*
1	1.71	YES
2	1.28	NO

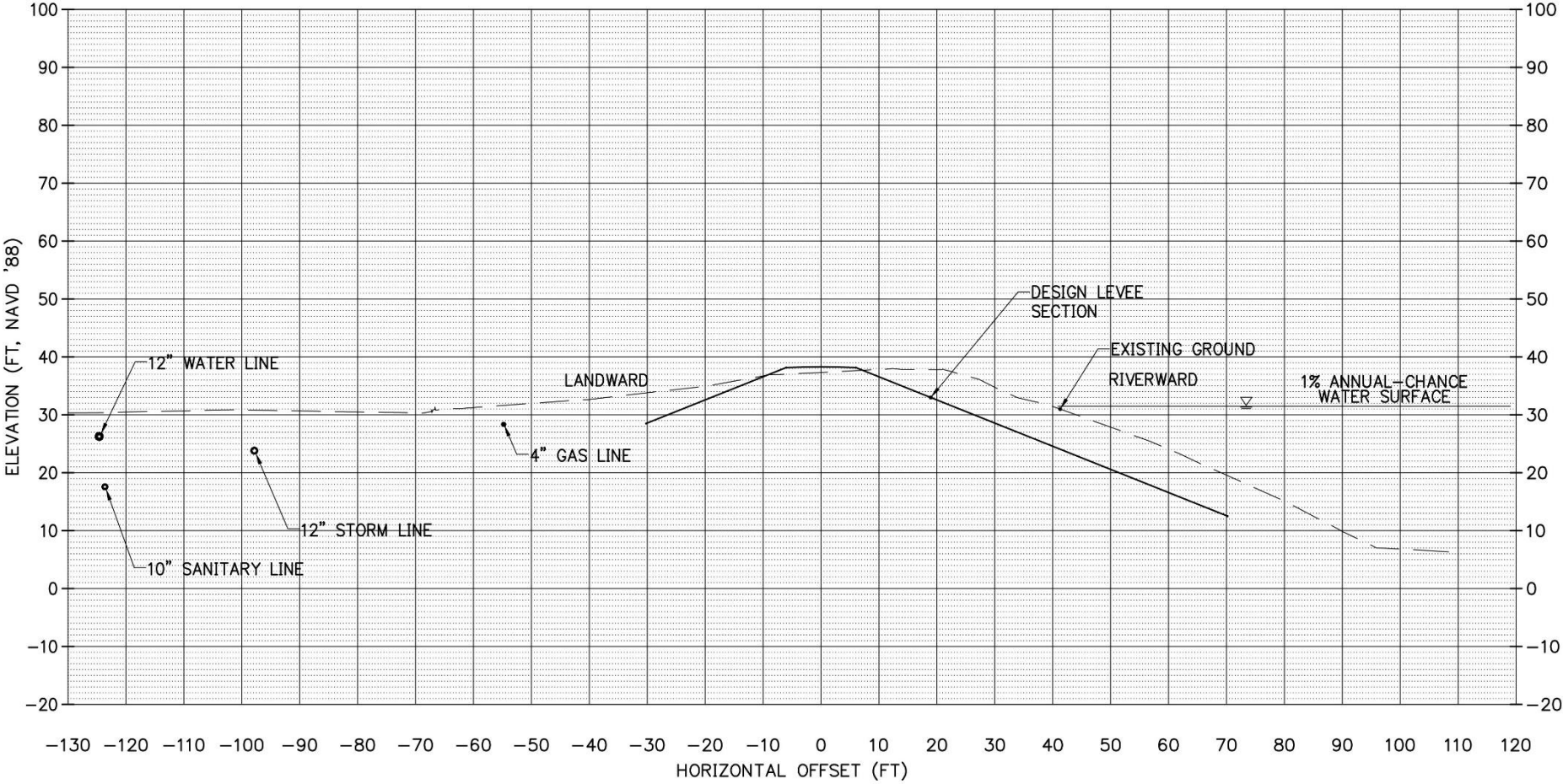
*MINIMUM ALLOWABLE FS=1.4, USACE, EM 1110-2-1913

