July 1, 2024

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SUBJECT: Invoice for Project Management (PM); FY22 CTP Project Management (PM)
Task B: Building Footprints for the WV Flood Tool
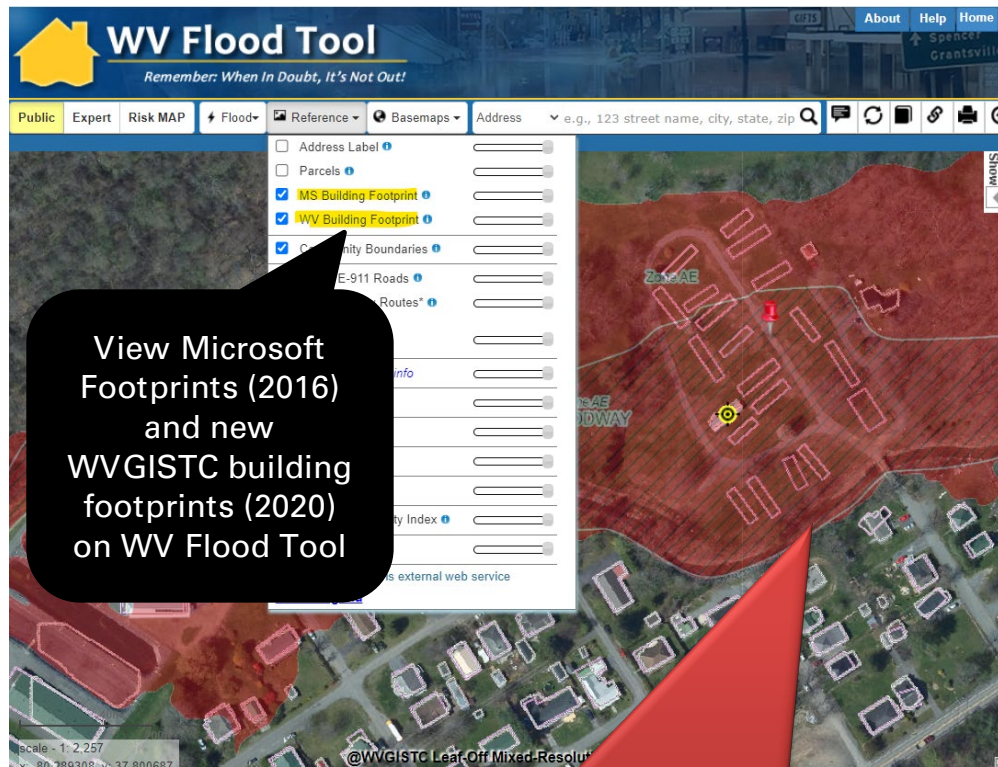Task C: Enhance Transportation Food Inundation Models

Dear Kevin,

In accordance with the FY22 CTP Service Agreement signed October 2021, this invoice in the amount of **$25,000.00** in creating 2.1 million building footprints (Task B) and enhancing the road and railroad flood inundation models (Task C) for the WV Flood Tool (www.mapwv.gov/Flood). See the scope of work as outlined in the amended 2022-23 (FY22) CTP Project Management (PM) plan dated July 2022, and authorized under a WV-48 service agreement between the WVEMD and WV GIS Technical Center, West Virginia University. Refer to the WVEMD Statement of Work documents for more details about the specific tasks.

