DEPARTMENT OF ENVIRONMENTAL CONSERVATION

FLOOD HAZARD AREA AND RIVER CORRIDOR PROTECTION PROCEDURE

DECEMBER 5, 2014

VERMONT
AGENCY OF NATURAL RESOURCES

DEC Flood Hazard Area and River Corridor Protection Procedure
December 5, 2014

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1.0 PURPOSE

(a) The purpose of this Procedure is to provide how the Department of Environmental Conservation (DEC or Department):

(1) defines and maps flood hazard areas and river corridors for the purposes of Act 250 (10 V.S.A. § 6001 *et seq.*), Section 248 (30 V.S.A. §§ 248 and 248a), administering the state Flood Hazard Area and River Corridor Rule (adopted October 24, 2014), and the regulation of berming (10 V.S.A. § 1021);

(2) shall involve municipalities, the Regional Planning Commissions, Act 250 District Commissions, affected parties, and the general public in the amendment and revision of flood hazard area maps under the National Flood Insurance Program (NFIP) and the update and administrative revision of river corridor maps through the DEC River Corridor Mapping Program.

(3) determines what constitutes an "Act 250 floodway"[1] as applied in the review of Act 250 and Section 248 applications under Criterion 1(D);

(4) makes recommendations to Act 250 District Commissions, the Natural Resources Board, the Public Service Board, municipalities, and other jurisdictions on the regulatory measures necessary to avoid the endangerment of the health, safety, and welfare of the public and of riparian owners during flooding[2];

(5) makes recommendations to other programs, departments, and agencies of state government regarding activities proposed in flood hazard areas and river corridors; and

(6) has established floodplain and river corridor best management practices, including the provision of model flood hazard area and river corridor protection bylaws and ordinances for adoption by municipalities and regional planning commissions.

(b) This Procedure replaces and supersedes the 2003 *Procedure on ANR Floodway Determinations in Act 250 Proceedings* and the 2009 *ANR Technical Guidance for Determining Floodway Limits Pursuant to Act 250 Criterion 1(D).*

(c) This Procedure may be amended by the Agency of Natural Resources (ANR or Agency) on its own motion or based upon input received from members of the public, municipalities and other governmental entities, and other affected persons.

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[1] For Act 250 proceedings, the Secretary of Natural Resources determines what constitutes the floodway under Criterion 1(D) in consideration of inundation and erosion hazards. The state definition differs from the NFIP definition. See "Act 250 floodway" in the definitions section.

[2] Regulatory recommendations made according to this Procedure shall be consistent with the state Flood Hazard Area & River Corridor Rule adopted by the Agency of Natural Resources (ANR or Agency) to regulate activities exempt from municipal regulation.

2.0 STATUTORY AUTHORITY

Between 2010 and 2014, the Vermont General Assembly passed four separate Acts (110 (2010), 138 (2012), 16 (2013), and 107 (2014)) containing various sections directing the Agency to establish a *River Corridor and Floodplain Management Program* and to promote and encourage the identification and protection of flood hazard areas and river corridors to reduce flood and fluvial erosion hazards.

ANR has charged DEC with the responsibility to carry out this Procedure. DEC will work in cooperation with municipalities, the Regional Planning Commissions, and other state agencies to map flood hazard areas and river corridors to ensure compliance with NFIP and state law, and to meet the policy objectives of protecting the health, safety, and welfare of the general public from flood and fluvial erosion hazards (10 V.S.A. §§ 753, 1023, 1427, and 1428).

Specifically, the Procedure shall be applied to the following areas of Department authority:

(1) **Stream Alteration Rule and Flood Hazard Area & River Corridor Rule.** The State must regulate the construction of berms in flood hazard areas and river corridors (10 V.S.A. § 1021(a)). Additionally, the State must regulate "activities exempt from municipal regulation" located within flood hazard areas or river corridors (10 V.S.A. § 754). To aid in meeting these statutory requirements, this Procedure defines the mapping methods used by the Federal Emergency Management Agency (FEMA) and DEC to delineate flood hazard areas and river corridors. The Procedure also details the process used to publically notice, amend, update, and revise such maps as required by 10 V.S.A. §§ 1422, 1427, and 1428.

(2) **Act 250 Land Use and Section 248 Facilities.** Criterion 1(D) of Act 250 provides that:

> A permit will be granted whenever it is demonstrated by the applicant that, in addition to all other applicable criteria: (i) the development or subdivision of lands within a floodway will not restrict or divert the flow of flood waters, and endanger the health, safety and welfare of the public or of riparian owners during flooding; and (ii) the development or subdivision of lands within a floodway fringe will not significantly increase the peak discharge of the river or stream within or downstream from the area of development and endanger the health, safety, or welfare of the public or riparian owners during flooding. 10 V.S.A. § 6086(a)(1)(D).
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> Act 250 authorizes the Secretary of Natural Resources[3] to make case-by-case determinations on what constitutes the Act 250 floodway and floodway fringe[4] (10 V.S.A. § 6001(6) and (7)). The Vermont Supreme Court affirmed the Secretary's authority to make floodway and floodway fringe determinations, without adopting an administrative rule, based on the plain language of the statute, which authorizes the Secretary to make such determinations (In re Woodford Packers, Inc., 2003 VT 60, ¶ 12-13, 175 Vt. 579, 830 A.2d 100).
>
> Section 248 requires the Public Service Board to give "due consideration" to Criterion 1(D) of

[3] The Secretary has delegated this authority to the Commissioner of the Department of Environmental Conservation.

[4] Act 250 floodway fringe areas, by statute, are determined in consideration of upstream impoundments and flood control projects. Since watershed hydrology has not been modelled statewide to consider the hydrologic factors, including impoundments, which may influence flood elevations, the regulatory flood fringe areas as mapped by FEMA are used by DEC in lieu of a separately mapped Act 250 floodway fringe.

Act 250 (30 V.S.A. §§ 248(b)(5) and 248a(c)(1)).

This Procedure shall be used by DEC to make Act 250 floodway determinations and to make recommendations to the Natural Resources Board and Public Service Board concerning restrictions necessary to avoid the endangerment of the health, safety, and welfare of the public and riparian owners during flooding.

(3) **Municipal Land Use Regulation.** The municipal and regional planning and development statutes mandate that if a municipality has adopted flood or other hazard area bylaws, no permit for new construction or substantial improvement[5] shall be granted for work in a flood or other hazard area until the application is submitted to the Agency of Natural Resources or its designee[6] 24 V.S.A. § 4424(a)(2)(D). This Procedure shall be used by DEC to provide advice on the delineation of flood hazard areas and river corridors protected in municipal bylaws, make recommendations to ensure development complies with the local bylaws, and promote the protection of floodplains and river corridors (24 V.S.A. § 4424(a)(2)(D); 10 V.S.A §§ 751 and 1421).

(4) **Additional Authorities for the Procedure.** The Secretary shall develop and adopt best management practices for upland, river, and riparian activities conducted in river corridors, floodplains, and buffers (10 V.S.A. § 1427) as they relate to the management of flood and fluvial erosion hazards. The Secretary must assist regional planning (24 V.S.A. § 4348a(a)(11)) and municipal planning (24 V.S.A. § 4382(a)(12)) with the development of flood resiliency plans. The Secretary must also create and make available to municipalities model flood hazard and river corridor protection area bylaws and ordinances for potential adoption by municipalities pursuant to 10 V.S.A. §§ 755, 1427, and 1428; 24 V.S.A. chapter 117; and 24 V.S.A. § 2291. The best management practices section of this Procedure (Section 8.0) references model bylaw and ordinance provisions that exceed the minimum requirements for compliance with the NFIP to further minimize the risk of harm to life, property, and infrastructure from flooding as required by 10 V.S.A. §§ 755 and 1428.

3.0 INTRODUCTION

The Vermont State Hazard Mitigation Plan (2013) identifies flooding as the most common natural hazard event in Vermont and the damages from flooding are due to inundation and fluvial erosion. Flooding, exacerbated by debris and ice jams, historic channelization practice, or the plugging and failure of stream crossing structures can threaten public safety, stress emergency services, cause widespread damage and property loss, bring about socio-economic disruption, and result in significant recovery costs for property owners, municipalities, the State, and the federal government. Nationally, flooding accounts for more losses in lives and damages to property and crops than any other natural disaster. [7]

Inundation, or overbank flooding, occurs when a stream channel or waterbody receives a significant amount of rain or snow melt from its watershed, or when the stream channel is blocked by a debris or ice jam. The excess water spills out onto or inundates the floodplain. Fluvial (river-related) erosion occurs when stream power, due to the increased velocities and height of floodwaters, act on the bed and banks of a stream channel. The magnitude or rate of fluvial erosion is highly variable, ranging from a

[5] The repairs to a substantially damaged structure as defined in 24 V.S.A. § 4303(8)(F).