CALCULATED EXIT GRADIENT AT TOE OF LANDWARD SLOPE = 0.0**

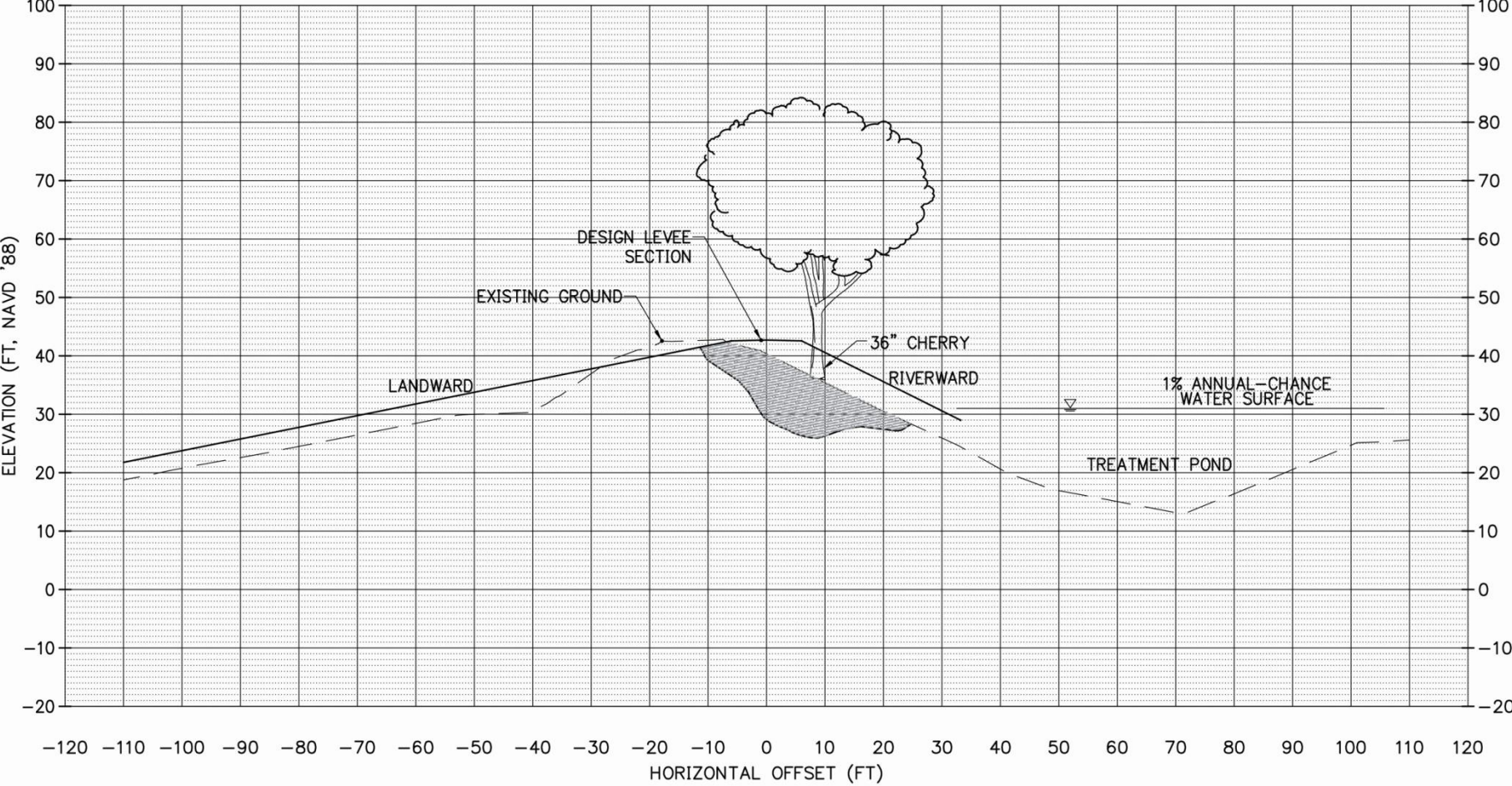
**RECOMMENDED MAXIMUM EXIT GRADIENT = 0.5, USACE, EM 1110-2-1913



MARINE DRIVE AREA



RAILROAD AREA



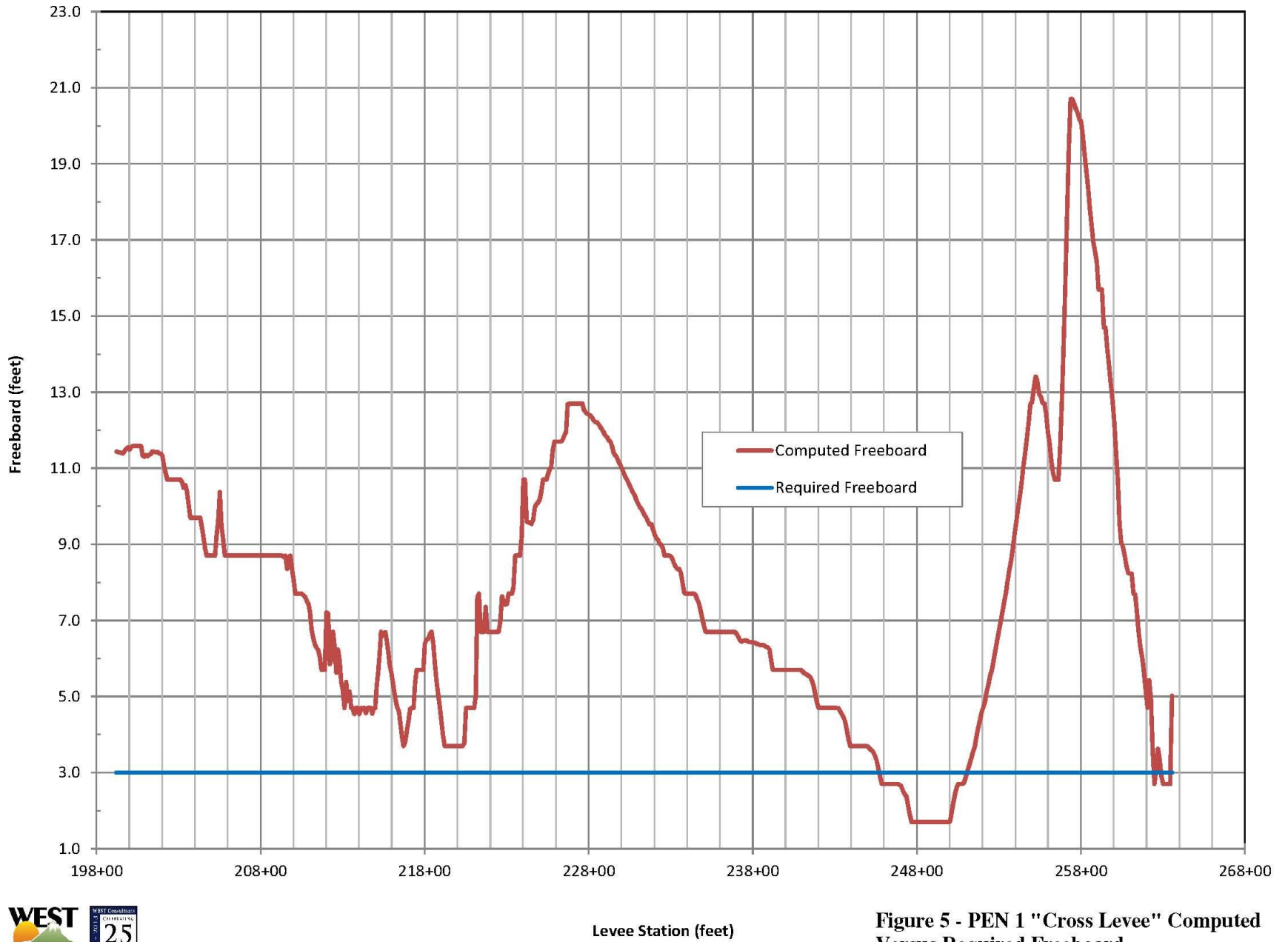



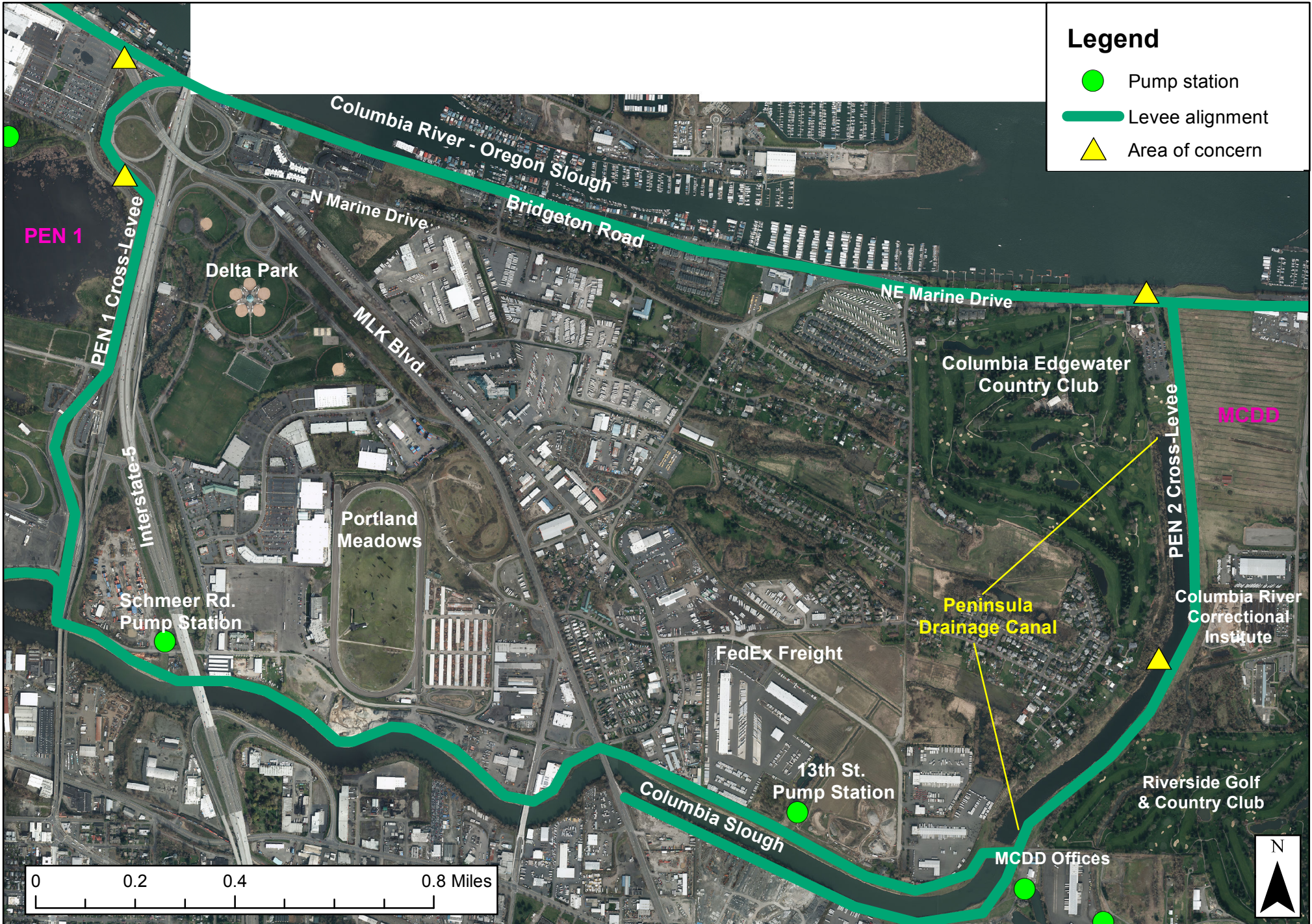