Invoice #	Services Rendered	Amount
07012024 **Time Period** 10/1/2022 to 3/1/2023 ==Task B==	**TASK B: [Generate new statewide Building Footprints Reference Layer].** This activity ties in with the WV Building Level Risk Assessment (BLRA) with FEMA's national inventory so standardized, consistent, and accessible building level information can be exchanged. ACTIVITIES SUMMARY: • A new statewide building footprint layer from the best available leaf-off imagery acquired between 2018 and 2023 was generated and published to the Reference Layers of the WV Flood Tool. See Technical Report dated March 2024. • Download Building Footprint Layer from WV Clearinghouse: https://wvgis.wvu.edu/data/dataset.php?ID=509 • View project report that details the methodology and results compared to 0Microsoft Building Footprints and FEMA's USA Structures. PROJECT HIGHLIGHTS: • Generated 2.1 million building footprints from best available leaf-off imagery for all 55 counties using Esri's software deep-learning package. • The WVGISTC generated building footprint layer had a statewide match rate of 85% compared to the Microsoft and FEMA USA Structure building footprint datasets that had match rates of 82% and 70%, respectively.	$15,000

- The WVGISTCT building footprints using the Esri algorithm extracted row houses and residential structures better but was not as accurate for large commercial structures. The imagery resolution and imagery quality (e.g., shadows, color balance) are also factors in the building footprint accuracy.
- Building footprints reference layer published to the WV Flood Tool
- Building footprints have multiple uses including:
  - Building counts of structures for Risk MAP studies
  - Depicting destroyed and news buildings before and post disaster.
  - 3D and 2D flood visualizations.
  - Thematic maps specialized to visualize a particular subject or theme.
 - Training data input for land cover classification

Figure PM-B-1. Comparison of older Microsoft (2016) and newer WVGISTC building footprints (2020) on the WV Flood Tool for White Sulphur Springs, WV.

https://www.mapwv.gov/flood/map/?wkid=102100&x=-8937767&y=4551460&l=11&v=0

View Microsoft Footprints (2016) and new WVGISTC building footprints (2020) on WV Flood Tool

Microsoft Footprints (2016) in which nearly all the structures of the trailer court were substantially damaged and removed after the major June 2016 flood.

Figure PM-B-2. Both older Microsoft and newer WVU-Generated Building Footprints are now published on the WV Flood Tool. Below is an example of buildings in an unmapped flood zone along Jordan Creek, Clendenin, WV, that were destroyed in the 2016 flood (depicted by older Microsoft Building Footprints) and then rebuilt post flood (WVU footprints). A flood fatality also occurred at this location.
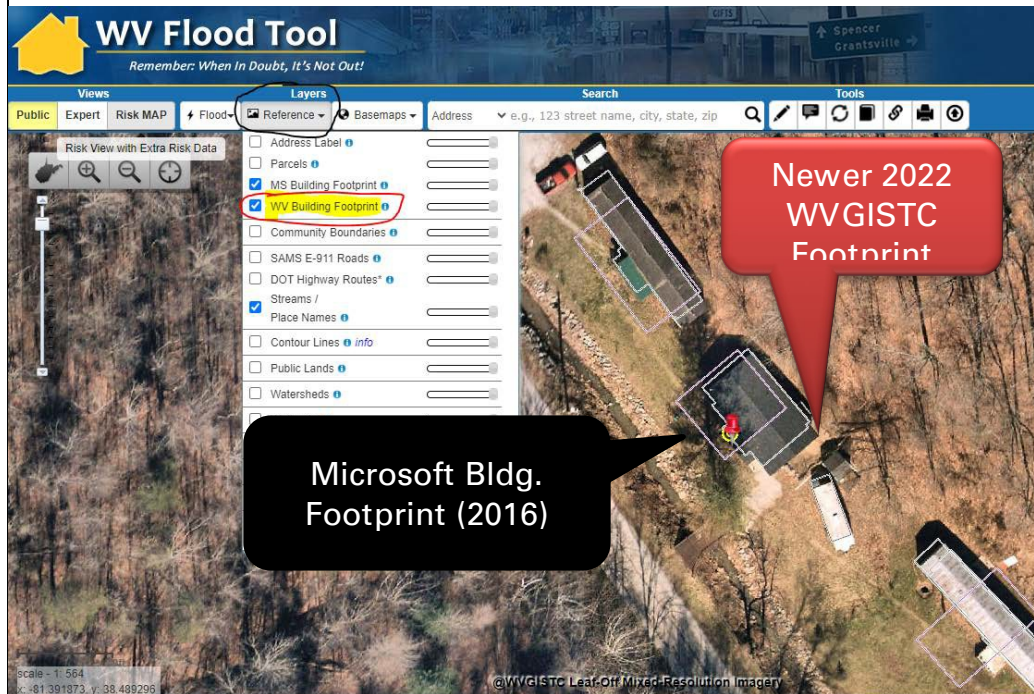

