APPENDIX A
FREP DISTRIBUTION

This FREP has been distributed to:

1. Fire Chief
2. Incident Commander
3. EMA Director
4. EMA Deputy Director
5. Floodplain Manager
6. Emergency Operations Director (E911)
7. Public Safety PIO
8. Mayor
9. County Commissioners Office
10. Columbus Township Fire Chief

The Flood Impact (4) and Flood-Safe Routes (1) maps have been provided to:

1. Columbus Public Works Department
2. BSCS Transportation Department
3. Red Cross

APPENDIX B
INCIDENT AND EMERGENCY EVENT LOG

For tracking purposes during and record keeping/reimbursement following a flood event, all information, observations, and actions as well as the time that the action or event occurred must be recorded. The Incident and Emergency Event Log form provided in this Appendix should be used by everybody involved in the flood fight.

In addition, or as an alternative, FEMA's Incident Command System (ICS) forms that are available at https://training.fema.gov/emiweb/is/icsresource/icsforms.htm may also be used, as appropriate.

Flood Response Plan
INCIDENT AND EMERGENCY EVENT LOG

YOU ARE *(circle one)***:**

FREP Coordinator / Incident Commander / EMA Deputy Director / Floodplain Manager / Emergency Operations Director E911 / Public Safety PIO / Other _____

DETECTION:

When did you detect/get notified of the event? _____

How did you detect/get notified of the event? _____

LEVEL DETERMINATION:

What initial level has the FREP Coordinator assigned to the event? _____

ACTIONS AND EVENT PROGRESSION

Date	Time	Action/Event Progression	Action Taken By

ACTIONS AND EVENT PROGRESSION (continued)

Date	Time	Action/Event Progression	Action Taken By

APPENDIX C
FLOOD DETECTION & FORECAST RESOURCES

SUMMARY OF FLOOD FORECAST RESOURCES

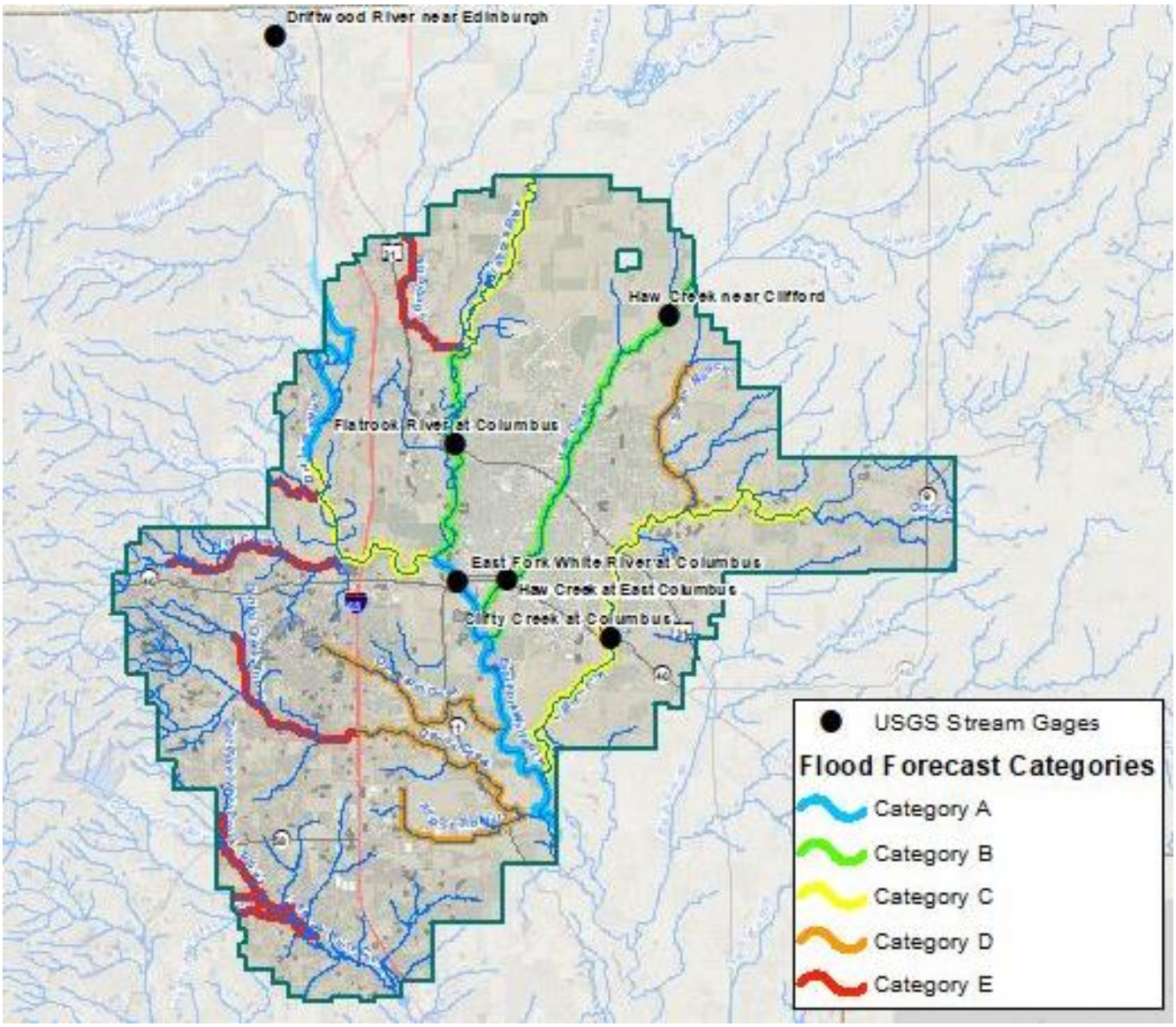
The following table and map summarize the flood forecast resources available to the City of Columbus and included in this appendix of the FREP.

Stream	USGS gage is NWS:			USGS inundation map library	CBBEL depth maps tied to USGS stream gage stages	CBBEL depth maps	USGS gage measuring real time stages	Precipitation forecast for the watershed	Flash flood guidance
	Forecast point (DLY)	Forecast during high water (FLD)	Observed stages only; no forecast (OBS)						
Category A – USGS Gage and NWS Forecast Point Available									
East Fork White River	√			√	√		√	√	√
Driftwood River, North	√			√			√	√	√
Category B – USGS Inundation Map used with Real Time USGS Stream Gage is Best Available Information									
Flatrock River, South		√		√	√		√	√	√
Haw Creek		√[1]	√	√	√		√	√	√
Category C – CBBEL Depth Map used with Real Time USGS Stream Gage is Best Available Information									
Clifty Creek, downstream Sloan Branch			√		√		√	√	√
Clifty Creek, upstream Sloan Branch					*		√	√	√
Driftwood River, South	√				√		√	√	√
Driftwood River, Middle	√				*		√	√	√
Flatrock River, North					*		√	√	√
Category D – CBBEL Depth Map is Best Available Information (No stream gage available)									
Airport Tributary						√		√	√
Denios Creek, downstream I-65						√		√	√
Opossum Creek						√		√	√
Sloan Branch						√		√	√
Category E - No Depth Mapping or Stream Gage Available									
Big Slough								√	√
Catherine Creek								√	√
Denios Creek, upstream I-65								√	√
Denios Creek Trib.								√	√
East Fork White Creek								√	√
East Fork White Creek								√	√

Trib. 1									
East Fork White Creek Trib. 2								√	√
North Ogleville Trib.								√	√
Wolf Creek								√	√

** development of depth maps for these reaches was out of the project scope currently but data does exist for development in the future*

[1] forecast available by calling NWS



C-1 USGS STREAM GAGES & FLOOD STAGES

MAIN STEM WATERWAYS & TRIBUTARIES	USGS GAGE NO.	TYPE[1]	USGS GAGE NAME	NWS AHPS FLOOD LEVEL (ft)[2]			
				Action Flood Stage	Minor Flood Stage	Mod. Flood Stage	Major Flood Stage
East Fork White River *(applies to tributaries east of SR 11 and Driftwood River east of I-65)*	3364000	DLY	East Fork White River at Columbus	4.5	9	14	16
Airport Tributary							
Denios Creek							
Denios Creek Tributary							
Opossum Creek							
East Fork White Creek							
East Fork White Creek Tributary							
North Ogleville Tributary							
Driftwood River *(west of I-65)*	3363000	DLY	Driftwood River near Edinburgh	9	11	14	17
Catherine Creek							
Wolf Creek							
Flatrock River	3363900	FLD	Flatrock River at Columbus	9	11	15	19
Big Slough							
Haw Creek	3364042	OBS	Haw Creek in Hope, IN *(for forecast)*	7.5	9	12	15
	3364200	OBS *FLD*[3]	Haw Creek near Clifford[4]	9	12	14	15.5
	3364340	OBS	Haw Creek in East Columbus	9	12.5	15.5	17
Clifty Creek	3364500	OBS	Clifty Creek at Hartsville *(for forecast)*	6	9	13	17
	3364650	OBS	Clifty Creek near Columbus[5]	14	17	20	23
Sloan Branch							

[1] DLY=Routine (Daily) Forecasts available FLD=Flood Forecast issued as needed during times of high water, but not routinely available; OBS=Observed stages only, forecast not available;

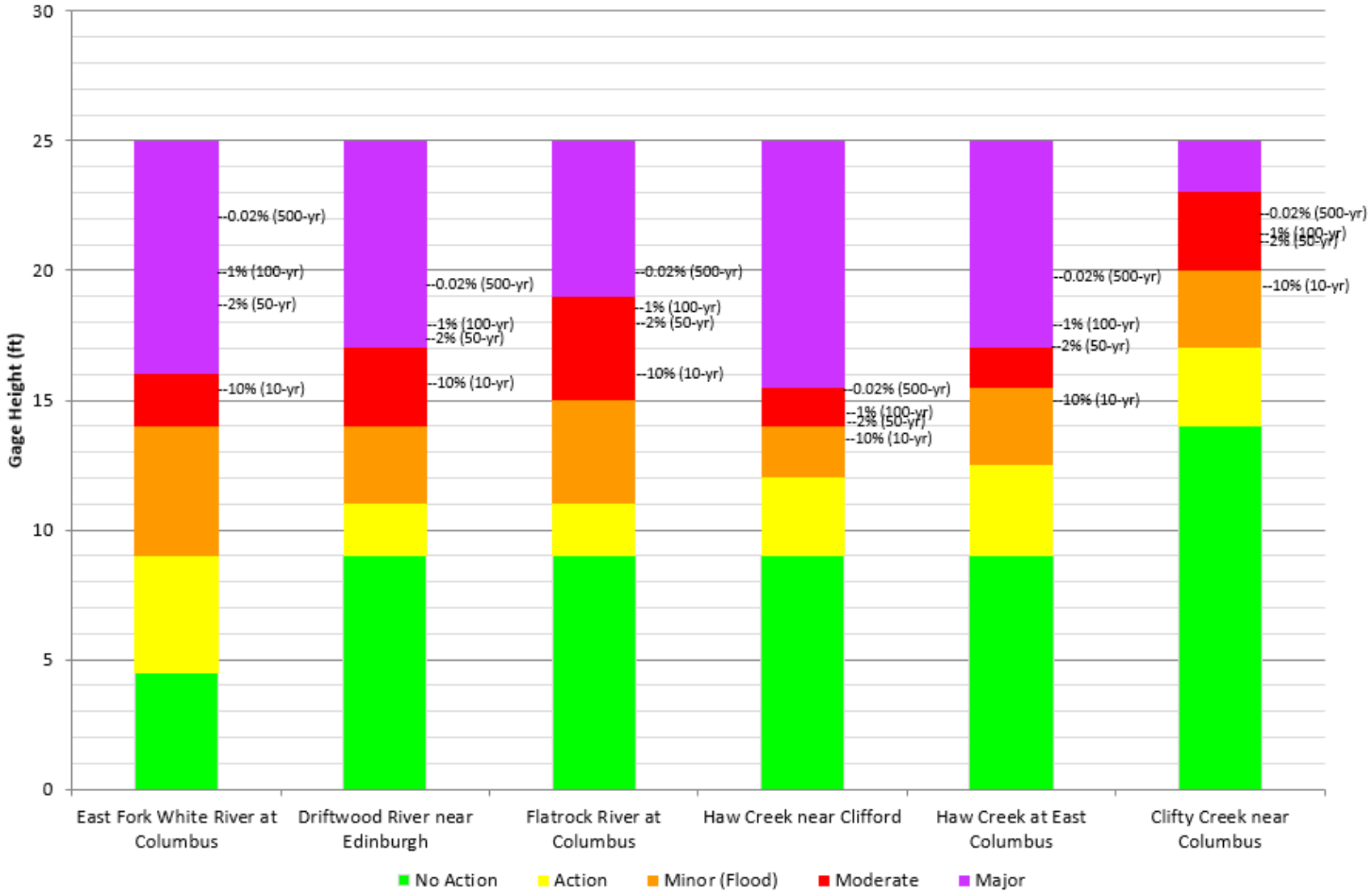
[2] http://water.weather.gov/ahps2/index.php?wfo=ind as reported August 2019

[3] Forecast available by calling NWS On-call Meteorologist 317-856-0367

[4] Estimated warning time is 4 hours from Haw Creek near Clifford gage

[5] Gage reading affected by backwater during high flows

C-2 USGS STREAM GAGE HEIGHT, AHPS LEVEL & ASSOCIATED FLOOD FREQUENCY



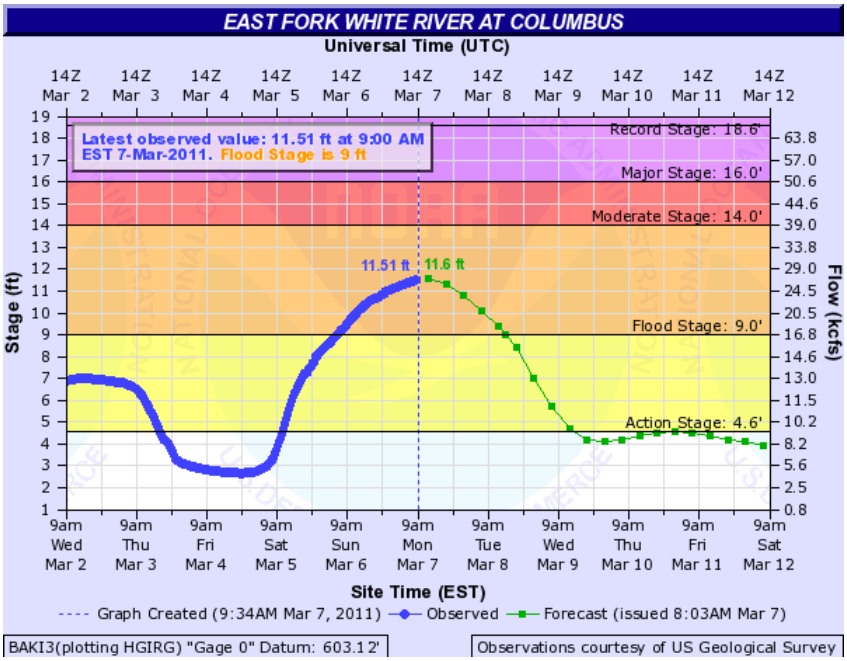
C-3 USGS/AHPS REAL TIME STREAM GAGES

The NWS typically designates various event levels for most USGS gages. These levels are typically determined by NWS based on historical information and local input. The different flood stages are shown compared to the USGS real-time stream gage data and flood forecast information provided by the NWS through the Advanced Hydrological Prediction Service (AHPS). Where data is available, this site also includes information on historical crests, flood impacts based on gage height, and photos.

