

Obtaining and Developing Base Flood Elevations in Zone A Areas



FEMA

National Flood Insurance Program
Administered by FEMA

YOUR INSTRUCTOR

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Important Information

- Please turn-off or silence cell phones
- Please take phone calls outside and away from the room
- Bathrooms are . . .
- Exits are . . .



Comments

- This course assumes a basic understanding of the **National Flood Insurance Program (NFIP)**
- Discussion pertains to minimum NFIP requirements
- Discussion applies to **Special Flood Hazard Areas (SFHA)**, i.e. “100-year” floodplain



**Questions and
comments are
encouraged!**

Acronyms....

- *BFE* Base Flood Elevation
- *CRS* Community Rating System
- *FEMA* Federal Emergency Management Agency
- *NFIP* National Flood Insurance Program
- *FIRM* Flood Insurance Rate Map
- *DFIRM* Digital Flood Insurance Rate Map
- *LOMA* Letter of Map Amendment
- *LOMR* Letter of Map Revision
- *SFHA* Special Flood Hazard Area
- *NGVD* National Geodetic Vertical Datum of 1929
- *NAVD* North American Vertical Datum of 1988
- *LFE* Lowest Floor Elevation
- *LAG* Lowest Adjacent Grade
- *HAG* Highest Adjacent Grade
- *WSE* Water Surface Elevation

PURPOSE OF WORKSHOP

To assist local floodplain officials, surveyors, and engineers develop base flood elevations in Approximate Zone A areas at a minimal cost

Workshop will **NOT** show how to use complex hydrology and hydraulics models, mapping tools, and survey techniques

PURPOSE OF WORKSHOP

Intended to be used in riverine and lake areas where flow conditions are fairly uniform

Workshop will **NOT** show how to develop BFEs in areas that experience alluvial fan flooding and in coastal flood hazard areas



Workshop presentation based on:

FEMA's Publication 265

“MANAGING FLOODPLAIN DEVELOPMENT IN APPROXIMATE ZONE A AREAS”

**A Guide for Obtaining and Developing
Base Flood (100-year) Elevations**

WORKSHOP TOPICS

- Floodplain Management Regulations for Approximate Zone A Areas
- Advantages to Develop Base Flood Elevations
- Show Ways to Develop Base Flood Elevations in Lacustrine and Riverine Systems

**FLOODPLAIN MANAGEMENT
REGULATIONS FOR
APPROXIMATE ZONE A AREAS**

THE NATIONAL FLOOD INSURANCE PROGRAM (NFIP)

- National Flood Insurance Act of 1968
- Administered by the Federal Emergency Management Agency (FEMA)



NFIP REGULATIONS FOR ZONE A AREAS

Minimum requirements for obtaining BFE Data (areas where BFEs have not been provided by FEMA)

Communities must obtain, review and reasonably utilize any base flood elevation and floodway data available from a Federal, State, or other source...

[44 CFR 60.3 (b) (4)]

Also in your ordinance

NFIP REGULATIONS FOR ZONE A AREAS

Minimum requirements for Developing BFE Data

Require that all new subdivision proposals and other proposed development (including proposals for manufactured home parks and subdivisions) greater than 50 lots or 5 acres, whichever is the lesser, include within such proposals base flood elevation data;

[44 CFR 60.3 (b) (3)]

Also in your ordinance

NFIP REGULATIONS FOR ZONE A AREAS

For large developments greater than 5 acres or 50 lots whichever is the lesser, communities must...

- Enforce Section 60.3(b)(3) of the NFIP regulations and require that BFE data be developed for affected lots through a **detailed study**.
- Follow FEMA's "*Guidelines and Specifications for Flood Hazard Mapping Partners*", April 2003.
<https://www.fema.gov/media-library/assets/documents/13948>

NFIP REGULATIONS FOR ZONE A AREAS

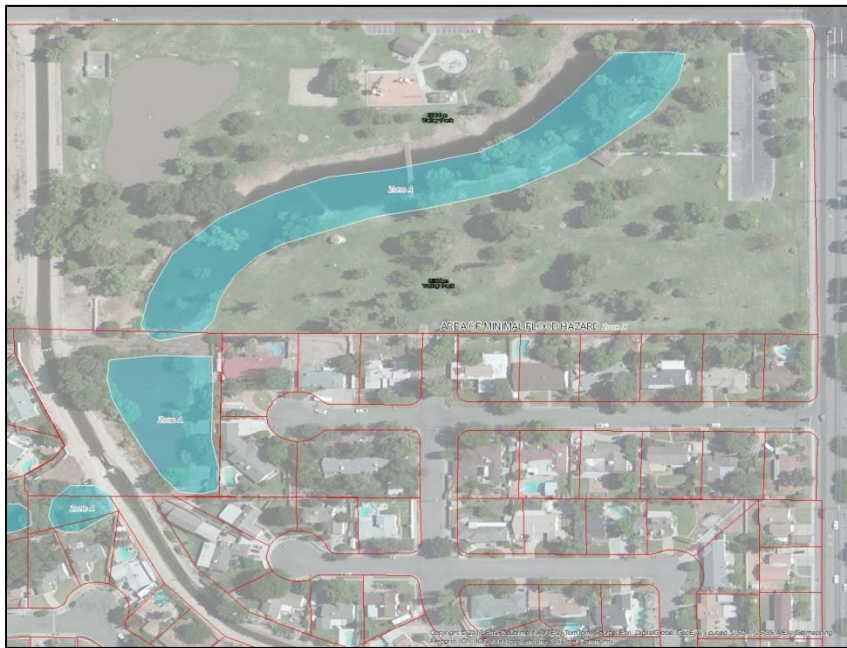
For large developments greater than 5 acres or 50 lots
whichever is the lesser, communities must...

(continued)

- Review and determine that the study is reasonable and accurate. Methods used are comparable to original FIS
- Make sure the lowest floor elevation is certified by a licensed land surveyor or registered P.E.
- Make sure that the applicant revises the FIRM, i.e, obtains a Letter of Map Revision from FEMA when required.

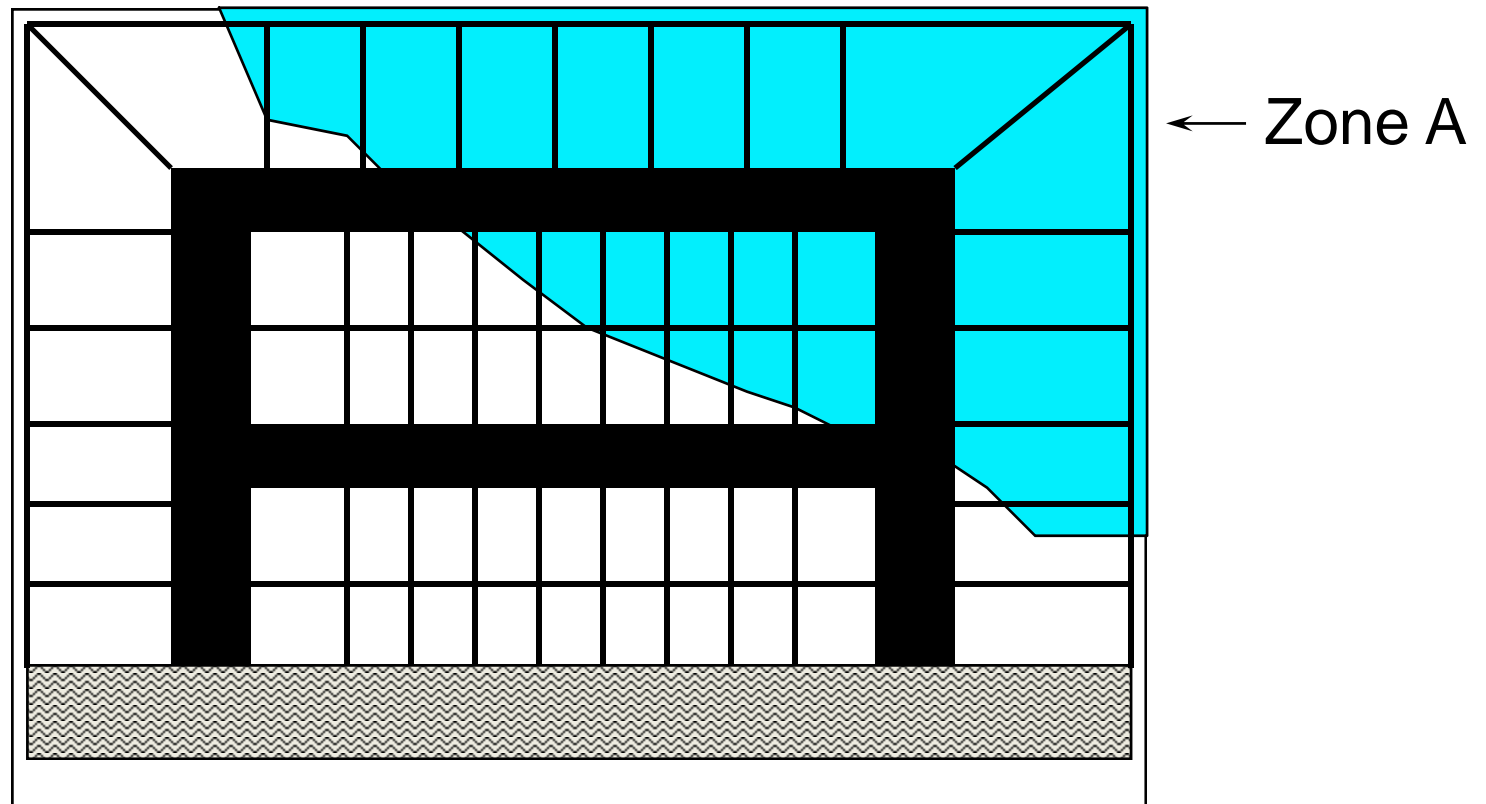
EXCEPTIONS

BFE may not be required if...

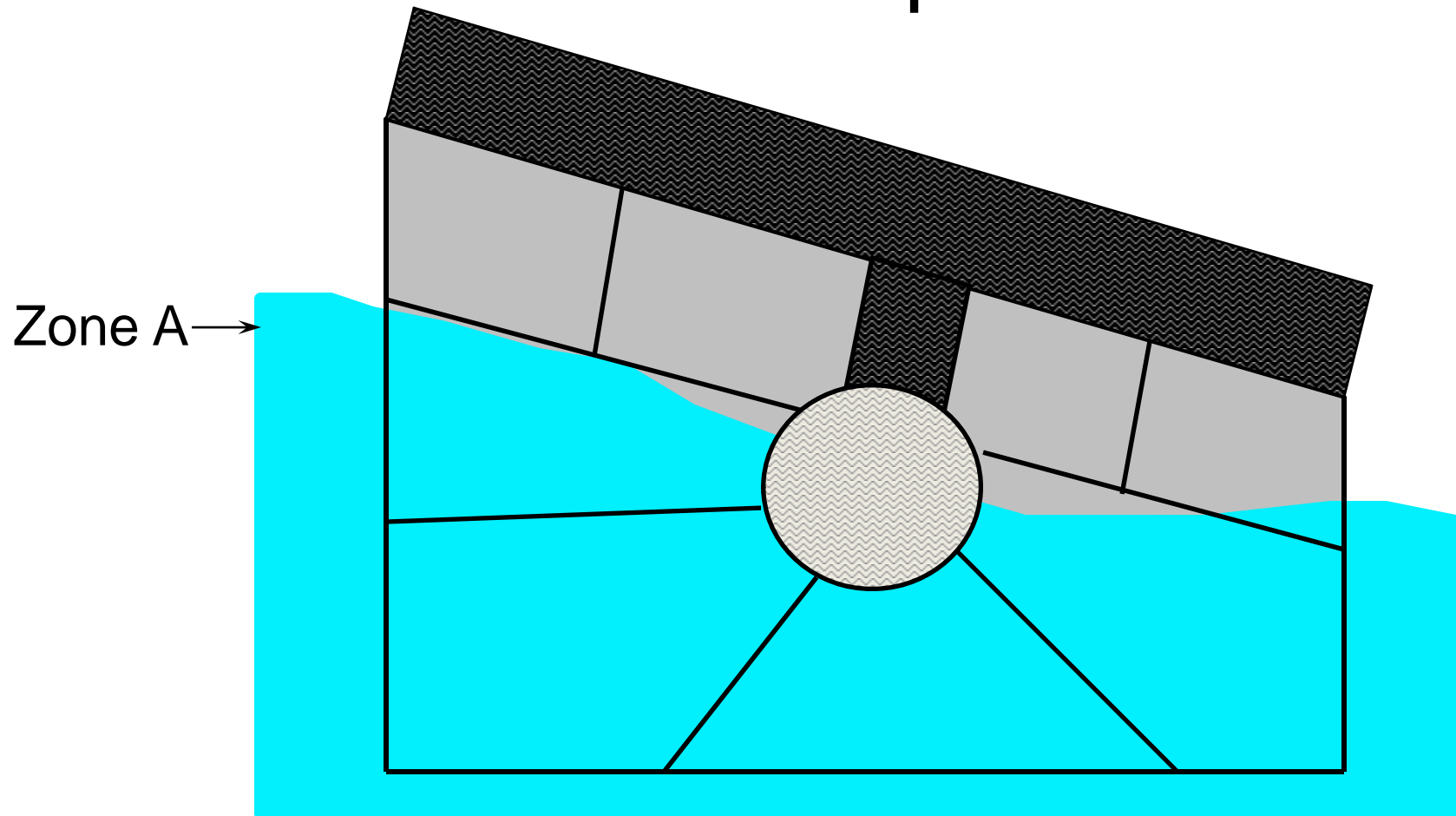


- Floodplain is contained entirely within an open space lot and building sites are **CLEARLY** outside of the Zone A area.
- If community has more stringent regulations, those higher standards should be applied.