<< see next page >>

Task C	**TASK C: [ENHANCE TRANSPORTATION FLOOD INUNDATION MODELS FOR ROADS, RAILROADS, AND BRIDGES TO WV FLOOD TOOL]**	$10,000

TASK C: [ENHANCE TRANSPORTATION FLOOD INUNDATION MODELS FOR ROADS, RAILROADS, AND BRIDGES TO WV FLOOD TOOL]

- New transportation inundation models were updated from new 1%-annual chance depth grids for the entire state and published on the WV Flood Tool.
  - Update existing road and railroad inundation models from new flood map restudies that produce new base flood elevations. Where no model-backed depth grids exist, substitute with the less accurate Hazus depth grid.
  - TIGERS Roads instead of the Statewide E-911 Roads layers was used for the models since it determined to be collected more uniformly.
  - Flood Study Profiles are used to validate bridges inundated.
- Updated transportation risk indicator at various geographic scales for statewide risk assessment.
  - 1% Annual Flood Event Inundation
    - Roads Density| Roads Depth Classes
    - Railroads
    - Bridges
  - Inundated Roads Ratio
    - PDC Region | County | Community | Unincorp. | Incorporated

Figure PM-C-1. Updated the statewide transportation inundation modes (roads, railroads, and bridges) for a 1% annual-chance event. The majority of the roads – including major roads – for the community of Clendenin in West Virginia will be flooded during a major storm.