As shown in the table in Appendix C-1, the "type" of gage is listed as "OBS" for observation stages only, "FLD" for flood forecast issued as needed during times of high water, but routinely not available, and "DLY" for routing daily forecast available.

To view USGS & NWS AHPS gage observed stages:

1. **http://water.weather.gov/ahps2/index.php?wfo=ind**
2. Observe flood condition based on color coding
3. Select stream gage of interest
4. Click on "Hydrograph Page" for flood categories, historic crests, flood impacts and photos



C-4 CRITICAL RAINFALL DURATIONS FOR VARIOUS WATERSHEDS AFFECTING COLUMBUS

The size of the watershed contributing flow to a point on a given stream impacts the duration of the rainfall that is required to produce flooding. Larger watersheds take longer for the rainfall to accumulate in the stream so if the rainfall is no longer than the critical duration, the rainfall over the whole watershed is not contributing to the flow in the stream and thus water surface elevations are lower. The critical rainfall duration for each watershed affecting Columbus is provided in the table below. Assessments of the potential for flooding on a given stream should consider forecasted rainfall durations at least as long as the critical duration.

Stream	Critical Rainfall Durations
Airport Tributary	2-6 hr
Clifty Creek	12-72 hr
Denios Creek	6-24 hr
East Fork White Creek	6-48 hr
Flatrock River	24-72 hr
Haw Creek	12-48 hr
Opossum Creek	2-6 hr
Sloan Branch	6-24 hr
Wolf Creek	6-24 hr

C-5 PRECIPITATION FORECASTS

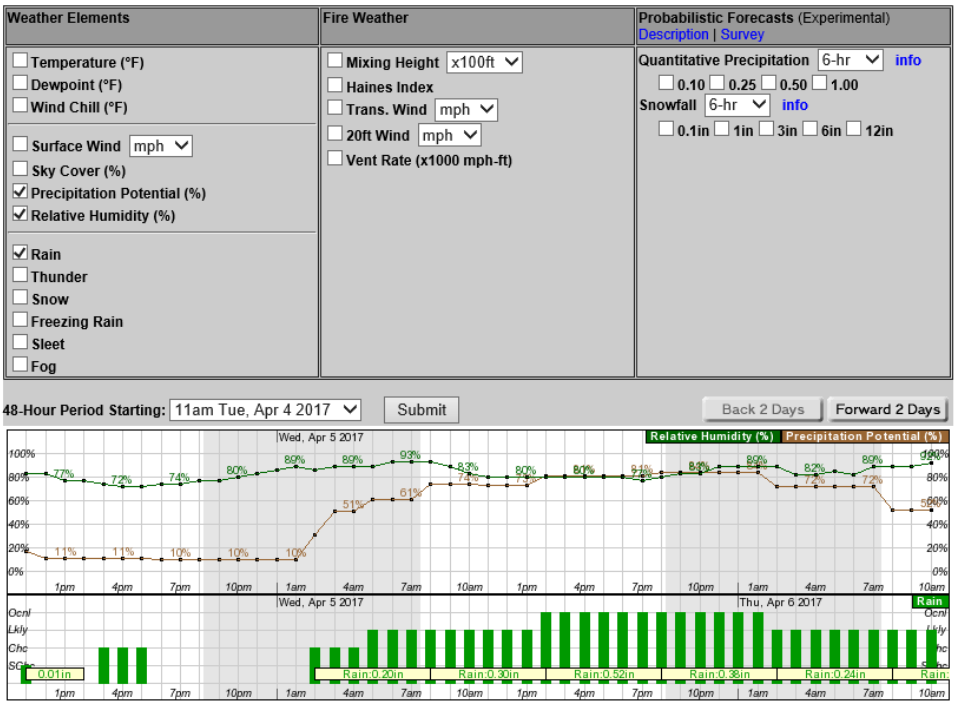
The NWS precipitation forecast is updated hourly and provides the forecast at a glance and 6-hour increments of temperature, precipitation potential, quantitative precipitation forecast (QPF), and snow accumulation at http://www.weather.gov/ind/

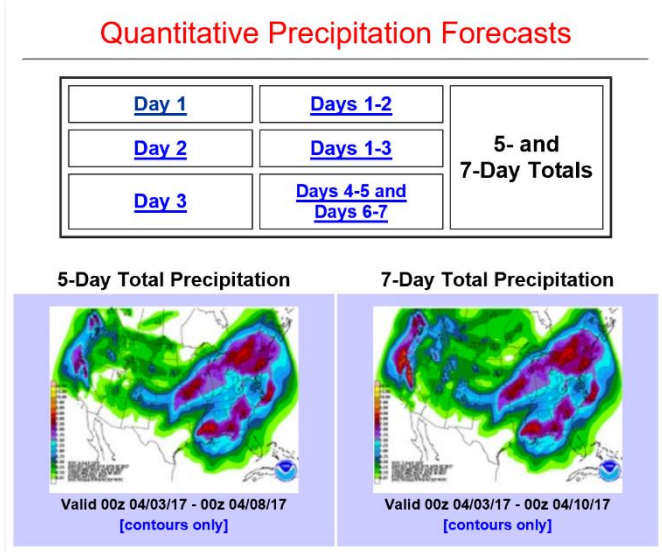
To view the NWS Precipitation Forecast:

1. http://www.weather.gov/ind/
2. Enter location using city/town name or zip code OR select point on map
3. Under "Other Information" select "Hourly Forecast"
4. Select the desired "Weather Elements"
5. Under "Probabilistic Forecasts" use the pull-down menus to select the duration of precipitation and snowfall
6. Determine QPF by adding forecasted precipitation totals
7. Determine the flood event level by applying the QPF for the same duration to the chart in Appendix C-7

To view 5-7 day QPF totals:

- Scroll to "Additional Forecasts & Information"
- Select "Precipitation"
- Select "5 and 7-day Totals"
- Select "Loop of 6-hourly QPF for Days 1-7"



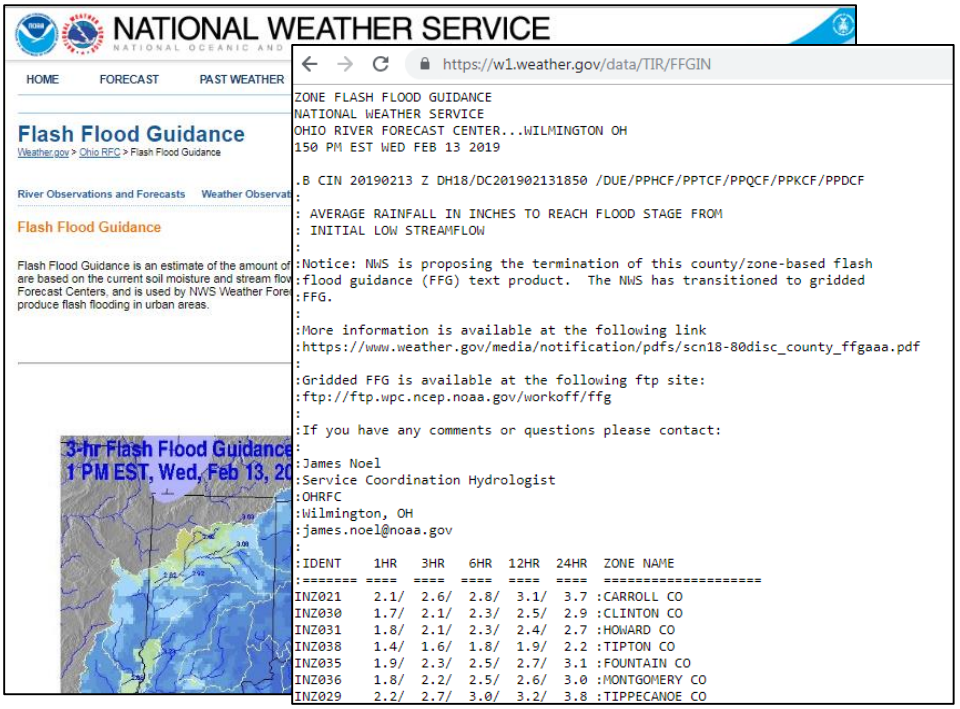


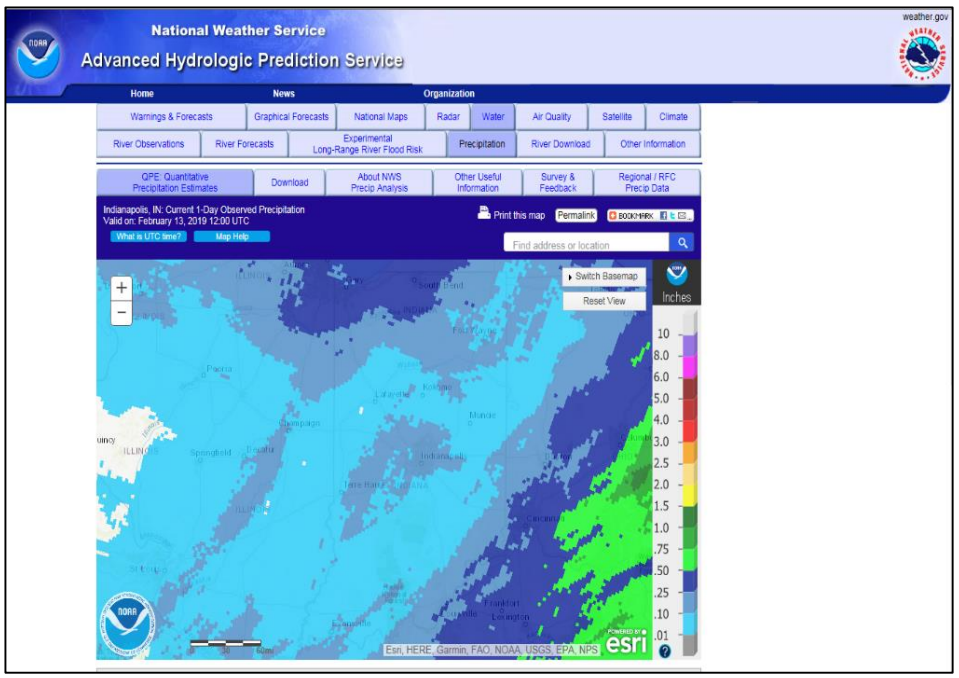
C-6 FLASH FLOOD FORECAST

The NWS provides Flash Flood Guidance. This tool is an estimate of the amount of rainfall required over a given area during a given duration to cause small streams to flood. These estimates are based on the current soil moisture and stream flow conditions for the area. The NWS routinely issues flash flood guidance throughout the day for every county. 1-, 3-, 6-, 12-, and 24- hour values are provided. The NWS cautions that in urban areas, less rainfall is required to produce flash flooding. Flash Flood Guidance for Indiana is available at https://www.weather.gov/ohrfc/FFG

To view the NWS Flash Flood Forecast:

1. https://www.weather.gov/ohrfc/FFG
2. Select Indiana
3. Select "View Text Product" to see inches of rain required to produce flash flood for each county
4. Compare forecasted rainfall with actual storm totals from radar https://water.weather.gov/precip/index.php?location_type=wfo&location_name=IND
5. An event is detected if forecast precipitation (Appendix C-5) or storm totals from radar (#5) is greater than the number of inches from #4 above





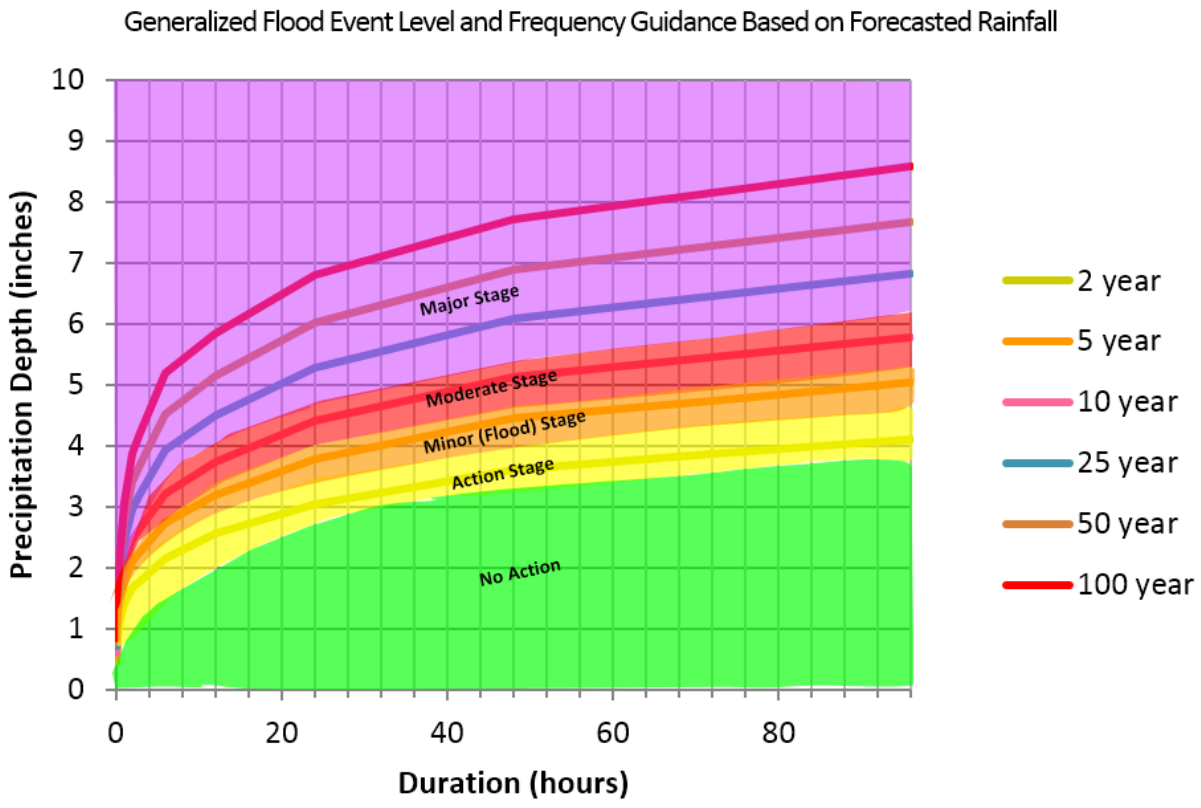
C-7 PRECIPITATION DEPTH-DURATION-FREQUENCY CURVES

Because rainfall events happen in all sorts of amounts and durations and resulting flooding depends on both factors, precipitation depth vs. duration graphs provide a way to combine both factors to obtain a general idea of the frequency flood level that could result from a given forecasted rainfall event for watersheds that do not have other stream gage related forecast tools.