[6] The Agency has 30 days following notification to provide technical comments on a proposed permit for new construction or substantial improvement in a flood hazard area.

[7] http://vem.vermont.gov/sites/vem/files/HazMit%20Plan%202013.pdf

gradual and continual process to an episodic or catastrophic event.

This Procedure establishes how DEC will make Act 250 and Section 248 Criterion 1(D) floodway determinations in consideration of inundation and fluvial erosion hazards for the protection of the health, safety, and welfare of the public. This Procedure is sufficiently detailed and includes references to technical documents throughout so that project designers may conduct inundation and erosion hazard analyses and factor Act 250 floodways into project planning, proposals, and design. Reference is made throughout to "*DEC technical guidance*," which includes documents available on the Watershed Management Division web pages[8] that have been produced to further detail the map production and update processes used to implement this Procedure and the state Flood Hazard Area & River Corridor Rule governing development exempt from municipal regulation.

DEC reviews the NFIP maps and flood insurance studies in the evaluation of proposed projects for inundation-related hazards. DEC's evaluation of erosion hazards relies on the DEC river corridor maps and river sensitivity data based on fluvial geomorphic (or physical) assessment protocols, which are contained within the Phase I-III *Vermont Stream Geomorphic Assessment (SGA) Handbooks* (Handbooks, VT DEC, 2009). The *Handbooks* are available from the DEC Watershed Management Division.[9]

While NFIP and state river corridor maps are largely technical in nature, being based on hydraulic, hydrologic, and fluvial geomorphic processes, there is and must be recognition that these physical processes engender change. Therefore, map amendment, revision, and update sections of the Procedure describe how new data and emerging information may be used to refine or modify maps as site specific information becomes available. The Procedure outlines the FEMA map amendment and revision processes and offers specific opportunities to participate in the update and administrative revision of DEC's river corridor maps with technical studies and municipal planning in conformance with a river corridor performance standard.

This Procedure describes opportunities to incorporate NFIP and DEC hazard area mapping and regulatory policy in local flood hazard bylaws and ordinances. Pursuant to 24 V.S.A. § 4382(a)(12), communities with town plans must incorporate local flood resiliency elements into their town plans. This Procedure helps to promote local flood resilience planning by providing consistent best management practices and land use regulations across jurisdictions consistent with state and municipal hazard mitigation goals.

Finally, in acknowledgement that floodplain and river corridor science and hazard mitigation policy have evolved at a fast pace, a set of terms are defined in Section 9.0 of this Procedure.

4.0 DEFINING AND MAPPING FLOOD HAZARD AREAS AND RIVER CORRIDORS

(a) **Background.** Flood hazard areas and river corridors are defined and mapped to serve the vital function of dissipating hydraulic energy and providing storage or attenuation of water, sediment, and debris during flooding (consistent with the National Flood Insurance Act of 1968[10]). Incremental land use changes adjacent to stream channels can result in unintended deleterious consequences such as increases in the magnitude and volume of the effective discharge and channelization practices that heighten channel instability (Ward, 2002).

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8 http://www.watershedmanagement.vt.gov/rivers.htm

9 Contact ANR at 802-828-1535 or visit http://www.watershedmanagement.vt.gov/rivers/htm/rv_geoassess.htm

10 42 U.S.C. § 4001 *et seq*.

(1) **Flood Hazard Areas.** Flood hazard areas are those areas of the floodplain that may be inundated by a range of flood frequencies up to and including the one percent annual chance flood (i.e. base flood). Flood hazard areas as referred to in this Procedure are shown on the most current, FEMA-published Flood Insurance Rate Maps (FIRM)[11] on which the NFIP is based. Where FEMA has conducted detailed engineering studies, the flood hazard area is subdivided into two distinct zones, the FEMA-designated floodway and flood fringe.

FEMA has published extensive information regarding the mapping of flood hazard areas. The FEMA Map Service Center[12] is the primary online repository of flood hazard area data and provides educational information and technical assistance.

Flood insurance studies and flood hazard area maps are on file in the municipal offices of communities participating in the NFIP. In addition, DEC maintains digital copies of the maps and studies and publishes the maps on the ANR Natural Resources Atlas (for those areas where FEMA has produced digital flood hazard area map layers).

Flood insurance study technical information detailing the engineering, scientific, and mapping specifications is available from the Regional Planning Commissions and on FEMA's webpage entitled *Guidelines and Standards for Flood Risk Analysis and Mapping.*[13]

(2) **River Corridors.** River corridors encompass an area around and adjacent to the present channel where fluvial erosion, channel evolution and down-valley meander migration are most likely to occur. River corridor widths are calculated to represent the narrowest band of valley bottom and riparian land necessary to accommodate the least erosive channel and floodplain geometry (i.e. equilibrium conditions) that would be created and maintained naturally within a given valley setting. This Procedure also outlines a process for recognizing certain rivers as highly managed or constrained by human structures and describes how a river corridor may be delineated to reflect the existence of modified streams, which are human constrained but exhibit vertical stability.

Concerns about channel stability and erosion hazards require a geomorphic (or physical) evaluation to characterize a stream's type, size, existing condition, and sensitivity to erosion hazards. A geomorphic evaluation recognizes the dynamic nature of streams[14]. Streams are constantly adjusting their form and configuration due to the influence of and variation in geology, climate, drainage area; the direction and gradient of flow in relation to a given valley slope; turbulence associated with curved flow; roughness of the bed and banks; erosion, transport, and deposition of sediment; the influx of debris; and the degree of floodplain access (Leopold, 1994, Thorne et al., 1997).

A river is considered stable, or in a state of "dynamic equilibrium," if it can adjust its channel geometry (width, depth, and slope) to efficiently discharge, transport, and store water, sedi-

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[11] How to Read a FIRM Tutorial: http://www.fema.gov/media-library/assets/documents/7984

[12] FEMA Map Service Center: https://msc.fema.gov/ , 877-336-2627

[13] http://www.fema.gov/guidelines-and-standards-flood-risk-analysis-and-mapping

[14] Commonly, the term "stream" refers to a smaller flowage, and the term "river" refers to a relatively larger flowage. There is no recognized size breakpoint in Vermont as to when a stream becomes a river. Vermont has chosen to use the term "river corridor" as a label for the corridors delineated around both streams and rivers. Throughout this Procedure the term "stream" is often used in describing the physical features and fluvial processes associated with river corridor management.

ment, and debris without significant aggradation or degradation (i.e., vertical instability) of its bed (Leopold, 1994, Rosgen, 1996). A river requires a sufficient corridor to accommodate equilibrium conditions and the channel adjustments that occur when channel geometry is changing vertically and laterally to achieve equilibrium (Brierley and Fryirs, 2005). Failure to provide a sufficient corridor will constrain the river from achieving the equilibrium condition. Thus, managing a river corridor to accommodate equilibrium and associated channel adjustment processes will serve to reduce damages to existing structures and property, avoid new damages, protect public safety, achieve the general health of the river system, and avoid the high cost to install and maintain channelization practices (Piegay, 2005). Precluding the use of channelization practices, in turn, will avoid the unintended consequences of transferring bank erosion and other damaging effects from concentrated flow and vertical channel adjustments to other locations along the river (Brookes, 1988; Huggett, 2003; Brierley and Fryirs, 2005).

Minimizing vertical channel instability is particularly crucial to maintaining or restoring equilibrium stream conditions and minimizing erosion during floods. Vertical channel instability may be initiated by an increase in scour of the stream bed and banks and subsequent sediment transport due to: (A) increasing runoff volume; (B) confining and/or shortening the stream channel thereby increasing its slope; or (C) restricting stream access to the floodplain. Therefore, consistent with the Performance Standards established in the State Stream Alteration Rule[15], this Procedure seeks to provide an adequate floodplain area to accommodate channel adjustment processes necessary to achieve and maintain vertical stability in the longitudinal profile over time. The meander belt represents, on average, the minimum amount of floodplain necessary to accomplish vertical stability (Ward et al., 2002, Ward, 2007). The river corridor includes space for both the meander belt and a riparian buffer.

