Numerical Models Accepted by FEMA for NFIP Usage

(Nationally Accepted Models)

TYPE	PROGRAM	DEVELOPED BY	AVAILABLE FROM	COMMENTS	Public Domain[1]?
Coastal Models:					
Coastal Storm Surges	FEMA Surge (1988)	Tetra Tech, Inc.; Engineering Methods & Applications (now Watershed Concepts); Greenhorne & O'Mara; Camp, Dresser & McKee, Inc.	Dewberry, Federal Programs 8401 Arlington Blvd. Fairfax, VA 22031	Incorporates modified NWS-23 model for hurricanes and Joint Probability Method. Reportedly more accurate for water elevations than water currents.	Yes
	Advanced Circulation Model (ADCIRC) 2DDI (2003)	Johannes Westerink, University of Notre Dame and Rick Luettich, University of North Carolina at Chapel Hill, Institute of Marine Sciences for USACE Coastal and Hydraulics Laboratory	Nick Krauss Coastal and Hydraulics Laboratory 3909 Halls Ferry Road Vicksburg, MS 39180-6199 Also can be purchased from software vendors as a component of SWM.	Finite element 2-D hydrodynamic model; the version 2DDI is vertically-integrated and solves a vertically-integrated continuity equation for water surface elevation; no storm or hurricane windfield models or statistical analysis tools are included with model, they must be acquired separately; ADCIRC performs well using Vince Cardone's planetary boundary layer model windfields; statistical analyses using ADCIRC model storm surge simulations are compatible with the USACE Empirical Simulation Technique (EST) as well as joint probability methods.	Yes for flood insurance study purposes
	ODISTIM (1975)	Coastal Consultants, Inc.	Dewberry, Federal Programs 8401 Arlington Blvd. Fairfax, VA 22031	Computes wind-driven surges propagating in estuaries or rivers described by one-dimensional elements; only for northeasters since wind direction is fixed.	Yes
	Northeaster Model (1978)	Stone & Webster Engineering Corp.	Dewberry, Federal Programs 8401 Arlington Blvd. Fairfax, VA 22031	Accommodates asymmetrical geometry for extratropical storms but requires separate program to compute resultant coastal surge for winds and pressures.	Yes
	FLOW2D (1975)[2]	Resource Analysis, Inc.	Camp, Dresser, & McKee, Inc. Ten Cambridge Center Cambridge, MA 02142	Unsteady flood flow for estuaries and floodplains, but no direct wind effects are considered.	No
	TABS RMA2 v. 4.3 (October 1996)	U.S. Army Corps of Engineers	Coastal and Hydraulics Laboratory 3909 Halls Ferry Road Vicksburg, MS 39180-6199	Two-dimensional steady/unsteady flow model, for water levels and velocities. Computes finite element solution of the Reynolds form of the Navier-Stokes equations for turbulent flows.	Yes
	MIKE 21 HD/NHD 2002 D	DHI Water and Environment	DHI Inc. 301 South State Street Newton, PA 18940	Solves the non-linear depth-averaged equations of continuity and conservation of momentum. Computes water levels and flows based on a variety of forcing functions. Can include wave-driven currents and setup. Uses a finite difference grid with dynamic nesting grid capabilities. Directly resolving small scale features such as narrow inland channels may result in a large computational costs.	No
	DYNLET	U.S. Army Corps of Engineers	Coastal and Hydraulics Laboratory 3909 Halls Ferry Road Vicksburg, MS 39180-6199	One-dimensional model of dynamic behavior of tidal flow at inlets. Can be used to predict tide dominated velocities and water level fluctuations at an inlet and interior back bay system. DYNLET solves the full one-dimensional shallow water equations using an implicit finite difference solution.	Yes
Coastal Wave Heights	WHAFIS 3.0 (1988)	Dames & Moore (now URS) revised by Greenhorne & O'Mara	Dewberry, Federal Programs 8401 Arlington Blvd. Fairfax, VA 22031	Defines wave heights associated with 100-year flood in coastal areas using modern wave action treatment; incorporates 1977 NAS recommendations on basic approximations for wind speeds, wave breaking criterion, and controlling wave height.	Yes
	WHAFIS 3.0 GL (1993)	Dames & Moore (now URS), Greenhorne & O'Mara, Dewberry & Davis LLC	Dewberry, Federal Programs 8401 Arlington Blvd. Fairfax, VA 22031	Identical wave treatments as WHAFIS 3.0, but with programmed reduction of wind speeds for U.S. shorelines of the Great Lakes.	Yes

[1]Public domain models are available from source with nominal fee for reproducing, shipping and handling. [2]This model is acceptable for coastal storm surge applications only.