To use the Precipitation Depth-Duration Frequency Curve:

1. Determine forecasted precipitation depth and duration (Appendix C-5)
2. Determine flood event level by plotting information on the chart below

By obtaining the forecasted precipitation totals for various time increments that are critical for a given watershed (this varies by size and physical characteristics of a watershed), the expected frequency of the rainfall can be determined from the graph and related to published Flood Insurance Study (FIS) or the best available data provided in this FREP to get an approximate idea of the flood extent expected.



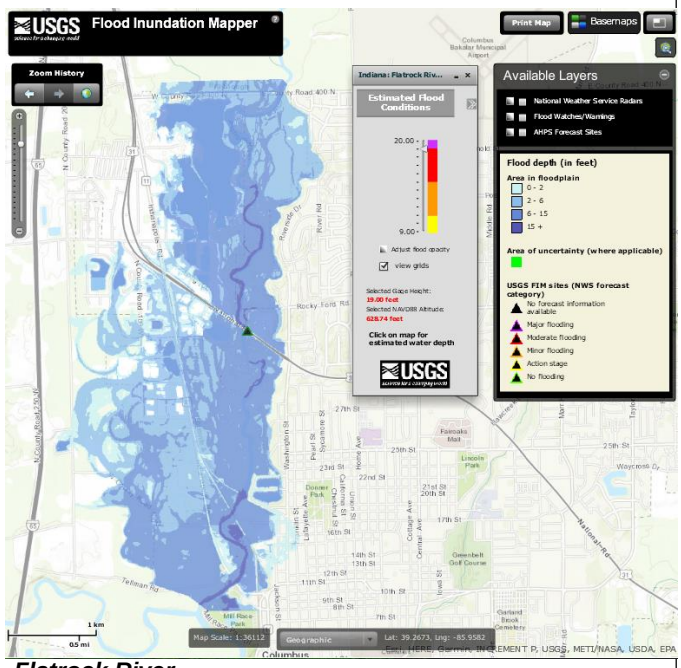
C-8 USGS INUNDATION MAPPING LIBRARY

USGS has prepared digital flood inundation mapping for a reach of Flatrock River between CR 400 N and Mill Race Park, the East Fork White River between Mill Race Park and CR 300 S, Haw Creek between CR 550N and the rail crossing below 3rd Street and the Driftwood River between Edinburgh and Lowell Road. These maps depict estimates of the real extent and depth of flooding corresponding to selected water levels (stages) for the aforementioned reached and are available at http://wimcloud.usgs.gov/apps/FIM/FloodInundationMapper.html#

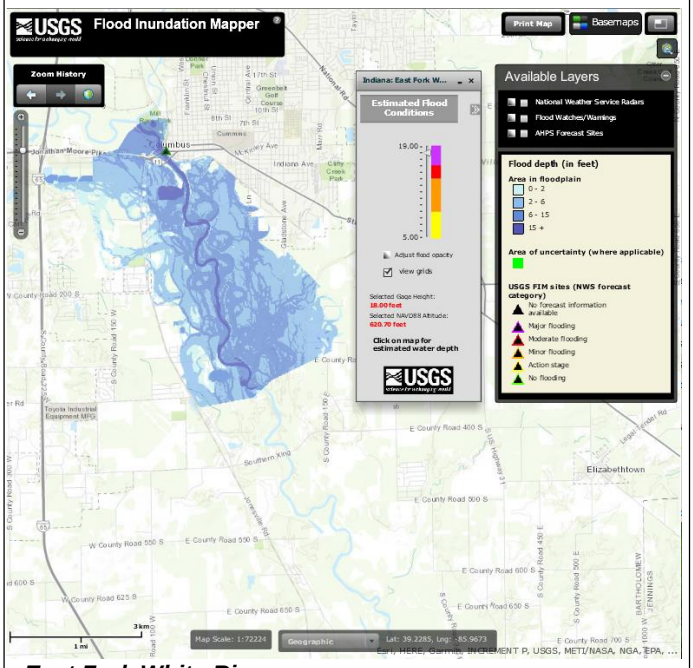
To view USGS inundation maps:

1. http://wimcloud.usgs.gov/apps/FIM/FloodInundationMapper.html#
2. On the map, zoom into Columbus
3. Select the triangle in Columbus
4. View the observed and forecasted gage stages
5. Using the toggle under "Estimated Flood Conditions" select the flood stage of interest
6. Click on the inundated area to determine flood depths for that location

NOTE: aerial photography available under "Basemaps"



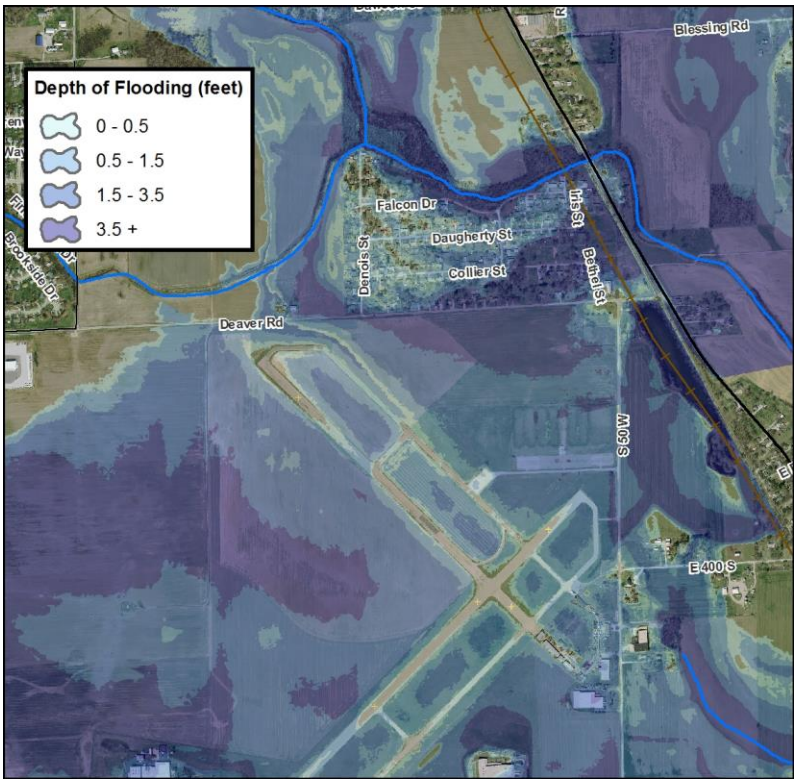
Flatrock River



East Fork White River

C-9 CBBEL FLOOD DEPTH MAPS

As part of the Flood Risk Management Plan prepared for the City, CBBEL developed Flood Depth Maps for portions of the East Fork White River, Airport Tributary, Denios Creek, Opossum Creek, Driftwood River, Flatrock River, Haw Creek, Clifty Creek, and Sloan Branch. For each of these areas studied, flood depths are illustrated for the 10-year, 50-year, 100-year, and 500-year flood frequencies. These flood depth maps can be used in conjunction with the USGS Inundation Map Library and NWS forecast tools to provide information on potential extent and depth of flooding along Columbus area streams. Flood depth maps and expected extent of flooding in floodprone areas are in Appendix E.



Example of flood depth maps

APPENDIX D
NOTIFICATION CONTACT LIST & SUMMARY OF EXPECTED ACTIONS

D-1 FLOOD EVENT NOTIFICATION CONTACT LIST

ORGANIZATION	NAME	EMAIL	PHONE
City Fire Chief	Andy Lay	play@columbus.in.gov	376-2679 603-2082(c)
Alternate	Mark Ziegler	mziegler@columbus.in.gov	(812) 376-2679
Alternate	Mike Kutsko	mkutsko@columbus.in.gov	376-2679 603-2084(c)
EMA Director *(FREP Coordinator)*	Shannan Cooke	scooke@bartholomew.in.gov	379-1680 371-0104 (c)
Alternate			379-1680 341-5806 (c)
NWS	On-Duty		317-856-0367
E911 Director	Todd Noblitt	tnoblitt@bartholomew.in.gov	379-1551opt 1 343-6560 (c)
Alternate	Julie Pierce	jpierce@bartholomew.in.gov	379-1551opt 2 343-6984 (c)
Incident Commander	TBD		
Alternate	TBD		
Mayor	James D. Lienhoop	jlienhoop@columbus.in.gov	376-2500 447-2994 (c)
Utilities Director	Roger Kelso	rkelso@columbusutilities.org	376-2400 x422 350-2686 (c)
Engineering Director	David Hayward	dhayward@columbus.in.gov	376-2540
Planning *(Floodplain Administrator)*	Chelsea Cottingham	ccottingham@columbus.in.gov	376-2550
Alternate	Jeff Bergman	jbergman@columbus.in.gov	376-2550 343-1200 (c)
City Council	Jerome Wood	jwood@columbus.in.gov	
City Council	Tom Dell	tdell@columbus.in.gov	
City Council	Elaine Hibler	ehilber@columbus.in.gov	
City Council	Frank Miller	fmiller@columbus.in.gov	
City Council	Tim Shuffett	tshuffett@columbus.in.gov	
City Council	David Bush	dbush@columbus.in.gov	
City Council	Grace Kestler	gkestler@columbus.in.gov	

ORGANIZATION	NAME	EMAIL	PHONE
County Commissioner	Larry Kleinhenz	commissioners@bartholomew.in.gov	350-0052 (c)
County Commissioner	Carl Lienhoop	commissioners@bartholomew.in.gov	350-0969 (c)
County Commissioner	Tony London	tlondon@bartholomew.in.gov	341-9782 (c)
IDHS	Through EMA		
Red Cross	Patricia Colon	patricia.colon@redcross.org	812-332-7869 (c)
Salvation Army			317-512-8575 (c)
Surveyor (Drainage Board)	Tom Finke	tfinke@bartholomew.in.gov	379-5348
Code Enforcement	Michelle Cox	mcox@bartholomew.in.gov	379-1535
School Buses	AJ McKeand	mckeanda@bcsc.k12.in.us	376-4246 812-592-0146 (c)
EMS/Hospital	Ben Caughey	bcaughey@crh.org	376-5270 350-8156 (c)
	Tony Pope	apope@crh.org	376-5658 345-6275 (c)
Sheriff (Law Enforcement)	Matt Myers	matt.myers@bartholomew.in.gov	379-1648 603-2026 (c)
Police Chief (Law Enforcement)	Mike Richardson	mrichardson@columbus.in.com	376-2600 603-2027 (c)
Fire County Fire Chiefs Assoc. President	Matt Lynch	mlynch@gtwpvfd.org	343-0563 (c)
County Highway	Danny Hollander	dhollander@bartholomew.in.gov	379-1660
Street Department	Bryan Burton	bburton@columbus.in.gov	376-2508 343-6777 (c)
Alternate- Streets	Vince Rubio		343-3673 (c)
Alternate- Transit	Stacy Heagy		376-2506 344-6714 (c)
Public Safety PIO - City (CPD)	Matt Harris	mharris@columbus.in.gov	376-2605 343-1875 (c)
Public Safety PIO - City (CFD)	Mike Wilson	mwilson@columbus.in.gov	350-6343 (c)
Public Safety PIO – County (BCSO)	Judy Jackson	judy.jackson@bartholomew.in.gov	812-343-5201
Media- (WCSI)	John Foster	jfoster@wcsiradio.com	374-9467 (c)
Volunteer Fire Department Clay Township	David Barnhill	barnhilld@claytownshipfire.org	812-552-4682
Alternate -	Courtney Barnhill	Barnhillc@claytownshipfire.org	812-390-9516

ORGANIZATION	NAME	EMAIL	PHONE
Clifford Volunteer Fire Department	Brandon Mize	bmize318@gmail.com	812-371-6799
Alternate -	Scott Pritchard	cliffordfire333@gmail.com	812-360-7232
Volunteer Fire Department Columbus Township	Dave Thompson	dthompson@ecifd.org	812-343-7225
Alternate -	Don Richards	drichards@ecifd.org	812-350-7158
Volunteer Fire Department Elizabethtown	Tom Nienaber	tdnienabor@hotmail.com	812-350-4442
Alternate -	Ivan Shinolt		812-343-3187
Volunteer Fire Department German Township	Matt Lynch	mlynch@gtwpvfd.org	812-343-0563
Alternate -	Kelli Lynch	klynch@gtwpvfd.org	812-343-5746
Alternate -	Jacob Goodin	jgoodin@gtwpvfd.org	812-603-1074
Volunteer Fire Department Harrison Township	Josh Kestler	soin1466@gmail.com	812-603-1736
Alternate -	Wally Dietz	wallydietz@bildico.com	812-343-4801
Volunteer Fire Department Hope	Chad Emmitt	chade_06@hotmail.com	812-764-0671
Alternate -	Adam Mathis	adam_mathis09@hotmail.com	812-390-7968
Volunteer Fire Department Wayne Township	Doug Burbrink	dgburbrink@yahoo.com	812-350-2878
Alternate -	Kyle Foist	foistkyle503@gmail.com	812-593-2986
Volunteer Fire Department Southwest	Billy Koons	southwest@bcremc.net	812-603-5690
Alternate -	Luke Hurt	hurt.luke@yahoo.com	812-371-9320
Volunteer Fire Department Hartsville	Donald Hedrick	dhedrich320@gmail.com	812-614-3055
Alternate -	John Ray	johnandconnie1@hotmail.com	812-343-5304