Figure 5 - PEN 1 "Cross Levee" Computed Versus Required Freeboard

Legend

-  Pump station
-  Levee alignment
-  Area of concern



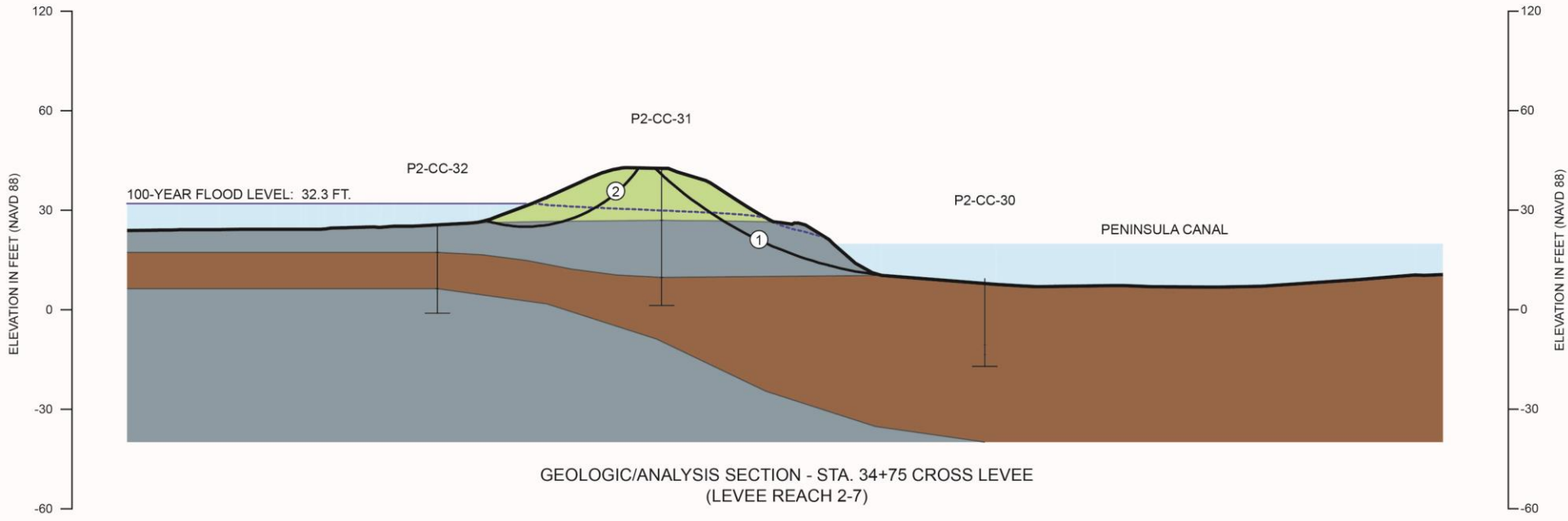
- Embankment Soft, slightly clayey to clayey SILT
- Embankment Loose, silty SAND to sandy SILT