Numerical Models Accepted by FEMA for NFIP Usage

(Nationally Accepted Models)

TYPE	PROGRAM	DEVELOPED BY	AVAILABLE FROM	COMMENTS	Public Domain?
Coastal Models (cont'd):					
Coastal Wave Heights	RCPWAVE (1986)	U.S. Army Corps of Engineers	Coastal and Hydraulics Laboratory 3909 Halls Ferry Road Vicksburg, MS 39180-6199	Treats linear, monochromatic waves propagating over grid giving coastal bathymetry, providing nearshore wave heights pertinent to proper spacing between transects or to magnitudes of wave setup.	Yes
	CHAMP 1.1 (2002)	Dewberry & Davis LLC	Dewberry, Federal Programs 8401 Arlington Blvd. Fairfax, VA 22031 http://www.fema.gov/mit/tsd/frm_soft.htm	Coastal Hazard Analysis Modeling Program (CHAMP) is a Windows-based program used for wave height analyses (enhanced WHAFIS 3.0 functionality) and provides summary tables and graphics for mapping.	Yes
	MIKE 21 Offshore Spectral Wave Model (OSW) 2002 D	DHI Water and Environment	DHI Inc. 301 South State Street Newton, PA 18940	Two-dimensional dynamic wind-wave growth model. Discretizes spectrum in frequency and direction. Does not include breaking. Appropriate for providing regional wave conditions in deep and intermediate depths, providing boundary data for nearshore modeling or basic analysis.	No
	MIKE 21 Nearshore Spectral Wave Model (NSW) 2002 D	DHI Water and Environment	DHI Inc. 301 South State Street Newton, PA 18940	Two-dimensional stationary model for propagation of waves into the nearshore zone (refraction, shoaling, breaking, bed friction, and wind-wave growth). Based on the conservation equation for the spectral wave action density; similar to HISWA model. Obstructions not directly resolvable in the grid, must be modeled with grid bed roughness coefficients.	No
Coastal Wave Effects	RUNUP 2.0 (1990)	Stone & Webster Engineering Corp., revised by Dewberry & Davis	Dewberry, Federal Programs 8401 Arlington Blvd. Fairfax, VA 22031 http://www.fema.gov/mit/tsd/frm_soft.htm	Executes 1978 guidance by USACE defining wave runup on shore barrier with specified approach and storm conditions; mean wave description determines mean runup elevation.	Yes
	GLWRM (1992)	U.S. Army Corps of Engineers	Department of the Army Detroit District, Corps of Engineers 477 Michigan Avenue Detroit, MI 48266	Developed particularly to analyze wave runup for the three types of situations most frequently encountered on U.S. shorelines of the Great Lakes: sand beach, sloping riprap revetment, and vertical wall.	Yes
	ACES 1.07 (1992)	U.S. Army Corps of Engineers	Coastal and Hydraulics Laboratory 3909 Halls Ferry Road Vicksburg, MS 39180-6199	Used for restricted fetch wave growth analysis and runup on vertical structures or revetments.	Yes
	CHAMP 1.1 (2002)	Dewberry & Davis LLC	Dewberry, Federal Programs 8401 Arlington Blvd. Fairfax, VA 22031 http://www.fema.gov/mit/tsd/frm_soft.htm	CHAMP is a Windows-based program used for storm-induced erosion treatments (enhanced EROSION functionality) and wave runup analyses (enhanced RUNUP 2.0), and provides summary tables and graphics for mapping.	Yes

Numerical Models Accepted by FEMA for NFIP Usage

(Nationally Accepted Models)