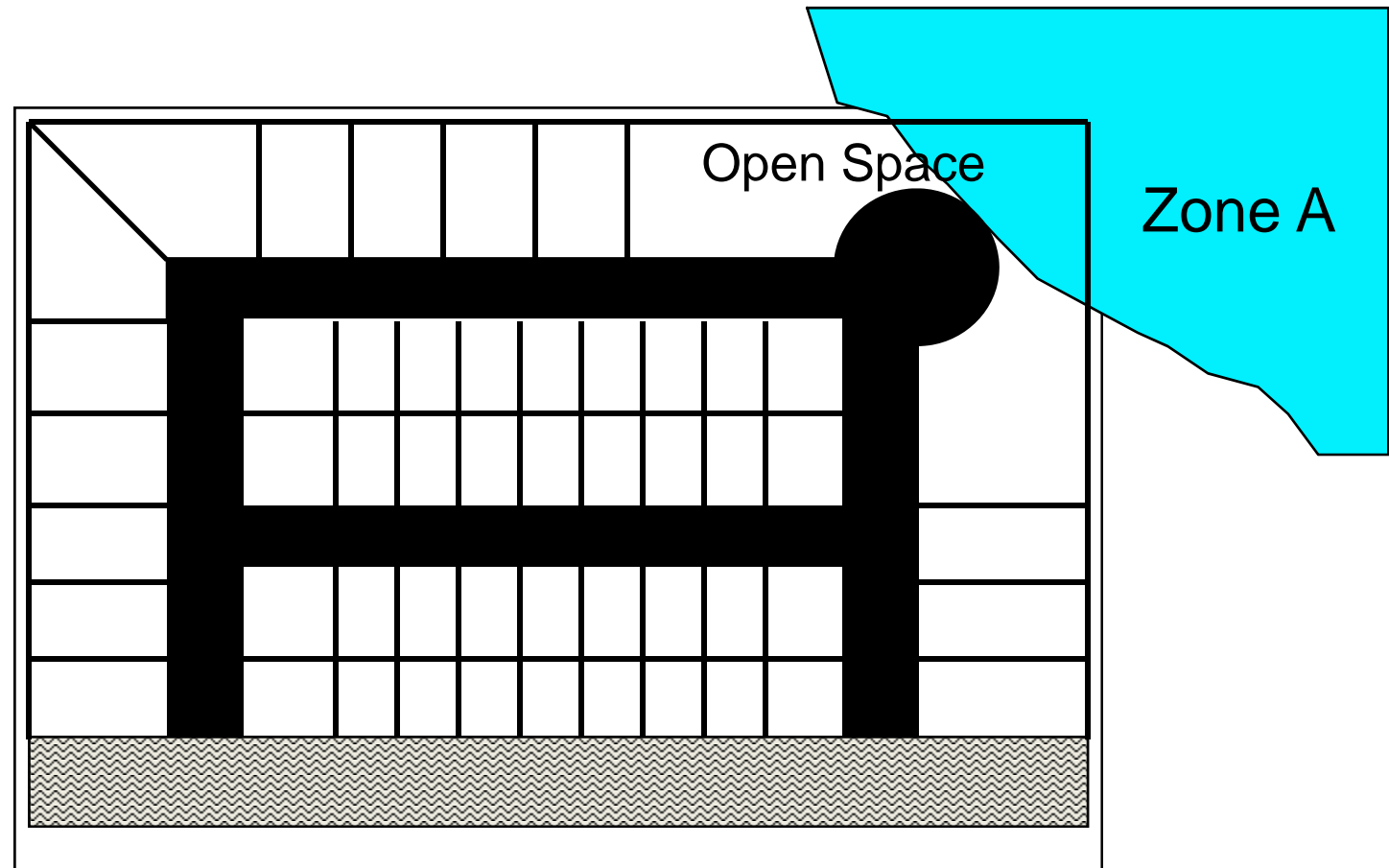
Proposed 56-lot Subdivision Is BFE Required?



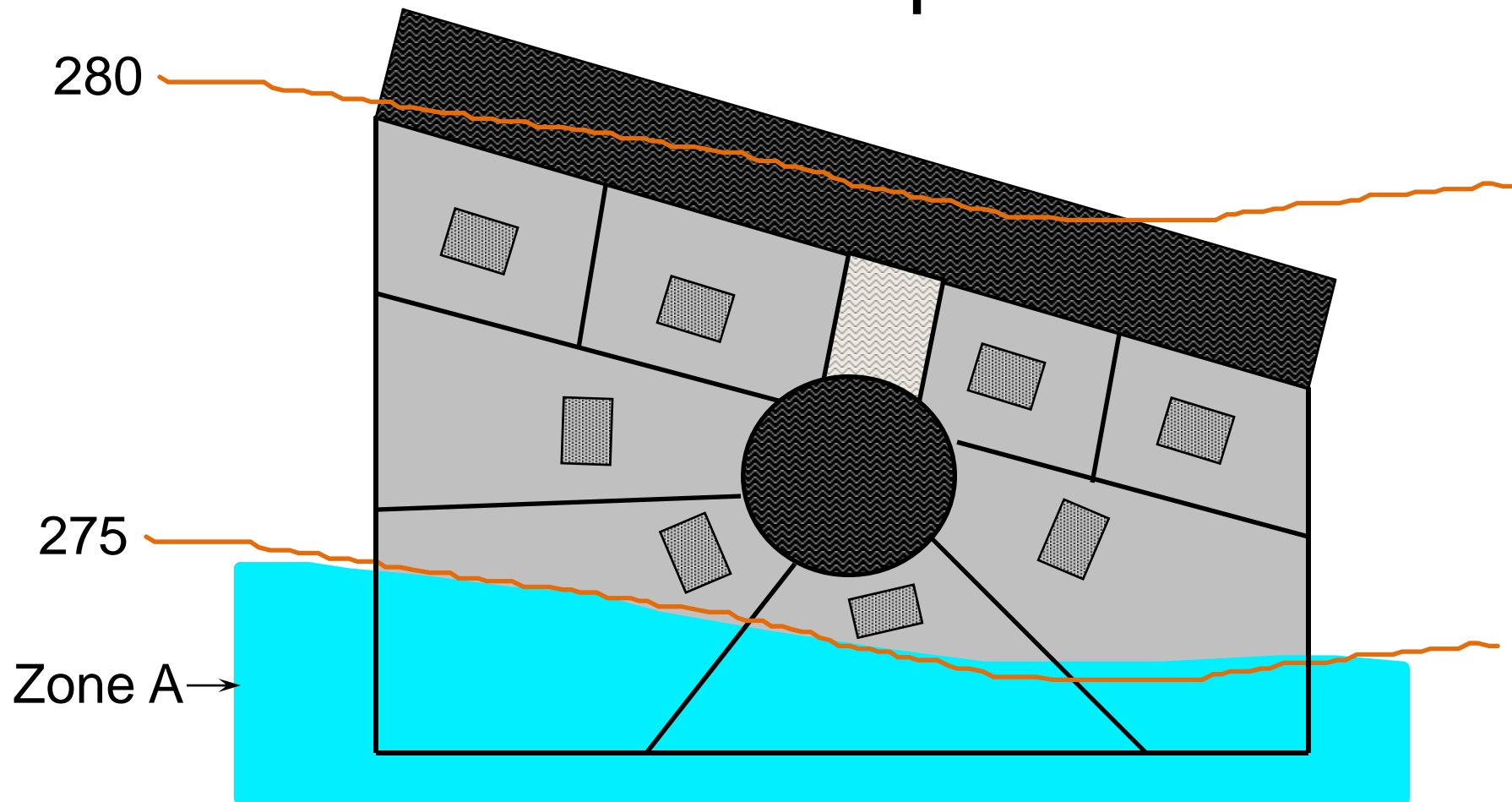
Proposed 6.7 Acre Subdivision Is BFE Required?...



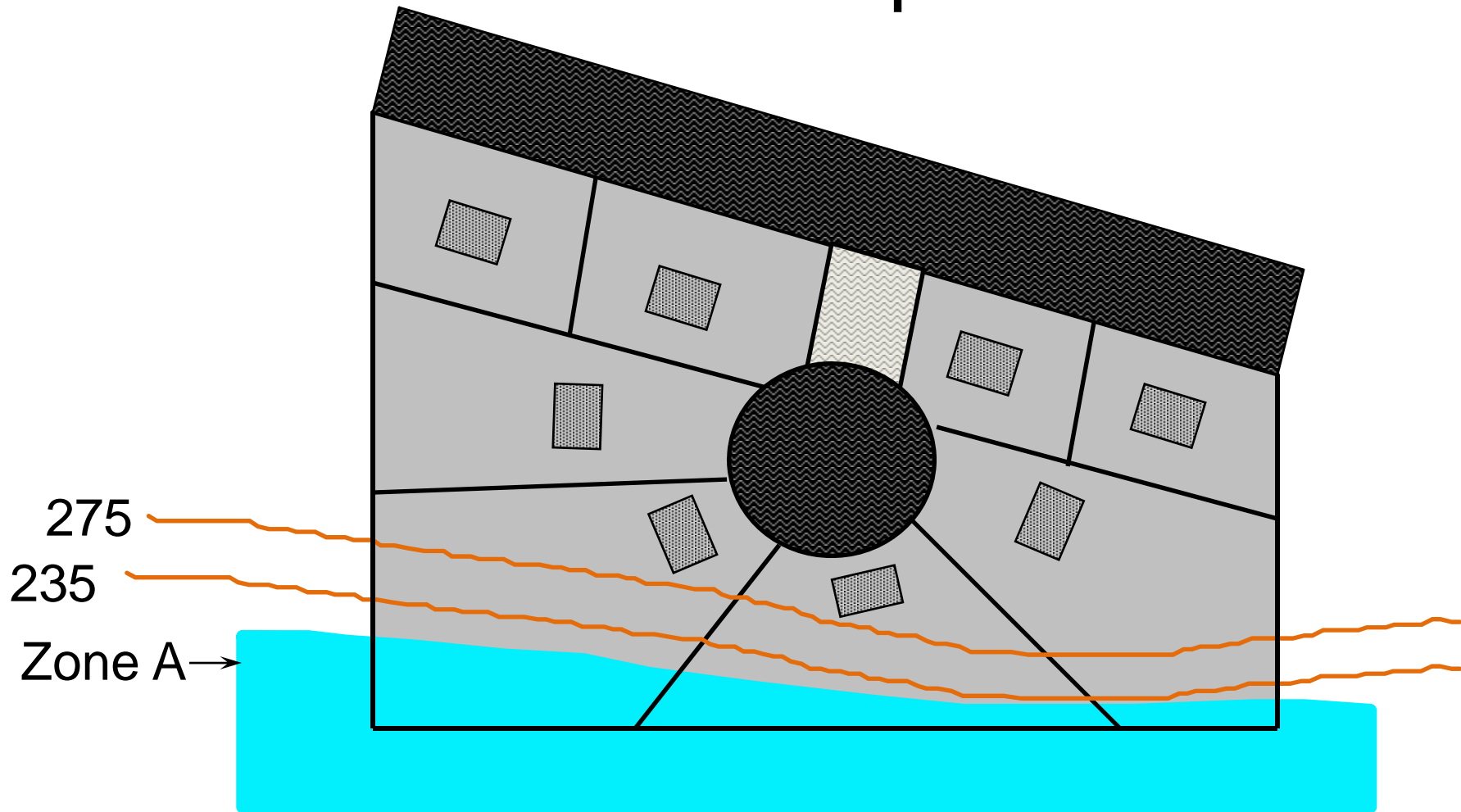
Proposed 56-lot Subdivision Is BFE Required?



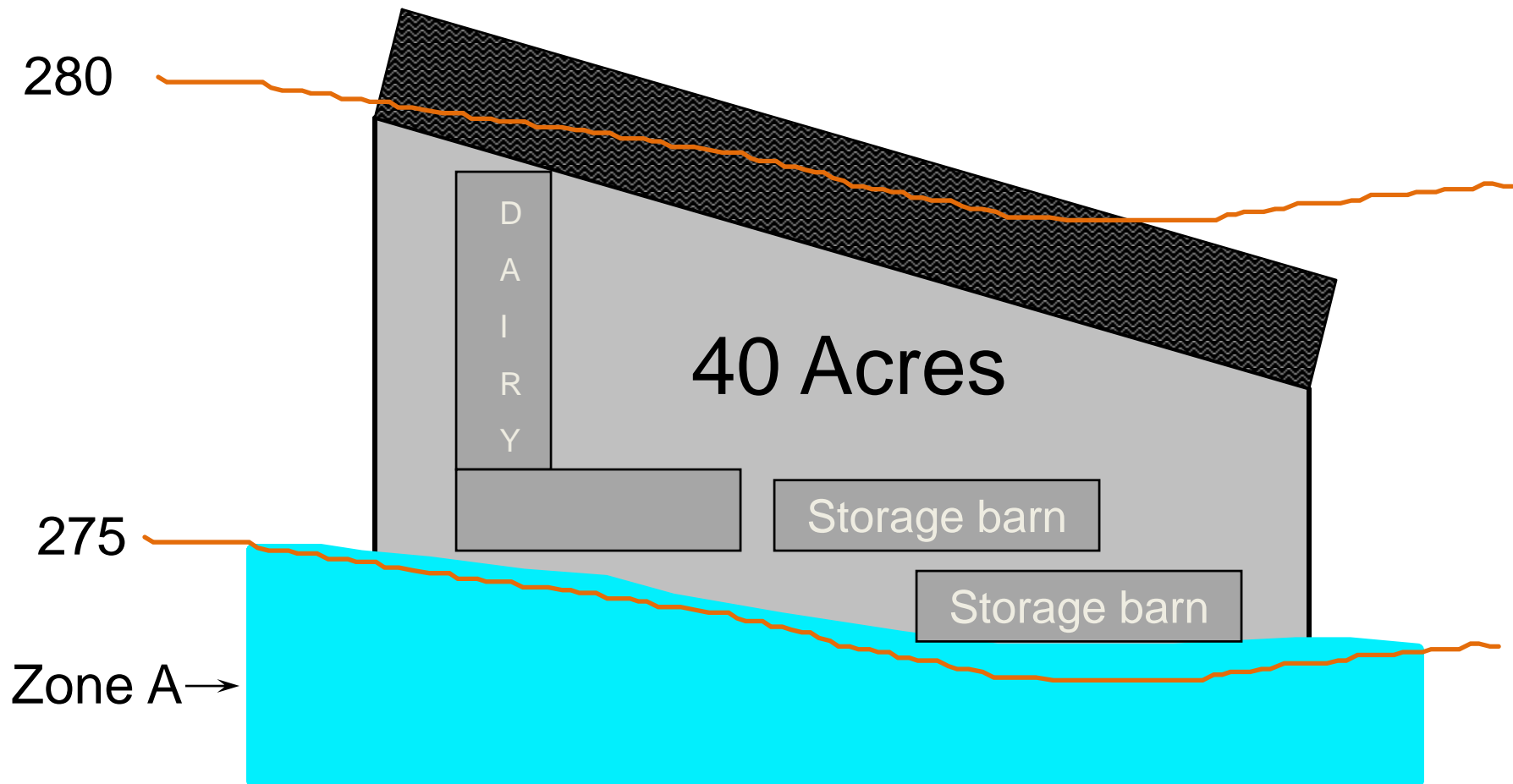
Proposed 6.7 Acre Subdivision Is BFE Required?...



Proposed 6.7 Acre Subdivision Is BFE Required?...



Proposed 40 Acre Dairy Farm. Is BFE Required?



NFIP REGULATIONS FOR ZONE A AREAS

For small developments less than 5 acres or 50 lots with no BFE's determined, communities should...

- Determine that construction will be reasonably safe from flooding
- Obtain, review, and reasonably use any base flood elevation and floodway data from federal, State, or other sources (60.3 (b)(4))
- Use local official's knowledge of flood conditions in area to establish a BFE
- Determine if a previous study was developed by a consultant or agency for the area in question
- Use the methods described in FEMA P-265 manual to estimate a BFE

NFIP REGULATIONS FOR ZONE A AREAS

For small developments less than 5 acres or 50 lots with no BFE's determined, communities should...

(continued)

- Obtain the elevation of the as-constructed lowest floor and maintain these records with community's files
- Elevate lowest floor to at least 2 feet or more above HAG for better insurance rates.

Questions?