Over 1,500 miles of Vermont streams have undergone detailed, field-based study through completed stream geomorphic assessments (SGA). Based on an analysis of this data, the Agency has divided the vast network of Vermont's perennial rivers and streams[16] into those streams which warrant geomorphic-based river corridor delineations, and those streams which, because of their low sensitivity, small watershed size, steeper valley slope, and/or valley confinement, may attain their least erosive form within an area delineated as a simple setback from the top of each streambank.

(3) **Meander Belt Component of the River Corridor.** The rationale for defining and managing river corridors is the strong association between stable, sustainable fluvial processes and minimal conflicts with human investments with an unconstrained river corridor which provides a meander belt width dimension (Thorne et al., 1997, Thorne, 1998). For streams in unconfined alluvial valley settings, the average meander belt width is approximately six channel widths wide (Williams, 1986; Vermont SGA data[17]). The meander belt extends laterally across the river valley from outside meander bend to outside meander bend, thereby encompassing the natural plan form variability of the stream channel (Figure 1), which maintains the equilibrium slope and minimizes vertical channel instability over time along the extent of

[15] The Equilibrium and Connectivity Performance Standards are found in §27-402 of the State Stream Alteration Rule and further described in the Standard River Management Principles and Practices. Both documents are available at http://www.watershedmanagement.vt.gov/rivers.htm.

[16] Based on the Vermont Hydrography Dataset (1:5000).

[17] See Vermont data in the *DEC technical guidance*.

the stream reach (Riley, 1998). Ideally, the meander belt can be achieved by three channel widths either side of a meander centerline.

The meander centerline consists of a line drawn connecting the cross-over points between the meander bendways, or in a straight channel, points along the center of the channel spaced every seven to ten channel widths. Where feasible, the channel width used in calculating the meander belt width should be that associated with equilibrium conditions (i.e., the **reference channel**) for the reach in question. The reference channel condition, however, may differ from the **existing channel** condition.[18] If a significant departure from equilibrium is known or is indeterminate, the reference channel width, as calculated using the Vermont Hydraulic Geometry Curves[19], is used. Otherwise, DEC uses the existing channel width. Channel width is equal to the bankfull width as referred to in the *Phase I-III Vermont Stream Geomorphic Assessment Handbooks*.

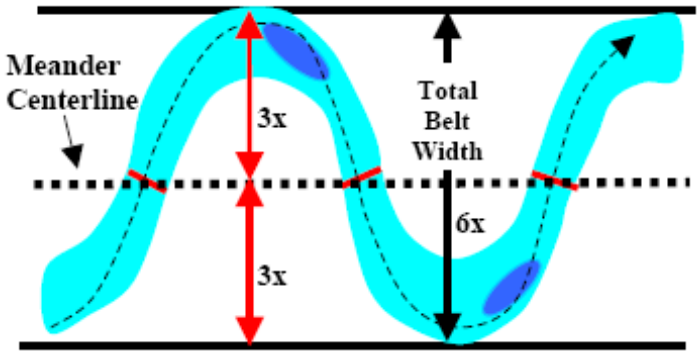

Figure 1. Depiction of Meander Centerline and Belt Width

Valley topography or other constraints (e.g., bedrock and exposed ledge) may prohibit channel plan form adjustment, such that the full six channel widths can only be achieved by providing more width on one side of the stream than the other.[20] Also, note that many of Vermont's streams have been straightened, channelized, or have become incised (deepened), losing access to their historic floodplains. The lateral extent of present-day meanders in this case may be narrower than they would be under equilibrium conditions. These streams are undergoing channel evolution or the processes of erosion and deposition to adjust and re-establish a stable channel slope.[21] Any river corridor which considers erosion hazards should accommodate both existing meanders and the meander belt width associated with equilibrium in order to support these fluvial processes (Ward, 2007).

(4) **Riparian Buffer Component of the River Corridor.** River corridors are defined and mapped with an additional 50 foot setback on either side of the meander belt to allow space for the establishment and maintenance of a vegetated buffer when the equilibrium slope and planform are achieved. The literature makes reference to appropriate buffer widths necessary to serve the different riparian functions important to society. The buffer component in this Procedure is established for the functions of bank stability and slowing flood water velocities in the near-bank region[22]. The Vermont General Assembly specifically called for the inclu-

[18] Refer to the Stream Geomorphic Assessment, *Program Introduction*, pg. 7 for a more detailed discussion of reference and existing stream types; see footnote 5 above for a link to the ANR website.
[19] See Hydraulic Geometry Curves at: http://www.watershedmanagement.vt.gov/rivers/htm/rv_geoassess.htm.
[20] For more discussion of the delineation of the meander centerline and the belt width, refer to Appendix E of the *Phase I-III Vermont Stream Geomorphic Assessment Handbooks* and other *DEC technical guidance*.
[21] Refer to the State Rivers Program's website to examine fluvial geomorphic data stored on the Data Management System or via Map Viewer: http://www.watershedmanagement.vt.gov/rivers.htm
[22] Woody vegetation plays a critical role in binding and stabilizing streambank soils and providing roughness to moderated flood flow velocities. The widths of vegetated buffer that effectively minimize streambank instability are reported between 10 and 30 meters or roughly between 30 and 100 feet (Fisher, R.A., and Fischenich, J.C., 2000; Wenger, S., 1999; PADEP, 2010; Brierley, G.J., and K.A. Fryirs, 2005; Castelle, A.J., et al., 1994;

sion of buffers within the river corridor (10 V.S.A. § 1422(12)). Vegetated buffers are a least cost, self-maintaining practice to provide natural boundary conditions and stream bank resistance against erosion and moderate lateral channel migration. Providing space for these functions is consistent with the goal of achieving and maintaining least-erosive, equilibrium conditions, thereby minimizing the risk of harm to life, property, and infrastructure from flooding.

(b) **Procedure for Delineating the Meander Belt and Buffer Components of the River Corridor.** The following steps describe how the meander belt width and other valley characteristics shall be used to ascertain the meander belt and buffer components of a river corridor. Variables include: the inherent stability of the stream channel; its sensitivity to erosion hazards; the presence of natural or significant human-created confining features; the evidence or likelihood of valley side slope failure; and the presence of hydrologically-connected features within the river valley.

(1) **Streams with a Drainage of Less than or Equal to Two Square Miles.** On the base layer of the Statewide River Corridor Map Layer, small streams shall be assigned a simple setback of at least 50 feet on either side of the stream, measured horizontally and perpendicularly from the top of each streambank. A corridor may be delimited for a small stream during a map update, if field data verifies a moderate to high sensitivity;

(2) **Very Low and Low Sensitivity Streams.** The meander belt width shall be equal to the existing channel width, if the stream is a bedrock or boulder substrate reference stream type (very low to low sensitivity). For mapping purposes, the meander belt shall be delimited at the top of the stream bank of the existing channel or a minimum of a half channel width on either side of the meander centerline, whichever provides the greater lateral extension on either side of the meander belt;

(3) **Moderately Sensitive Streams (with a drainage greater than 2 square miles).** The meander belt width shall be equal to a minimum of four channel widths, if the stream (i.e., at the reach scale) is a steep to moderate gradient (greater than 2 percent gradient) reference stream type, and the existing stream type does not represent a stream type departure. The meander belt is delineated with a minimum of two channel widths on either side of the meander centerline; or,

(4) **Highly and Extremely Sensitive Streams (with a drainage greater than 2 square miles).** The meander belt width shall be equal to a minimum of six channel widths, if the stream is a gentle gradient or braided reference stream type or if the stream is in a moderate gradient valley setting, but the existing stream type represents a stream type departure.[23] For stream types that are in either very low gradient settings or very high deposition areas, the meander belt width multiplier may be increased up to eight times the channel width. The meander belt is delineated with a minimum of three to four channel widths on either side of the meander centerline. Within zones of extremely high and active deposition (e.g., active alluvial fans), the river corridor shall be delineated to include all recent channels and the entire zone of active depositional process; and,

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Langendoen, E.J. et al, 2006 and 2012; Mitchell, E.R. et al., 2004; and Rosgen, D. 2006).