TYPE	PROGRAM	DEVELOPED BY	AVAILABLE FROM	COMMENTS	Public Domain?
Hydrologic Models: Determination of Flood Hydrographs					
Single Event	HEC-1 4.0.1 and up[1] (May 1991)	U.S. Army Corps of Engineers	Water Resources Support Center[2] Corps of Engineers Hydrologic Engineering Center (HEC) 609 Second Street Davis, CA 95616-4687	Flood hydrographs at different locations along streams. Calibration runs preferred to determine model parameters.	Yes
	HEC-HMS 1.1 and up (March 1998)	U.S. Army Corps of Engineers	U.S. Army Corps of Engineers Hydrologic Engineering Center 609 Second Street Davis, CA 95616-4687 http://www.hec.usace.army.mil/	The Hydrologic Modeling System provides a variety of options for simulating precipitation-runoff processes. It has a capability to use gridded rainfall data to simulate runoff. It does not provide snowmelt and snowfall functions; it cannot be used for areas where snowmelt is an important flood hazard source and must be considered in estimation of flood discharges.	Yes
	TR-20 (February 1992)	U.S. Department of Agriculture, Natural Resources Conservation Service	U.S. Department of Commerce National Technical Information Service 5285 Port Royal Road Springfield, VA 22161	Flood hydrographs at different locations along streams. Calibration runs preferred to determine model parameters.	Yes
	TR-55 (June 1986 and up)	U.S. Department of Agriculture, Natural Resources Conservation Service	U.S. Department of Commerce National Technical Information Service 5285 Port Royal Road Springfield, VA 22161 http://www.wcc.nrcs.usda.gov/water/quality/common/tr55/tr55.html	Peak discharges and flood hydrographs at a single location.	Yes
	SWMM (RUNOFF) 4.30 (May 1994), and 4.31 (January 1997)	U.S. Environmental Protection Agency and Oregon State University	Center for Exposure Assessment Modeling U.S. Environmental Protection Agency Office of Research and Development Environmental Research Laboratory 960 College Station Road Athens, GA 30605-2720 http://www.epa.gov/ceampubl/swater/ Department of Civil, Construction, and Environmental Engineering Oregon State University 202 Apperson Hall Corvallis, OR 97331-2302 http://www.ccee.orst.edu/swmm/ ftp://ftp.engr.orst.edu/pub/swmm/pc	Calibration or verification to the actual flood events highly recommended.	Yes

[1]The enhancement of these programs in editing and graphical presentation can be obtained from several private companies.
[2] Program is typically distributed by vendors and may not be available through HEC. A list of vendors may be obtained through HEC.

Numerical Models Accepted by FEMA for NFIP Usage

(Nationally Accepted Models)

TYPE	PROGRAM	DEVELOPED BY	AVAILABLE FROM	COMMENTS	Public Domain?
Hydrologic Models: Determination of Flood Hydrographs (cont'd)					
Single Event	MIKE 11 UHM (June 1999 and 2002 D)	DHI Water and Environment	DHI Inc. 301 South State Street Newton, PA 18940	Simulates flood hydrographs at different locations along streams using unit hydrograph techniques. Three methods are available for calculating infiltration losses and three methods for converting rainfall excess to runoff, including SCS Unit hydrograph method. The web page is at: http://www.dhisoftware.com/mike11/Description/RR_module.htm	No
	DBRM 3.0 (1993)	Bernard L. Golding, P.E. Consulting Water Resources Engineer Orlando, FL	Center for Microcomputers in Transportation (McTrans) University of Florida 512 Weil Hall Gainesville, FL 32611-6585	Flood hydrographs at different locations along streams. Calibration runs preferred to determine model parameters.	No
	HYMO	U.S. Department of Agriculture, Natural Resources Conservation Service	U.S. Department of Commerce National Technical Information Service 5285 Port Royal Road Springfield, VA 22161	Flood hydrographs at different locations along streams. Calibration runs preferred to determine model parameters.	Yes
	PondPack v. 8 (May 2002) and up	Haestad Methods, Inc.	Haestad Methods, Inc. 37 Brookside Road Waterbury, CT 06708-1499 http://www.haestad.com	The program is for analyzing watershed networks and aiding in sizing detention or retention ponds. Only the NRCS Unit Hydrograph method and NRCS Tc calculation formulas are acceptable. Other hydrograph generation methods or Tc formulas approved by State agencies in charge of flood control or floodplain management are acceptable for use within the subject State.	No
	XP-SWMM 8.52 and up	XP Software	XP-Software, 2000 NE 42nd Ave. #214 Portland, OR 97213-1305 http://www.xpsoftware.com	Model must be calibrated to observed flows, or discharge per unit area must be shown to be reasonable in comparison to nearby gage data, regression equations, or other accepted standards for 1% annual chance events.	No

Numerical Models Accepted by FEMA for NFIP Usage
(Nationally Accepted Models)