- Foundation Loose, silty SAND and sandy SILT (Alluvium)
- Foundation Soft, clayey SILT to silty CLAY (Alluvium)

SLIP SURFACE	CALCULATED FS	MEETS REQUIRED FS*
1	0.99	NO
2	1.75	YES

*MINIMUM ALLOWABLE FS=1.4, USACE, EM 1110-2-1913

CALCULATED EXIT GRADIENT AT TOE OF LANDWARD SLOPE = 0.1**

**RECOMMENDED MAXIMUM EXIT GRADIENT = 0.5, USACE, EM 1110-2-1913



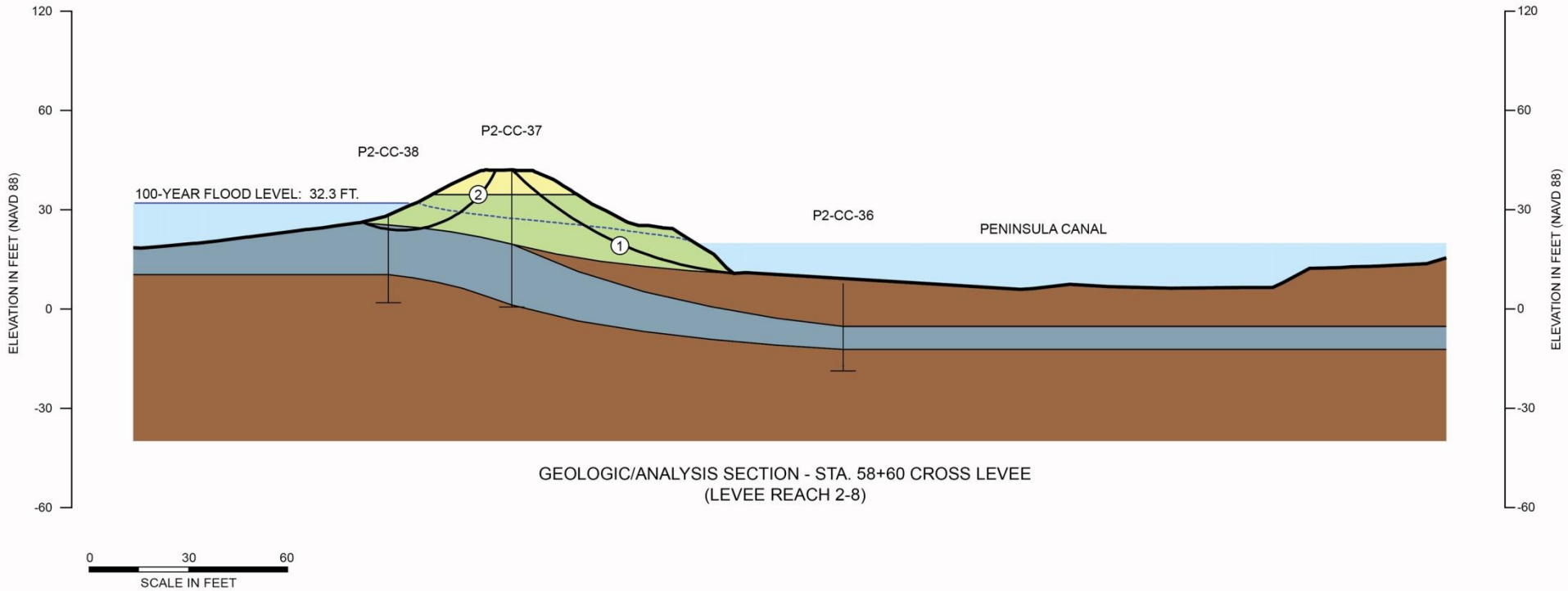
- Embankment Soft, slightly clayey to clayey SILT
- Embankment Loose, silty SAND to sandy SILT
- Foundation Loose, silty SAND and sandy SILT (Alluvium)
- Foundation Soft, clayey SILT to silty CLAY (Alluvium)

