NFIP & FEH Fact Sheet

Flood Hazard Planning for Both Inundation and Fluvial Erosion


Inundation


Fluvial Erosion

Many Vermont towns are well-acquainted with the damaging effects of flooding. Municipal officials should be aware of the nature of Vermont's flood events and how best to create a comprehensive, effective flood hazard reduction strategy, suitable for the Vermont landscape. Two complementary flood hazard mitigation programs are: (1) the National Flood Insurance Program (NFIP) promoted by FEMA to address inundation hazards, and (2) the Fluvial Erosion Hazard Program (FEH) developed by the Vermont ANR River Management Program to address fluvial erosion hazards.

The Basics:

The National Flood Insurance Program (NFIP) is a voluntary program that provides federally-subsidized flood insurance to participating communities. These communities adopt and administer land use regulations in flood hazard areas, so as to reduce property damage from inundation. Residents of participating communities are then able to purchase NFIP flood insurance to protect their buildings and possessions. Flood insurance rates are based on Flood Insurance Rate Maps (FIRMs), which delineate areas of the floodplain likely to be inundated during a flood. Inundation areas are divided into zones according to flood risk and include the Special Flood Hazard Area and the FEMA regulatory floodway.

The Vermont ANR River Management Program has developed an additional program to supplement the NFIP called the Fluvial Erosion Hazard Program. The FEH program maps a river corridor specially tailored to protect against the predominant form of flood damage in Vermont—fluvial erosion. Based on studies of each stream's geomorphic (or physical) condition and inherent sensitivity to erosion, FEH maps provide towns with a powerful flood hazard planning tool. Once the FEH map is created, towns have the option to adopt an FEH overlay district, limiting development in the floodplain.

What is the technical/scientific basis for the NFIP maps?

NFIP maps have been created nation-wide, and may be based on assorted data sources, such as studies of historical river flows, rainfall, community knowledge, floodplain topographic surveys, and hydrologic and hydraulic data. There is some degree of variability in how much detail and accuracy is captured in a given location's map. This variability is related in part to the extent of supporting data available. For example, elevation data for rural areas may be unavailable; as a result, many Vermont streams have more "approximate" floodplain delineations than streams mapped in more populated, developed areas.

The NFIP maps focus on a *particular type of flood risk* to the low-lying lands next to the river channel. They show the areas that would be covered, or "inundated," by water as flood waters rise. One way to imagine this is to think of the floodplain as a giant bathtub filling up. As the water first enters the tub, it slowly spreads out until the entire tub bottom is covered in water.

Technically speaking, the Special Flood Hazard Area (or floodplain) includes the stream channel plus adjacent land inundated by river discharge during a "base flood" (Figure 1a). The base flood is sometimes referred to as the "100-year flood", which may give the false impression that a base flood can only occur once every 100 years. A more accurate way of describing the base flood is to say that in any given year, there is a 1% chance that a flood of this size will occur. Some Vermont rivers have experienced more than one "100-year flood" within a decade. For example, the upper Lamoille River and Wild Branch experienced flooding of that magnitude in both 1995 and 1997.

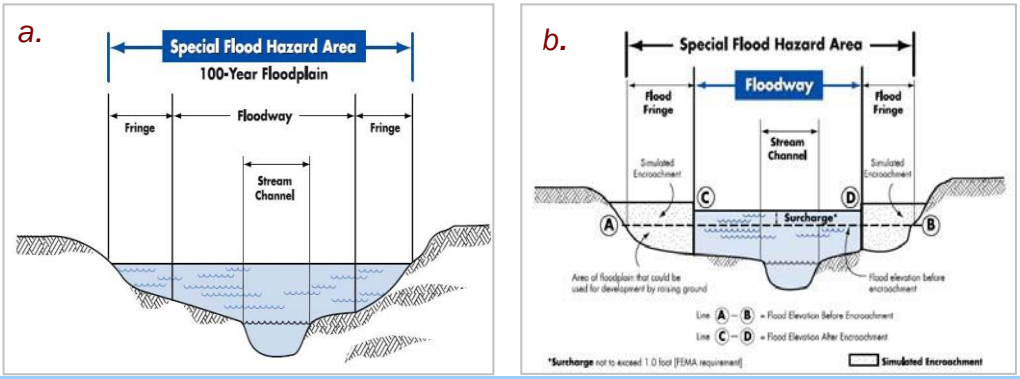


Figure 1. (*a*) A flooding river, shown in cross-section, inundates the entire "100-year" floodplain during a base flood. NFIP designates this inundation zone as the Special Flood Hazard Area, which includes the FEMA regulatory floodway and flood fringe. (*b*) If development occurs within the flood fringe, the base flood elevation is raised. As a result, the FEMA regulatory floodway is forced to convey all floodwaters, as well as flood energy that would otherwise be dissipated throughout the floodplain.