[23] A stream type departure may be represented by a shift of stream type or a **major** vertical stream adjustment (degradation and/or aggradation); see Steps 2.14 (pp. 34-37) in the *Stream Geomorphic Assessment Handbooks*, Phase 2: http://watershedmanagement.vt.gov/rivers/docs/assessmenthandbooks/rv_weblinkpgphase2.pdf

(5) **Natural or Human-Imposed Confining Features.** Where the meander belt extends a certain distance beyond the toe of the valley wall (including bedrock outcrops or ledge that limit river movement), the corridor is truncated at the valley toe, and that truncated distance is used to extend the meander belt laterally on the opposite side, to provide a total belt width as described in Sections 4(b)(2)-(4) above (Figure 3). This extension may, in some cases, be limited by the valley wall on the opposite side of the stream as well; in which case the meander belt extends from the toe of one valley wall to the toe of the other and will be narrower than the multiple of channel widths prescribed above.

If the initial meander belt delineation extends beyond an engineered levee, railroad, or federal aid highway[24], the full river corridor shall be measured from the embankment toe of that infrastructure and extend laterally on the opposite side. This shift of the river corridor acknowledges the alignment of the road has been structurally maintained over time in those locations. The river corridor is shifted to optimize attainment of equilibrium conditions and the reduction of flood velocities and erosion potential within the stream reach. Adjustment of the river corridor for road infrastructure does not imply that adjacent road infrastructure is outside of an area subject to fluvial erosion hazards; on the contrary, infrastructure or other improvements directly abutting the boundaries of a river meander belt may be as, or more, vulnerable to fluvial erosion as infrastructure within the corridor[25].

The Secretary may designate a "modified stream" where existing developments have modified the watershed, channel, valley, and/or floodplain and effectively constrained stream adjustments that would establish a more natural equilibrium condition. To make such a designation the Secretary shall determine that the river segment or reach has become vertically stable (i.e., the stream bed is not actively aggrading or degrading) and shall alter the meander belt delineation according to the existing, modified sensitivity.

(6) **Streams Subject to Bank or Slope Failure.** Erosion hazards outside the meander belt may also exist. If field evidence indicates bank erosion and/or large, mass wasting failures along the valley wall exist or would exist concurrent with the edge of the calculated meander belt, an additional setback to the top of the immediately adjacent erodible side-slope[26] (that has a toe that is less than one channel width from the top of the stream bank as depicted in Figure 3) or slope stability allowance, as determined by a geo-technical analysis, shall be added to the meander belt to accommodate stable bank slopes (see River Corridor Map Amendment described in Section 5(c)(4)(D)(iv) below);

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[24] Federal aid highways are a subset of the Vermont roads for which the Vermont Agency of Transportation uses federal aid and include any roads with a functional class designation of 1, 2, 4, 6, 7, 11, 12, 14, 16, or 17.

[25] The corridor is shifted to achieve the stabilizing effect of full or partial expression of meanders away from the road. Over time, this will reduce erosion hazard to both the road and downstream properties. Alternatively, if the corridor was not shifted and new development was placed opposite the highway, the river would become pinched between the highway and the new structures and become even more hazardous. The fact that ANR has placed river corridors at the edge of state highways does not change the State's commitment to transportation corridor planning that will examine erosion hazards where roads and rivers meet. Alternatives, including the possible movement of a state highway, will be examined based on the benefits and costs and the opportunity to mitigate hazards system-wide within a watershed. If and when a state highway is moved, ANR will review and, where possible, realign the meander belt consistent with Section 4(a)(3) above. Importantly, this same planning process is available to municipalities who may wish to shift corridors off certain town highways or other public infrastructure important to the community as part of the corridor map revision process.

[26] In this context, an adjacent side slope is a non-bedrock terrace or hillside slope, as described in the ANR Stream Geomorphic Assessment Phase 2 Protocols (Step 1.4).

(7) **Natural or Manmade Depressions Adjacent to Streams.** If field evidence indicates features such as natural or human-created depressions and old channels adjacent to the stream are deeper than the stage of the annual flood, the meander belt may extend laterally to encompass those features in recognition of their potential to be captured by the river or contribute to a channel avulsion (relocation) during a flood;

(8) **The Riparian Buffer Component.** All river corridors, except small streams with a drainage of less than or equal to two square miles, shall include a 50 foot setback as an extension on either side of the meander belt. For small streams, the 50 foot setback from each bank described in Section 4(b)(1) above is to serve both meander and riparian buffer functions. The buffer components may extend past the mapped line of a naturally confining feature (e.g., the toe of the natural valley wall), but shall not go beyond the boundary of an engineered levee, railroad, or federal aid highway (see Figure 2).

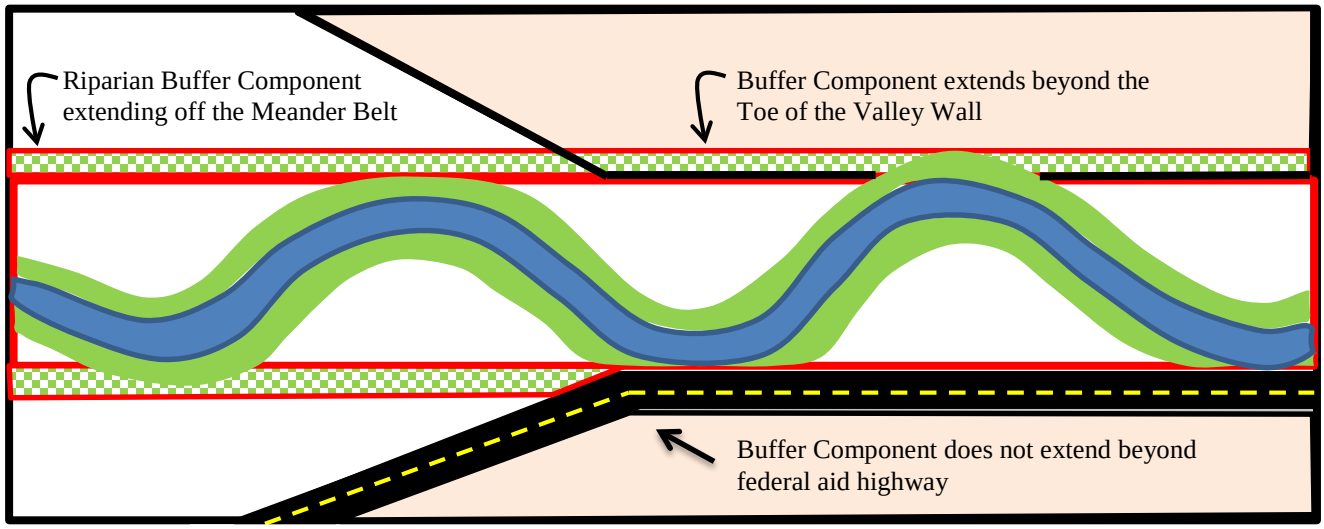
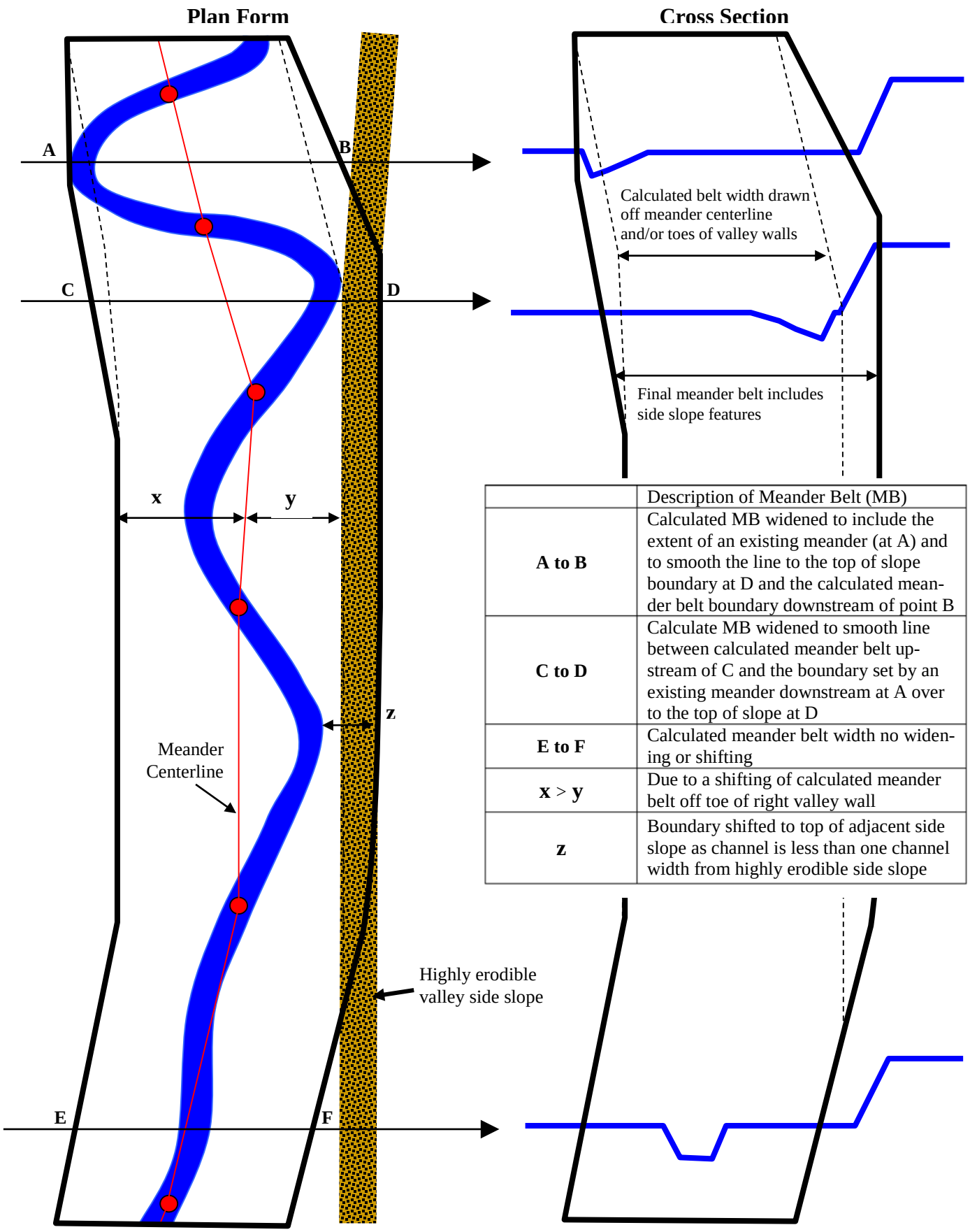