SLIP SURFACE	CALCULATED FS	MEETS REQUIRED FS*
1	1.09	NO
2	1.61	YES

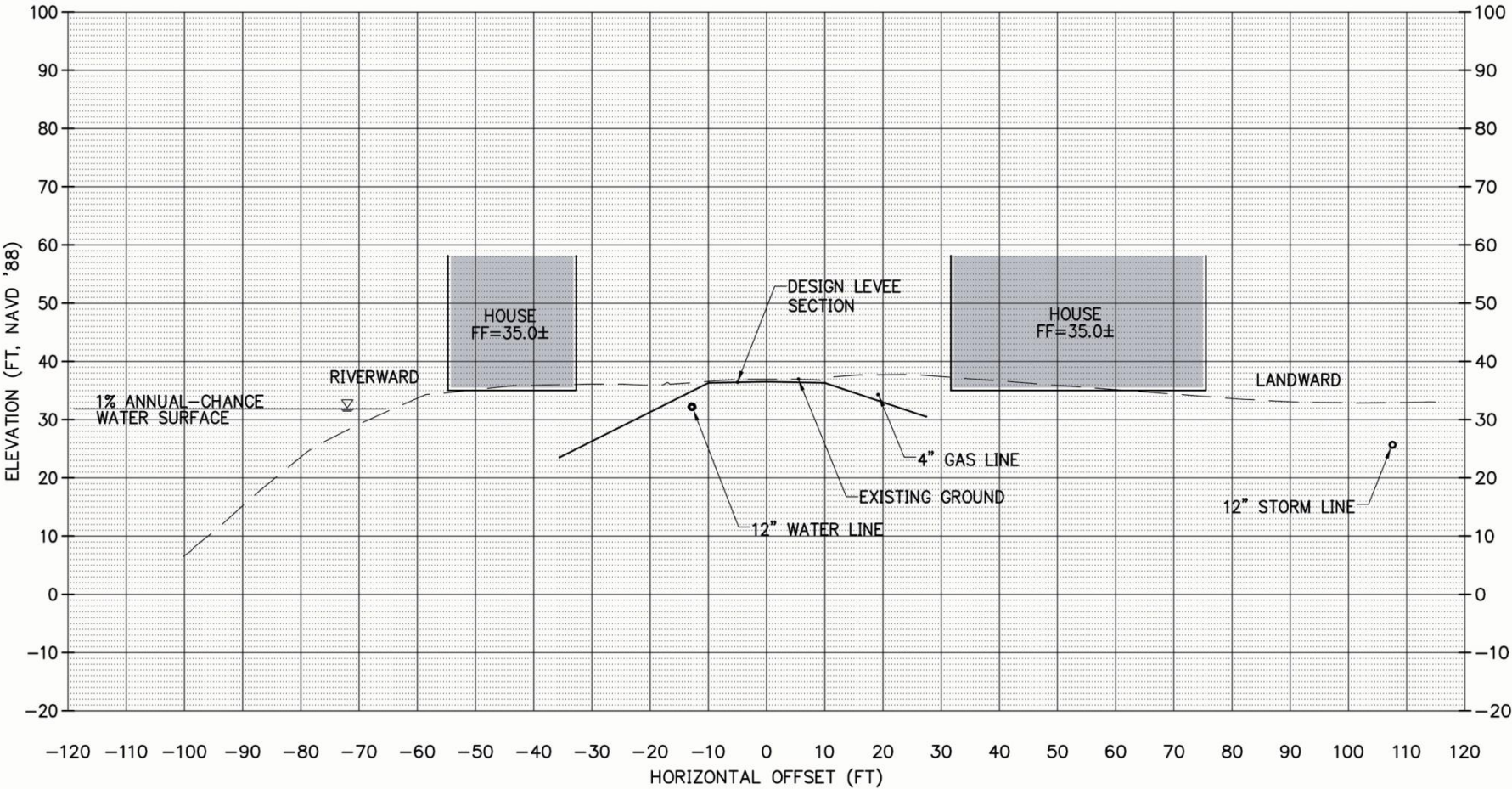
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