TYPE	PROGRAM	DEVELOPED BY	AVAILABLE FROM	COMMENTS	Public Domain?
Hydrologic Models: Determination of Flood Hydrographs (cont'd)					
Continuous Event	DR3M (October 1993)	U.S. Geological Survey	U.S. Geological Survey National Center 12201 Sunrise Valley Drive Reston, VA 22092	Calibration to actual flood events required. The web page is at: http://water.usgs.gov/software/surface_water.html	Yes
	HSPF 10.10 and up (December 1993)	U.S. Environmental Protection Agency, U.S. Geological Survey	Center for Exposure Assessment Modeling U.S. Environmental Protection Agency Office of Research and Development Environmental Research Laboratory 960 College Station Road Athens, GA 30605-2720	Calibration to actual flood events required. The web page is at: http://water.usgs.gov/software/surface_water.html	Yes
	MIKE 11 RR (June 1999 and 2002 D)	DHI Water and Environment	DHI Inc. 301 South State Street Newton, PA 18940	The Rainfall-Runoff Module (RR, formerly NAM) is a lumped-parameter hydrologic model capable of continuously accounting for water storage in surface and sub-surface zones. Flood hydrographs are estimated at different locations along streams. Calibration to actual flood events is required. The web page is at: http://www.dhisoftware.com/mike/Description/RR_module.htm	No
	PRMS Version 2.1 (January 1996)	U.S. Geological Survey	U.S. Geological Survey 12201 Sunshine Valley Drive Reston, VA 22092 http://water.usgs.gov/software/surface_water.html U.S. Geological Survey P.O. Box 25046, Mail Stop 412 Denver Federal Center Lakewood, CO 80225-0046 http://wwwbrr.cr.usgs.gov/mms	PRMS is a modular-designed, deterministic, distributed-parameter modeling system that can be used to estimate flood peaks and volumes for floodplain mapping studies. Calibration to actual flood events required. The program can be implemented within the Modular Modeling System (MMS) that facilitates the user interface with PRMS, input and output of data, graphical display of the data, and an interface with GIS.	Yes
Interior Drainage Analysis	HEC-IFH 1.03 and up	U.S. Army Corps of Engineers	U.S. Army Corps of Engineers Hydrologic Engineering Center 609 Second Street Davis, CA 95616-4687	Provides both continuous simulation and hypothetical event analyses. Coincidence frequency analysis (not included in the model) may be needed for some cases. Supporting documentation is available at: http://www.fema.gov/mit/tsd/dl_ifh.htm	Yes

Numerical Models Accepted by FEMA for NFIP Usage

(Nationally Accepted Models)

TYPE	PROGRAM	DEVELOPED BY	AVAILABLE FROM	COMMENTS	Public Domain?
Statistical Models:					
	HEC FFA 3.1 (February 1995)	U.S. Army Corps of Engineers	Water Resources Support Center[1] Corps of Engineers Hydrologic Engineering Center 609 Second Street Davis, CA 95616-4687	Performs flood frequency analyses following *Bulletin 17B, Guidelines for Determining Flood Flow Frequency*, prepared by the Interagency Advisory Committee on Water Data (1982). Supersedes HECWRC.	Yes
	PEAKFQ 2.4 and up	U.S. Geological Survey	U.S. Geological Survey Hydrologic Analysis Software Support Team 437 National Center Reston, VA 20192 http://water.usgs.gov/software/surface_water.html	Performs flood frequency analyses following *Bulletin 17B, Guidelines for Determining Flood Flow Frequency*, prepared by the Interagency Advisory Committee on Water Data (1982).	Yes
	FAN	FEMA	Michael Baker, Jr., Inc. 3601 Eisenhower Avenue, Suite 600 Alexandria, VA 22304	Determines depth and velocity zones over alluvial fans.	Yes

[1]Program is typically distributed by vendors and may not be available through HEC. A list of vendors may be obtained through HEC.