Figure 2. Showing the (green cross-hatched) riparian buffer component of the river corridor, as an extension off the meander belt, to accommodate the actual buffers (green bands) when the stream meanders are at their equilibrium amplitude. Buffer components are drawn beyond natural confining features such as the valley wall but not beyond engineered levees, railroads, or federal aid highways.



	Description of Meander Belt (MB)
A to B	Calculated MB widened to include the extent of an existing meander (at A) and to smooth the line to the top of slope boundary at D and the calculated meander belt boundary downstream of point B
C to D	Calculate MB widened to smooth line between calculated meander belt upstream of C and the boundary set by an existing meander downstream at A over to the top of slope at D
E to F	Calculated meander belt width no widening or shifting
x > y	Due to a shifting of calculated meander belt off toe of right valley wall
z	Boundary shifted to top of adjacent side slope as channel is less than one channel width from highly erodible side slope

Figure 3. Planform and cross-sectional views of the meander belts used in constructing River Corridors and River Corridor Protection Areas (RCPA) based on a highly sensitive river type adjacent to a highly erodible valley side slope.

(c) **Procedure for the Statewide River Corridor Map Layer.**

(1) Rivers and streams, with a drainage area greater than two square miles, shall have drawn corridors based on the criteria for stream sensitivity, riparian buffer setbacks, and confining features established in Section 4(b).

(2) A Statewide River Corridor Map Layer shall depict or indicate the following map categories:

(A) simple top-of-bank setbacks indicated for streams with a drainage area of less than or equal to two square miles;

(B) river corridors drawn using hydrographic and topographic data and human-imposed confining features as defined in Section 4(b)(7) above (hereafter referred to as the *base layer or base map*); and

(C) river corridors drawn as updates or administrative revisions to the base layer based on new data, detailed field studies, or municipal planning at the reach scale or the watershed scale.

(3) The river corridor base layer shall be ArcGIS derived from analysis of topographic data to calculate valley geometry (slope and width) and an analysis of hydrographic data to calculate hydraulic geometry and meander belt widths. Human-imposed confining features, including railroads and federal aid highways, were established as artificial valley walls and used to delineate the location of the meander belt on the base layer. As needed, the base layer may be field-verified using the principles of fluvial geomorphology as documented in the *DEC technical guidance*.

5.0 APPLICABILTY, AMENDMENT, UPDATE, AND REVISION OF MAPS

(a) **Introduction.** Flood hazard area maps are developed under the auspices of the NFIP as administered by FEMA. By contrast, river corridor maps are developed by the DEC River Corridor and Floodplain Management Program. The following sections describe how the two map types become applicable in this Department Procedure and how they may be revised, amended, and updated. As a program unique to the state of Vermont, this Procedure is necessarily more detailed with respect to river corridors.

(b) **Flood Hazard Area Maps.**

(1) **Applicable Maps.**

The applicable flood hazard area maps shall be those delineated in a manner consistent with the federal definition of *"area of special flood hazard"* (44 C.F.R § 59.1), in other words, that land in the floodplain within a community subject to a one percent or greater chance of flooding in any given year (10 V.S.A. § 752(3)).

(2) **Revision.**

(A) Requests for revisions to flood hazard area maps must be made through FEMA's Letter of Map Revision (LOMR) process. A LOMR is FEMA's modification to an effective

NFIP flood hazard area map.[27]

(B) All requests for changes to effective maps, other than those initiated by FEMA, must be made to FEMA in writing by the chief executive officer (CEO) of the community or an official designated by the CEO. Pursuant to 44 C.F.R. Part 65, LOMRs must be noted on the community's master flood map and filed by panel number in an accessible location. All LOMR requirements are found at 44 C.F.R. Part 65- *Identification and Mapping of Special Flood Hazard Areas.*

(C) While DEC may provide information and technical assistance on LOMR requirements, application must be made directly to FEMA. More information on the revision process is available by contacting the FEMA Map Information Exchange (FMIX) at 1-877-336-2627.

(3) **Amendment.**

(A) Amendment to flood hazard areas must be made through FEMA's Letter of Map Amendment (LOMA) process. A LOMA is an official amendment, by letter, to an effective NFIP flood hazard area map. A LOMA establishes a property's location in relation to the flood hazard area. FEMA typically issues LOMAs when a property has been inadvertently mapped as being in the flood hazard area and, in actuality, is located on natural high ground above the base flood elevation.

(B) Pursuant to 44 C.F.R. Part 70, LOMAs must be noted on the community's master flood map and filed by panel number in an accessible location. All LOMA requirements are found in 44 C.F.R. Part 70 – *Procedure for Map Correction.*

(C) While DEC may provide information and technical assistance on LOMA requirements, application must be made directly to FEMA. More information on the amendment process is available by contacting the FEMA Map Information Exchange (FMIX) at 1-877-336-2627.

(c) **River Corridor Maps.**

(1) **Applicable Maps.**

(A) The Statewide River Corridor Map Layer and best available stream geomorphic data not yet incorporated into the Statewide Layer, developed pursuant to Sections 4(b) and (c) above, shall be the applicable ANR river corridor maps for purpose of implementing this Procedure.

(B) The State shall publish and maintain the Statewide River Corridor Map Layer on the ANR Natural Resource Atlas.

[27] LOMRs are generally based on the implementation of physical measures that affect the hydrologic or hydraulic characteristics of a flooding source and thus result in the modification of the existing FEMA-designated floodway, the effective base flood elevations (BFEs), or the flood hazard area. The LOMR officially revises the flood hazard area, and sometimes the flood insurance study (FIS) report, and when appropriate, includes a description of the modifications. The LOMR is generally accompanied by an annotated copy of the affected portions of the flood hazard area map or FIS report.

(2) **Map Updates.**

(A) "Updates" are technical changes which fall into the categories of "minor updates" and "major updates." "Major updates" involve the collection of data and analysis to reevaluate stream sensitivity type on which to derive specific meander belt or buffer widths. "Minor updates" include the correction of remnants from the mapping process, computer mapping errors, and single adjustments to factor in stream geomorphic features documented with data (e.g., unmapped bedrock outcrop) unavailable when the base layer was developed. Multiple "updates" (minor and/or major) may occur when new reach- or watershed-scale data becomes available.