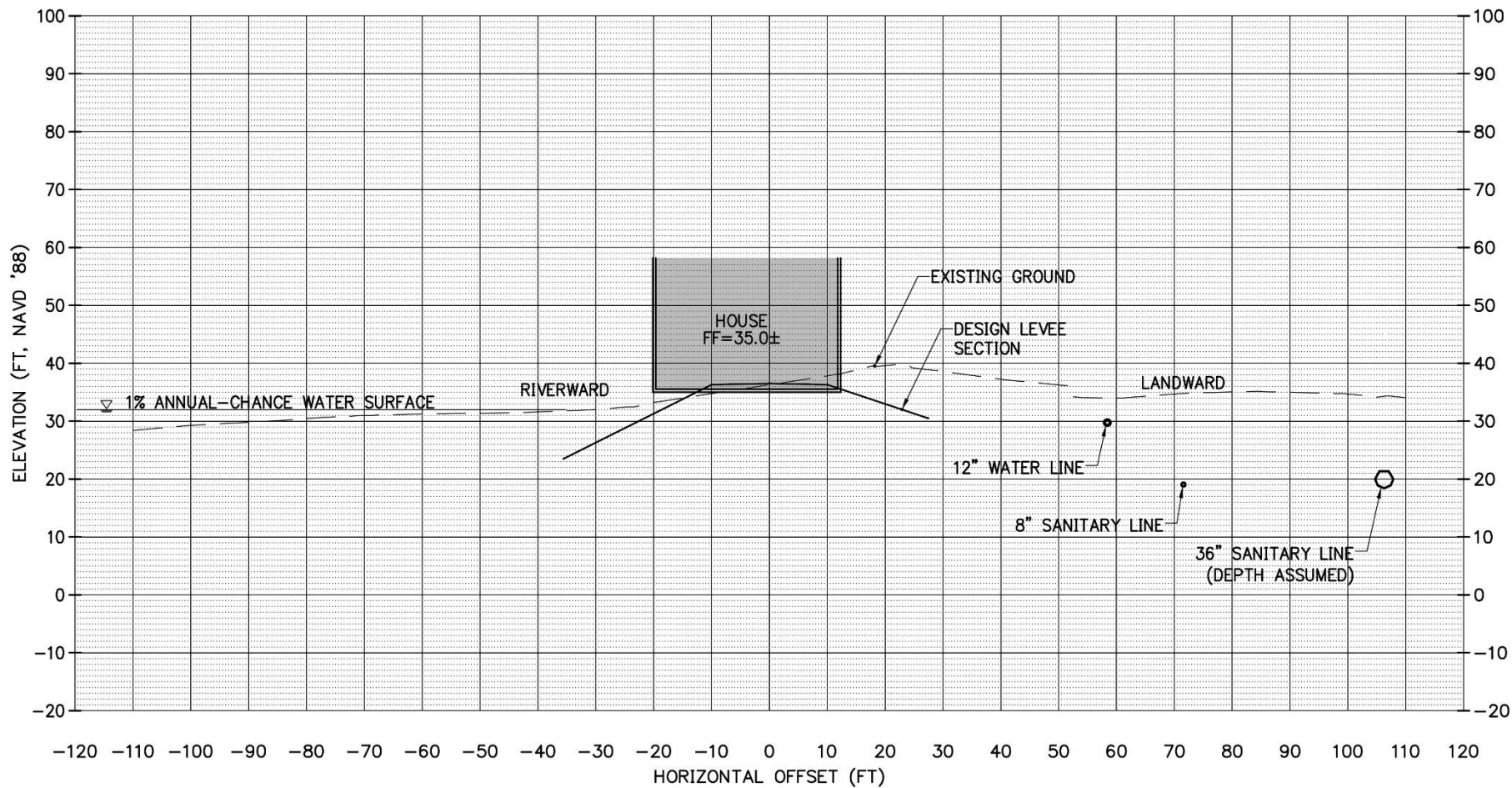
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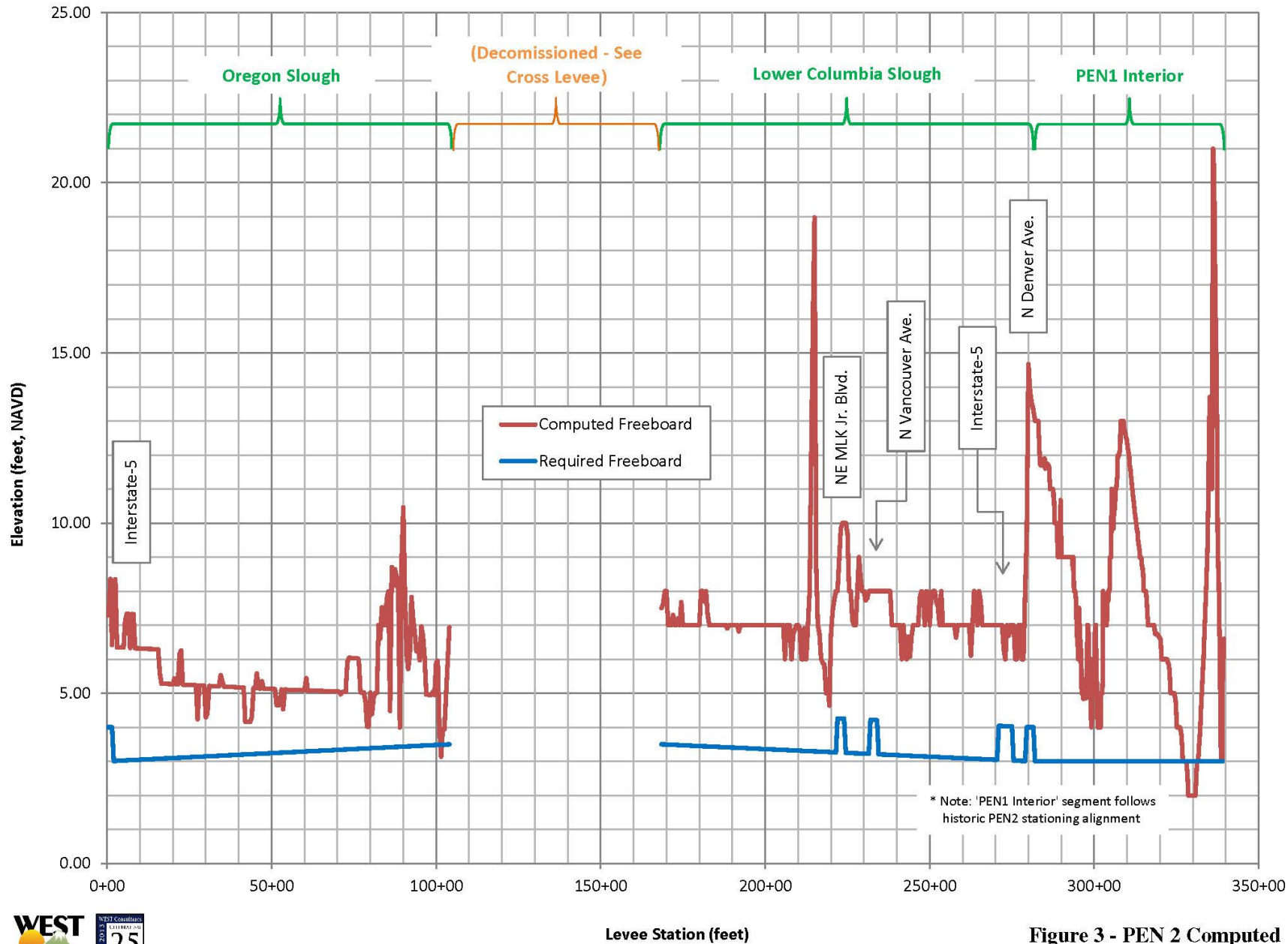


BRIDGETON AREA



MARINE DRIVE AREA





Levee Station (feet)

Figure 3 - PEN 2 Computed Versus Required Freeboard



OREGON MARINE CONSTRUCTION

OR 276 178