Numerical Models Accepted by FEMA for NFIP Usage

(Nationally Accepted Models)

TYPE	PROGRAM	DEVELOPED BY	AVAILABLE FROM	COMMENTS	Public Domain?
Hydraulic Models: Determination of Water-surface Elevations for Riverine Analysis					
One-dimensional Steady Flow Models	HEC-RAS 3.0 and 3.1	U.S. Army Corps of Engineers	Water Resources Support Center Corps of Engineers Hydrologic Engineering Center 609 Second Street Davis, CA 95616-4687 http://www.hec.usace.army.mil/	Under rare circumstances, for bridges with low flow, and weir flow on the overbanks, HEC-RAS 3.0 may not be able to balance the flow using weir flow equation and low flow bridge analysis methods. HEC-RAS 3.0 will then use the energy method, and the computed energy grade elevations and water-surface elevations may be on the high side.	Yes
	HEC-2 4.6.2[1] (May 1991)	U.S. Army Corps of Engineers	Water Resources Support Center[2] Corps of Engineers Hydrologic Engineering Center 609 Second Street Davis, CA 95616-4687	Includes culvert analysis and floodway options.	Yes
	WSPRO (June 1988 and up)	U.S. Geological Survey, Federal Highway Administration (FHWA)	Federal Highway Administration (FHWA) web page at: http://www.fhwa.dot.gov/bridge/hyddescr.htm	Floodway option is available in June 1998 version. 1988 version is available on the USGS web page at: http://water.usgs.gov/software/surface_water.html	Yes
	QUICK-2 1.0 and up (January 1995)	FEMA	Federal Emergency Management Agency Hazard Identification Branch Mitigation Directorate 500 C Street, SW Washington, DC 20472	Intended for use in areas studied by approximate methods (Zone A) only. May be used to develop water-surface elevations at one cross section or a series of cross sections. May not be used to develop a floodway.	Yes
	HY8 4.1 and up (November 1992)	U.S. Department of Transportation, Federal Highway Administration (FHWA)	Federal Highway Administration (FHWA) web page at: http://www.fhwa.dot.gov/bridge/hyddescr.htm	Computes water-surface elevations for flow through multiple parallel culverts and over the road embankment.	Yes
	WSPGW 12.96 (October 2000)	Los Angeles Flood Control District and Joseph E. Bonadiman & Associates, Inc.	Joseph E. Bonadiman & Associates, Inc. 588 West 6th Street San Bernardino, CA 92410 http://www.bonadiman.com	Windows version of WSPG. Computes water-surface profiles and pressure gradients for open channels and closed conduits. Can analyze multiple parallel pipes. Road overtopping cannot be computed. Open channels are analyzed using the standard step method but roughness coefficient can not vary across the channel. Overbank analyses cannot be done. Multiple parallel pipe analysis assumes equal distribution between pipes so pipes must be of similar material, geometry, slope, and inlet configuration. Floodway function is not available. Demo version available from: http://www.civildesign.com	No
	StormCAD v. 4 (June 2002) and up	Haestad Methods, Inc.	Haestad Methods, Inc. 37 Brookside Road Waterbury, CT 06708-1499 http://www.haestad.com	Perform backwater calculations. Should not be used for systems with more than two steep pipes (e.g. supercritical conditions). Inflow is computed by using the Rational Method; the program is only applicable to watershed which has the drainage area to each inlet less than 300 acres.	No
	PondPack v. 8 (May 2002) and up	Haestad Methods, Inc.	Haestad Methods, Inc. 37 Brookside Road Waterbury, CT 06708-1499 http://www.haestad.com	Cannot model ineffective flow areas. HEC-RAS or an equivalent program must be used to model tail water conditions when ineffective flow areas must be considered.	No
	Culvert Master v. 2.0 (September 2000) and up	Haestad Methods, Inc.	Haestad Methods, Inc. 37 Brookside Road Waterbury, CT 06708-1499 http://www.haestad.com	Compute headwater elevations for circular concrete and RCB culverts for various flow conditions.	No

[1]The enhancement of these programs in editing and graphical presentation can be obtained from several private companies.
[2]Program is typically distributed by vendors and may not be available through HEC. A list of vendors may be obtained through HEC.

Numerical Models Accepted by FEMA for NFIP Usage
(Nationally Accepted Models)

TYPE	PROGRAM	DEVELOPED BY	AVAILABLE FROM	COMMENTS	Public Domain?
Hydraulic Models: Determination of Water-surface Elevations for Riverine Analysis (cont'd)					
One-dimensional Steady Flow Models	XP-SWMM 8.52 and up	XP Software	XP-Software, 2000 NE 42nd Ave. #214 Portland, OR 97213-1305 http://www.xpsoftware.com	XP-SWMM cannot represent more than three Manning's n values per channel section. Where more than this number of values per section are required, the user must demonstrate that the three n values used accurately depict the composite n value for the entire section at various depth.	No

Numerical Models Accepted by FEMA for NFIP Usage

(Nationally Accepted Models)