(B) Major updates may involve the analysis of:

(1) Watershed Hydrologic Modifications including those natural processes and human activities or facilities which result in a significant **decrease** in peak discharges (e.g., flood control facilities); or significant watershed hydrologic modifications associated with, for example, land use conversion which raises peak discharges, as these activities serve to **increase** stream power, the level of erosion hazard, and stream sensitivity.

(2) Slope Modifications Related to Sediment Transport and Sediment Regime Changes. Meander belt modelling captures a range of watershed factors and natural channel conditions and enables the State to cost-effectively implement this Procedure statewide. However, project proponents and their consultants may propose a stream-specific equilibrium slope assessment for a geomorphically-defined stream reach which, if approved, could be conducted and provide data to calculate a stream reach-specific meander belt width. Updates delimiting vertically stable "modified streams" (designated as moderate to low sensitivity) would fall into this category. A river corridor map amendment in consideration of a modified stream shall be limited to situations where the physical human constraints are so pervasive as to effectively preclude any expectation of re-establishing natural equilibrium conditions, and where active erosion hazards (vertical channel adjustments), upstream and downstream of the human-constrained reach, are low or have been mitigated.

(3) Boundary Conditions. The resistance of the channel boundary materials to the erosive power of the stream as influenced by local conditions such as material type, size, and gradation; cohesiveness; and vegetation, or lack thereof, may significantly influence the anticipated range of channel adjustment and may therefore increase or decrease the level of erosion hazard, channel sensitivity, and river corridor extent. The role of human constructed channel stabilization treatments (such as rock rip rap) with respect to constraining channel adjustments, particularly in the absence of other improvements, will not be considered, because the typical long-term response to human-placed bank revetments is a higher rate of channel adjustment and an increased erosion hazard.

(4) Bank and Valley Side-Slope Failure / River-Associated Landslide Hazard. There are stream bank, landslide, and other erosion hazards that may exist at or beyond the boundaries of the meander belt. The river corridor may be extended beyond the top of the banks, slopes, or meander belt if there is evidence of active toe erosion or historic mass wasting failures. Determining an acceptable setback allowance to mitigate a slope or landslide hazard by evaluating the erosion rate of an exposed and actively

eroding terrace or high bank does not capture the degree to which erosion could occur (Rapp, 2003). A Slope Stability Allowance (SSA) is an additional setback distance from the top-of-bank or top-of-adjacent side slope which may be added to the meander belt to mitigate damages and public safety concerns with respect to potential slope failure or landslide hazard (Table 1). The SSA is principally a function of the local soils and geologic materials present on the slope adjacent to the stream where the proposed development is to occur as well as any aggravating factors that could contribute to slope failure such as the incised or entrenched stream conditions, existing and proposed hydrologic conditions from groundwater, or stormwater runoff (Simon, 2003).

Table 1. Slope Stability Allowance (SSA)

Condition	Local Conditions of Side Slope	Options
1	Bedrock present in the floodprone area of the side slope (to an elevation 2X maximum channel depth).	Toe of the side slope represents the boundary of the River Corridor
2	Normal surficial materials present[28]	Calculate SSA as 2:1 slope measured from the toe of the slope[29] or conduct a geotechnical analysis
3	Champlain lowland clayey surficial materials present[30]	Calculate SSA as 3:1 slope measured from the toe of the slope or conduct a geotechnical analysis

Note that a slope stability analysis must demonstrate that the proposed development will not require channelization practices, such as rock armoring, to maintain a stable slope.

(3) **Assisting Municipalities and Regional Planning Commissions with Administrative Revisions, Map Updates, and the Local Adoption Process.**

(A) The Agency, after notifying and seeking coordination with the Regional Planning Commission, shall assist any municipality expressing an interest in flood resiliency planning and the adoption of river corridor or river corridor protection area bylaws and maps. During the local planning process, the Agency will present the Statewide River Corridor Map Layer and any other available assessment data and explain the opportunities for administrative revisions and updates to the Statewide River Corridor Map Layer.

(B) DEC shall, upon request, provide municipalities with maps depicting "river corridor protection areas" (10 V.S.A. §1422(19)) comprised only of the meander belt, without the 50 foot riparian buffer component. All streams on a "protection area" map shall be indicated or depicted with a corridor that is at least as wide as the small stream setback described in Section 4(b)(1).

(C) **Administrative Revisions**. Administrative revisions are river corridor delineation adjustments made at the request of the municipal legislative body to facilitate infill and redevelopment away from undeveloped river corridors and protect public infrastructure. The

[28] "Normal surficial materials" include alluvium, ice-contact deposits, and glacio-lacustrine materials. See Appendix F in *SGA Handbooks* for more information and sources of geologic information in Vermont.

[29] Measure the setback, horizontally from the toe of the slope, at a distance two times the vertical height of the slope.

[30] Champlain lowland clayey materials include locations where glacio-marine deposits exist.

Agency shall make those administrative revisions to the river corridor or river corridor protection area on the Statewide River Corridor Map Layer that are consistent with this Procedure prior to municipal adoption. Examples of administrative revisions consistent with this Procedure include:

(i) adjusting the river corridor within all or a portion of a designated center where there is a concentration of existing encroachments and, wherever possible, away from known repetitive loss areas, and high to extremely sensitive and actively adjusting river reaches; and

(ii) shifting the river corridor to the side of adjacent transportation or other public infrastructure critical to the community to achieve a significantly greater river meander belt width and reduce erosion hazards over time, acknowledging structures immediately adjacent to a meander belt are as, or more, vulnerable to fluvial erosion than infrastructure within the corridor.

(C) During the municipal planning and map review process, DEC and other parties may also bring forth any minor or major map updates that may be applicable, for example, adding known flood prone or erosion hazard areas, such as landslides or alluvial fans.

(D) When a municipal legislative body seeks administrative revisions and updates to the river corridor or river corridor protection area, consistent with this Procedure, the Agency shall update the Statewide River Corridor Map Layer following the public notice process in Section 5(c)(4)(D) above. Necessary administrative revisions must be finalized on the Statewide River Corridor Map Layer at the time of an Act 250 project application for DEC to consider them during Act 250 project reviews.

(E) Where a municipality elects to adopt an administratively revised or updated river corridor protection area, DEC shall assist the municipality and Regional Planning Commission in maintaining these locally adopted maps, particularly when further updates are made to the Statewide River Corridor Map Layer.

(F) While the Agency will promote river corridor mapping and bylaw adoption to achieve consistency between local, regional, and state objectives for fluvial erosion hazard reduction, the Agency does not have the authority to mandate municipal adoption of river corridor or river corridor protection area bylaws and maps or limit municipal adoption of administrative revisions to those outlined in this Procedure.

(4) **Map Update Process.**

(A) The Agency may incorporate minor and major updates and administrative revisions on all or portions of the Statewide River Corridor Map Layer as needed (e.g., following major floods or when new field studies are available) and on a published schedule to incorporate those updates and administrative revisions consistent with this Procedure and as submitted by municipalities and other interested parties.

(B) The Department shall file all minor and major updates and administrative revisions by stream reach and verify receipt of each map update and revision request along with information as to when and how the DEC will review the map update or revision.

(C) Updates addressing reach-scale technical adjustments, such as meander centerline and valley wall adjustments, or remnants of the ArcGIS mapping process will be made at the discretion of the DEC River Scientists and posted on the Statewide River Corridor Map Layer with notification to the affected municipalities, the Regional Planning Commissions, and the Act 250 District Commissions.

(D) Major updates and administrative revisions shall be noticed on the DEC web pages for public review and comment for a 30-day period. The Agency shall provide maps to and solicit comments from the affected municipalities, the Regional Planning Commissions, the Act 250 District Commissions, and other interested parties and shall provide a response summary and notify these jurisdictions when the State has applied updates and revisions to the Statewide River Corridor Map Layer.

(E) Applications for Major Project-Related Map Updates.

i. Applications for major project-related map updates involving meander belt delineation based on sediment transport modelling and technical evaluations of stream reach sensitivity must be accompanied by a qualified consultant's rationale using qualified data such as those assessments outlined in the Agency's Phase 2 and Phase 3 geomorphic assessment (SGA) protocols. Applications for major updates must document stream sensitivity type, and may be required to ascertain the equilibrium channel slope associated with an even distribution of stream power, sediment continuity, and vertical channel stability. Assessments must be based on methods outlined in *DEC technical guidance* or another prior-approved methodology.

ii. The applicant shall be responsible for conducting the additional assessment and submitting proposed major map updates, with applicable fees, to DEC, with certification that copies were provided to the local governing body, the Regional Planning Commission(s), and the Act 250 District Commissions.