D-2 SUMMARY OF EXPECTED ACTIONS DURING A FLOOD FIGHT

EVENT	ACTION	REFERENCE SECTION, EXHIBIT &/or APPENDIX	EMA DIRECTOR (FREP Coord.)	FIRE CHIEF (FREP Coord.)	FLOODPLAIN MANAGER	E911 Operations	INCIDENT COMMANDER	CITY STREETS	COUNTY ROADS	PUBLIC SAFETY PIO	EMA	RED CROSS / ANIMAL CARE	BUSES (School/Transit)	LAW ENFORCEMENT	FIRE	ENGINEERING	SURVEYOR	COUNTY CODE ENFORCEMENT
ACTION FLOOD STAGE	**A. Determine Areas Affected / Extent & Severity**	Sec. 1	X	X	X	X												
	Make Notifications (if additional rain forecasted)	Sec. 2	X	X														
	B. Monitor Data & Conditions		X	X														
	Monitor USGS/NWS Data	App. C	X															
	C. Warning & Evacuation																	
	D. Record Observations & Actions	App. B	X	X	X	X												
	Evaluate the Situation		X	X														
MINOR FLOOD STAGE	**A. Determine Areas Affected/ Extent & Severity**	Sec. 1	X	X	X	X												
	Activate the FREP		X	X														
	Make Notifications	Sec. 2	X	X			X			X								
	B. Monitor Data & Conditions		X	X														
	Monitor USGS/NWS Data	App. C	X															
	Unfilled Sandbags Ready (if large event forecasted)		X						X									
	Run Flood-safe Routes	Ex.5		X				X	X									
	C. Warning & Evacuation																	
	D. Record Observations & Actions	App. B	X	X	X	X	X	X	X	X								
	Evaluate the Situation		X	X														
MODERATE FLOOD STAGE	**A. Determine Areas Affected/ Extent & Severity**	Sec. 1	X	X	X	X												
	Make Notifications	Sec. 2	X	X			X			X								
	Open EOC (if major flood event expected)		X								X							
	B. Monitor Data & Conditions		X	X														
	Monitor USGS/NWS Data	App. C	X															
	Unfilled Sandbags Ready		X						X									
	Run Flood-safe Routes/Install High Water Signs	Ex.5		X		X		X	X									
	C. Warning & Evacuation		X	X														
	Identify Affected Public/Order from Mayor	Ex. 1-4 & App. E	X	X	X	X	X											
	Prepare Shelters/Transportation		X								X	X	X					
	Identify Impassable Roads/Flood-safe Routes Clear	Ex. 1-4 & App. E		X		X		X	X					X				
	Notification to Affected Public/General Public, Media	Sec. 2	X	X		X				X								
	Document Flood Areas/UAV/Initiate Data Collection	App. F		X	X										X			
	D. Record Observations & Actions	App. B	X	X	X	X	X	X	X	X	X	X	X	X	X			
	Evaluate the Situation		X	X														

EVENT	ACTION	REFERENCE SECTION, EXHIBIT &/or APPENDIX	EMA DIRECTOR (FREP Coord.)	FIRE CHIEF (FREP Coord.)	FLOODPLAIN MANAGER	E911 Operations	INCIDENT COMMANDER	CITY STREETS	COUNTY ROADS	PUBLIC SAFETY PIO	EMA	RED CROSS / ANIMAL CARE	BUSES (School/Transit)	LAW ENFORCEMENT	FIRE	ENGINEERING	SURVEYOR	COUNTY CODE ENFORCEMENT
MAJOR FLOOD STAGE	**A. Determine Areas Affected/ Extent & Severity**	Sec. 1 & App. E	X	X	X	X												
	Make Notifications	Sec. 2	X	X			X			X								
	B. Monitor Data & Conditions		X	X														
	Monitor USGS/NWS Data	App. C	X															
	Run Flood-safe Routes/Install High Water Signs	Ex.5		X		X		X	X									
	C. Warning & Evacuation		X	X														
	Identify Affected Public	Ex. 1-4 & App. E	X	X	X	X	X											
	Shelters Open/Transportation Available		X								X	X	X					
	Affected Public Evacuation or Shelter-in-place			X			X							X	X			
	Identify Impassable Roads/Flood-safe Routes Clear	Ex. 1-4 & App. E		X		X		X	X					X				
	Notification to Affected Public/General Public/Media	Sec. 2	X	X		X				X								
	Document Flood Areas/UAV/Initiate Data Collection	App. F		X	X										X			
	D. Record Observations & Actions	App. B	X	X	X	X	X	X	X	X	X	X	X	X	X			
	Evaluate the Situation		X	X														
TERMNATE & FOLLOW-UP	**A. Terminate Flood Event**		X	X														
	Make Notifications	Sec. 2	X	X			X			X								
	Close EOC		X								X							
	Notification to General Public and Media	Sec. 2		X						X								
	B. Clear Roads & Flood Impact Areas		X	X														
	Re-entry Evacuated Areas		X	X	X		X							X	X			
	Mass Notification to Affected Public		X			X												
	Close Shelters/Transportation		X								X	X	X					
	Run Flood-safe Routes	Ex.5		X				X	X									
	C. Conduct Damage Assessment		X															
	Evaluate Damaged Structures/Bridges	App. F	X								X					X	X	
	Document Depth & Areas Flooded/Building Damage	App. F	X		X													X
	Collect & Dispose of Debris		X					X	X									
	D. Restock Supplies																	
	Unfilled Sandbags		X						X									
	Street Barricades/High Water Signs			X				X	X									
	E. Record Observations & Actions	App. B	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Flood Fight Debrief	App. H	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	After Action Report/Updates to NWS AHPS	App. H	X															
	F. Initiate Short and Long-term Recovery Efforts		X	X														

APPENDIX E
EXPECTED EXTENT OF FLOODING IN FLOODPRONE AREAS

E-1 EXPECTED EXTENT OF FLOODING ALONG AIRPORT TRIBUTARY (500-YR FLOOD)

Neighbor-hood Reference	General Location	Description of Flood Impacts at 500-Year Flood Levels and Frequency at Which Impacts Begin	Critical Facilities
Walesboro Airport (1)	CR 50 West and CR 400 South just east of CR 50 West	Up to half foot of flooding of a reach of CR 400 South. Prevents access to at least 3 sets of structures. Flooding begins above the 100-year flood event	
	former airport property bounded by Deaver Road, CR 50 West, CR 400 South, and CR 175 West	Significant flooding of potential development area. Average flood depths of 1/2'. Flooding of the area begins below the 10-year flood event	
	business in the northwest corner of the CR 50 West and CR 450 South intersection	Shallow flooding of entrance road	1 hazardous material facility
	business north of Airport Tributary in the northeast corner of the CR 175 W and CR 450 South intersection	Potential for shallow flooding of parking lot as well as some flooding of road leading to business. Flooding begins below the 100-year flood level	1 hazardous material facility
Walesboro (2)	area bounded by Airport Tributary, railroad, and CR 450 South	very shallow flooding possible on 2 structures. Access to structures limited by approximately ½ 'deep water. Road flooding starts at approximately the 50-year flood.	

Descriptions are based on depth mapping using results from 1D/2D modeling done for City of Columbus in 2019.

E-2 EXPECTED EXTENT OF FLOODING ALONG CLIFTY CREEK (500-YR FLOOD)

Neighbor-hood Reference	General Location	Description of Flood Impacts at 500-Year Flood Levels and Frequency at Which Impacts Begin	Critical Facilities
Wehmeier/Columbus East (24)	Businesses along Repp Drive south of State Street (SR46)	Flooding up to 3 feet deep may occur at one building with flooding starting above the 50-year flood level. Parking lots may experience shallow flooding. Access roads may be flooded by over 1 foot of water (once flooding exceeds 100-year flood levels) preventing access to 9 businesses.	1 fire station
	Wehmeier Addition north and east of Marr Road and State Street (SR 46)	Flooding of 45 structures to depths less than 2' and 69 structures over 2', neighborhood roads are also flooded to depths up to 3', approximately 5 structures would be above flood waters but without access to and from the neighborhood, flooding begins below the 50-year level, 16 structures located in the floodway	
	Marr Road and Indiana Avenue north of State Street	Flooding of Indiana Avenue north of the softball diamonds begins below the 100-year event. Flooding of Marr Road begins above the 100-year event and reaches depths up to about 1'. Depths on Indiana Avenue reach 1 1/2 feet and prevent access to the buildings on Salzburg Boulevard. Flooding of Marr Road prevents access to the Columbus East High School from Marr Road but access from the north is still available.	
	A portion of the building complex on Salzburg Boulevard north of Indiana Avenue (Steinhurst Manor)	The northeast most parking lot is flooded by about a foot of water, access to the northwest parking is prevented by water up to almost 2' deep, access to the northwest parking is impacted above the 10 year flood, access to the northeast parking begins to be impacted at the 50-year flood	
	Columbus East High School	Flooding of a portion of the high school & parking areas with up to 3' flood depths is possible. Flooding begins above the 100-year flood as long as there are no culverts under Marr Road to transfer flood water from the east to the west side. Access to the flood- free portions of the school is only available from the north, protection has been constructed to above the 100-year flood	1 school
Sandy Hook/Clifty Crossing (25)	Businesses just south of National Road between Clifty Creek and just west of 10th Street	Parking lots are flooded by up to approximately 1 ½' but buildings appear to be elevated above flood elevations. Parking lot flooding begins at about the 50-year flood level. Open ground between the businesses east of Taylor Road appears to be an important auxiliary path for flood waters to pass under National Road	

Neighbor-hood Reference	General Location	Description of Flood Impacts at 500-Year Flood Levels and Frequency at Which Impacts Begin	Critical Facilities
	National Road west of Taylor Road	About 1200' of the road just west of the intersection is flooded at depths up to about 2 1/2 feet preventing access to at least one business. Flooding begins above the 100-year flood level	
	Sandy Hook neighborhood bounded by Taylor Road, National Road, and Waycross Drive	Potential shallow depth flooding of about a dozen homes, significant street flooding depths up to 3' preventing access to and from about 50 homes, road flooding blocks one of the accesses to an assisted living facility, flooding of at least one business. Water overtops Taylor Road and begins flooding the area above the 100-year level flood, structure flooding is beginning at the 500-year flood level	1 childcare facility
Regency Drive (28)	Hartford Place neighborhood bounded by Dawnshire Drive, Tally Road, Clifty Creek, and 25th Street	Up to 2' of flood depths possible in some streets limiting access to and from up to 50 homes. Flooding begins above the 50-year flood level of Clifty Creek, 1 or 2 homes may experience minor flooding	

E-3 EXPECTED EXTENT OF FLOODING ALONG DENIOS CREEK (500-YR FLOOD)

Neighbor-hood Reference	General Location	Description of Flood Impacts at 500-Year Flood Levels and Frequency at Which Impacts Begin	Critical Facilities
Bethel Village (4)	Bethel Village neighborhood northwest of Deaver Road and SR 11	Over 100 structures with flood depths less than 2', 60 structures with flood depths over 2', flooding of almost all streets by up to approximately 4', flooding of several structures and inundation of the access into and out of the neighborhood occurs below the 10-year flood elevation,6 structures in the floodway, various projects are being or have been considered/constructed to attempt to reduce flooding of the neighborhood. (This description applies to flooding from Denios Creek only. See East Fork White River, Bethel Village table entry for description of impacts when flooding source is East Fork White River)	
	Deaver Road west of SR 11	Overtopped by over 5 feet cutting off access to and from the neighborhood and a farmhouse to the north, flooding starts below the 10-year flood elevation, prevents as much access to surrounding properties as the flooding of the properties themselves (This description applies to flooding from Denios Creek only. See East Fork White River, Bethel Village table entry for description of impacts when flooding source is East Fork White River)	
SR 11 South (5)	Neighborhood along Dawson Street west of SR 11	Approximately 10 structures in the floodway, 5 structures are flooded by depths up to 2', 10 structures are flooded by water over 2' deep. Access to about all of the structures is prevented by road flooding up to almost 1 1/2', flooding begins at less than 10-year levels (This description applies to flooding from Denios Creek only. See East Fork White River, SR11 South table entry for description of impacts when flooding source is East Fork White River)	
Shadow Creek Farms (6)	CR 150 West between CR 200 South and CR 300 South	Overtopped by over 1' of water cutting off access to 2 residences and potentially the east access to the subdivision north of Denios Creek (Shadow Creek Farms), shallow flooding occurs near the creek at the 10-year flood elevation. EFK White River flood waters come near to the road but do not appear to overtop it.	
	Access roads along I-65 between CR 200 South and CR 300 South	West side access road flooded by less than about 1' of water, flood-free to flood levels above the 100-year. East side access road flooded by up to more than 3' of water, minimal flooding occurs for the 10-year flood level alternative route exists	

E-4 EXPECTED EXTENT OF FLOODING ALONG DRIFTWOOD RIVER (500-YR FLOOD)

Neighbor-hood Reference	General Location	Description of Flood Impacts at 500-Year Flood Levels and Frequency at Which Impacts Begin	Critical Facilities
Front Door East/ Jonathan Moore Pike (10)	SR46 (Jonathan Moore Pike) east of I-65 to EFK White River	The road is overtopped by up to 6' of water, blocks access to multiple businesses east of I-65, prevents access to 3 hazardous material facilities, flooding of the edge of SR 46 begins at about the 10-year flood level.	
	Along Jonathan Moore Pike and Merchants Mile east of I-65	Approximately 17 structures are flooded to depths less than 2' and 5 greater than 2'. Jonathan Moore Pike floods to over 5' of depth. Parking lots are flooded to depths of around 2'. Flooding of Jonathan Moore Pike starts below the 10-year flood levels as does access road and potentially some structure flooding	3 hazardous material facilities
Front Door West/ Westhill (11)	North and south of Jonathan Moore Pike west of I-65	Approximately 12 structures are flooded to depths of less than 2' while 9 are greater than 2'. Jonathan Moore Pike floods to about 6' of depth. Access to buildings further south is flooded but other flood free access exists from Jonathan Moore Pike to the west. Flooding of Jonathan Moore Pike starts above the 10-year flood levels as does access road and some structure flooding.	3 hazardous material facilities
	Carlos Folger Drive between CR 315 West and Jonathan Moore Pike	Flooding begins below the 10-year flood elevation reaching almost 4' of depth during the 50-year flood. Alternative access to structures along the road exists.	
	Between Jonathan Moore Pike and Carlos Folger Drive along CR 325 West	Carlos Folger Drive and CR 325 West are flooded by up to 7' of water cutting off access to SR 46 from the north. Flooding of the road begins at less than the 10-year flood level. alternate access to structures exists	water treatment plant office
Tellman Camp Road (15)	Along Tellman Road between CR 250 West and Indianapolis Road	Approximately 30 structures are inundated to levels greater than 2', approximately 4 structures are inundated to levels less than 2'. Tellman Road is flooded by over 10 feet of water cutting off access to approximately 5 structures, flooding of most of the access to the structures begins below the 10-year flood level.	