TYPE	PROGRAM	DEVELOPED BY	AVAILABLE FROM	COMMENTS	Public Domain?
Hydraulic Models: Determination of Water-surface Elevations for Riverine Analysis (cont'd)					
One-dimensional Unsteady Flow Models	HEC-RAS 3.0 and up	U.S. Army Corps of Engineers	Water Resources Support Center Corps of Engineers Hydrologic Engineering Center (HEC) 609 Second Street Davis, CA 95616-4687 http://www.hec.usace.army.mil/	Calibration or verification to the actual flood events highly recommended. Floodway concept formulation unavailable. Version 3.1 cannot create detail output for multiple profiles in the report file. CHECK-RAS cannot extract data.	Yes
	FEQ 8.92 and FEQUTL 4.68 (1997, both)	Delbert D. Franz, Linsley, Kraeger Associates; and Charles S. Melching, USGS	U.S. Geological Survey 221 North Broadway Avenue Urbana, IL 61801 http://water.usgs.gov/software/surface_water.html and technical support available at http://www-il.usgs.gov/proj/feq/	The FEQ model is a computer program for the solution of full, dynamic equations of motion for one-dimensional unsteady flow in open channels and control structures. The hydraulic characteristics for the floodplain (including the channel, overbanks, and all control structures affecting the movement of flow) are computed by its companion program FEQUTL and used by the FEQ program. Calibration or verification to the actual flood events highly recommended. Type 5 culvert flow computations of FEQUTL need verification with results obtained using methodology or models accepted for NFIP use. Floodway concept formulation is unavailable.	Yes
	ICPR 2.20 (October 2000), and 3.02 (November 2002)	Streamline Technologies, Inc.	Streamline Technologies, Inc. 6961 University Boulevard Winter Park, FL 32792 www.streamnologies.com	Calibration or verification to the actual flood events highly recommended. Floodway concept formulation unavailable; however, version 3 allows user to specify encroachment stations to cut off the cross section.	No
	SWMM 4.30 (May 1994), and 4.31 (January 1997)	U.S. Environmental Protection Agency and Oregon State University	Center for Exposure Assessment Modeling U.S. Environmental Protection Agency Office of Research and Development Environmental Research Laboratory 960 College Station Road Athens, GA 30605-2720 http://www.epa.gov/ceampubl/swater/ Department of Civil, Construction, and Environmental Engineering Oregon State University 202 Apperson Hall Corvallis, OR 97331-2302 http://www.ccee.orst.edu/swmm/ ftp://ftp.engr.orst.edu/pub/swmm/pc	Calibration or verification to the actual flood events highly recommended. Structural loss calculations unavailable and must be accommodated via roughness factor manipulation. Floodway concept formulation unavailable. Preferably, for NFIP purposes, head losses at bridges should be verified using WSPRO; losses at culverts should be verified using the U.S. Geological Survey's six equations for culvert analysis. Losses at storm sewer junctions should also be verified with separate calculations; contact FEMA for guidance with these calculations. Supporting documentation for floodway calculations is available at: http://www.fema.gov/mit/tsd/dl_swmm.htm	Yes
	UNET 4.0 (April 2001)	U.S. Army Corps of Engineers	Water Resources Support Center Corps of Engineers Hydrologic Engineering Center (HEC) 609 Second Street Davis, CA 95616-4687	Calibration or verification to the actual flood events highly recommended. Comparison of bridge and culvert modeling to other numerical models reveals significant differences in results; these differences may be investigated in the near future. Floodway option is not accepted for NFIP usage.	Yes

Numerical Models Accepted by FEMA for NFIP Usage

(Nationally Accepted Models)