6.0 ACT 250/SECTION 248 FLOODWAY DETERMINATIONS

(a) The goal of Act 250 Criterion 1(D) is to promote the health, safety, and welfare of the public. 10 V.S.A. § 6086(a)(1)(D). The Secretary has determined that the Act 250 floodway includes areas associated with both flood inundation and fluvial erosion hazards. The Act 250 floodway limit is determined by considering the inundation hazards as delineated by the NFIP inundation maps (Flood Insurance Rate Maps, or FIRMs) **and** fluvial erosion hazards as delineated in river corridor maps.

(b) For the purpose of determining the Act 250 floodway under 10 V.S.A. § 6001(6), and the impacts of a project proposed to be built in an Act 250 floodway under Criterion 1(D), DEC shall use the applicable maps defined in Section 5 of this Procedure for the:

(1) Flood hazard area as the Act 250 inundation floodway; and

(2) River corridor as the Act 250 erosion hazard floodway.

(c) For the purposes of determining the Act 250 floodway fringe under 10 V.S.A. § 6001(7), DEC shall use the mapped FEMA-designated flood fringe.

(d) The flood hazard area includes the regulatory floodway and the flood fringe as mapped by the FEMA. River corridors are distinct from the NFIP inundation-based flood hazard areas mapped on the FIRMs and may apply to lands that lie outside of the regulatory inundation floodplain. Upon comparison of the two determinations (NFIP and DEC river corridors) the Act 250 floodway limit shall be whichever laterally extends farther from the stream.

(e) Where available, base flood elevations and FEMA-designated floodway limits provided by the NFIP and in the most current flood insurance studies and accompanying maps shall be used to administer this Procedure. Where an approximate flood hazard area has been delineated on rivers for which base flood elevations and FEMA-designated floodway limits *have not* been provided by the NFIP, or on lakes for which base flood elevations have not been provided by NFIP, it shall be the applicant's responsibility to develop the necessary data. Where available, the applicant shall use data provided by FEMA or state or federal agencies.

(f) For proposals along rivers and streams with watershed areas greater than two square miles, and where a flood hazard area has not been mapped, the Secretary has the discretion to require base flood elevation and floodway data if documented flood damages or flood history exists indicating the risk of inundation hazards outside of the river corridor.

(g) If a project satisfies this Procedure and Act 250 Criterion 1(D), it must still meet all the other Act 250 criteria, including Criterion 1(E) that may, for example, require the protection of riparian buffers[31] greater than 50 feet.

(h) In making Act 250 and Section 248 Criterion 1(D) floodway determinations and recommendations and under the State Flood Hazard Area and River Corridor Rule, the Secretary shall include the riparian buffer component as an extension to the meander belt component, that is revised and updated on the Statewide River Corridor Map Layer to match a municipally adopted river corridor protection area, if such a buffer component is not precluded by other existing human constraints.

(i) The Secretary shall apply this section when making recommendations to the Public Service Board regarding projects requiring permits under 30 V.S.A. §§ 248 or 248a.

7.0 DEC REGULATORY RECOMMENDATIONS

DEC shall make recommendations to the Act 250 District Commissions, the Natural Resources Board, the Public Service Board, municipalities, and other state regulatory programs according to the following standards.

(a) **Projects Requiring an Act 250 Permit or Section 248 Certificate of Public Good.** If a project requiring Act 250/Section 248 review is proposed within the flood hazard area or river corridor (i.e. the Act 250 floodway), DEC shall recommend that the project meet the No Adverse Impact Standard to avoid restricting or diverting the flow of flood waters, and endangering the health, safety, and welfare of the public or of riparian owners during flooding.

[31] For the purposes of Act 250 and Section 248, the Agency will make an explicit floodway determination and a separate vegetated buffer recommendation in accordance with the ANR Riparian Buffer Guidance (2005).

(1) **No Adverse Impact Standard.**

(A) Except as provided in Section 7(a)(2), projects shall not include new fill, new structures, substantial excavations, and other improvements within the river corridor;

(B) A development shall not be located in the FEMA-designated floodway unless:

(i) Hydrologic and hydraulic analyses are performed in accordance with standard engineering practice, by a registered professional engineer, certifying that the proposed development will not increase base flood elevations or velocities. The Secretary has determined that hydrologic and hydraulic analyses conducted in accordance with FEMA's *Guidelines and Standards for Risk Analysis and Mapping* are standard engineering practices, or

(ii) Concurrence and approval are received from FEMA through the Conditional Letter of Map Revision review process confirming that the proposal meets the requirements of NFIP in 44 C.F.R. § 60.3(d)(3) or (4). Proposals receiving FEMA approval for encroachment in the FEMA-designated floodway shall meet the requirements of Section 7(a)(3).

(C) Except as provided in Section 7(a)(2)(A), a development shall not decrease flood fringe storage capacity. New development that displaces floodwater storage in the flood hazard area must provide compensatory storage to offset the impacts of the proposal, when in the judgment of the Secretary, said loss will cause an increase or will contribute incrementally to an increase in the horizontal extent and level of flood waters during peak flows up to and including the base flood discharge. No Adverse Impact volumetric analysis and supporting data must be provided by the applicant and certified by a registered professional engineer.

(E) For a proposed development representing a particular risk to adjacent landowners, as determined by the Secretary, the Secretary may recommend a hydraulic analysis to verify that the proposal will not increase flood elevations or velocities for adjacent landowners. Hydraulic analyses and supporting data must be provided by the applicant and certified by a registered professional engineer.

(2) **No Adverse Impact – Exceptions.**

(A) Exceptions to the No Adverse Impact compensatory storage requirement within the flood fringe:

(i) Proposals determined by ANR to have no more than a minimal effect on floodwater storage and do not divert floodwaters onto adjacent property. Examples of designs that have a minimal effect on floodwater storage include open foundation designs, utility work that is largely below grade, and minor above ground improvements such as fences or poles that minimally displace or divert floodwaters.

(ii) Replacement structures provided that there is no increase in the structure's footprint.

(iii) Replacement structures relocated to a location less proximal to the river within the river corridor or to a less hazardous location within the flood fringe provided that there is no increase in the structure's footprint.

(B) Exceptions to the No Adverse Impact requirement within the river corridor:

(i) Redevelopment and infill development in designated centers provided that the distance between the redevelopment or infill development and the river or stream is no less than the shortest distance between immediately adjacent existing above ground development and such river or stream[32] or if the Secretary determines that the proposed development within the designated center will not cause or contribute to fluvial erosion hazards as determined in (iv)(a) of this subsection.

(ii) Bridges, culverts, utility crossings, and associated transportation and utility networks; dams; and functionally dependent uses that must be placed in or over rivers and streams. "Associated transportation and utility networks" means those transportation and utility networks connected to a bridge, culvert, or utility for the purpose of crossing a river or stream and do not include transportation or utility networks within the river corridor that merely run parallel to a river or stream.

(iii) The replacement of improvements within a comparable footprint of an existing improvement or immediately adjacent to an existing improvement, provided that the replacement improvement is no closer to the river than the improvement that is being removed and meets the River Corridor Performance Standard outlined in (iv) below.

(iv)(a) In addition to the specific exceptions outlined in subdivisions (i) through (iii) above, development shall be allowed within the river corridor if the Secretary determines that, because of other existing and adjacent development within the corridor, the proposed development will not cause or contribute to fluvial erosion hazards. To make this determination the Secretary shall apply the following River Corridor Performance Standard. The Secretary must find that a proposed development will:

(1) not cause the river reach to depart from or further depart from the channel width, depth, meander pattern, and slope associated with natural stream processes and equilibrium conditions; and

(2) not result in an immediate need or anticipated future need for stream channelization, solely as a result of the proposed development, that would increase flood elevations and velocities or alter the sediment regime triggering channel adjustments and erosion in adjacent and downstream locations.

(b) Development that meets the requirements of Appendix A or Appendix B of this Procedure satisfies the River Corridor Performance Standard outlined in this subdivision (Section 7(a)(2)(B)(iv)(a)).

[32] ANR will not consider administrative revision to the applicable river corridor map during an Act 250 project review.