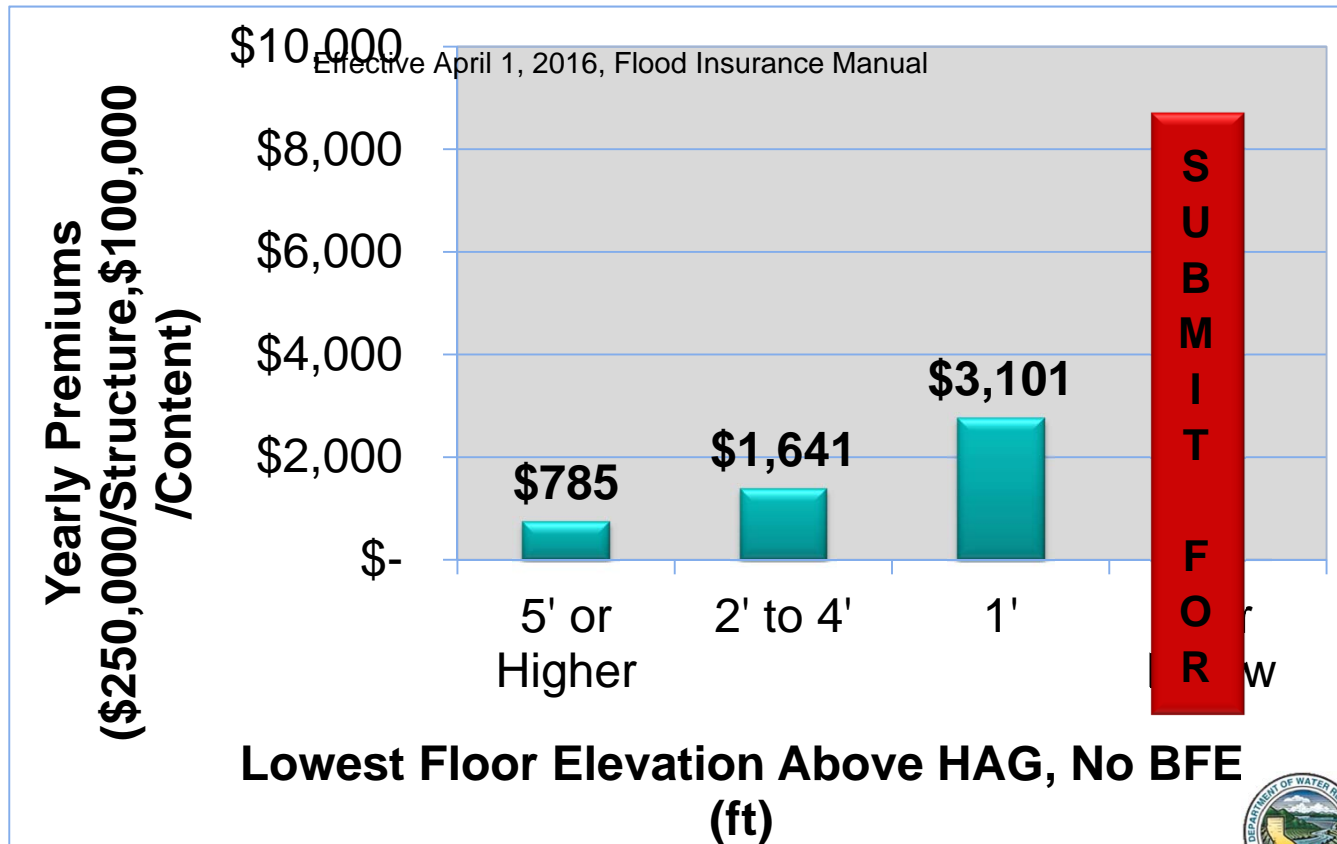


ADVANTAGES OF DEVELOPING BFEs

ADVANTAGES OF DEVELOPING BFE DATA...

- Elevating Lowest Floor Elevation (LFE) to or above the BFE will help reduce future flood losses
- Assure compliance with the community's floodplain management regulations
- Flood insurance policies are lower cost with an established BFE
- Flood insurance requirement could be removed from the building or property (LOMC)
- CRS program provides credit points (Activity 410)

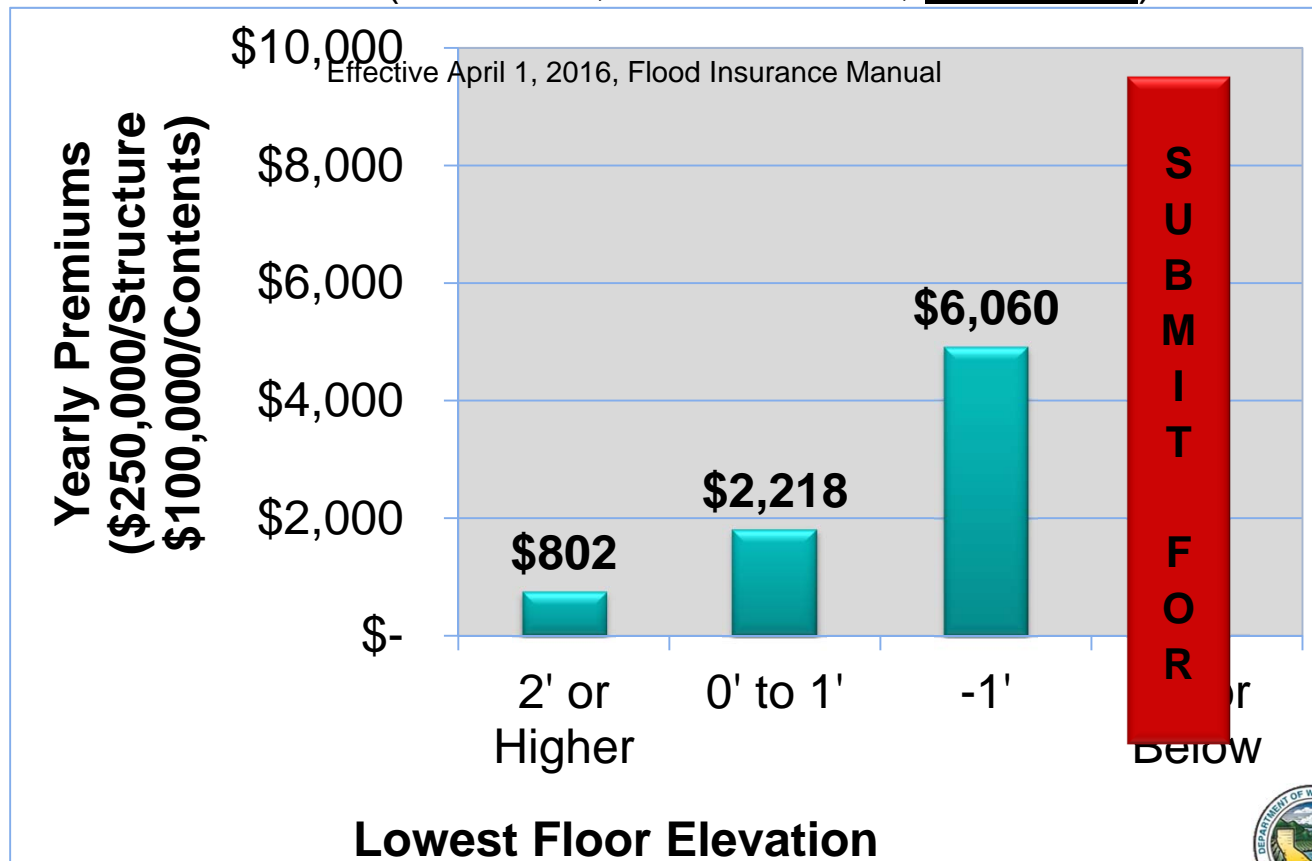
INSURANCE COST vs. LOWEST FLOOR ELEVATION ZONE A (One floor, no basement, **NO BFE**)



ADVANTAGES OF DEVELOPING BFE DATA



INSURANCE COST vs. LOWEST FLOOR ELEVATION ZONE A (One floor, no basement, **With BFE**)

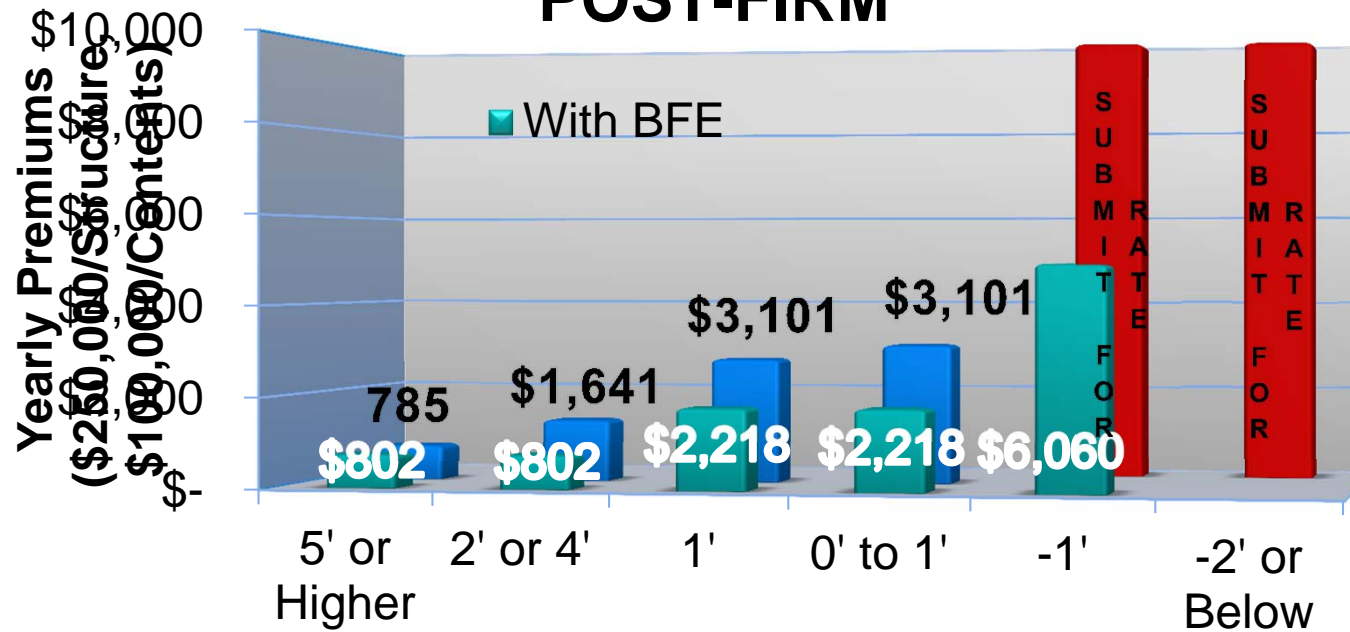


ADVANTAGES OF DEVELOPING BFE DATA



COST COMPARISON OF NO BFE vs. BFE

POST-FIRM



Lowest Floor Elevation Above Estimated BFE or HAG

Effective April 1, 2016, Flood Insurance Manual



ADVANTAGES OF DEVELOPING BFE DATA

CHANGES TO THE NFIP BW-12 and HFIAA



<http://www.fema.gov/national-flood-insurance-program>

ADVANTAGES OF DEVELOPING BFE DATA

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SOURCES FOR EXISTING BASE FLOOD ELEVATIONS.

DATA SOURCES FOR BFE DEVELOPMENT

- Flood Insurance Study
“Best Available Data”
- Engineering studies
(published or non-published)
- High water marks from severe storms
- High flow staking conducted by a Federal,
State, or Local agency
- Aerial photogrammetry
- Preliminary Firms
- LOMRs
- Backup data from LOMAs



DATA SOURCES FOR BFE DEVELOPMENT

- Local Public Works Department
- Flood Control Districts
- Levee Improvement Districts
- Local Planning Commissions
- Municipal Water Districts
- River Basin Commissions
- Water Control Board

COUNTY AGENCIES

Local Floodplain Managers

Contact Info can be found at: www.hawaiiinfip.org

- **City and County of Honolulu**

[Mario Siu-Li, CFM](#)

- **County of Maui**

[Carolyn Cortez, CFM](#)

- **County of Kauai**

[Stanford Iwamoto, P.E.](#)

- **County of Hawaii**

[Kelly Gomes, P.E. \(East Hawaii\)](#)

[Kiran Emler, P.E. \(West Hawaii\)](#)

STATE AGENCIES

Department of Land and Natural Resources

Engineering Division

<https://dlnreng.hawaii.gov/>

- **Contacts:**

Flood Control / Dam Safety Section Head – Edwin Matsuda, P.E., CFM

State NFIP Coordinator - Carol Tyau-Beam, P.E., CFM

State General Flood Control Plan Administrator – Jesse Colandrea, P.E.

- **Hawaii Flood Hazard Assessment Tool**

<http://gis.hawaiinfip.org/fhat/>

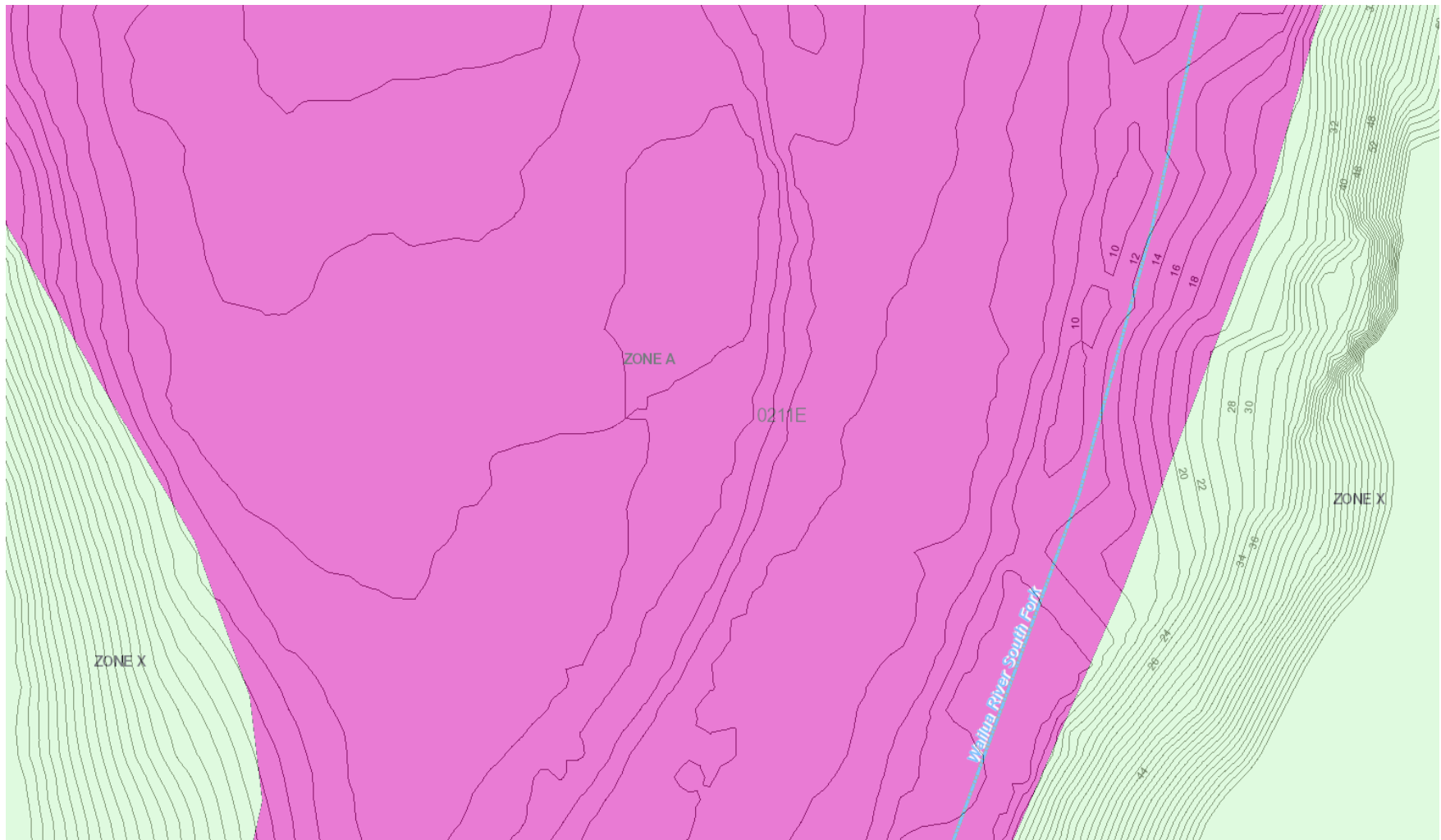
www.hawaiinfip.org

- **State General Flood Control Plan**

<https://dlnreng.hawaii.gov/fcds/gfcp/>

Topo Contours from LIDAR & Flood Zones+

- Hawaii FHAT: <http://gis.hawaiiinfip.org/FHAT/>



FEDERAL AGENCIES

- U.S. Army Corps of Engineers
- Federal emergency Management Agency
- U.S. Department of Interior, Geological Survey
- U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS)
- U.S. Department of Transportation, Federal Highway Administration