TYPE	PROGRAM	DEVELOPED BY	AVAILABLE FROM	COMMENTS	Public Domain?
Hydraulic Models: Determination of Water-surface Elevations for Riverine Analysis (cont'd)					
One-dimensional Unsteady Flow Models	FLDWAV (November 1998)	National Weather Service	Hydrologic Research Laboratory Office of Hydrology National Weather Service, NOAA 1345 East-West Highway Silver Spring, MD 20910	Includes all the features of DAMBRK and DWOPER plus additional capabilities. It is a computer program for the solution of the fully dynamic equations of motion for one-dimensional flow in open channels and control structures. Floodway concept formulation is unavailable. Calibration to actual flood events required. This model has the capability to model sediment transport. Program is supported by NWS. Supporting documentation is available at: http://www.fema.gov/mit/tsd/dl_fdwv.htm	Yes
	MIKE 11 HD (2002 D)	DHI Water and Environment	DHI Inc. 301 South State Street Newton, PA 18940	Hydrodynamic model for the solution of the fully dynamic equations of motion for one-dimensional flow in open channels and control structures. The floodplain can be modeled separately from the main channel. Calibration to actual flood events highly recommended. Floodway concept formulation is available for steady flow conditions. This model has the capability to model sediment transport. The web page is at: http://www.dhisoftware.com/mike11/	No
	FLO-2D v. 2000.11 (December 2000)	Jimmy S. O'Brien, Ph.D., P.E.	FLO-2D Software, Inc. Tetra Tech, ISG P.O. Box 66 Nutrioso, AZ 85932	Hydrodynamic model for the solution of the fully dynamic equations of motion for one- dimensional flow in open channels and two-dimensional flow in the floodplain. Bridge or culvert computations must be accomplished external to FLO-2D using methodologies or models accepted for NFIP usage. Calibration to actual flood events required. Floodway computation is unavailable.	Yes
	XP-SWMM 8.52 and up	XP Software	XP-Software, 2000 NE 42nd Ave. #214 Portland, OR 97213-1305 http://www.xpsoftware.com	XP-SWMM cannot represent more than three Manning's n values per channel section. Where more than this number of values per section are required, the user must demonstrate that the three n values used accurately depict the composite n value for the entire section at various depth. Calibration to actually flood events required. The floodway procedures are for steady flow purposes only. Use the procedure posted on FEMA website at http://www.fema.gov/mit/tsd/en_modl.htm for unsteady flow floodway calculation.	No

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TYPE	PROGRAM	DEVELOPED BY	AVAILABLE FROM	COMMENTS	Public Domain?
Hydraulic Models: Determination of Water-surface Elevations for Riverine Analysis (cont'd)					
Two-dimensional Steady/Unsteady Flow Models	TABS –RMA2 v. 4.3 (October 1996) –RMA4 v. 4.5 (July 2000)	U.S. Army Corps of Engineers	Coastal Engineering Research Center Department of the Army Waterways Experiment Station Corps of Engineers 3909 Halls Ferry Road Vicksburg, MS 39180-6199	Limitations on split flows. Floodway concept formulation unavailable. More review anticipated for treatment of structures.	Yes
	FESWMS 2DH 1.1 and up (June 1995)	U.S. Geological Survey	U.S. Geological Survey National Center 12201 Sunrise Valley Drive Reston, VA 22092 http://water.usgs.gov/software/surface_water.html	Region 10 has conducted study in Oregon. Floodway concept formulation unavailable. This model has the capability to model sediment transport.	Yes
	FLO-2D v. 2000.11 (December 2000)	Jimmy S. O'Brien, Ph.D., P.E.	FLO-2D Software, Inc. Tetra Tech, ISG P.O. Box 66 Nutrioso, AZ 85932	Hydrodynamic model that has the capabilities of modeling unconfined flows, complex channels, sediment transport, and mud and debris flows. It can be used for alluvial fan modeling.	No
	MIKE Flood HD (2002 B and 2002 D)	DHI Water and Environment	DHI Inc. 301 South State Street Newton, PA 18940	A package facilitates the dynamic coupling of MIKE 11 (one dimensional) and MIKE 21 (two-dimensional) hydrodynamic models. Solves the fully dynamic equations of motion for one- and two-dimensional flow in open channels, riverine flood plains, alluvial fans and in costal zones. Control structures are modeled with one-dimensional flow using bridge and culvert routines in MIKE 11 HD. This combination allows users to model some areas in 2D detail, while other areas can be modeled in 1D. Calibration for actual flood events is highly recommended. The model has the capability to model sediment transport. The web page is at http://www.dhisoftware.com/mikeflood/	No
Floodway Analysis	SFD	U.S. Army Corps of Engineers/FEMA	Federal Emergency Management Agency Hazard Identification Branch Mitigation Directorate 500 C Street, SW Washington, DC 20472	Simplified floodway procedure for streams with no regulatory floodway limits.	Yes
	PSUPRO	Pennsylvania State University/ U.S. Army Corps of Engineers/FEMA	Federal Emergency Management Agency Hazard Identification Branch Mitigation Directorate 500 C Street, SW Washington, DC 20472	Encroachment analysis for streams with no regulatory floodway limits.	Yes