E-5 EXPECTED EXTENT OF FLOODING ALONG EAST FORK WHITE RIVER (500-YR FLOOD)

Neighbor-hood Reference	General Location	Description of Flood Impacts at 500-Year Flood Levels and Frequency at Which Impacts Begin	Critical Facilities
Walesboro (2)	West of SR 11 between CR 400 S and Southern Crossing	Approximately 13 structures in the 500-year floodplain of EFK White River, flooding may limit access to some of the structures	
	East of SR 11 north of CR 400 South for 600 feet	Approximately 1 structure in the floodway, 5 more in the 100-year floodplain and 3 more in the 500-year floodplain, access to these structures may be prevented by floodwaters	
Bethel Village (4)	Deaver Road west of SR 11	Inundated by up to almost 6' but flooding does not start until over the 10-year flood event, prevents as much access to surrounding properties as the flooding of the properties themselves. (This description applies to flooding from East Fork White River only. See Denios Creek, Bethel Village table entry for description of impacts when flooding source is Denios Creek.)	
	Bethel Village neighborhood northwest of Deaver Road and SR 11	80 structures with flood depths less than 2', 60 structures with flood depths over 2', flooding of almost all streets by up to approximately 4', flooding of several structures and inundation of the access into and out of the neighborhood occurs above the 10-year flood elevation. (This description applies to flooding from East Fork White River only. See Denios Creek, Bethel Village table entry for description of impacts when flooding source is Denios Creek.)	
SR 11 South (5)	East of SR 11 near Deaver Road and near Denios Creek crossing	Approximately 10 structures flooded to depths >2' and 2 structures flooded to depths <2', access is prevented by flooding of SR 11, flooding begins at less than 10-year levels, 6 structures are in the floodway	
	SR 11 approximately 1500 feet north and south of Deaver Road	Flood depths of over 3' beginning near the 50-year level, prevent direct access to 4 properties with structures	
	Blessing Road east of SR 11	Flood depths of about 6' prevent access to about 2' deep flooding at approximately 3 structures starting below 10-year levels	
	Neighborhood along Dawson Street west of SR 11	About 10 structures are flooded to depths of about 2', another almost 12 structures are isolated due to flood waters on Dawson Street up to almost 2' deep, flooding begins above the 50-year level. (This description applies to flooding from East Fork White River only. See Denios Creek SR 11 South table entry for description of impacts when flooding source is Denios Creek.)	

Neighbor-hood Reference	General Location	Description of Flood Impacts at 500-Year Flood Levels and Frequency at Which Impacts Begin	Critical Facilities
Huffman Drive/ WWTP (8)	SR11, Huffman Drive, & WWTP access road just north and south of Denios Creek under SR 11	Flooding of a portion of SR 11 (2' deep), Huffman Drive (5' deep) and WWTP access road (1' deep), flooding begins on each road below the 10-year flood level, access to a few structures that are above flood levels is prevented, minor flooding of about 5 structures	Wastewater treatment plant, Southside Elementary School access from the south
Garden City (9)	Garden City east of RR	Approximately 35 structures flooded to depths less than 2' and 20 structures flooded to depths over 2', although some structures are also above the 500-year flood elevations, access to most of these structures is prevented by flooding of SR 11,minor flooding begins at about the 10-year level, 6 structures are in the floodway	1 hazardous material facility, mobile home park
	Garden Street west of SR 11	While structures in this reach appear to be above the 500-year flood levels, flooding of Garden Street up to about 4' begins below the 10-year flood level preventing access to and from approximately 16 structures	
Water Street (29)	South of 1st Street between Lafayette Avenue & Brown Street	Access roads flooded by up to over 7' of water preventing access to 1 or 2 businesses, structures appear to be near or above flood elevations, road flooding begins at less than 10-year flood levels	
Mariah/ Reo St (30)	Commercial and residential area east of Haw Creek, south of State Street and north of the RR	Approximately 6 structures flooded to depths less than 2' and 6 structures flooded to depths over 2', flooding begins around the 50-year flood level of EFK White River. (This description applies to flooding from East Fork White River only. See Haw Creek, Mariah/Reo St table entry for description of impacts when flooding source is Haw Creek.)	1 hazardous material facility

E-6 EXPECTED EXTENT OF FLOODING ALONG FLATROCK RIVER (500-YR FLOOD)

Neighbor-hood Reference	General Location	Description of Flood Impacts at 500-Year Flood Levels and Frequency at Which Impacts Begin	Critical Facilities
Mill Race Park (14)	Between 5th and 11th Streets and Flatrock River and Jackson Street	1 or 2 structures flooded by less than 2' of water with access blocked for those structures. Road flooding begins at about the 100-year level. Potential for flooding of Cummins COB loading dock at 500-year level.	1 hazardous material facility
Indianapolis Road (16)	Along Indianapolis Road from about 3000' north to 2000' south of CR 100 N	Flood depths along Indianapolis Road are over 3', 7 groups of structures are flooded by over 2', road and structure flooding begins at the 10-year flood level, direct access to more than 15 businesses is blocked by flood waters, 3 groups of structures are located in the floodway	
	CR 100 North from Indianapolis Road to CR 200 West	Flood depths along this road segment are over 9', cutting off access to at least 2 sets of buildings, flooding starts below the 10-year flood level	
	West of Indianapolis Road roughly between Brian Drive and Arcadia Drive	Road flooding at over 5' depth preventing access to several businesses that appear to be above the 500-year flood level, road flooding (including Indianapolis Road) begins around the 10-year level	1 hazardous material facility
	CR 200 West from CR 100 North to approximately 3,500 feet north	Flooding of road up to about 2' blocks access for 3 sets of structures, flooding begins at northern end at 50-year flood.	
	Along Princeton Park Drive	Road flooding over 2’ deep limits access to some areas at the 100-year and higher floods. Shallow flooding of approximately 13 residences.	
Washington St (17)	Area from Washington Street to Flatrock River and between 12th Street and Newsome Avenue	35 structures with flood depths less than 2', 95 structures with flood depths over 2', flooding of streets to 3' or more of water, flooding of several structures and inundation of the access into and out of the neighborhood begins below the 50 year flood elevation	
Noblitt Falls (18)	Noblitt Falls neighborhood west of Washington Street and Newsome Avenue to 23rd Street	10 structures with flood depths less than 2', 45 structures with flood depths over 2', flooding of streets to 3' or more of water, flooding of several structures and inundation of the access into and out of the neighborhood begins at about the 50-year flood elevation when the lagoon berm is overtopped or water flows over a low point in Newsome Avenue near its intersection with Lawton Avenue, 40 structures located in the floodway	
Riverside Drive South (19)	Riverside Drive between 23rd and 28th Streets	Flooding of auxiliary access to some structures may occur at less than the 10-year flood level, all structures appear to be above 500-year flood levels and have access to the east	

Neighbor-hood Reference	General Location	Description of Flood Impacts at 500-Year Flood Levels and Frequency at Which Impacts Begin	Critical Facilities
Commerce Park (21)	Northeast, southeast, and southwest quadrant of National Road and Indianapolis Road intersection	Potential flooding less than 2' deep on 5 structures with street flooding up to 3' deep preventing access, some flooding begins around the 50-year level, approximately 20 structures in the floodway	2 hazardous material facilities
Long Road (22)	North and east of Indianapolis Road and US 31 intersection (near Lowell Road)	Minimal flooding of buildings, access road flood depths 0-3' which may block access to 2 businesses starting above the 100-year flood level, 5 structures in the floodway	
Riverside Drive North (45)	Riverside Drive between Rocky Ford Road and Washington Street	3 structures flooded by less than 2', 3 structures flooded by more than 2', flooding begins above the 10-year flood level, auxiliary access is available for all but 1 structure via alley east of the structures	

Description of flooding along Indianapolis Road assumes RR embankment along the east side does not remain intact during a flood. If RR embankment does remain intact and has no openings, it prevents flooding up to levels above the 50-year flood.

E-7 EXPECTED EXTENT OF FLOODING ALONG HAW CREEK (500-YR FLOOD)

Neighbor-hood Reference	General Location	Description of Flood Impacts at 500-Year Flood Levels and Frequency at Which Impacts Begin	Critical Facilities
Mariah/ Reo St (30)	Commercial and residential area east of Haw Creek, south of State Street and north of the RR	Approximately 5 structures flooded to depths less than 2' and 17 structures flooded to depths over2', begins near the 10-year level of Haw Creek (This description applies to flooding from Haw Creek only. See East Fork White River, Mariah/Reo St for description of impacts when flooding source is East Fork White River	1 hazardous material facility
CEP/ 2nd St (31)	Central Avenue between 3rd Street and 7th Street	Depths of over 1' with flooding beginning at about the 100-year level, flooding eliminates one access route for the business	
	Cummins Engine Plant north of 3rd Street and Central Avenue	Flooding of parking may begin near the 50-year, floodwall is constructed to protect structure from flooding	1 hazardous material facility (protected)
	West side of Haw Creek between 3rd Street and the RR	South of 2nd St depths over 3' in a portion of the site. North of 2nd Street flood depths are up to 5', 7 buildings may be flooded to depths over 2', 3rd Street flood depths are over 4' while 2nd Street depths may be up to a little over 3', flooding of the area north of 2nd St begins below the 50-year flood	1 hazardous material facility
Tech Center/ Pleasant Grove (32)	Cummins, Inc property	levee/floodwall system has been built to protect Cummins Technology Center structures from flooding, Child Care Center begins flooding between the 50- and 100-year flood level	1 hazardous material facility (protected), 1 childcare facility
	Pleasant Grove neighborhood between State Street and 7th Street between Pleasant Grove and Cherry Street	20 structures with flood depths <2', approximately 20 structures with flood depths>2', flood depths up to over 7' for structures and streets, flooding begins below the 50-year flood level, several structures have been bought out	
10th / Central (33)	Neighborhood between Haw Creek and Cottage Avenue and between 7th and 12th Streets	40 structures with flood depths less than 2', 60 structures with flood depths over 2', structure flooding may begin below 10-year level, significant street flooding with depths over 6', access is cut off to approximately 20 structures that appear to be flood-free , some structures have been bought out	
	8th Street between Haw Creek and Central Avenue	Over 3' depth, flooding begins below the 50-year flood level, access is prevented to already flooded areas	
	10th Street between Haw Creek and Hutchins Avenue	Street flooding up to 6', flooding begins below the 10-year level, access is prevented to already flooded areas	

Neighbor-hood Reference	General Location	Description of Flood Impacts at 500-Year Flood Levels and Frequency at Which Impacts Begin	Critical Facilities
17th/ Keller (34)	Neighborhood between 17th and 20th Streets and Keller Avenue to Haw Creek Avenue	Approximately 17 structures with less than 2' flood depths, 1 structure with more than 2' flood depths, 2 commercial structures with less than 2' flood depths, street flooding up to 4' of water, street flooding begins at about the 50-year level	
CRH (35)	Columbus Regional Hospital east of Haw Creek along 17th Street	Flooding of parking areas near the creek with approximately 3' of water, north parking lot flooding begins at approximately the 10-year level, hospital has constructed flood control measures to protect against structure flooding	medical facility (protected)
Midway (36)	North of Columbus Regional Hospital to 24th Street between Haw Creek and Midway Street	Approximately 20 structures with flood depths less than 2', 2 structures with flood depths over 2', street flooding generally about 2' deep, structure flooding begins below the 100-year level, no access to non- flooded structures, impacts to Columbus Health and Rehabilitation Center begin below the 100-year event level, impacts to school begin about the 100-year level	assisted living facility, school
Everroad Park East (37)	Everroad Park East along Griffa Avenue north of 25th Street	Flooding of structures begins at about the 50-year level, shallow flooding of about 12 residential structures and a business,20 structures with flood depths over 2'	
Everroad Park West/ Eastbrook (38)	West side of Haw Creek between 25th Street and National Road (Eastbrook Plaza)	Approximately 2' deep flood waters in strip mall structures and parking areas beginning around the 50-year flood level	
	Everroad Park West neighborhood west of Haw Creek between National Road and 31st Street	Street flooding begins below the 100-year level making most residences inaccessible, structure flooding beginnings at about the 100-year level, approximately 150 structures flooded by about 1', streets flooded by over 2' of water, approximately 10 flood free residences are inaccessible	
Ravenswood Drive (39)	Ravenswood Drive and 15th Street west of Meridian St	Shallow street flooding at the 500-year level could prevent access to 10 residences with potential shallow flooding of 3 residences	
Windsor Place/ Hillcrest (40)	Windsor Place/Hillcrest neighborhood east of Haw Creek between 30th Street and Rocky Ford Road	Approximately 95 structures flooded by less than 2' of water, 10 structures flooded by over 2', streets flooded by over 2' of water, access prevented to even more structures, structure and street flooding begins between the 10- and 50-year flood level	
Northbrook/ Candlelight (41)	Candlelight/Northbrook neighborhood between Candlelight Drive and Haw Creek and Northbrook Drive and Rocky Ford Road	More than half of the houses and mobile homes flooded by less than 2', Approximately 80 mobile homes flooded by over 2', street flooding begins at the 10-year flood level, structure flooding begins at the 50-year level	mobile home park

Neighbor-hood Reference	General Location	Description of Flood Impacts at 500-Year Flood Levels and Frequency at Which Impacts Begin	Critical Facilities
	Rocky Ford Road between Haw Creek and Taylor Road	flooding to depths of over 3' cutting off 1 of the accesses to the mobile home park on the north, shallow flooding begins at the 10-year level	
Sycamore Bend/Arrowood (42)	Arrowood/Willowwood neighborhood north of Rocky Ford Road and west of Indianwood Drive	Minor street flooding begins at the 10-year flood level, approximately 50 structures are flooded by less than 2' of water, streets are flooded by approximately 2' of water making over 50 structures inaccessible even though some are above flood waters	
	Marr Road and Sawin Drive near their intersection	Flood depths over 3' beginning below the 50-year level, no impact on direct access to structures	
	Rocky Ford Road between Candlelight Drive and Haw Creek	Flooding to 3' depth of water preventing access to flooded structures	
Ravenswood Drive (39)	Along Ravenswood Drive between 15th and 17th Streets	Minor flooding possible for 3 structures, potential street flooding up to almost 1' would block access to about 7 residences, flooding begins at depths over the 100-year flood level	

E-8 EXPECTED EXTENT OF FLOODING ALONG OPOSSUM CREEK (500-YR FLOOD)

Neighbor-hood Reference	General Location	Description of Flood Impacts at 500-Year Flood Levels and Frequency at Which Impacts Begin	Critical Facilities
Shadow Creek Farms (6)	CR 150 West between CR 200 South and CR 300 South	Overtopped by over 1' of water cutting off access to 2 residences and potentially the east access to the subdivision north of Denios Creek (Shadow Creek Farms), shallow flooding occurs near the creek at the 10-year flood elevation. EFK White River flood waters come near to the road but do not appear to overtop it.	

