First Order Approximation (FOA)

Case Studies and Lessons Learned

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What is First Order Approximation (FOA) ?

- **Mapping on a massive scale**
  - Minimum size is usually HUC-8 (or large county)
- **Mapping in a highly automated manner**
  - Intent is to automate as much as possible
- **Recognizing the limitations of input data**
  - Quality in defines quality out
- **Planning far ahead for future uses of the data**
  - Measure twice, cut once
FOA Guidance

• **SID 29:** During Discovery, data must be identified that illustrates potential changes in flood elevation and mapping that may result from the proposed project scope. If available data does not clearly illustrate the likely changes, an analysis is required that estimates the likely changes. This data and any associated analyses must be shared and results must be discussed with stakeholders.
FOA Uses

• NVUE validation for Zone A
  • Use FOA to compare to existing Zone A data and determine if the effective data needs to be updated

• Discussion data for Discovery process
  • Use FOA to create maps of the approximate extent of floodplains that may result from remodeling

• Base for future creation of model backed Zone A
  • Leverage FOA created in discovery or CNMS processes to create FIRM Zone A

• Base to help with future action analysis
  • Use the modeling behind FOA to perform what-if and benefit-cost analysis for actions (example: increase capacity of culvert)
The FOA Process

• General Requirements for FOA
  • Be re-usable for later stages of other Risk MAP processes
  • Offer meaningful data on likely changes to floodplain delineations as a result of re-mapping
  • Be intuitive to local officials and stakeholders
  • Be available in all areas with effective studies and all areas that drain over 1 square mile and may be studied
  • Include as many return periods as feasible, to aid in leveraging the data later into mapped Zone A as needed
Generalized FOA Process

Input: NHD Plus Streams, topography, gridded hydrology

Automated Cross Section Layout

Automated Cross Section Extraction

Automated read of hydrology file

Initial QC

Simple post processing

Automated floodplain delineation

Generation of WSELS

Create depth grids, if any

Final QC
Process and Methodology - Hydrology

- Most common methods
  - Regression Equations
  - Gage Analysis
  - Stream Stats
- No requirements to adjust for regulated flow
- Typically evaluate either urban or rural equations, not both
Process and Methodology - Hydraulics

- Terrain: Use best available, but must meet topographic standards if used for NVUE analysis
- Automated cross section placement with minimal manual adjustments is acceptable
- No bridges and culverts is OK
- No requirement to correct crossing profiles or adverse slopes
- No requirement to model ineffective flow areas
Process and Methodology - Mapping

• Manual Clean Up and Smoothing
  • In general raw output of floodplain mapping is acceptable.
  • Remove disconnected areas
  • Check for serious backwater issues

• Water Surface Elevation and Depth Grids
  • May be produced and used for risk communication
Case Studies and Lessons Learned
Lessons Learned

• Bigger is better
  • Well-known economies of scale for watersheds and larger
    • *Ideal minimum is USGS regression equation area*
      • All hydrology variables the same for entire area, minimal transitions
  • Lesser known economies for really big areas
    • *Ability to create a factory production line*
      • Terrain, Hydrology, Hydraulics
Lessons Learned

• **Small challenges at really big scales**
  • The more different topographic input data sets, the more time spent processing topo
  • Regression equations do not apply to some very large (or small) drainage areas
    • *Need to use gage or other methods to get flows*
Lessons Learned

• **Technology Is Important**
  • Input and output data sets are huge
    • *Even moving the data on a local network is slow*
  • Solid state drives and fast read-write provide noticeable improvements
  • Cloud computing is not a game changer
    • *Data transmission time frames*
Lessons Learned

• What to Map and Model
  • Even though 1%, 1%+, and 1%- are not strictly required, they are nice to have
    • Enables many other comparisons
  • Possible to do FOA-effective comparisons without mapping
    • Using FBS-based methods in FOA guidance
Lessons Learned

• Miscellaneous
  • Helpful to model all return periods if going on to Zone A
    • *Once setup for hydrology, extra effort is small to add additional return periods*
    • *Compute WSEL for other return periods, but may not need to map, or can map later as desired*
    • *Multiple return periods can also be used for some automated QA-QC techniques (e.g. 100-yr must be bigger than 50-yr, etc)*
Communicating Results (NVUE validation)

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<th>CNMS Reach ID</th>
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<th>1%</th>
<th>1%+</th>
<th>1%-</th>
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Thank you

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