Numerical Models Accepted by FEMA for NFIP Usage

(Locally Accepted Models)

TYPE	PROGRAM	DEVELOPED BY	AVAILABLE FROM	COMMENTS	Public Domain?
Hydrologic Models: Determination of Flood Hydrographs					
Single Event	AHYMO 97 (August 1997)	Albuquerque Metropolitan Arroyo Flood Control Authority, Anderson-Hydro	Anderson-Hydro 13537 Terragon Drive, NE Albuquerque, NM 87112	Flood hydrographs at different locations along streams. **Only accepted for usage and the default parameters in the model applicable within New Mexico.** Information on the AHYMO model can be found at: www.ahymo.com.	Yes
	Colorado Urban Hydrograph Procedure (CUHPF/PC) (May 1996 and May 2002)	Denver Urban Drainage and Flood Control District	Denver Urban Drainage and Flood Control District 2480 West 26th Avenue, Suite 156-B Denver, CO 80211	Flood hydrographs at different locations along streams. Hydrographs are routed using UDSWM2-PC (a modified version of the Runoff Block of EPA's SWMM). **Only accepted for usage and the default parameters in the model applicable within the Denver, Colorado, metro area.**	Yes
Hydraulic Models: Determination of Water-surface Elevations for Riverine Analysis					
One-dimensional Unsteady Flow Models	HCSWMM 4.31B (August 2000)	Stormwater Management Section Public Works Department Hillsborough County, Florida	Stormwater Management Section Public Works Department Hillsborough County, Florida 601 E. Kennedy Boulevard, 21st Floor P.O. Box 1110 Tampa, FL 33601	Modified version of EPA SWMM 4.31. The major modifications are: integrated the SCS-CN method into the model to calculate the rainfall-runoff process; allow up to 21 different Manning's coefficients for each cross-section; added 4 more fields to C1 line to calculate the exit, entrance, and other minor losses, and to stretch the pipe based on stability condition automatically create an ASCII file, HYDROG.DAT, containing hydrograph for each subbasin generated after each run. **Only accepted for usage and applicable within Hillsborough County, Florida.** The web page is at: http://www.hillsboroughcounty.org/publicworks/engineering/home.html	Yes
	NETWORK (June 2002)	Southwest Florida Water Management District	Engineering Section Resource Management Department 2329 Broad Street Brooksville, Florida 34604-6899	Interconnected ponds and channels routing model. **Only accepted for usage within Southwest Florida Water Management District.**	Yes
	CHAN for Windows v.2.03 (1997)	Aquarian Software, Inc.	Aquarian Software, Inc. 1415 Briercliff Drive Orlando, Florida 32806-1407 http://www.aquarian-software.com/	Calibration or verification to the actual flood events highly recommended. Floodway concept formulation is unavailable. Encroachment stations can be specified in editor to cut off section. **Only accepted for usage within Southwest Florida Water Management District.**	No
Two-dimensional Unsteady Flow Models	SHEET2D 9 (July 2000)	Tomasello Consulting Engineers, Inc.	Tomasello Consulting Engineers, Inc. 5906 Center Street Jupiter, FL 33458	DOS program applied to a grid network presenting the topography and hydrologic parameters of the watershed. Computes runoff for applied rainfall distribution for each grid based on SCS formula and input soil and depression storage. Routes overland flow via two-dimensional dynamic equations. Channel routings performed with special grids with assigned HEC-2 type cross sections. Sheetflow barriers used to represent dikes and roads separating sheetflow grids. Special grids are used to define cascading water management systems with stage/storage and hydrologic parameter inputs that connect to the sheetflow regime via structures described in input. Outputs include high water elevation, discharge from structures, sheetflow hydrographs, and stage hydrographs for any point in the model. **Only accepted for usage within Big Cypress Basin, Florida.**	No
Two-dimensional Steady/Unsteady Flow Models	DHM 21and 34 (August 1987)	Theodore V. Hromadka II, Ph.D., Ph.D., P.E., P.H.	Department of Mathematics, Geology, and Environmental Studies California State University, Fullerton Fullerton, CA 92958-9020 thromadka@fail.com	Diffusion flow model which can route unconfined surface and open channel flows. Can be used to model alluvial flooding. Rainfall-runoff output can be used for hydrologic studies. Kinematic routing optional. Floodway concept formulation unavailable. Calibration to actual flood events is recommended. **Only accepted forusage within the San Bernardino County Flood Control District, California.**	No