U.S. Army Corps of Engineers

Honolulu District

Civil Works Technical Branch

Building T-223

Fort Shafter, HI 96858

(916) 835-4138

CEPOH-EC-T@usace.army.mil

<http://www.poh.usace.army.mil/About/Offices-and-Units/Engineering-Construction-Division/Civil-Works-Technical/>

U.S. Department of Interior, Geological Survey

Pacific Island Water Science Center

<http://hi.water.usgs.gov/>

National Weather Service

Pacific Island Water Science Center

<http://hi.water.usgs.gov/>

Federal Emergency Management Agency

REGION IX

<http://www.r9map.org>

FEMA, Federal Insurance and Mitigation Division
1111 Broadway, Suite 1200
Oakland, California 94607-4052
(510) 627-7100

<http://www.fema.gov/fhm/>



DOWNLOADS



- FEMA P-265 (1995)
<https://www.fema.gov/media-library/assets/documents/1911>
- FEMA's Quick-2 Software v.2.0
<http://www.fema.gov/quick-2-version-20#1>
- USGS National Streamflow Statistics Program v.6
<http://water.usgs.gov/software/NSS/>

WEBSITES

- FEMA's Map Service Center

<https://msc.fema.gov/portal/>



- FEMA's National Flood Hazard Layer (Geoplatform)

<http://fema.maps.arcgis.com/home/webmap/viewer.html?webmap=cbe088e7c8704464aa0fc34eb99e7f30>



WEBSITES



- USGS StreamStats v.3
<http://water.usgs.gov/osw/streamstats/>
- USGS The National Map Viewer
<http://viewer.nationalmap.gov/viewer/>



Topographic Data Availability for Hawaii

- Federal Inventory: <https://coast.noaa.gov/inventory/>



**DEVELOPING
BASE FLOOD ELEVATIONS
FEMA'S P-265**

DOWNLOADS



- FEMA P-265 (1995)
<https://www.fema.gov/media-library/assets/documents/1911>
- FEMA's Quick-2 Software v.2.0
<http://www.fema.gov/quick-2-version-20#1>
- USGS National Streamflow Statistics Program v.6
<http://water.usgs.gov/software/NSS/>

METHODS OF DEVELOPING BFES

Simplified Methods

Limited Detailed Method (Quick-2)

METHODS OF DEVELOPING BFES

Simplified Methods

- ❖ Contour Interpolation
- ❖ Data Extrapolation

SIMPLIFIED METHOD

- May be used to determine if the development is reasonably safe from flooding
- Limitations of BFEs using simplified methods
 - May not be used to apply for a Letter of Map Change
 - May not be used for flood insurance rating
 - May not be used to complete an Elevation Certificate

METHODS OF DEVELOPING BFES

Simplified Methods

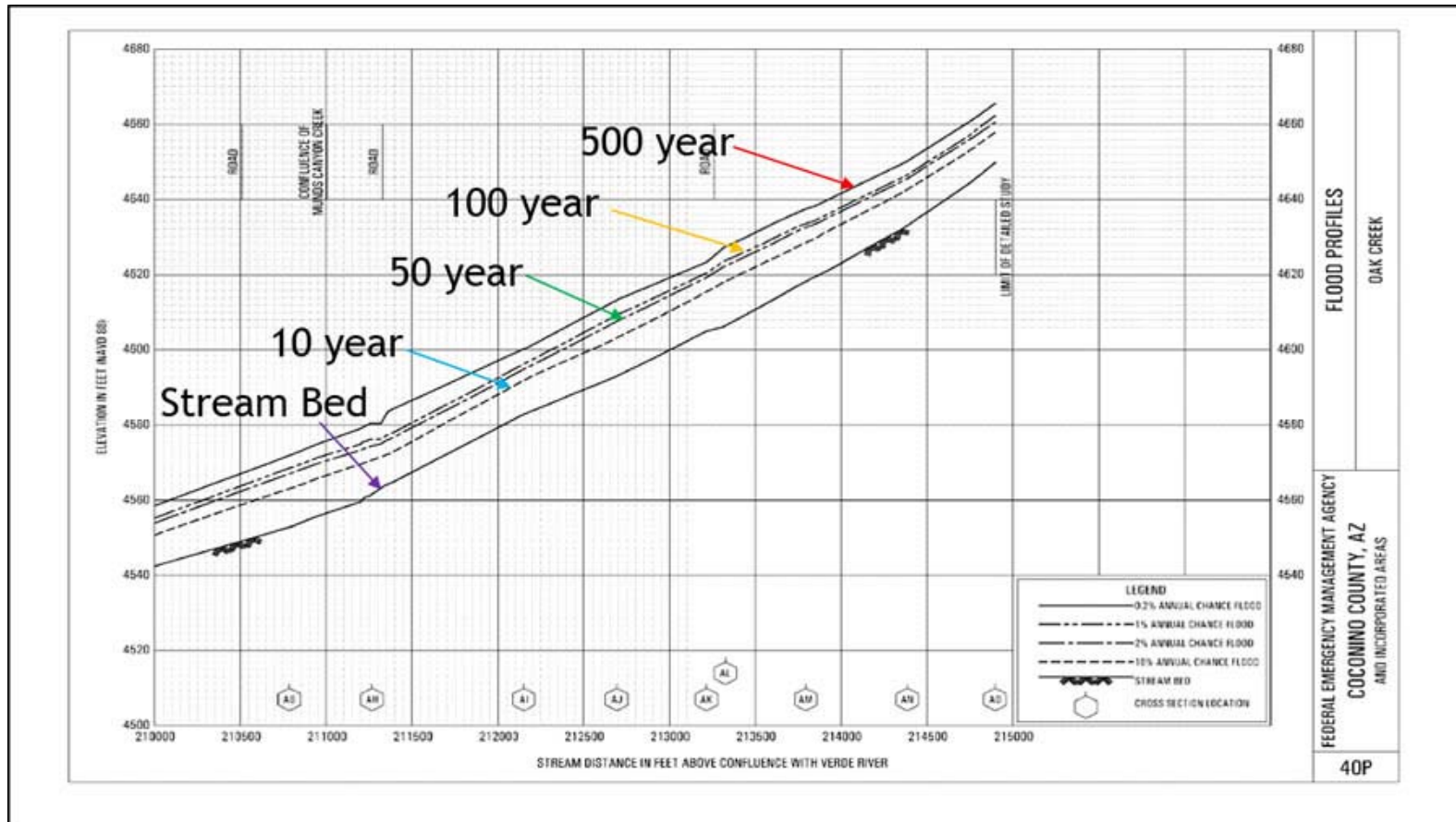
❖ Data Extrapolation

DATA EXTRAPOLATION

Extrapolate existing 100-yr profile computed by detailed methods to obtain BFE

- Requires existing 100-yr profile computed by detailed methods

100-YEAR PROFILE

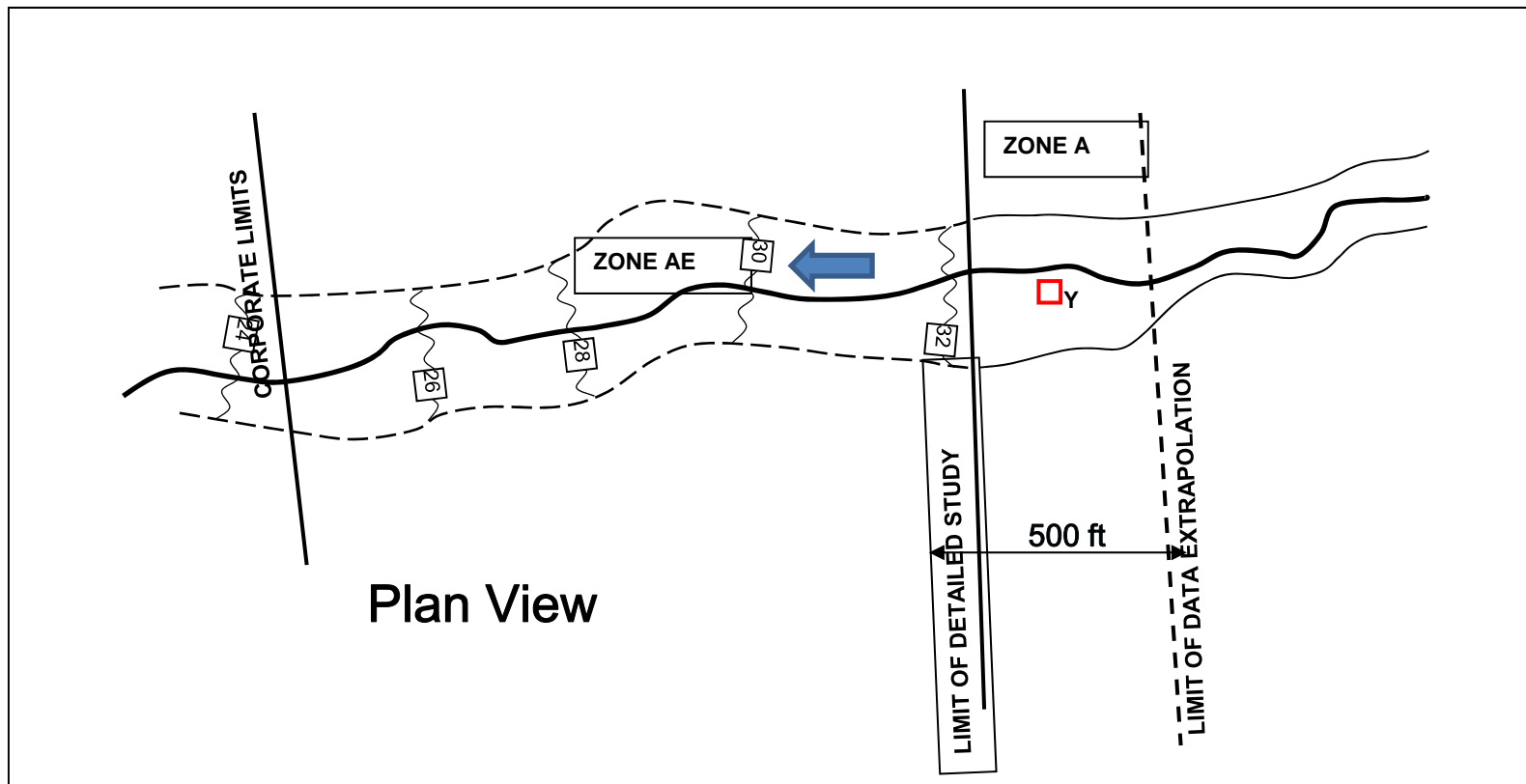


DATA EXTRAPOLATION

Extrapolate existing 100-yr profile computed by detailed methods to obtain BFE

- Requires existing 100-yr profile computed by detailed methods
- Only used if site is within 500 ft (upstream) from limit of detailed study

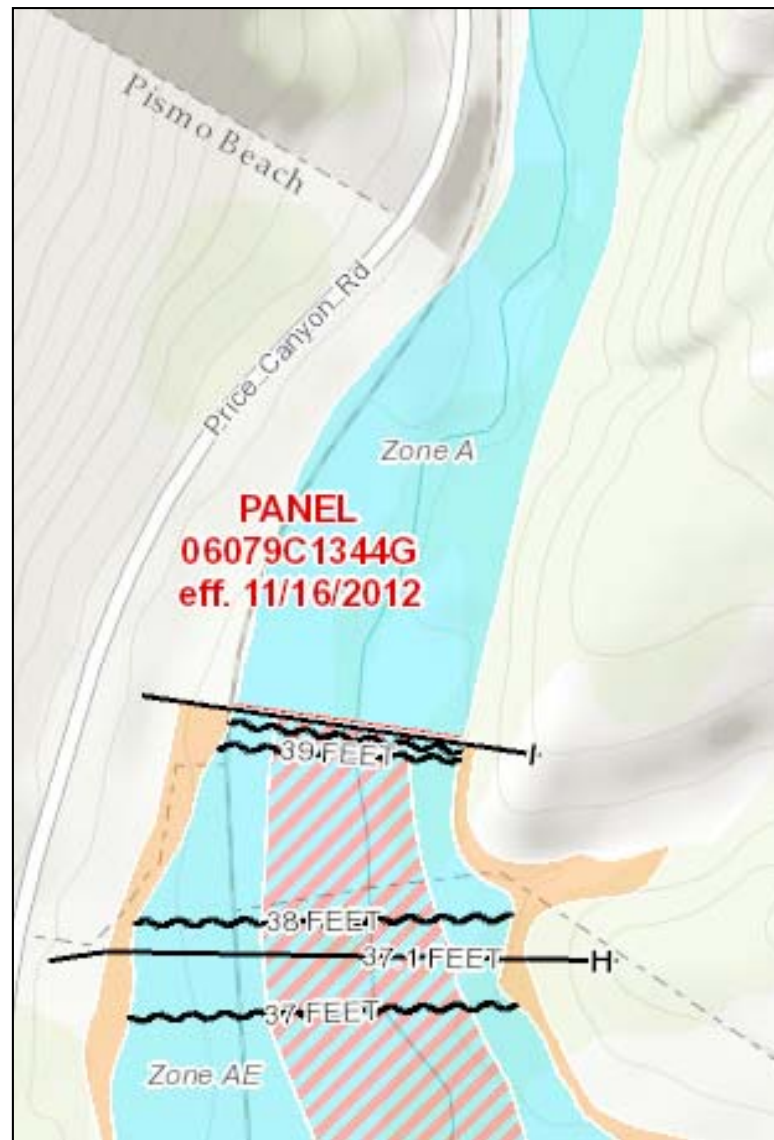
Property within 500 ft from Limit of Detailed Study