E-9 EXPECTED EXTENT OF FLOODING ALONG SLOAN BRANCH (500-YR FLOOD)

Neighbor-hood Reference	General Location	Description of Flood Impacts at 500-Year Flood Levels and Frequency at Which Impacts Begin	Critical Facilities
Madison/ Grant/ Flintwood (26)	Talley Road and Valley Forge Avenue north of 25th Street	Street flood depths over 1' preventing access to approximately 20 residences along these road segments, flooding begins at about the 10-year level	
	Neighborhood north of 25th Street between Flintwood Drive and Talley Road	Approximately 65 structures flooded to depths less than 2', 2 structures flooded by over 2' of water, street flooding up to 2' in the neighborhood and up to almost 1 foot along 25th Street preventing access to over 250 structures , flooding of 1-2 structures may begin at the 10-year level, additional structure and street flooding begins below the 50-year level, significant areas plus 25th Street are affected by the 100-year level, access to the Lutheran Home is impacted above the 50-year flood level	1 hazardous material facility, medical facility, school, Lutheran Home
Eastridge Manor (27)	Eastridge Manor neighborhood south of Rocky Ford Road between Talley Road and Virginia Street	Approximately 26 structures flooded to depths less than 2', 5 structures flooded to depths over 2', access is prevented to most structures along Elizabeth Street, Rocky Ford Road is flooded by up to 2', minor flooding of structures, Elizabeth Street, and Rocky Ford Road occurs at the 10-year level	

E-10 RELATIONSHIP OF RIVER GAGE STAGE & ANTICIPATED OVERTOPPING OF MAJOR TRANSPORTATION ROUTES

Major Transportation Routes By Stream	USGS Gage	Approximate Gage Stage When Road Overtops*	Stream Stage at USGS Gage: 10	11	12	13	14	15	16	17	18	19	20	21	22	23
Haw Creek	Reccurance Interval (RI) >					10 yr	50 yr	100 yr	500 yr							
Marr Road	Haw Creek near Clifford	12														
Rocky Ford Road		12.5														
National Road (US 31)		14.5														
25th Street		15														
17th Street		undetermined stage > 16														
10th Street		14														
7th Street		14														
State Street (SR 46)		14														
Clifty Creek	RI >											10 yr		50yr	100 yr	500 yr
National Road (US 31)	Clifty Creek at Columbus	undetermined stage > 23														
State Street (SR 46)		undetermined stage > 23														
Galdstone Avenue		18.5														
Flatrock River	RI >								10 yr		50 yr	100 yr	500 yr			
CR 800 N	Flatrock River at Columbus	undetermined stage > 20														
CR 550 N		11.5														
CR 400 N		11.5														
National Road (US 31)		undetermined stage >20														
Indianapolis Road		14.5														
Driftwood River	RI >							10 yr		50 yr	100 yr	500 yr				
Lowell Road	Driftwood River near Edinburgh	16														
Driftwood River	RI >							10 yr			50 yr		100 yr		500 yr	
SR 46	EFK White River at Columbus	15.5														
EFK White River	RI >							10 yr			50 yr	100 yr			500 yr	
SR 46 W	EFK White River at Columbus	15.5														
3rd Street			*Limited by SR 46*													
2nd Street			*Limited by SR 46*													
SR 11 N of CR 200 S		12.5														
SR 11 S of CR 200 S		17														
Southern Crossing		15														
Gladstone Avenue		14														
Sloan Branch	RI >		10 yr				50 yr				100 yr				500 yr	
25th Street	No Gage Available															

* Estimated based on available data. Should be updated based on gage peaks observed near the time that road experiences overtopping.

Road overtopping is not expected

Road overtopping is expected

Road overtopping is not expected at or below the 500 year flood level. Actual point of overtopping was not determined.

E-10 DESCRIPTION OF SELECTED ROAD FLOODING

River	General Location	Description of Flood Impacts at 500-Year Flood Levels and Frequency at Which Impacts Begin
Big Slough	CR 550 North	See road depth mapping
Denios Ck	CR 400 West north of CR 250 South	Overtopped by up to about 2', does not prevent access to any structures, flooding starts below the 10-year flood elevation
	Crossing Lane south of CR 200 South	See Denios Ck depth mapping
	CR 225 West south of CR 200 South	See Denios Ck depth mapping
Driftwood River	Vicinity of the Lowell Road and CR 250 West intersection	At a stage of 17 feet (approximately the 50-year flood) portions of both roads are flooded to over 1' deep cutting off access to a few structures north of Lowell Road and others west of CR 250 West and preventing access to the west side of Driftwood River along Lowell Road. Flooding begins between the stages of 15 and 16' (approximately the 10-year) as measured at the Driftwood at Edinburg USGS gage.
	CR 325 West between Lowell Road and SR 46	See Driftwood River depth mapping
EFK White River	Southern Crossing of White River	Approximately 3' deep flooding beginning below the 10-year flood level, flooding of the road approaches does not appear to directly impact the entrance to structures
	Gladstone Avenue south of Clifty Creek	Over 6' flood depths preventing access to approximately 3 sets of structures, up to 3' depths for Clifty Creek flooding, flooding from EFK White River or from Clifty Creek begins at less than 10-year flood levels
	Gladstone Avenue between the RR and Clifty Creek	Road overtops by up to about 7', prevents access to a couple sets of structures when White River floods, a few additional structures are cut off when Clifty Creek floods, flooding begins at less than 10-year levels
Flatrock River	Along National Road between Washington Street and 2000' east of Indianapolis Road	Minor flooding possible at the 500-year flood level, access to adjoining properties becomes flood free before internal access within those properties, impacts access to 2 hazardous material facilities
	CR 400 North between US 31 & River Road	Flood depths of over 3' beginning below the 10-year level.
	CR 550 North between Flatrock River and US 31	Flood depths on road over 7' preventing direct access to about 3 parcels beginning below the 10-year flood elevation
	CR 800 North	See Flatrock River depth mapping
Haw Creek	Along Marr Road from CR400 North to Sawin Drive	Depths over 4' preventing direct access to one or two farmsteads, flooding begins west of Haw Creek at less than the 10-year level

River	General Location	Description of Flood Impacts at 500-Year Flood Levels and Frequency at Which Impacts Begin
Opossum Creek	CR 200 South and CR150 West south and east of their intersection	Flooding of 1 structure less than 2’ deep and 3 structures greater than 2’, CR 150 West is flooded up to 3' from Opossum Creek and up to about 2' from EFK White River, CR 200 South is flooded by up to 1/2' water from Opossum Creek and no flooding from EFK White River, flooding of CR 150 West here in combination with further south prevents access to about 10 residences, flooding along CR 200 South prevents access to 1 residence and to Southside Elementary School from the west, flooding of CR 150 West begins from EFK White River at the 50-year level and from Opossum Creek below the 10-year level, flooding of CR 200 South begins above the 100-year level
Sloan Branch	Talley Road south of Sawin Drive	6 structures flooded to depths less than 2', 2 structures flooded to depths over 2', Talley Road flood depths near 4' prevent access to flooded structures, minor flooding begins near the 10-year level

E-11 POTENTIAL EVACUATION GATHERING PLACES

Potential Evacuation Gathering Places

The following represents potential gathering places where residents evacuating with very short notice can gather as a group to await transportation to a more permanent shelter location. Flooding conditions can vary greatly for each specific flood event. When needed, specific gathering places shall be determined by the FREP Coordinators in coordination with the American Red Cross. Gathering places are needed only when flooding is occurring or imminent and people are escaping on foot with very little advance warning. Gathering places should be coordinated, as possible, with the American Red Cross comfort stations and/or shelters. Evacuations occurring in advance of flooding should direct evacuees to the American Red Cross shelters or designated comfort stations (depending on the expected duration and severity of the flooding).

Neighborhood or Area	Gathering Place Location Options		
	500-year Flood Safe (for use with inclement weather)	500-year Flood Safe (for use with favorable weather)	Lesser Flood Alternate* (for use with inclement weather)
(1) Walesboro Airfield	Columbus Fire Station #6	Columbus Fire Station #6	Jonesville Fire Department
(2) Walesboro	Columbus Fire Station #6	Bartholomew County Landfill	Jonesville Fire Department
(3) Reserved for Future Use			
(4) Bethel Village	Bartholomew County REMC Building	Bartholomew County REMC Building	Bethel Baptist Church
(5) State Road 11 South	New Life Baptist Church		
(6) Shadow Creek Farms	Shadow Creek Farms Clubhouse	Shadow Creek Farms Clubhouse	
(7) Reserved for Future Use			
(8) Huffman Drive/WWTP	County Fairgrounds	County Fairgrounds	Columbus Waste Water Plant
(9) Garden City	Garden City Mobile Home Park	Garden City Mobile Home Park	
(10) Front Door East	Charwood	Charwood	Menards
(11) Front Door West/Westhill	Riverstone Apartments	Riverstone Apartments	INDOT Garage
(12) Reserved for Future Use			
(13) Reserved for Future Use			
(14) Mill Race Park	Not Applicable (park only)		
(15) Tellman Camp Road	As Needed (seasonal residences)		

*** inclement weather locations closer to the affected area that may be appropriate for a less than a 500-year flood event**

Potential Evacuation Gathering Places

Neighborhood or Area	Gathering Place Location Options		
	500-year Flood Safe (for use with inclement weather)	500-year Flood Safe (for use with favorable weather)	Lesser Flood Alternate* (for use with inclement weather)
(16) Indianapolis Road	Lakeview Church of Christ	Lakeview Church of Christ	Any Area Manufacturing Facility
(17) Washington Street	Donner Park	Corner of 15th & Washington Street	
(18) Noblitt Falls	Donner Park	Corner of 20th & Washington Street	
(19) Riverside Drive South	Not Applicable (roadway only)		
(20) Reserved for Future Use			
(21) Commerce Park	Lakeview Church of Christ	US 31 Railroad Bridge	
(22) Long Road	Bethel Wesleyan Church	Bethel Wesleyan Church	
(23) Reserved for Future Use			
(24) Wehmeier/Columbus East	East Columbus Christian Church	Corner of US 31 & Fairview Drive	Columbus East High School
(25) Sandy Hook/Clifty Crossing	Four Seasons	Taylor Road & Lakeside Drive	
(26) Madison/Grant/Flintwood (north of Yellowwood Dr.)	Richards Elementary School	Corner of Chapel & Flintwood Drive	
(26) Madison/Grant/Flintwood (south of Yellowwood Dr.)	Columbus Fire Station #4	Columbus Fire Station #4	Flintwood Wesleyan Church
(27) Eastridge Manor	Calvary Church of the Nazarene	Calvary Church of the Nazarene	
(28) Regency Drive	Smith Elementary School	Corner of Talley Rd. & Kennesaw Tr.	
(29) Water Street	Not Applicable (roadway only)		
(30) Mariah/Reo	Bartholomew County Annex	Corner of State & Hinman Streets	

*** inclement weather locations closer to the affected area that may be appropriate for a less than a 500-year flood event**

Potential Evacuation Gathering Places

Neighborhood or Area	Gathering Place Location Options		
	500-year Flood Safe (for use with inclement weather)	500-year Flood Safe (for use with favorable weather)	Lesser Flood Alternate* (for use with inclement weather)
(31) CEP/Second Street	St. Peters Church	Corner of Sycamore & 3rd Streets	
(32) Tech Center/Pleasant Grove	Foundation for Youth	Corner of Pleasant Grove & McKinley	
(33) 10th and Central	United Way Center	United Way Center	
(34) 17th & Keller	Columbus New Tech High School	Columbus New Tech High School	
(35) CRH	Not Applicable (floodwall protected)		
(36) Midway	Columbus Health & Rehab	Columbus Health & Rehab	
(37) Everroad Park East	Church of the Latter Day Saints	Corner of 30th St. & Marr Rd.	
(38) Everroad Park West	Total Fitness	Corner of US 31 & Brentwood Drive	
(39) Ravenswood	Greenbelt Golf Course Clubhouse	Corner of 17th St. & Gladstone Ave.	
(40) Windsor Place/Hillcrest	St. John's Lodge	Corner of Richland & Briar Drives	
(41) Northbrook	Airport Terminal	Corner of Middle Rd. & Cessna Dr.	
(41) Candlelight	Candlelight Club House	Candlelight Club House	
(42) Sycamore Bend/Arrowood	Rocky Ford Free Methodist Church	Rocky Ford Free Methodist Church	
(43) Reserved for Future Use			
(44) Reserved for Future Use			
(45) North Riverside Drive	Not Applicable (roadway only)		
(46) Griffin Industries	City Hall	City Hall	

*** inclement weather locations closer to the affected area that may be appropriate for a less than a 500-year flood event**

APPENDIX F
POST-FLOOD DAMAGE ASSESSMENT & DATA COLLECTION PROTOCOLS

F-1 SUMMARY OF POST-FLOOD DAMAGE ASSESSMENT
F-2 DATA COLLECTION PROTOCOL
F-3 USGS HIGH-WATER MARK DOCUMENTATION

F-1 SUMMARY OF POST-FLOOD DAMAGE ASSESSMENT

1. EVALUATE DAMAGE TO STRUCTURES
    - EMA – conduct initial assessment using Red Cross form to determine if structure is "Destroyed", "Major Damage", "Minor Damage" or "Affected"
    - EMA – coordinate with Red Cross, IDHS and FEMA on post flood damage assessments for larger flood events
    - EMA - contact IDHS to see if anyone has submitted an online form reporting damage or losses
    - EMA – leave a door hanger that an initial damage assessment has been done. Hanger should include contact information regarding permits
    - EMA – create database and provide it to the Floodplain Manager

2. IDENTIFY DAMAGE AREAS IN SFHA
    - Floodplain Manager – use floodplain maps to identify "Destroyed", "Major Damage", "Minor Damage" (excludes Affected) structures in the SFHA
    - Floodplain Manager – update database with worksheet data

3. DISTRIBUTE OUTREACH MATERIALS
    - County Code Enforcement (with Floodplain Manager support and assistance) – distribute information using the local media; flyers posted at shelters, churches, and city offices; city webpage; E911 mass notification system; etc. This should include policies and procedures for repairs, a checklist, and contact information for building permits.