How does NFIP affect development?

The NFIP regulations do not prohibit development in the Special Flood Hazard Area (SFHA), comprised of the regulatory floodway and the flood fringe. Towns adopt and agree to regulate the regulatory floodway – the stream channel and immediate overbank areas that is reserved to safely pass the base flood discharge.[1] Development in the regulatory floodway is prohibited unless standard hydraulic analysis demonstrates that the proposed encroachment will not cause any increase in the community's base flood elevations. Development may take place in the flood fringe as long as it meets local and federal minimum standards. Although a community may permit development in the flood fringe, the cumulative effects of development may increase the base flood elevation by as much as a 1 foot. The only way to prohibit development in the SFHA is for a town to adopt higher regulatory standards.

Development in the flood fringe limits a river's floodplain access, which may increase a flood's destructive capacity by: 1) raising the base flood elevation and/or 2) increasing the flood velocity and power (Figure 1b). When base flood elevation is raised, structures and properties that were previously "high and dry" may now experience inundation flooding. In addition, when floodwaters are "bottled up" within the channel, flood energy that would naturally be dissipated throughout the floodplain may now be more concentrated in close proximity to human structures. Thus, communities that adopt only the minimum NFIP guidelines may unwittingly *exacerbate flood damage*, believing they are keeping property and infrastructure safe. Moreover, rivers and streams without necessary floodplain access will likely become more and more unstable, leading to ever greater and more costly conflict with Vermont communities.

What are the limitations of NFIP in Vermont?

While more and more Vermont towns are participating in NFIP, adopting at least minimum NFIP standards, it is important to recognize the program's limitations. Although NFIP does provide critical flood protection functions, Vermont towns should be advised against relying solely on minimum NFIP guidelines for flood hazard mitigation. Consider these reasons:

- Two-thirds of Vermont flood damages to property and infrastructure occur *outside* the mapped NFIP floodplain.
- The mapped NFIP floodplain assumes the river channel is static; i.e., river bends will not move up or down valley or side to side, and river beds will not scour down or build up. Often, floods create severe damage as river channels change location or shift laterally in quick moving, powerful "flash floods."
- The NFIP flood maps evaluate risk based on *inundation*; i.e., they assume a flood event will consist of rising water levels, without consideration for the tremendous physical force of large volumes of water, sediment, and debris undermining banks or moving down the river valley.
- In spite of increased and widespread participation of towns in the NFIP, Vermont continues to suffer an average of $14 million in flood damages annually.

What is the technical/scientific basis for the FEH Zone?

[1] NFIP maps with more approximate (Zone A) floodplain delineations will not show a regulatory floodway. Additional study is required to refine these maps.

The Fluvial Erosion Hazard zone is designed with the recognition that rivers are *not static*, and that flood damages in Vermont are often a result of Fluvial Erosion Hazards (FEH). FEHs are most evident when a flooding river dramatically enlarges or makes a catastrophic change in course, resulting in severe erosion of the river bed and banks. A certain amount of erosion is natural in Vermont floods because of the region's relatively steep terrain and flashy, frequent storms. However, due to human encroachments and historical channel engineering (e.g., bank armoring, berming, and channel straightening), many Vermont rivers have become unstable and now have increased FEH risk.

The FEH zone is a mapped river corridor that includes both the channel and the adjacent land. The purpose of the zone is to identify the space a river needs to re-establish and maintain stable "equilibrium" conditions. In other words, if the river has access to floodplain and meander area within this corridor, the dangers of flood erosion can be reduced over time. The FEH corridor is delineated based on scientific, location-specific assessment of the fluvial geomorphic[2] (or physical) condition of a river. Vermont ANR River Management Program has designed protocols to evaluate river conditions all over the state. The resulting data are used to rate reaches (or linear sections) of river according to their sensitivity to fluvial erosion. These sensitivity ratings are incorporated into the mapped corridor and represent low to extreme FEH risk (Figure 2).

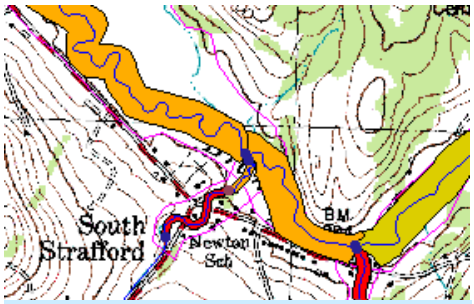


Figure 2. Map of draft FEH corridor with sensitivity ratings coded by color.