DATA EXTRAPOLATION

Extrapolate existing 100-yr profile computed by detailed methods to obtain BFE

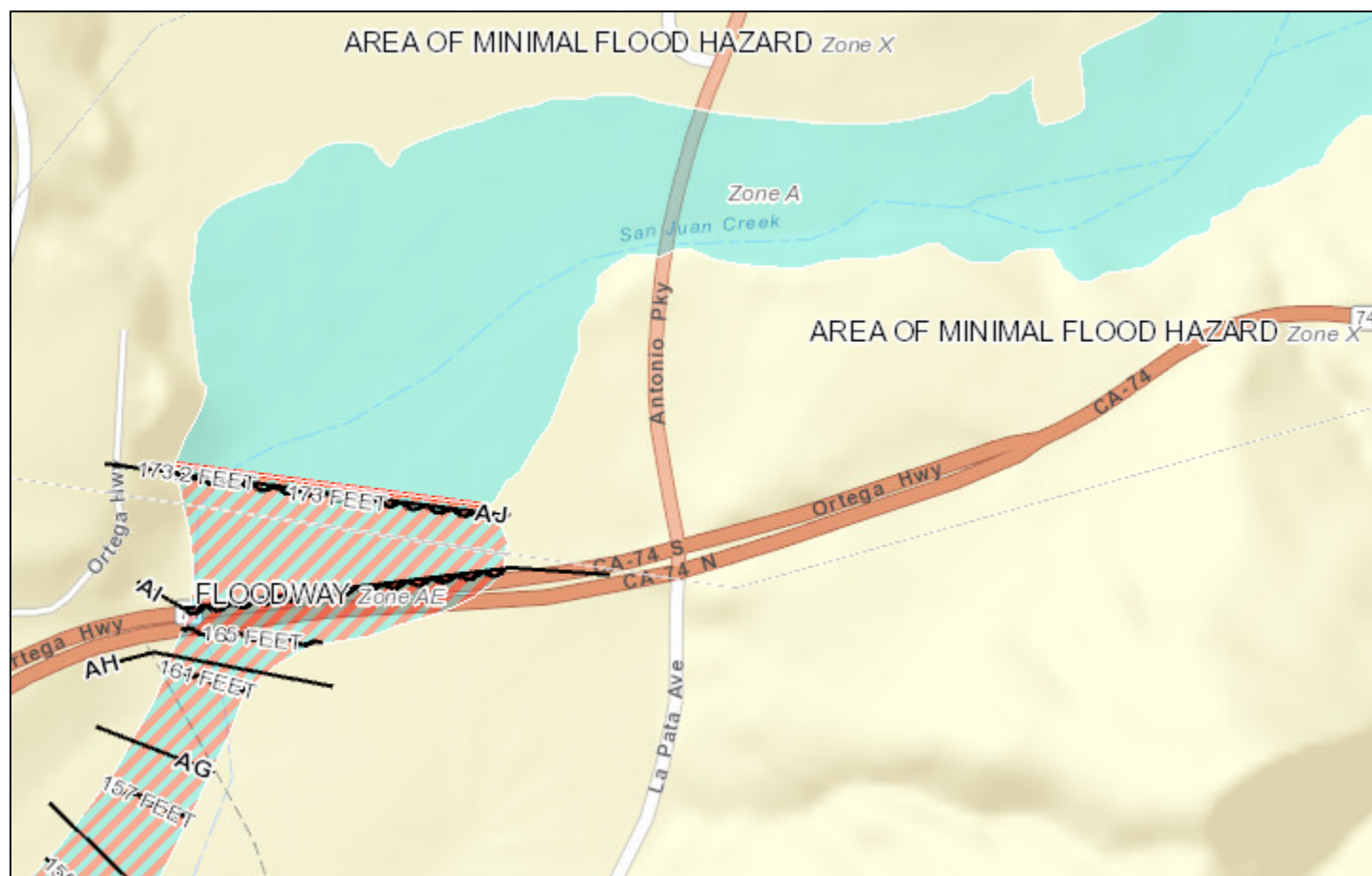
- Requires existing 100-yr profile computed by detailed methods
- Only used if site is within 500 ft (upstream) from limit of detailed study
- Channel width and slope similar to downstream reaches



DATA EXTRAPOLATION

Extrapolate existing 100-yr profile computed by detailed methods to obtain BFE

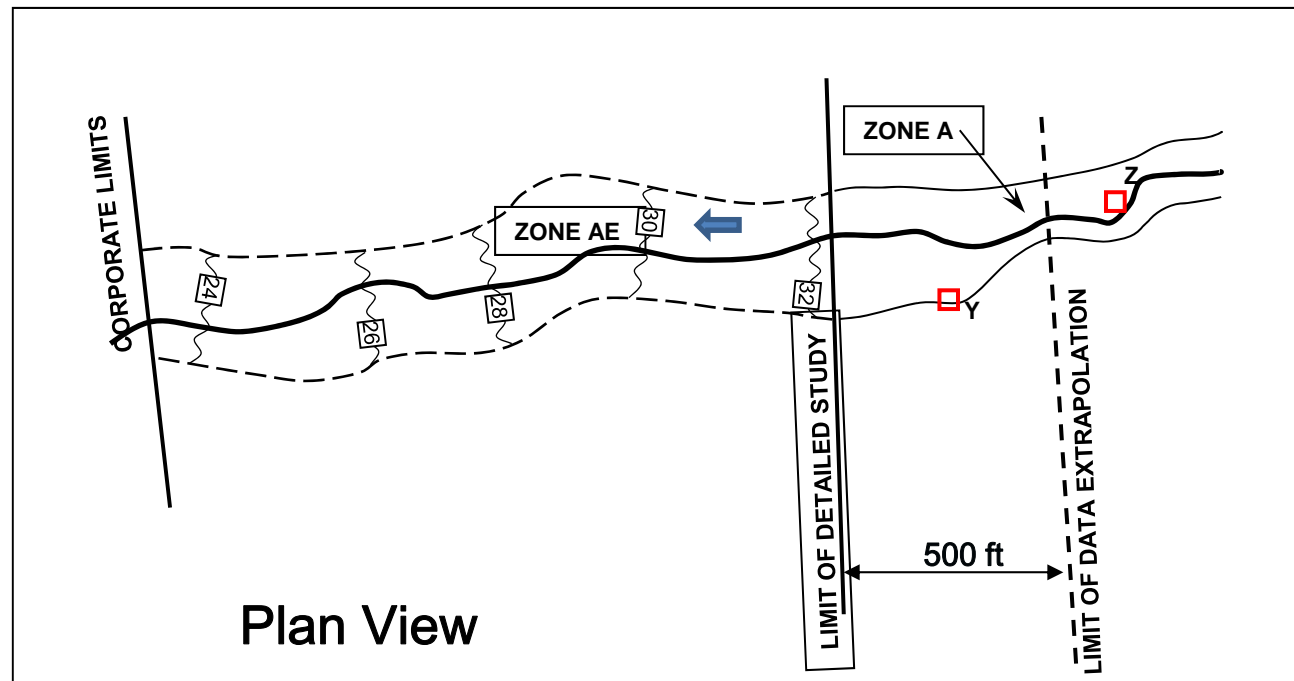
- Requires existing 100-yr profile computed by detailed methods
- Only used if site is within 500 ft (upstream) from limit of detailed study
- Channel width and slope similar to downstream reaches
- Free of backwater effects and slope breaks close to end of study



3 STEP

DATA EXTRAPOLATION METHOD

- Step 1: Determine location of site on flood profile

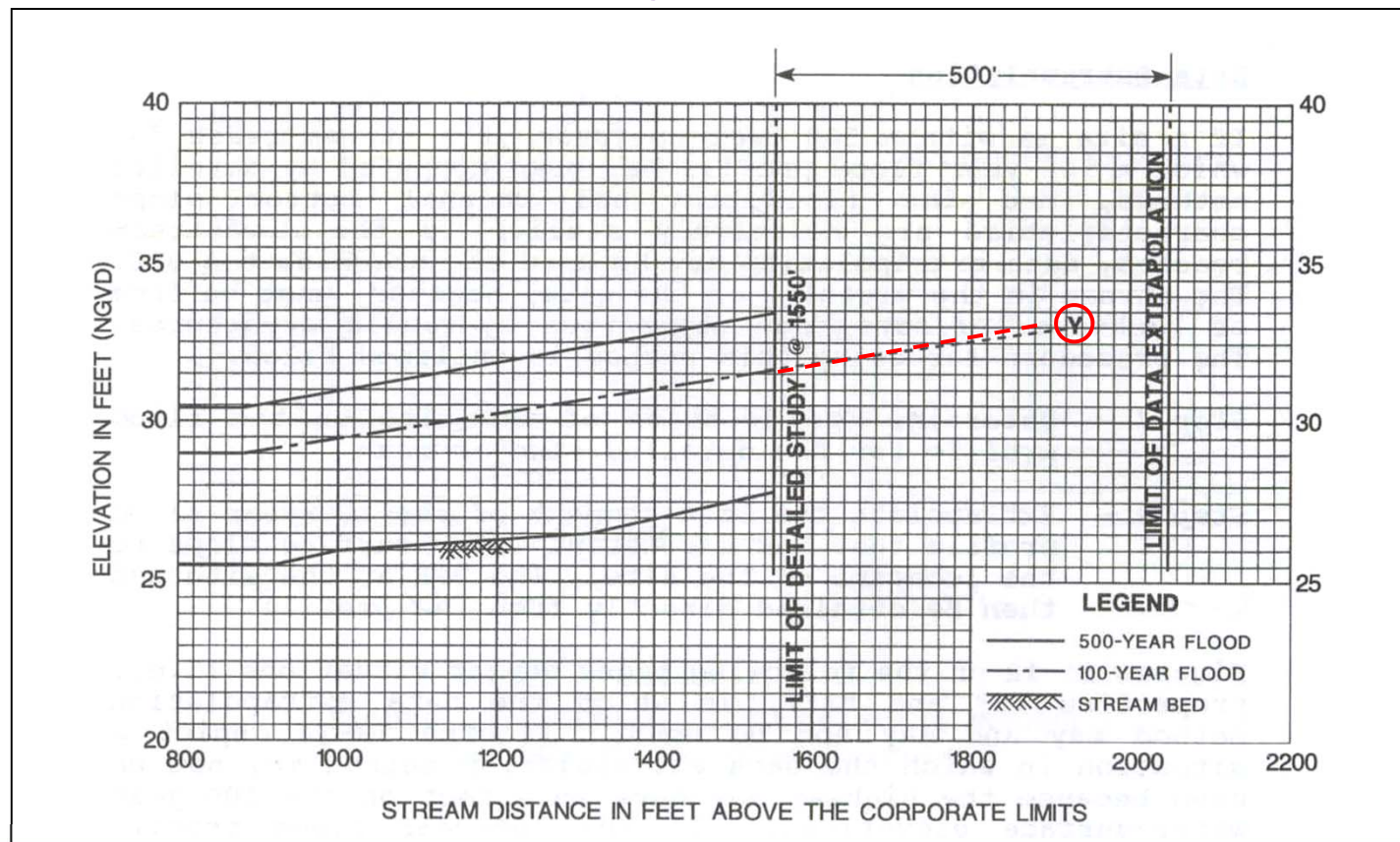


Property Y within 500 ft of extrapolation limit – Obtain BFE from Profile

Property Z beyond 500 ft of extrapolation limit – Cannot obtain BFE from Profile

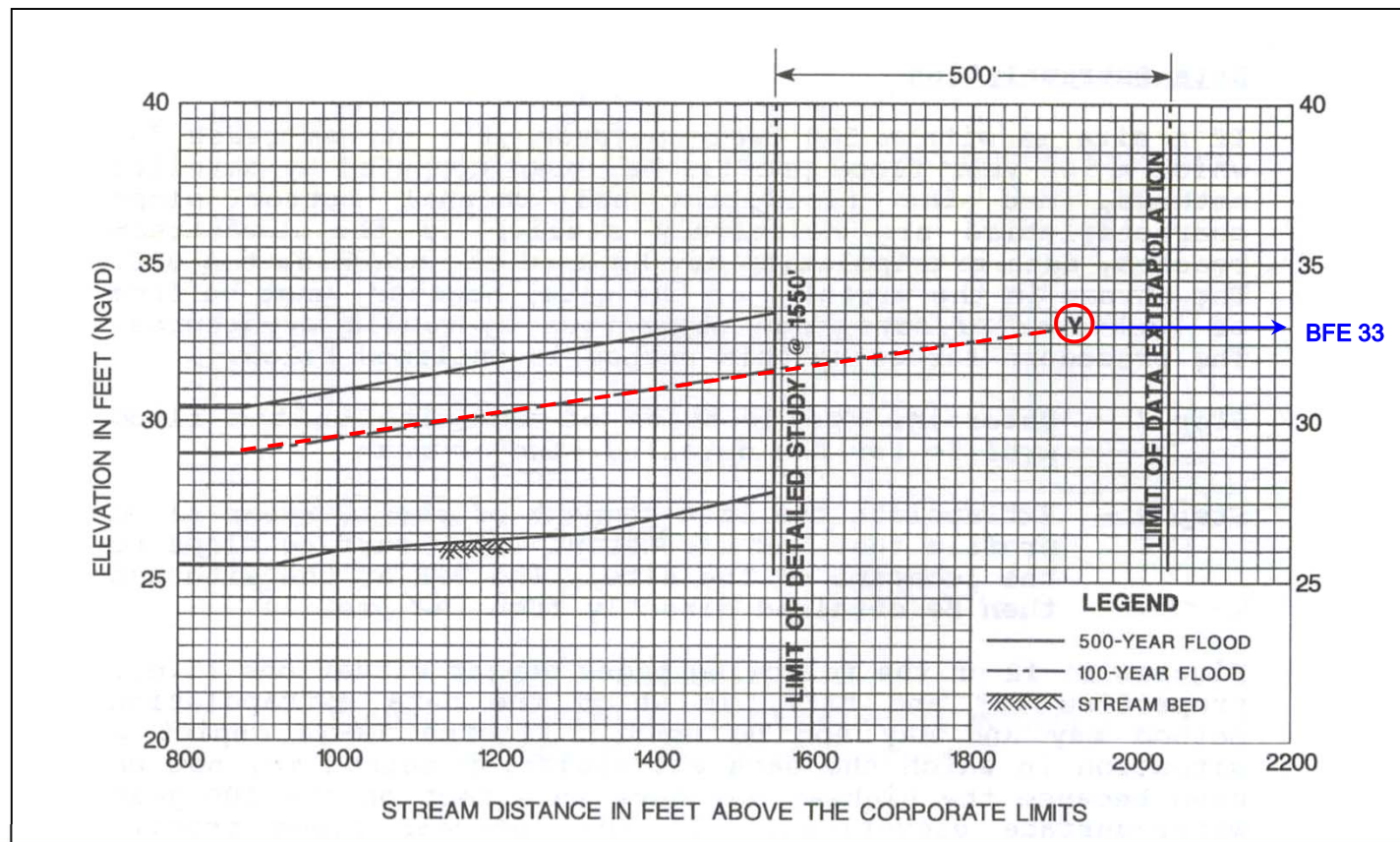
3 STEP DATA EXTRAPOLATION METHOD

- Step 2: extend 100-yr profile line to the site



3 STEP DATA EXTRAPOLATION METHOD

- Step 3: Obtain BFE from extended profile



BACKWATER EFFECTS

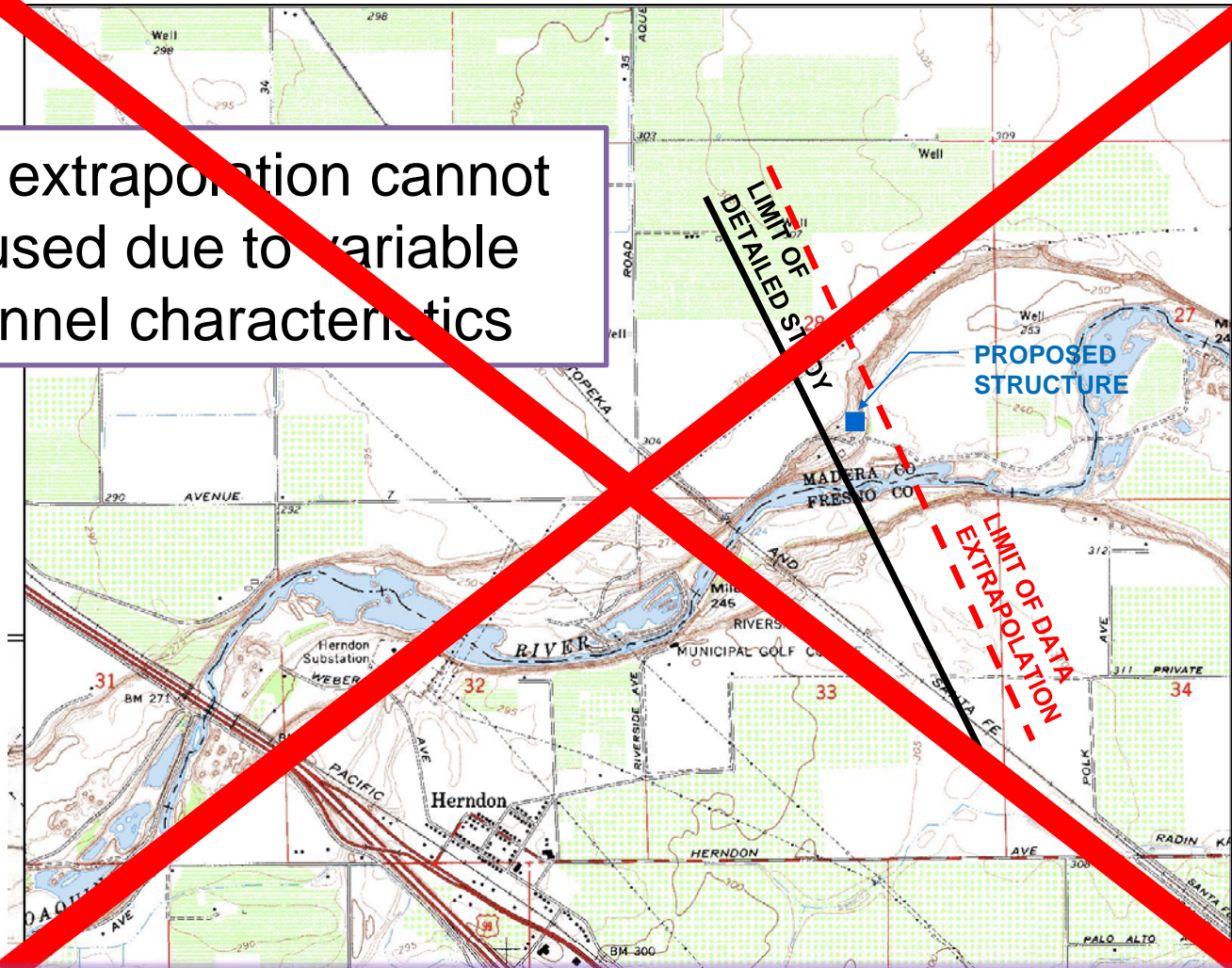
The map illustrates the Madera River and its surrounding infrastructure. Key features include:

- Waterways:** Madera Canal, Madera River, and Lost Lake Rd.
- Roads:** RM 114, RM 112, RM 111, North Fork Rd, E Mono, E Wagner, E Bug, N Friant Rd, E Granite Rd, E Beech Rd, E Walnut Rd, E Elm Rd, E Oak Rd, E Pine Rd, E Cedar Rd, E Spruce Rd, E Fir Rd, E Hemlock Rd, E Cypress Rd, E Juniper Rd, E Sycamore Rd, E Ash Rd, E Hickory Rd, E Maple Rd, E Birch Rd, E Willow Rd, E Cherry Rd, E Peach Rd, E Plum Rd, E Apple Rd, E Pear Rd, E Grape Rd, E Olive Rd, E Lemon Rd, E Lime Rd, E Orange Rd, E Tangerine Rd, E Citrus Rd, E Grapefruit Rd, E Pineapple Rd, E Mango Rd, E Papaya Rd, E Guava Rd, E Kiwi Rd, E Strawberry Rd, E Raspberry Rd, E Blueberry Rd, E Blackberry Rd, E Elderberry Rd, E Mulberry Rd, E Fig Rd, E Pomegranate Rd, E Dragonfruit Rd, E Passionfruit Rd, E Starfruit Rd, E Jackfruit Rd, E Rambutan Rd, E Durian Rd, E Lychee Rd, E Mango, E Papaya, E Guava, E Kiwi, E Strawberry, E Raspberry, E Blueberry, E Blackberry, E Elderberry, E Mulberry, E Fig, E Pomegranate, E Dragonfruit, E Passionfruit, E Starfruit, E Jackfruit, E Rambutan, E Durian, E Lychee.
- Study Zones:** ZONE AE (shaded blue), ZONE A (circled in blue).
- Infrastructure:** Proposed Structure (indicated by a red arrow and a 500 ft scale bar).
- Boundaries:** Madera Co. / Fresno Co. boundary, and a dashed line indicating the "LIMIT OF DATA EXTRAPOLATION".
- Warnings:** A large red 'X' is drawn across the map. A blue box contains the text: "Data extrapolation cannot be used due to backwater effects caused by bridge." A black line indicates the "LIMIT OF DETAILED STUDY".

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DATA EXTRAPOLATION CHANNEL CHARACTERISTICS

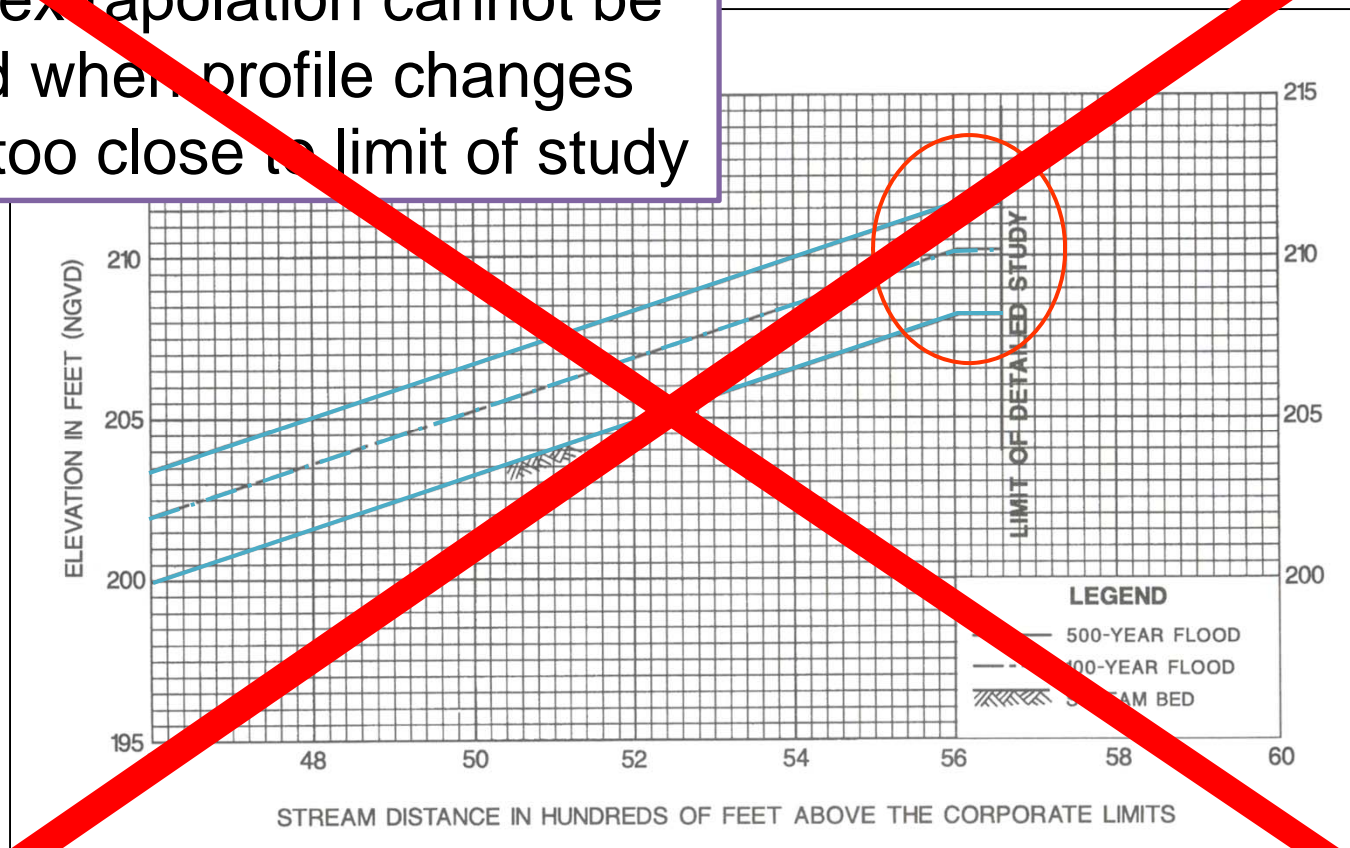
Data extrapolation cannot
be used due to variable
channel characteristics



DATA EXTRAPOLATION

PROFILE SLOPE BREAKS

Data extrapolation cannot be used when profile changes slope too close to limit of study



METHODS OF DEVELOPING BFES

Simplified Methods

❖ Contour Interpolation

CONTOUR INTERPOLATION

- Superimposing contour maps (topographic data) on top of FIRM to obtain BFE
- Used on riverine systems and level-ponding from lakes
- Assumed accuracy of $\frac{1}{2}$ contour interval of contour map used
- Smaller contour interval, higher accuracy
- Conservative estimate of BFE

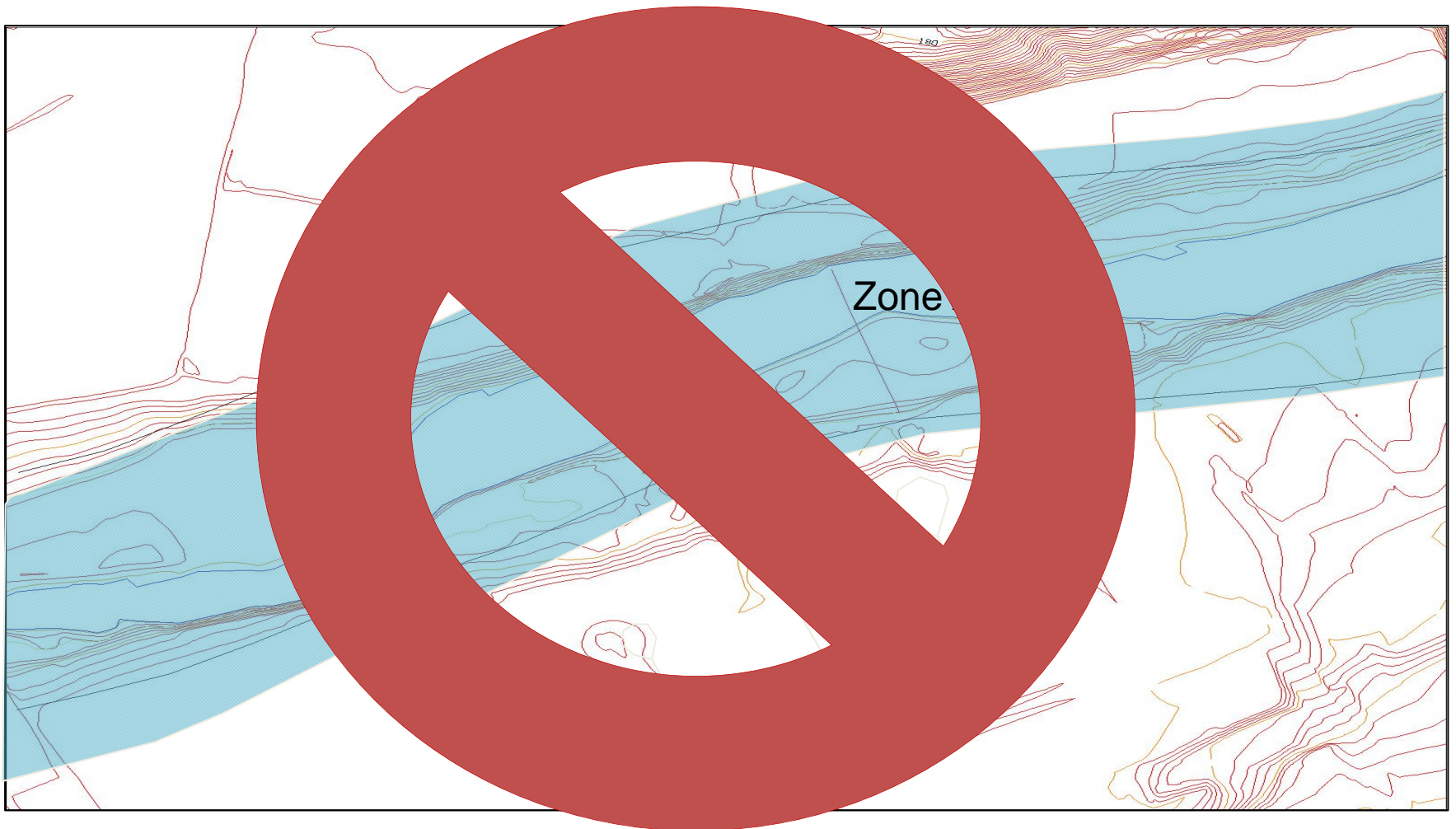
ACCEPTABILITY

- Floodplain conforms to the contour map

CONFORMING MAP



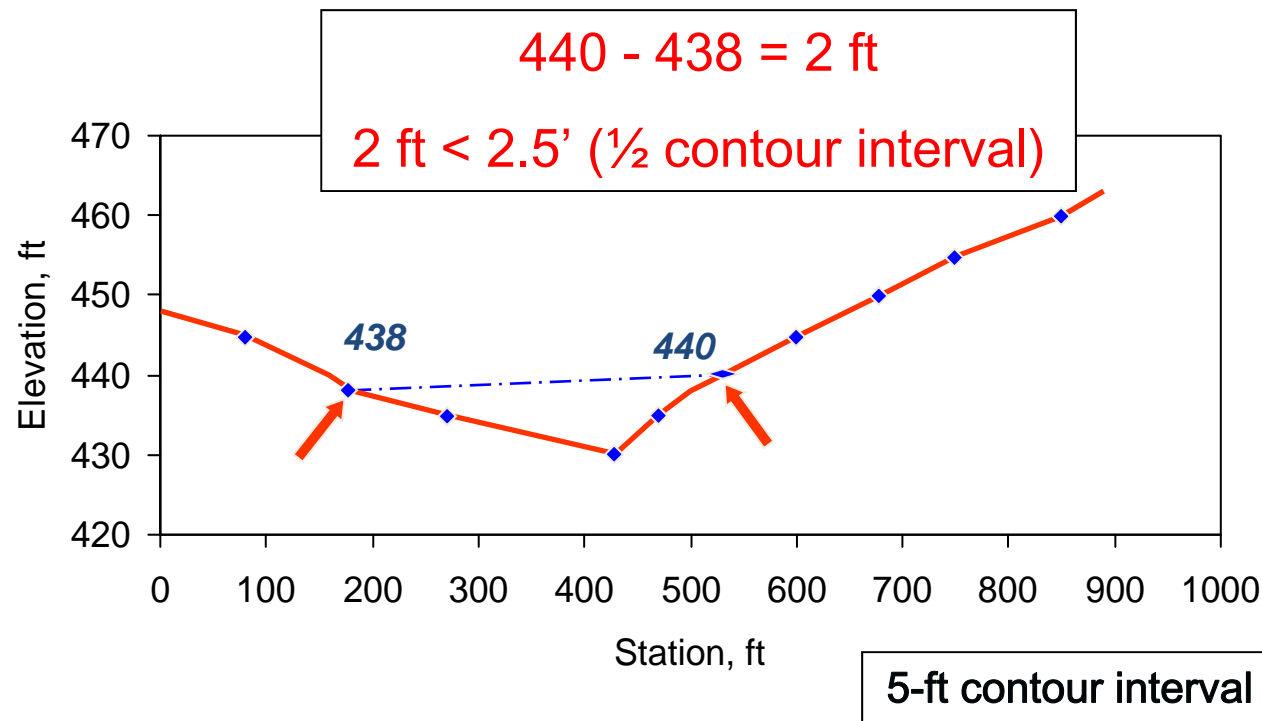
NON-CONFORMING MAPS



ACCEPTABILITY

- Riverine flooding – difference between the left and right bank elevations (along a cross-section) are within $\frac{1}{2}$ contour interval