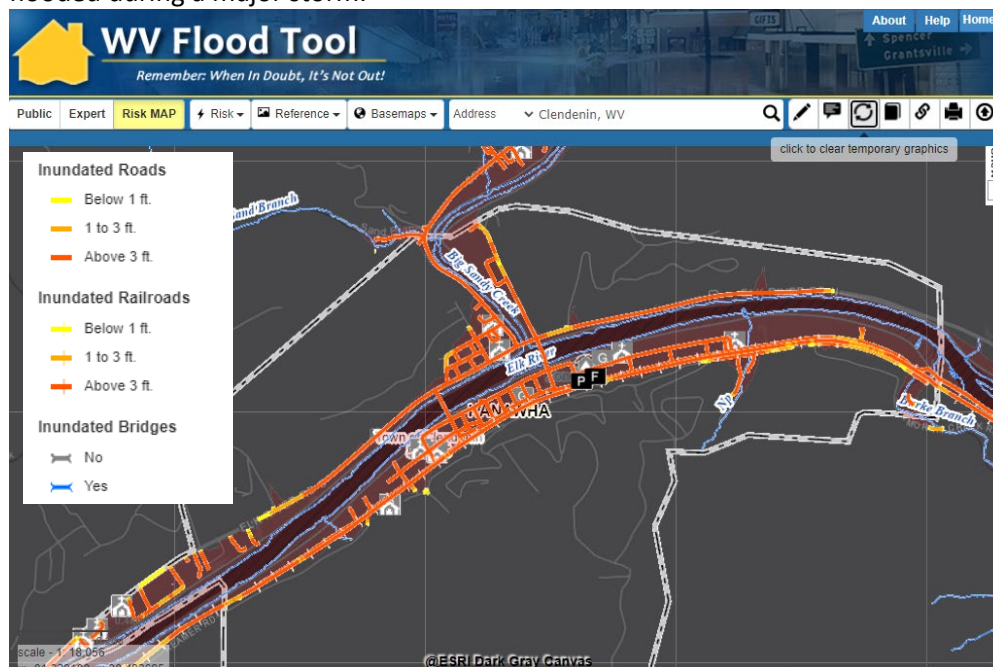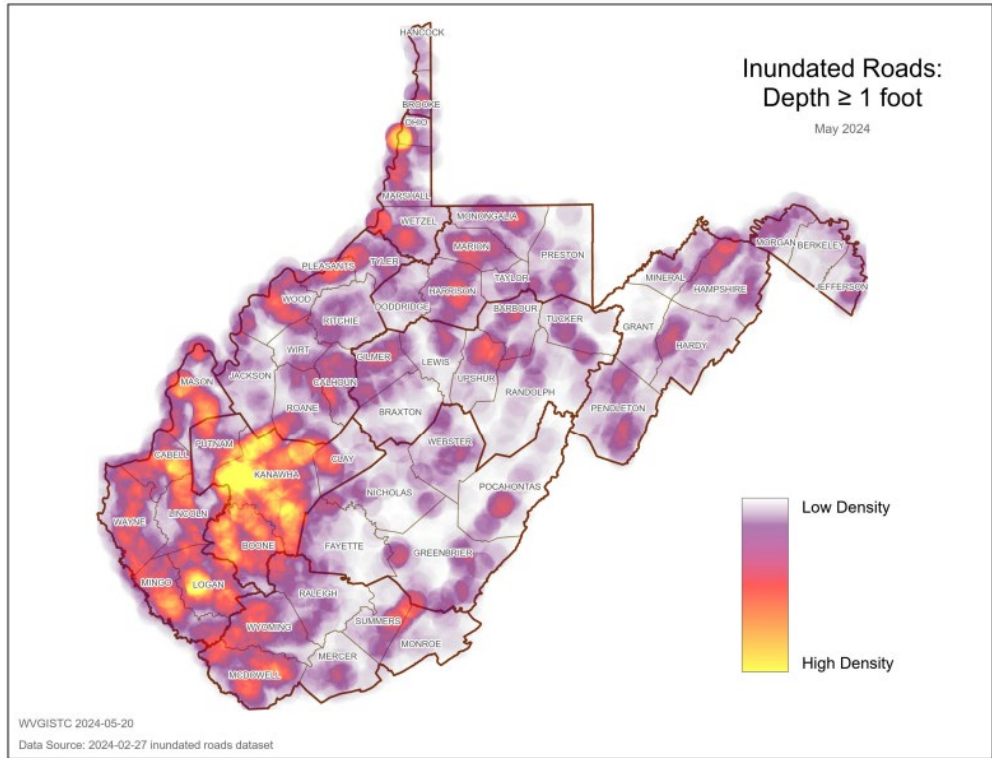
Figure PM-C-2. Flood water depth are important for communicating risk to communities and property owners.

Why Water Depth Matters

| ~1 Foot | ~3 Feet | ~6 Feet | ~9 Feet |
| Response focused on those who need additional assistance | Near the limit to use High Profile Vehicles to perform high water rescues | Boats and helicopters now required to perform high water rescues | 1st Floors completely inundated |

"How many helicopters, boats, and high profile vehicles and where to send them"
– Texas State Operations Center

National Weather Service's West Gulf River Forecast Center in Fort Worth Texas

Figure PM-C-3. Inundated Roads Density graphic for 1% annual chance flood event.

| Grand Total | | *Total invoice amount:* | **$25,000** |

Please use the following information for paying electronically:

Payment Transfer Information:

OASIS: 4187 111 1463 1463 6909 H514

WVU Acct: 11. 110530213. 11303179. 4108501. 999. 99999999

If you have any questions, or need clarifications, please do not hesitate to call.

Sincerely,

Kurt Donaldson
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CC: WVU Revenue Services - RevenueServices@mail.wvu.edu