In addition to sensitivity ratings, the FEH zone has a specific corridor width, based on the river's meander belt width[3] (Figure 3). One can think of this belt width as the particular "wiggle room" a river needs to find its most stable path down the valley, while efficiently moving and storing its sediment load. The shape and width of the meander belt varies with valley shape, surficial geology (e.g. bedrock, glacial lake sand), and the natural channel length, slope, and width. The lower the slope and the broader the valley, the more sinuous a river will likely be, in a natural setting. Rivers that have been historically straightened or encroached upon lose their natural stability when they lose their meanders and floodplain access. Given an appropriate amount of lateral space, an unstable river can eventually develop a stable meander pattern. Meanders may shift within the corridor over time, but the river will be less susceptible to dramatic channel adjustments and accelerated erosion.

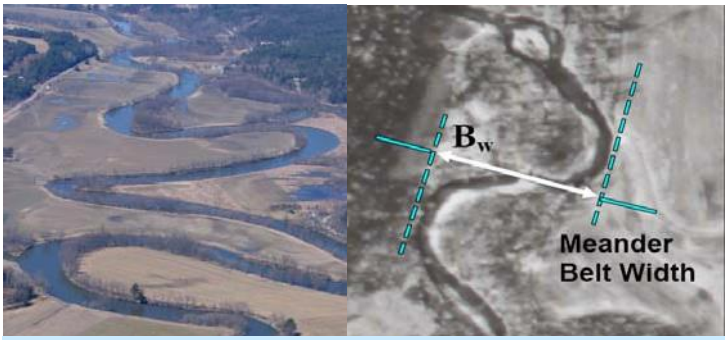


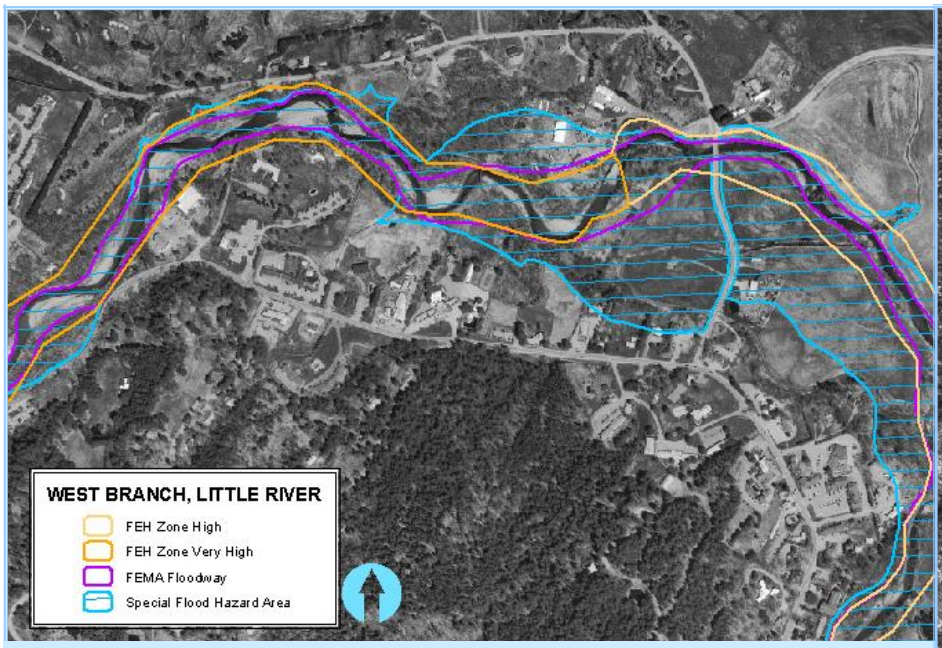
Figure 3. River meanders like those on the Lamoille River are best viewed from the air (left). The meander belt width is measured as the lateral distance between the outermost bends of a meander, when a river is in "equilibrium" condition (right).

How do the NFIP maps and FEH zones compare?

Because the underlying methods of mapping differ significantly, it is not surprising the flood maps differ. In some situations, the FEH zone is narrower than the FEMA floodplain, usually as a result of bedrock or elevated landforms that may not have been evaluated in the NFIP studies. In other areas, the FEH may extend beyond the FEMA regulatory floodway or even the Special Flood Hazard Area boundaries. These locations are potentially hazardous, and under minimum NFIP guidelines alone, development and infrastructure in these areas may be susceptible to flood damage and/or may contribute to further instability and erosion hazard upstream or downstream. Moreover, on streams where FEMA has mapped "approximate" flood hazards (Zone A areas), FEH maps provide communities with essential, more detailed flood risk data. The following page shows some examples of draft FEH maps compared with the Special Flood Hazard Area and the FEMA regulatory Floodway (Figure 4).