4. REVIEW PERMIT APPLICATION & VERIFY SFHA STATUS
    - Owner – obtain an estimate to repair to pre-damaged condition (including cost of materials, labor, clean-up, debris removal)
    - County Code Enforcement – on a case-by-case basis, use maps to verify the floodplain status of structures provided by owner (refer to IDNR for all floodway and non-delineated floodplain locations)
    - County Code Enforcement – if structure is not in the SFHA, review permit application and proceed to Step 6

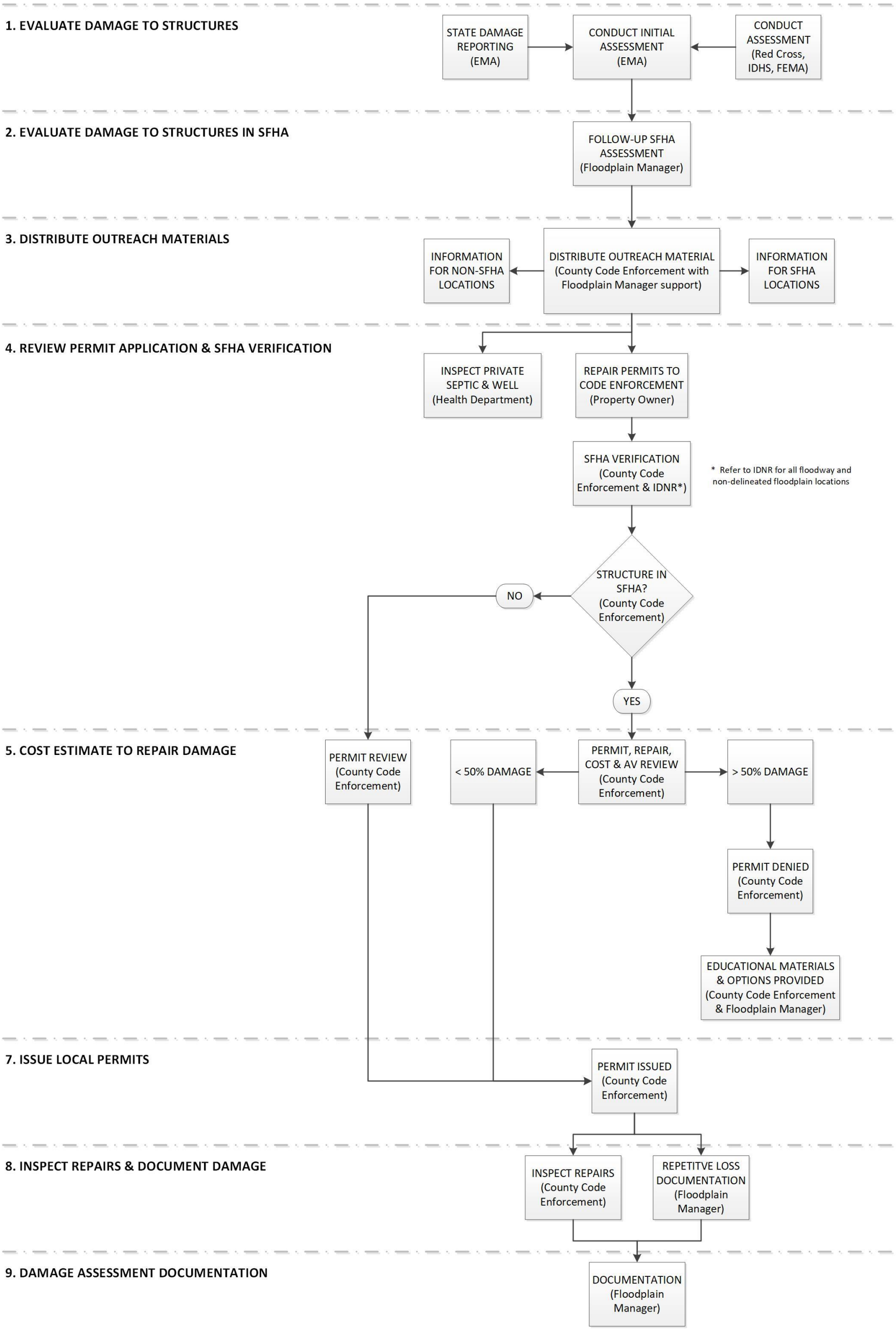
5. COST ESTIMATE TO REPAIR DAMAGE (for structures in the SFHA)
    - County Code Enforcement – determine assessed value of pre-damaged structure
    - County Code Enforcement – determine if there is cumulative damage resulting from past flood damage
    - County Code Enforcement – update database to include cost to repair, assessed value, and cumulated damage amount (if applicable)

6. ISSUE LOCAL PERMITS
    - County Code Enforcement – issue local permits for repairs

7. INSPECT REPAIRS & DOCUMENT DAMAGE
    - County Code Enforcement – conduct inspections of repairs
    - County Code Enforcement – update database with list of permits obtained and work completed
    - Floodplain Manager – update database to document Repetitive Loss status

8. DOCUMENTATION
    - Floodplain Manager – maintain all flood-related records (database and worksheets), depth of flooding documentation (photography, water marks, mapping, etc.) as well as repetitive loss structures.

POST-FLOOD DAMAGE ASSESSMENT FLOW CHART



F-2 POST-FLOOD DATA COLLECTION PROTOCOL

Immediately after a flood event, there is a window of opportunity to gather data that will improve the tools for evaluating future flood risks and possible alternatives to reducing those risks. Potential data to collect includes aerial mapping of the flood at or near its peak crest, setting high water marks, collecting rainfall distribution data, and comparing high water marks and inundated areas with how the risk areas associated with a similar type of an event are delineated on existing FIRMs. The following steps should be taken at the height and immediately after a major flood event:

1. Coordinate Collection of Aerial Photography of the Flooded Areas

Aerial photography provides information on approximate areas affected by the flooding. This data can be used immediately to locate areas needing assistance. They can also be used for improving the FIRMs that are used to regulate development in the floodplain. The more realistic those FIRMS appear the better tool they become. To make the photos valuable in the future, they need to be labeled with the location and a date and time (real time and time in relation to the peak flood elevations) of the photography. It is critical to photograph areas and/ or objects where the "high water" demarcation can be "field surveyed" after the floodwaters recede and crews have time to work such tasks into their schedule. Noting the location and direction of the photos on a map is a useful way of cataloging the pictures. Potential parties that can assist in this matter include, but are not limited to, IDHS, IDNR, aerial photography companies, and local news media.

2. Coordinate Collection of High-Water Marks along the Streams and in Flooded Areas

High water marks indicate peak flood elevations reached during a flood event and are no more than a nail set in a tree, a crow's foot scribed on a bridge abutment, a paint mark on street pavement, or a notation of the distance down or up from some physical feature. The location of the mark is described and a surveyor later ties in the elevation. Consideration should be given to stetting marks upstream and downstream of features such as bridges or other structures that are of interest in regard to their effect on flood elevations. It is extremely important to document the date and time that the high-water mark was set so that post-flood analysis can be performed appropriately. This information is kept on file and used later for a variety of purposes. The main purpose is to calibrate hydraulic models. As an example, the high-water marks set by the USGS and the Bartholomew County Surveyor's Office for the June 2008 flood were invaluable in the development and calibration of a hydraulic model for Haw Creek that was used to evaluate potential flood protection measures.

These high-water marks should, at the very least, be kept on file with the community for use in the future. Additional flood related information such as ground photos, aerial photography, rainfall data, news articles, etc. collected and kept on file could prove useful in the future as well.

Potential parties that can assist in this matter include, but are not limited to, IDNR, USGS, County Surveyor's Office, County Highway Department, and City Engineering and Street Departments. The IDNR has developed standard forms that may be obtained by various

potential data collectors in advance so that the quality and formatting of collected data by various entities is, to the extent possible, compatible.

3. Coordinate Collection and Capture of Data on Observed Rainfall Depths and Patterns

Often, rainfall data can be obtained for a short period from various websites after the rain event but then is lost due to storage space limitations. This data should therefore be obtained soon after the flood and preserved for future reference. Potential websites and data sources for recorded/observed rainfall information associated with a flooding event include, but are not limited to, Indiana COOP data from the National Weather Service website, the Community Collaborative Rain, Hail, & Snow Network (CoCoRaHS) available from CoCoRaHS website, and National Weather Service – NOAA precipitation hourly precipitation radar data and shape files available from the NWS-NOAA website. A copy of the captured data should be printed and kept in files for future use.

4. Coordinate Collection and Capture of AHPS Observed and Forecast Flood Stages

The AHPS observed and, if available, forecast flood stages provide invaluable information on how fast and how high the flood stages reached during a given flood event and how the actual observed stages compared to the predicted flood stages. This data is readily available for a short period of time at the outset, during, and immediately after the flood event for each USGS station from the AHPS website, but then is lost due to storage space limitations. This data (perhaps screen shots of what is seen on the web page) should therefore be captured throughout the flooding event, printed, and kept in files for future use.

5. Compare the Extent of Observed Flooded Areas to FIRMs

Flood events also provide a good opportunity to compare Flood Insurance Rate Map (FIRM) delineations with the actual areas inundated by the flood event. If large discrepancies are found, it could indicate that the mapping used for the floodplain delineation or the data used for the hydraulic or hydrologic modeling were not detailed enough or accurate. Noting differences is good documentation for either showing the need for the community to pursue a Letter of Map Revision or to have documentation to provide to the State for selecting and prioritizing revisions under the current FEMA program to update flood maps.

F-3 USGS HIGH-WATER MARK DOCUMENTATION

USGS has prepared a guidance document called “Identifying and Preserving High Water Mark Data”. The report and a copy of the form to document high-water marks is available at https://pubs.er.usgs.gov/publication/tm3A24.

USGS science for a changing world

U.S. DEPARTMENT OF THE INTERIOR
U.S. Geological Survey

HIGH WATER MARK FORM

Collection Team: _____
Event: _____
Date: _____

Site Visit Summary

STATION ID: _____ STATION NAME: _____

SITE DESCRIPTION: _____ WATERBODY: _____

LAND OWNER: _____ EMAIL: _____

ADDRESS: _____ COUNTY: _____

Party:_____ Start Time(UTC): _____ End Time(UTC): _____ Weather: _____

Site Visit Tasks

☐ Flagging HWMs only ☐ Retrieving flagged HWMs ☐ Levels Ran ☐ Pictures Taken ☐ Site Sketch

Comments:_____

Datum

Horizontal datum: _____ How was it determined: _____ Vertical datum (Arbitrary, NAVD88, NGVD29)

How was it determined:_____

Type of "on-site" Objective Point used to determine HWM elevation(NGSBM, GNSS BM, RM, RP) Elevation: _____

Name(If NGSBM, PID/DES): _____ Description: _____

_____

High Water Mark

HWM Elevation: _____ (+/-): _____ Rated: _____ Environment (coastal, riverine): _____

Type (runup, wave, stillwater): _____ Location (lat/long): _____

How was elevation determined: _____

_____

Description (seed line, debris, mud): _____

_____

Height above ground: _____ Date Flagged: _____ Date Surveyed: _____

Comments:

_____

_____

_____

Site Sketch

N

APPENDIX G
STANDARD OPERATING PROCEDURES

This Appendix is a placeholder of Standard Operating Procedures that are specifically developed as part of the FREP. These may be used to clarify roles and responsibilities or procedures.

APPENDIX H
PAST FREP ACTIVITY

This Appendix is the placeholder for copies of past FREP activities. It includes a suggested outline for After-Action Reports and Tabletop Exercises.

AFTER-ACTION REPORT TEMPLATE

A. FLOOD EVENT OVERVIEW

Narrative summarizing the flood event including an overview of the timeline, amount and duration of precipitation, areas impacted, and response efforts.

B. FLOOD EVENT TIMELINE

Populate the following table to summarize the date, time, and major milestones in the flood response effort.

DATE	TIME	MAJOR MILESTONES IN FLOOD RESPONSE

C. OBSERVED STRENGTHS & AREAS FOR IMPROVEMENT/SUGGESTED ACTIONS

Populate the following table with the observed strengths and areas for improvement for each of the FREP steps.

FREP STEPS	OBSERVED STRENGTHS	AREAS FOR IMPROVEMENT/ SUGGESTED ACTIONS
1. Event Detection, Level Determination and Expected Extent and Severity		
2. Notification and Communication		
3. Expected Actions		
4. Termination and Follow-up		

D. SUMMARY & KEY FINDINGS

Narrative summarizing flood event and key findings.

APPENDIX I
FREP REVIEW, REVISIONS AND RECOMMENDED ENHANCEMENTS

I-1 ANNUAL REVIEW, PERIODIC TEST & REVISIONS

FREP Annual Review

The FREP Coordinator is responsible for conducting an Annual Review of the FREP. This review will include:

A. Confirm that all contact names, email, and phone numbers on the Flood Event Notification flow chart (Appendix D) are accurate.
B. Review FEMA Incident Command System (ICS) Form for ease of use and accuracy of recording actions during a flood event (Appendix B).
C. Update the FREP, as needed with the assistance of the Columbus Fire Chief and the Planning Department Floodplain Administrator
D. Complete the following FREP Annual Review Verification Statement for inclusion in this Appendix.

The FREP Coordinator and Fire Chief are responsible for reviewing the emergency response in the FREP and the Floodplain Manager is responsible for reviewing the flood mapping and post-flood damage assessment.

FREP Periodic Test

The FREP Coordinator is responsible to perform a Periodic Test of the FREP every 3 years. The Periodic Test will consist of a meeting and a table-top exercise. Attendance should include members of the Flood Team and a facilitator. Other organizations involved with a moderate or major flood event are encouraged to participate, at the discretion of the FREP Coordinator. Such organizations may include the Red Cross and NWS.

The table-top exercise will begin with the facilitator presenting a scenario of a moderate or major flood event in one or more streams in the City of Columbus. The scenario will be developed by the FREP Coordinator or the facilitator prior to the exercise. Once the scenario has been presented, the participants will discuss their responses and actions to address and resolve the scenario. The facilitator will control the discussion, ensuring realistic responses and developing the scenario throughout the exercise. As it progresses, the table-top exercise will be recorded using the event log (Appendix B). Participants should each complete the event log as they would during an actual event.

After the table-top exercise, the FREP Coordinator will both lead the group in a discussion on edits and recommendations to improve the FREP. In addition, any other emergency procedures or standard operating procedures can be discussed. If there are no other topics for discussion, then the FREP Coordinator will adjourn the meeting and write a Periodic Test Summary Memorandum for inclusion in this Appendix of the FREP.

Revisions

The FREP Coordinator , working with the Planning Department Floodplain Administrator, is responsible for ensuring that the FREP is revised (updated). When revisions occur, the FREP Coordinator will provide the revised sections to those listed on the FREP Distribution List (Appendix A).

I-2 FREP ANNUAL REVIEW VERIFICATION STATEMENT

Date of Drill: _____

A. All contact names, email, and phone numbers on the Flood Event Notification flow chart (Appendix D) are accurate.
B. The event log is available for use and accuracy of recording actions during a flood event (Appendix B).
C. The FREP has been updated, as needed.
D. The FREP Annual Review procedures were followed.

Additional Comments:

_____ _____

FREP Coordinator Date

_____

Printed name

I-3 RECOMMENDED ENHANCEMENTS TO THE FREP

The following list should be revisited as part of the regular revision to ensure that the full vision of the FREP is eventually achieved.

- The Fire Department should purchase a boat and complete the necessary training for water rescues. This boat is meant to supplement not replace the Sheriff's Water Rescue Team
- The Floodplain Manager should replace paper maps and post-flood damage assessment reporting forms with digital resources (handheld GPS data loggers or laptops) and automatic updates to an Excel-based tracking system
- The Floodplain Manager should work with USGS to expand the current limited interval depth mapping into a library of static maps and/or a dynamic inundation map that would change automatically as the stage height forecast would change.