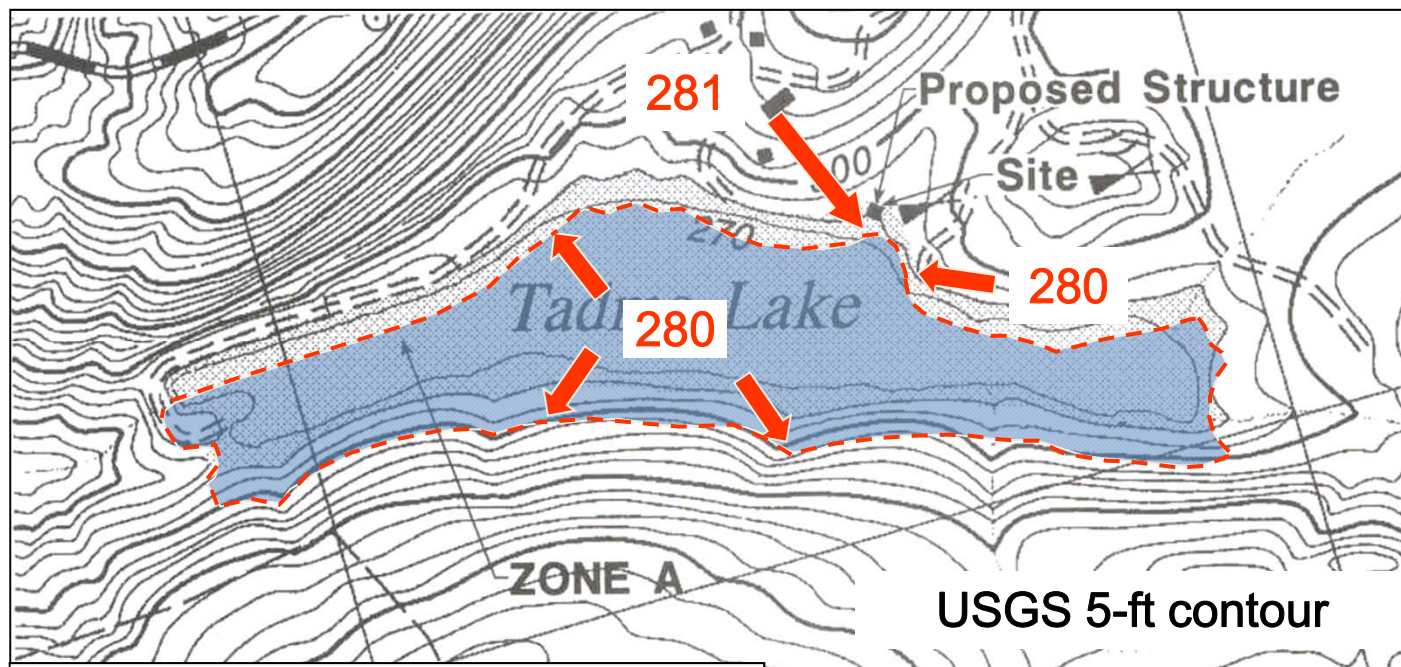
ACCEPTABILITY



ACCEPTABILITY

- Lake flooding – difference between the highest and lowest surface elevations, around the lake perimeter, are within $\frac{1}{2}$ contour interval

ACCEPTABILITY



$$281 - 280 = 1 \text{ ft}$$

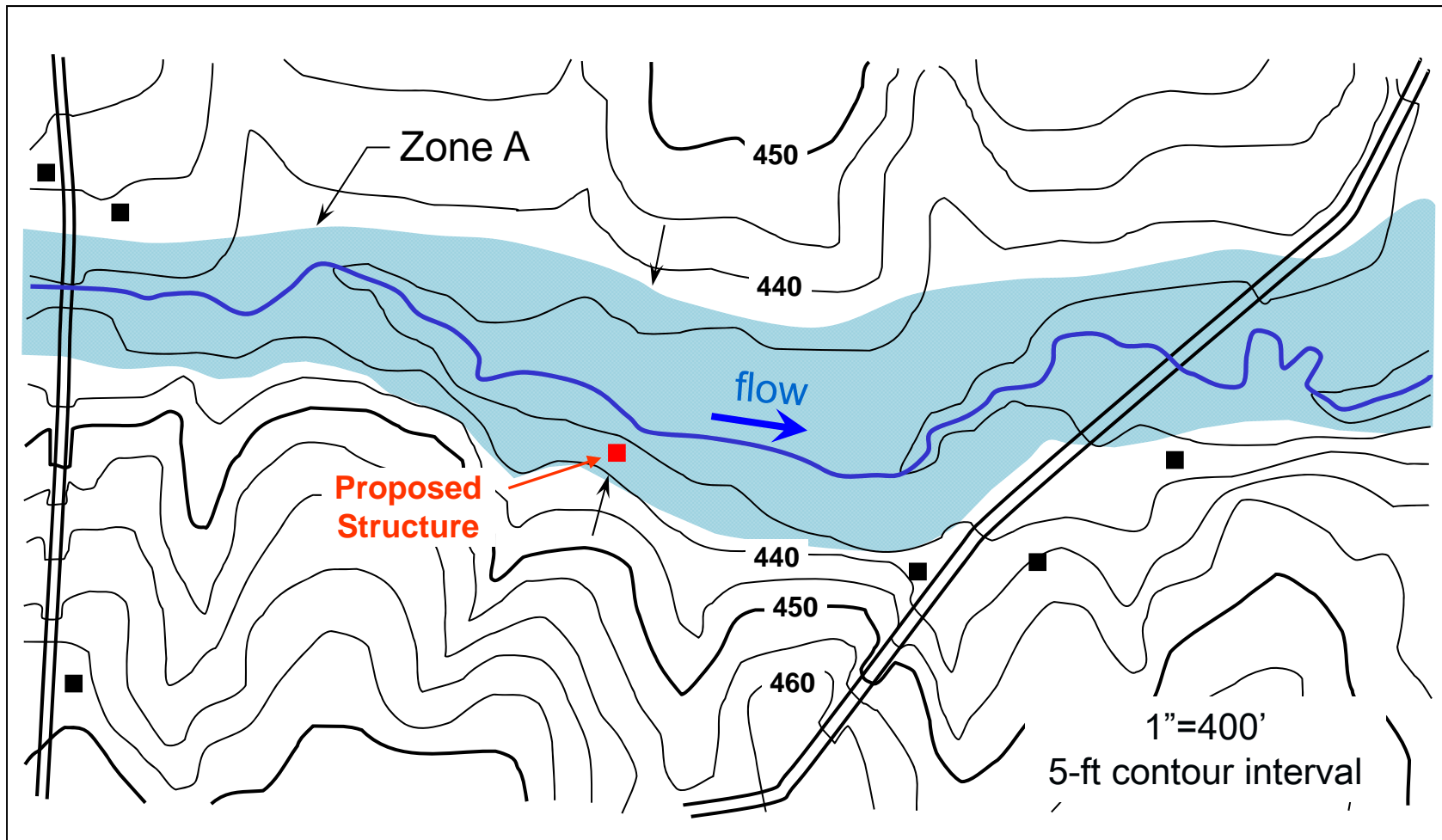
$$1 \text{ ft} < 2.5' \text{ (}\frac{1}{2} \text{ contour interval)}$$

EXAMPLE 1
CONTOUR INTERPOLATION
METHOD

5 STEP CONTOUR INTERPOLATION METHOD

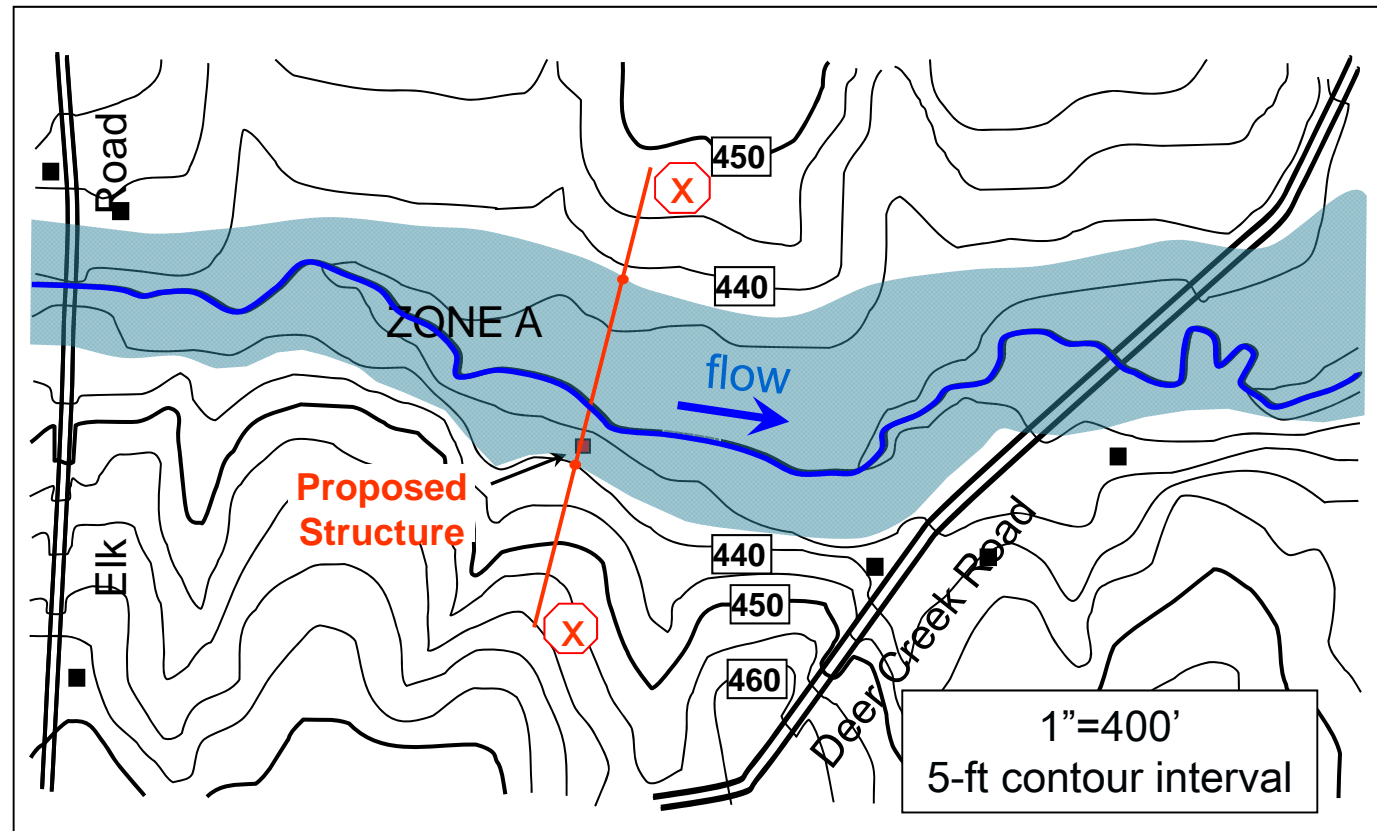
- Step 1: Obtain topographic map and FIRM
- Step 2: Superimpose one map over the other
- Step 3: Check map scales
- Step 4: Check acceptability
- Step 5: Determine BFE at location of interest

CONTOUR INTERPOLATION



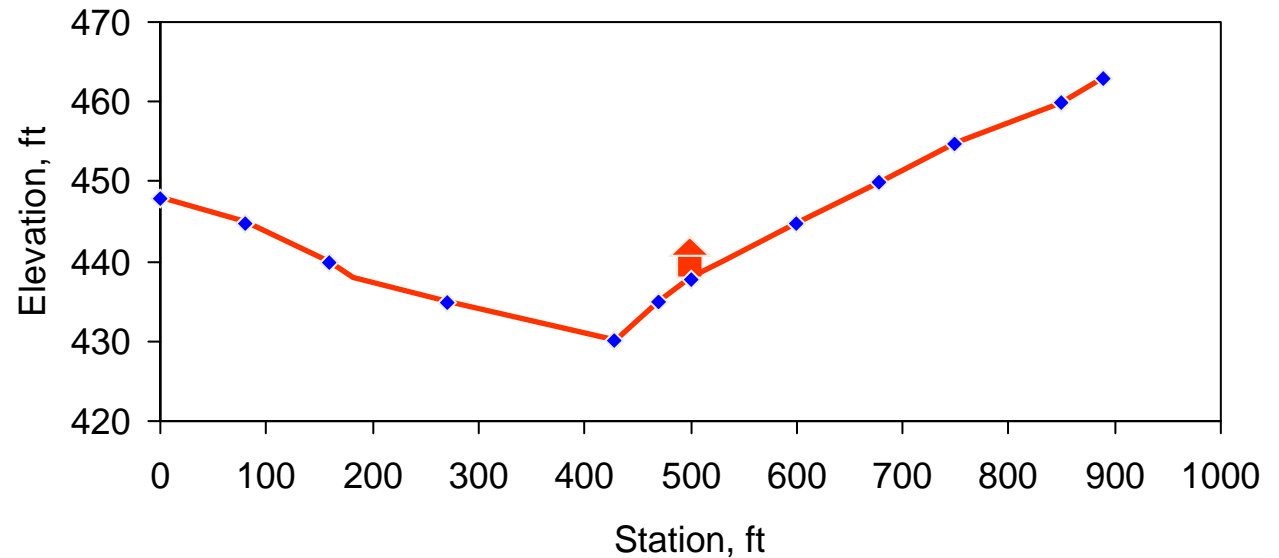
CONTOUR INTERPOLATION

- Obtain contour/topo map and appropriate FIRM
- Make scales equal
- Check acceptability
 - Draw x-section



CROSS-SECTION PLOT

Sta	Elevation
0	448
80	445
160	440
180	438
270	435
430	430
470	435
500	438
530	440
600	445
680	450
750	455
850	460
890	463



ACCEPTABILITY CHECK

1. Determine where Zone A crosses contour on both left and right banks, interpolate if necessary:

Left Elev: 438

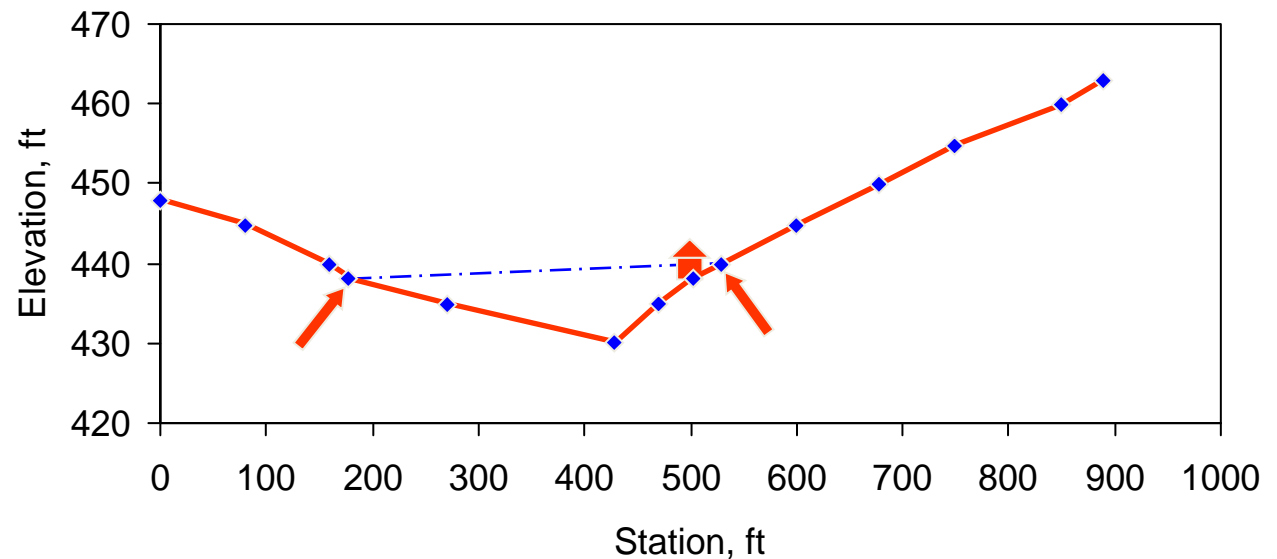
Right Elev: 440

2. If difference is less than $\frac{1}{2}$ of contour interval, topo is acceptable

$$(440 - 438 = 2 < 2.5)$$

Okay!