[2] Fluvial geomorphology is the scientific study of how flowing waters (rivers) shape the land while eroding, transporting, and depositing sediment.

[3] Williams (1986) collected data from 153 alluvial rivers around the world and found meander belt widths equal to about 6 bankfull channel widths. See "River Corridor Protection Guide" at http://www.watershedmanagement.vt.gov/rivers.htm for details on how FEH corridors vary for different stream types.



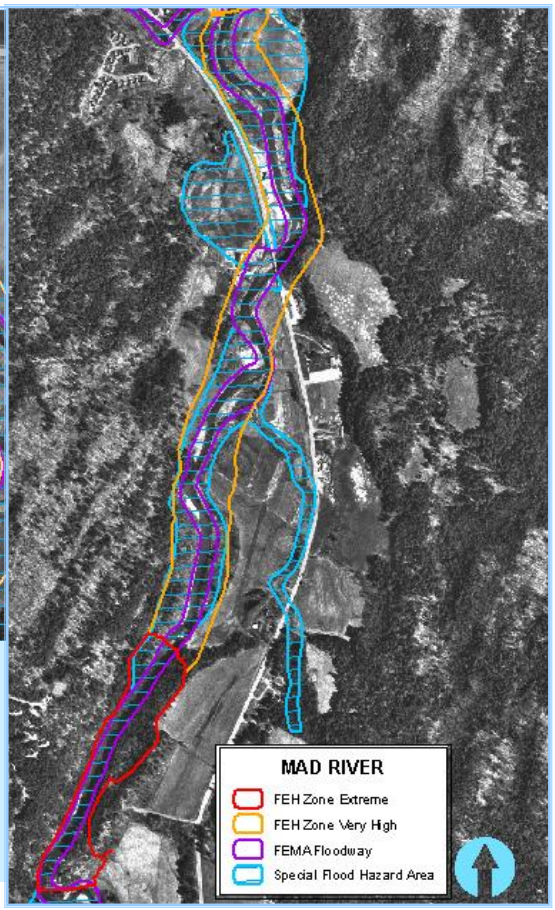


Figure 4. The FEH zone overlaps with much of the FEMA regulatory floodway, although there are notable differences. The FEH zone targets areas sensitive to fluvial erosion, while the FEMA floodplain is designed to address inundation flooding. In many areas along the West Branch of Little River, Stowe (left), the FEH corridor extends beyond the floodway, whereas some areas of FEH are not as wide as the Special Flood Hazard Area. On the Mad River in Waitsfield (right), the floodway is consistently too narrow to capture fluvial erosion hazards. Rivers managed only with respect to a narrower FEMA floodway are not likely to ever reach stable, equilibrium condition.

How does the FEH zone affect development?

The Vermont ANR River Management Program *partners with towns* to develop an FEH zone that works within existing communities. Once the FEH map is created, towns may choose to adopt an FEH zone. A model overlay district is available in "The Municipal Guide to Fluvial Erosion Hazard Mitigation[4]." ANR acknowledges the need to protect important public infrastructure without making rivers more unstable; however, the primary goal is to allow rivers to achieve "equilibrium" conditions while reducing fluvial erosion hazards. Adopting an FEH zone will prevent new development and storage within the hazard area, with conditional use review for other activities, such as channel management.

~~~~~

The NFIP flood hazard regulations alone do not provide sufficient protection against flood damage. The FEH corridor is fundamentally different from the FEMA mapped floodplain. Not only does the FEH Program target fluvial erosion where NFIP targets inundation, but it provides communities with the scientific information needed to build a more economically and ecologically sustainable relationship with rivers in the long term.

For More Information

Visit the website of Vermont ANR River Management Program at http://www.watershedmanagement.vt.gov/rivers.htm to find materials relating to the NFIP and FEH programs, including "The Municipal Guide to Fluvial Erosion Hazard Mitigation" and the new Vermont Flood Hazard Regulation models. See also FEMA's NFIP website at www.floodsmart.gov or http://www.fema.gov/about/programs/nfip/index.shtm.

4 Dolan, Kari and Mike Kline. Vermont ANR River Management Program, 11/2008. www.watershedmanagement.vt.gov/rivers.htm.
~~~~~