APPENDIX J
FLOOD HAZARD INFORMATION

The following pages are from the 2017 Bartholomew County Multi-Hazard Mitigation Plan. These pages include important historical flood information, a current vulnerability assessment, as well as the critical and non-critical facilities at risk to flooding.

3.3.4 Flood

Flood: Overview

Floods are the most common and widespread of all natural disasters. Most communities in the United States have experienced some kind of flooding, after spring rains, heavy thunderstorms, or winter snow melts. A flood, as defined by the NFIP, is a general and temporary condition of partial or complete inundation or 2 or more acres of normally dry land area or of 2 or more properties from overflow of inland or tidal waters and unusual and rapid accumulation or runoff of surface waters from any sources, or a mudflow. Floods can be slow or fast rising but generally develop over a period of days.

Flooding and associated flood damages are most likely to occur during the spring because of heavy rains combined with melting snow. However, provided the right saturated conditions, intense rainfall of short duration during summer rainstorms are capable of producing damaging flash flood conditions.

The traditional benchmark for riverine or coastal flooding is a 1% annual chance of flooding, or the 100-year flood. This is a benchmark used by FEMA to establish a standard of flood protection in communities throughout the country. The 1% annual chance flood is referred to as the "regulatory" or "base" flood. Another term commonly used, the "100-year flood", is often incorrectly used and can be misleading. It does not mean that only 1 flood of that size will occur every 100 years. What it actually means is that there is a 1% chance of a flood of that intensity and elevation happening in any given year. In other words, the regulatory flood elevation has a 1% chance of being equaled, or exceeded, in any given year and it could occur more than once in a relatively short time period.

Flood: Recent Occurrences

The NCDC reports that between January 2009 and January 2016, there were 4 flood events (2 floods and 2 flash floods) that resulted in approximately $2.5K in property damages and an additional $0.7K in crop damages. NCDC indicates that during the December 2013 event near Riverview Acres, water came across both sides of the road near the intersection of Marr and Rocky Ford Roads, resulting in approximately $1K in property damages. **Appendix 6** provides the NCDC information regarding flood events that have resulted in injuries, deaths, or monetary damages to property and/or crops.

One of the more recent flooding events, not reported in detail by NCDC, occurred in December of 2013 and affected many areas of the City of Columbus. According to the East Fork White River Stream Gage website, as the river neared 16 feet, "SR 46 at Columbus completely closed from I-65 to Columbus… Also SR 11 south of Columbus closed. In the Walesboro area, at least 10 homes experienced flooding

and Southern Crossing was closed". Some of these areas are those also impacted by the flooding in 2008 (**Figure 3-8**).

Figure 3-8 Flooding in Columbus IN

Stream gages are utilized to monitor surface water elevations and/or discharges at key locations and time periods. Some such gages are further equipped with National Weather Service's Advanced Hydrologic Prediction Service (AHPS) capabilities. These gages have the potential to provide valuable information regarding historical high and low water stages, hydrographs representing current and forecasted stages, and a map of the surrounding areas likely to be flooded. Within Bartholomew County, there are three active USGS stream gages equipped with AHPS capabilities; identified on **Exhibit 2**.

Any property having received two insurance claim payments for flood damages totaling at least $1,000, paid by the NFIP within any 10-year period since 1978 is defined as a repetitive loss property. These properties are important to the NFIP because they account for approximately one-third of the country's flood insurance payments. According to the City of Columbus Planning Department, there are seven properties within the unincorporated area of Bartholomew County considered to be repetitive loss property. The City of Columbus has 17 repetitive loss properties while an additional 5 properties are located within the Town of Edinburgh.

There have been a large number of claims made for damages associated with flooding in Bartholomew County; many of which are related to the 2008 and 2013 flooding events. Within the City of Columbus, there have been 293 paid losses resulting in approximately $10.6M in payments. Further, within the unincorporated areas of the county, there were 171 payments totaling approximately $2.9M. **Table 3-7** identifies the number of claims per NFIP community as well as payments made. Information was not provided specifically for the Town of Jonesville.

Table 3-7 Repetitive Loss Properties, Claims, and Payments

NFIP COMMUNITY	# OF REPETITIVE LOSS PROPERTIES	CLAIMS SINCE 1978	$$ PAID
Bartholomew County	8 (single family)	171	$2.88M
Columbus	20 (18 single family; 2 non-residential)	293	$10.28M
Edinburgh	5 (single family)	45	$1.19M
Hope	0	0	$0
Jonesville	0		
TOTAL	**33**	**509**	**$14.64M**

(IDNR, 2016)
(FEMA Region V, 2016)

Mandatory flood insurance purchase requirements apply to structures in 1% annual chance of flooding delineated areas. Total flood insurance premiums for Bartholomew County and the NFIP communities is approximately $804K. Total flood insurance coverage for Bartholomew County is nearly $173.7M. **Table 3-8** further indicates the premiums and coverage totals for individual NFIP communities. Information was not provided specifically for the Town of Jonesville

Table 3-8 Insurance Premiums and Coverage

NFIP COMMUNITY	FLOOD INSURANCE PREMIUMS	FLOOD INSURANCE COVERAGE
Bartholomew County	$194.0K	$38.9M
Columbus	$537.3K	$124.7M
Edinburgh	$72.3K	$9.4M
Hope	$0.7K	$0.7M
Jonesville		
TOTAL	**$804K**	**$173.7M**

(IDNR, 2015)

As determined by the Committee, the probability of a flood occurring throughout Bartholomew County ranges from "Unlikely" in Hope; "Possible" in Columbus; and "Likely" within the County, Edinburgh, and Jonesville. Impacts from such an event are anticipated to range from "Negligible" to "Limited". The Committee also determined that the warning time would vary based on proximity to warning measures and local streams, and that the duration of such an event is anticipated to last less than 1 week for most areas. A summary is shown in **Table 3-9**.

Table 3-9 CPRI for Flood

	PROBABILITY	MAGNITUDE /SEVERITY	WARNING TIME	DURATION	CPRI
Bartholomew County	**Likely**	**Limited**	**6-12 Hours**	**< 1 Week**	**Elevated**
City of Columbus	**Possible**	**Negligible**	**12-24 Hours**	**< 1 Week**	**Low**
Town of Edinburgh	**Likely**	**Limited**	**12-24 Hours**	**< 1 Week**	**Elevated**
Town of Hope	**Unlikely**	**Negligible**	**>24 Hours**	**< 6 Hours**	**Low**
Town of Jonesville	**Likely**	**Limited**	**12-24 Hours**	**< 1 Week**	**Elevated**

As mentioned within this section, there is a 1% chance each year that the regulatory flood elevation will be equaled or exceeded and these types of events may occur more than once throughout each year. Further, based on information provided by the USGS/NWS stream gages, the NCDC, and previous experiences, the Committee determined that flooding is "Unlikely" to "Likely" throughout the county.

Flood: Assessing Vulnerability

Flood events may affect large portions of Bartholomew County at one time as large river systems and areas with poor drainage cover much of the county and several

communities. Within Bartholomew County, direct and indirect effects of a flood event may include:

Direct Effects:

- Structural and content damages and/or loss of revenue for properties affected by increased water
- Increased costs associated with additional response personnel, evacuations, and sheltering needs

Indirect Effects:

- Increased response times for emergency personnel if roads are impassable
- Increased costs associated with personnel to carry out evacuations in needed areas
- Increased risk of explosions and other hazards associated with floating propane tanks or other debris
- Losses associated with missed work or school due to closures or recovery activities
- Cancellations of special events in impacted areas or water related activities that become too dangerous due to high water

Estimating Potential Losses

Critical and non-critical structures located in regulated floodplains, poorly drained areas, or low lying areas (**Figure 3-9**) are most at risk for damages associated with flooding. For this planning effort, a GIS Desktop Analysis methodology was utilized to estimate flood damages.

Figure 3-9 Car Submerged on Flooded Street

For the GIS Desktop Analysis method, an analysis was completed utilizing the effective Digital FIRMs (DFIRMs) overlaid upon the Modified Building Inventory provided by Bartholomew County and structures located within each flood zone were tallied using GIS analysis techniques.

The Modified Building Inventory was created in ESRI ArcGIS by converting parcels to centroids, and joining Assessor Data to these centroids. Assessor data included square footage for the structure, and any structure that was listed as less than 400 ft² in area or was classified in the Assessor's database as a non-habitable structure was assumed to be an outbuilding. Also, buildings with an assessed value of $0.00 or buildings that did not match the Assessor Data (parcel numbers did not match) were excluded from the analysis. Replacement values were calculated using:

Residential = Assessed Value x 0.5

Commercial = Assessed Value x 1.0
Industrial = Assessed Value x 1.5
Agricultural = Assessed Value x 1.0
Education = Assessed Value x 1.0
Government = Assessed Value x 1.0
Religious = Assessed Value x 1.0

The resulting Modified Building Inventory was used in the GIS analyses.

In order to estimate anticipated damages associated with each flood in Bartholomew County and NFIP communities, it was estimated that 25% of structures in the flood zones would be destroyed, 35% of structures would be 50% damaged, and 40% of structures would be 25% damaged. **Table 3-10** identifies the estimated losses associated with structures in the floodway, the 100-year floodplain, and the 500-year floodplain areas by NFIP community within Bartholomew County.

Table 3-10 Manual GIS Analysis Utilizing Most Recent Preliminary DFIRM Data and Bartholomew County Building Inventory

	FLOODWAY		1%		0.2%		UNNUMBERED	
	#	$	#	$	#	$	#	$
Bartholomew County	323	$21.3M	692	$44.6M	487	$31.6M	655	$41.7M
Columbus	163	$20.2M	721	$64.0M	612	$52.9M	122	$6.9M
Edinburgh	0	0	88	$5.6M	0	0	0	0
Hope	1	$0.06M	4	$0.4M	1	$0.06M	0	0
Jonesville	0	0	0	0	0	0	0	0
Total	**487**	**$41.6M**	**1,504**	**$114.6M**	**1,100**	**$84.6M**	**778**	**$48.6M**

Structures and damages within each zone are not inclusive

Utilizing the same GIS information and process, **Table 3-11** identifies the number of critical infrastructure within each of the Special Flood Hazard Areas (SFHA) in Bartholomew County. These buildings are included in the overall number of structures and damage estimate information provided in Table 3-7.

Table 3-11 Critical Infrastructure in SFHA by NFIP Community

NFIP COMMUNITY	FLOODWAY	1%	0.2%	UNNUMBERED
Bartholomew County	Driftside Mobile Home Park	German TWP VFD	Jonesville VFD Growers Farm Service	Grandview Lake Dam Grandview WWTP Hillview Estates WWTP Indian Lake Dam Kindred Lake Dam Lutheran Lake Dam Schaffer Lake Dam
Columbus	Candlelight Village Griffin Industries Speedway #5521 ZAYO Columbus	AK Tube, LLC Faurecia Emissions Mariah Foods, Inc SW Bartholomew Water WHUM Radio Station	Columbus Container Columbus Headend & Warehouse VFD Station 1 Cummins Tech Ctr INDOT Columbus Little Lambs Child Care Ministry Red Cross Office Sam's Club #4926	
Edinburgh				
Hope				
Jonesville				

Utilizing the information in Table 3-7 regarding the number of structures within each Flood Hazard Area, it is also important to note the number of flood insurance policies within each NFIP area in Bartholomew County. **Table 3-12** provides the comparison between the number of structures in the SFHA and the number of flood insurance policies. It is also important to note that flood insurance is voluntary unless the property owner carries a federally subsidized mortgage; insurance coverage may be discontinued when the mortgage is completed.

Table 3-12 Number of Structures in the SFHA and Number of Flood Insurance Policies

NFIP COMMUNITY	# STRUCTURES IN SFHA	# POLICIES
Bartholomew County	2,157	246
Columbus	1,618	536
Edinburgh	88	74
Hope	6	2
Jonesville	0	
Total	**3,869**	**858**

(IDNR, 2016)

Future Considerations

As the municipalities within Bartholomew County continue to grow in population, it can be anticipated that the number of critical and non-critical infrastructure will also increase accordingly. Location of these new facilities should be carefully considered and precautions should be encouraged to ensure that school, medical facilities, community centers, municipal buildings, and other critical infrastructure are located outside the 0.2% annual chance (500-year) floodplain and/or are protected to that level along with a flood-free access to reduce the risk of damages caused by flooding and to ensure that these critical infrastructure will be able to continue functioning during major flood events.

It is also important to ensure that owners and occupants of residences and businesses within the known hazard areas, such as delineated or approximated flood zones, are well informed about the potential impacts from flooding incidents as well as proper methods to protect themselves and their property.

Despite these efforts, the overall vulnerability and monitory value of damages is expected to increase in the area unless additional measures, such as those discussed later in Chapter 4 of this report, are implemented.

Indirect effects of flooding may include increased emergency response times due to flooded or redirected streets (**Figure 3-10**), the danger of dislodged and floating propane tanks causing explosions, and the need for additional personnel to carry out the necessary evacuations. Additional effects may include sheltering needs for those evacuated, and the loss of income or revenue related to business interruptions. As many communities within Bartholomew County are closely tied to the river systems, special events occurring near to or on these rivers and waterways may be cancelled or postponed during periods of flooding or high water levels.

Flood: Relationship to Other Hazards

While flooding creates social, physical, and economic losses, it may also cause other hazards to occur. For example, flooding may increase the potential for a hazardous materials incident to occur. Above ground storage facilities may be toppled or become loosened and actually migrate from the original location. In less severe situations, the materials commonly stored in homes and garages such as oils, cleaners, and de-greasers, may be mobilized by flood waters. Should access roads to hazardous materials handlers become flooded, or if bridges are damaged by flood waters, response times to more significant incidents may be increased, potentially increasing the damages associated with the release.

Figure 3-10 Fire Engine in Flood Waters

Increased volumes of water during a flood event may also lead to a dam failure. As the water levels rise in areas protected by dams, at some point, these structures will over-top or will breach leading to even more water released. These two hazards, flood and dam failure, when combined, may certainly result in catastrophic damages.

In a similar fashion, a snow storm or ice storm can also lead to flooding on either a localized or regional scale. When a large amount of snow or ice accumulates, the potential for a flood is increased. As the snow or ice melts, and the ground becomes saturated or remains frozen, downstream flooding may occur. Ice jams near bridges and culverts may also result in flooding of localized areas and potentially damage the bridge or culvert itself.

Flooding in known hazard areas may also be caused by dams that experience structural damages or failures not related to increased volumes or velocities of water. These "sunny day failures", while not typical, may occur wherever these structures exist.