3. If difference is not less than $\frac{1}{2}$ contour interval, this method cannot be used



BFE COMPUTATION

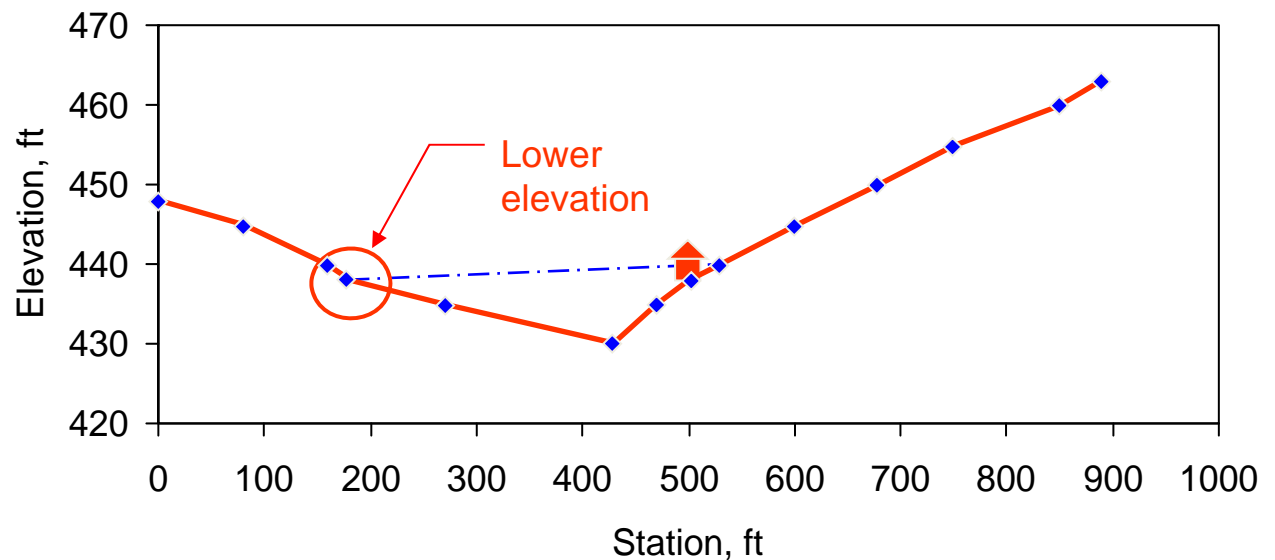
1. Take lower of the two elevations:

438

2. Add $\frac{1}{2}$ of contour elevation

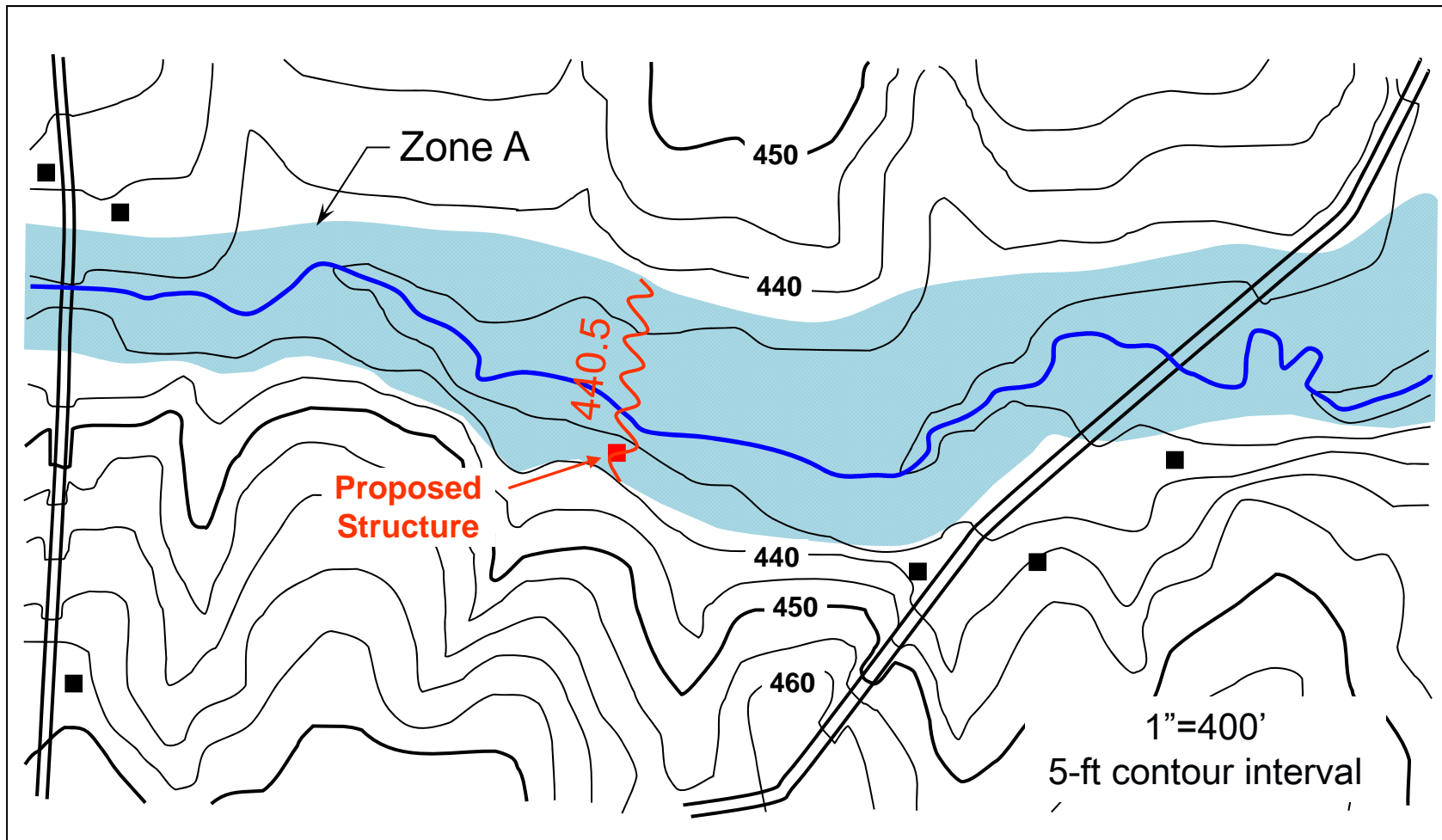
$$\underline{438} + \underline{2.5} = \underline{440.5}$$

3. BFE = 440.5 ft



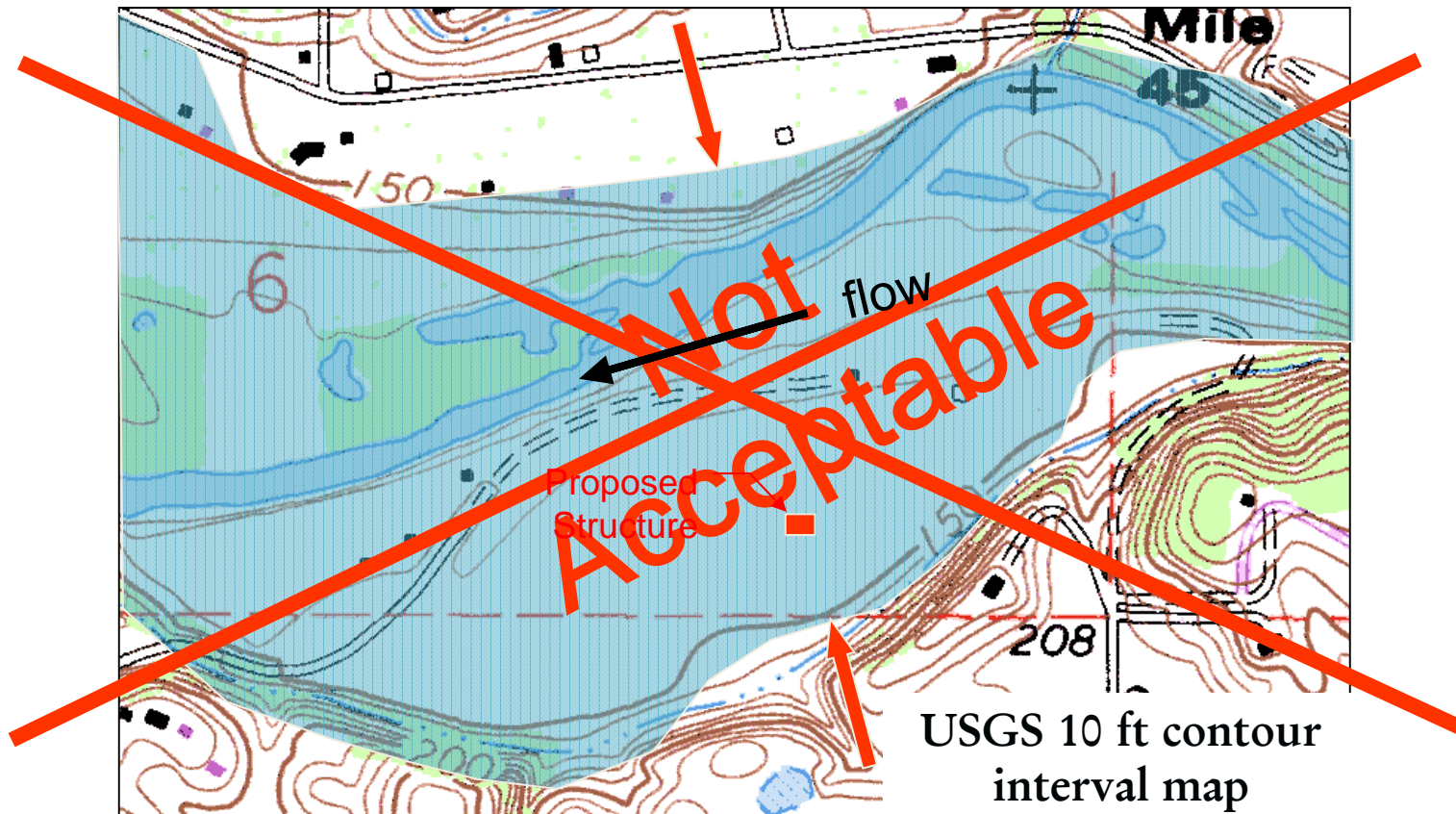
Note: A topographic map with large contour intervals may result in excessively conservative BFE estimates

CONTOUR INTERPOLATION



EXAMPLE 2
CONTOUR INTERPOLATION
METHOD

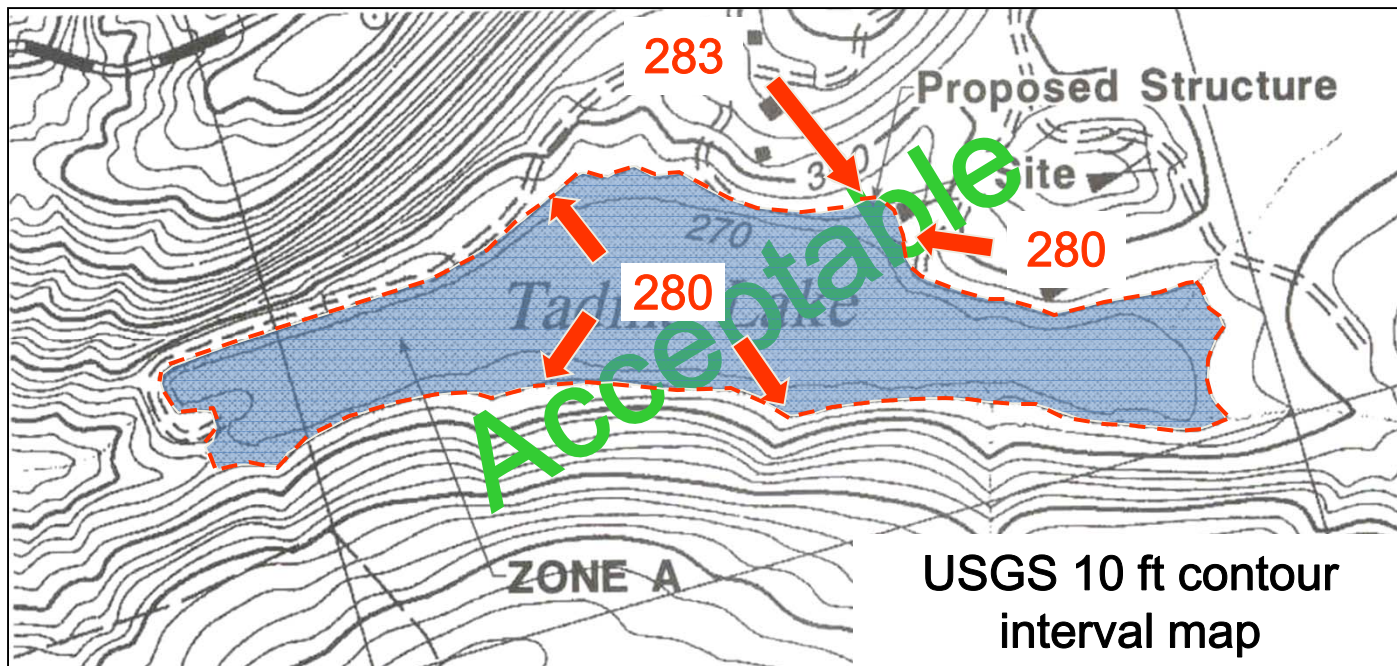
RIVERINE FLOODING EXAMPLE



1. Zone A Elevations on:
Left bank 154
Right bank 148
2. Difference between elevations = 6'
3. Less than $\frac{1}{2}$ contour interval (5 ft >) NO
4. BFE = Lo elev + $\frac{1}{2}$ contour interval
_____ + _____ = _____ ft

EXAMPLE 2
CONTOUR INTERPOLATION
METHOD

LACUSTRINE



1. WS Elevations along perimeter

Hi 283 Lo 280

2. Difference between ws elevations = 3'

3. Less than $\frac{1}{2}$ contour interval (5 ft) YES

4. BFE = Lo elev + $\frac{1}{2}$ contour interval

$$\underline{280} + \underline{5} = \underline{285} \text{ ft}$$

Questions?



SIMPLIFIED METHOD SUMMARY

- Appropriate for floodplain management purposes
- Appropriate only for developments less than 5 acres or 50 lots in size
- Not suitable to apply for Letters of Map Change

Questions?



FEMA'S QUICK-2 LIMITED DETAILED METHOD

DOWNLOADS



- FEMA P-265 (1995)
<https://www.fema.gov/media-library/assets/documents/1911>
- FEMA's Quick-2 Software v.2.0
<http://www.fema.gov/quick-2-version-20#1>
- USGS National Streamflow Statistics Program v.6
<http://water.usgs.gov/software/NSS/>