(3) **Floodplain Management Standards.**

If the No Adverse Impact standard has been met, Agency technical staff shall, consistent with the requirements of 44 C.F.R. § 60.3, recommend that development be made reasonably safe from flooding and comply with all applicable floodplain management criteria of the NFIP. Technical staff shall make the following recommendations, unless the municipality in which the project is located has more stringent bylaws or ordinances, in which case, technical staff shall make recommendations consistent with those requirements. 24 V.S.A. § 4413(c).

(i) Residential structures shall be elevated such that the lowest floor is at least two feet above the base flood elevation[33];

(ii) Non-residential structures shall be elevated such that the lowest floor is at least two feet above the base flood elevation, or shall be dry-floodproofed and certified in accordance with FEMA floodproofing guidance to at least two feet above the base flood elevation;

(iii) Critical facilities[34] shall have the lowest floor elevated or floodproofed to at least the 500-year flood elevation or two feet above the base flood elevation, whichever is greater;

(iv) Development shall be designed, operated, maintained, modified, and adequately anchored to prevent flotation, collapse, or lateral movement of the structure during the occurrence of the base flood;

(v) Development shall be constructed with materials resistant to flood damage;[35]

(vi) Development shall be constructed by methods and practices that minimize flood damage;

(vii) Development shall be constructed with waterproofed systems, such that electrical, heating, ventilation, plumbing, and air conditioning equipment and other service facilities are designed and/or located so as to prevent water from entering or accumulating within the design components during flooding.

(viii) Development must be constructed with adequate drainage to reduce exposure to flood hazards; and

(ix) Fuel storage tanks (as needed to serve buildings in the flood hazard area) must be located a minimum of one foot above the base flood elevation and be securely anchored to prevent flotation, and protected from flood forces and debris; or storage tanks may be placed above or below ground, if securely anchored and certified by a qualified professional that the design is watertight and will resist buoyancy, scour and uplift forces, and that the fuel storage tank vent is located at least one foot above the base flood elevation.

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[33] Residential Structures shall not have fully enclosed areas that are below grade on all sides (including below grade crawlspaces and basements

[34] For Act 250 proceedings, ANR routinely recommends that critical facilities not be located in flood hazard areas unless there is no practicable alternative.

[35] Refer to FEMA Technical Bulletin 2-93: Flood-Resistant Materials Requirements.

(b) **Projects subject to Municipal Hazard Area Regulations and submitted for DEC review.**

(1) Municipalities that have adopted flood hazard area or river corridor bylaws are required to submit permit applications for flood hazard area and river corridor development to DEC, or DEC's designee, for review and comment pursuant to 24 V.S.A. § 4424(a)(2)(D). DEC shall review applications for completeness in accordance with the Development Review Checklist.[36] Incomplete applications will be returned to municipalities within 10 business days with the information deficiency noted.

(2) **Flood Hazard Areas.** Upon receipt of a complete application, DEC shall review the development proposal against the effective Flood Insurance Study and flood hazard area map, in conjunction with the standards contained in the flood or other hazard area bylaw adopted by the municipality. DEC shall provide written comments with regard to any aspect of the proposal not in compliance with the municipal bylaw and the NFIP and provide recommended permit conditions to ensure the development complies with the adopted regulations. If during the application review the Agency sees opportunities to increase public safety, changes to local bylaws may be recommended.

(3) **River Corridors and River Corridor Protection Areas.** Upon receipt of a complete application, DEC shall review the application against the effective municipally-adopted river corridor or river corridor protection area map, in conjunction with the standards contained in the river corridor, river corridor protection area, or fluvial erosion hazard area bylaw adopted by the municipality. DEC shall provide written comments with regard to any aspect of the proposal not in compliance with the municipal bylaw and provide recommended permit conditions to ensure the development complies with the adopted regulations. If during the application review the Agency sees opportunities to increase public safety, changes to local bylaws may be recommended.

(c) **Recommendations to Other State and Federal Programs and Interested Parties.** Other non-municipal programs regulate development located within flood hazard areas and river corridors and may seek technical and regulatory assistance to minimize flood and fluvial erosion hazard. The DEC River Corridor and Floodplain Management Program shall provide technical assistance to other programs consistent with the No Adverse Impact Standard as outline in Sections 7(a)(1-3) above and the following performance standards:

(i) Compensatory Storage Performance Standard. Proposed development must provide for a volume of storage that ensures no increased risk to public safety by increasing the horizontal and vertical extent of floodwaters or increasing flood velocities. A positive finding may require the rule or regulation to include a requirement that a hydraulic analysis be submitted to the DEC River Corridor and Floodplain Management Program to verify that a proposed development will not increase flood elevations or velocities on floodwaters that would materially impact adjacent landowners.

(ii) River Corridor Performance Standard. Proposed development must provide for a meander belt and riparian buffer component that ensures no increase in fluvial erosion hazards by causing the river reach to depart from or further depart from the channel width, depth, meander pattern, and slope associated with natural stream processes and equilibrium con-

[36] http://watershedmanagement.vt.gov/rivers/docs/nfip/rv_4424_checklist_final.pdf

ditions. Proposed development shall not be approved if, as a result of the development, there is an immediate need or anticipated future need for stream channelization that would increase flood elevations and velocities or alter the sediment regime triggering channel adjustments and erosion in adjacent and downstream locations.

8.0 BEST MANAGEMENT PRACTICES IN FLOODPLAINS AND RIVER CORRIDORS

(a) **Introduction.** This section of the Procedure includes best management practices for managing Vermont streams and rivers toward a dynamic equilibrium, i.e., geomorphic forms and fluvial processes which result in functioning floodplains and least erosive stream channels. Maximizing the use of these best management practices, with respect to stream and floodplain equilibrium, is in the interest of landowners, the communities of a watershed, and the State as a whole. In addition to the benefit of reducing flood damages associated with inundation and fluvial erosion, streams and floodplains in equilibrium store fine sediments and nutrients that may degrade Vermont waters, and provide for complex aquatic, wetland, and riparian habitats that support the most highly diverse communities of native plants and animals in this eco-region.

While this Section does not attempt to cover a complete set of best management practices for achieving the State's water quality objectives and the highest ecological integrity of Vermont river systems, the Department has publish the State Surface Water Management Strategy for this purpose[37].

DEC provides technical assistance and works with partner agencies and organizations to complete river corridor plans and stormwater master plans which engender the technical analyses for identifying site-specific opportunities to implement the following best management practices. Municipalities and regional planning commissions are encouraged to consider both general and site-specific best practices in preparing local hazard mitigation plans and the resiliency elements of town plans. The State is directed by statute to provide incentives for local planning and implementation of local projects and practices to address flood and fluvial erosion hazards.

The following sub-sections outline and reference other best practice sources for achieving stream equilibrium, including those for managing runoff, floodplain encroachments, river channels, and riparian buffers. Detailed descriptions of these practices are, in many cases, provided in separate best practice documents published by other state programs, including *technical guidance* documents (e.g., the State Surface Water Management Strategy) published on the Watershed Management Division web pages. Presenting this set of references is intended to knit together these programs and practices into a single framework for managing floodplains and river corridors.

(b) **Best Management Practices.**

(1) **Slowing, Spreading, and Infiltrating Runoff.** Stream and floodplain geometry are a function of watershed hydrology. Natural runoff characteristics are altered by ditching, wetland loss, and changes in land use and land cover. When runoff is quickened and peak discharges are increased, flood water depths and erosive power are increased. A stream receiving runoff from ditched lands or a watershed with impervious cover exceeding 5% may become energized, erosive, enlarged, and unstable (Fitzgerald, 2007; Doyle et al., 2000). Best practices to minimize the stream disequilibrium associated with altered upland hydrology involve slowing, spreading, and infiltrating runoff from urban, farm, and working forest lands and

[37] The Sate Surface Water Management Strategy may be found at http://www.watershedmanagement.vt.gov/swms.html.

transportation networks. *DEC technical guidance* for stormwater management, low impact (LID) development, green infrastructure (GI) planning, and ecosystem restoration lists and describes current programs outlining the best management practices for watershed hydrology. In general, natural systems such as vegetative cover, organic soils, land forms (e.g., wetlands and floodplains) that store and more slowly release runoff are the preferred, least cost and self-maintaining systems for stormwater treatment.

See: http://www.watershedmanagement.vt.gov/stormwater.htm

(2) **Avoiding and Removing Encroachments.** Investments placed within flood hazard areas and river corridors inevitably result in human-imposed structural constraints on flood waters and stream channel adjustments to protect those investments and address associated threats to public safety. Typically, the constraint of flooding and channel adjustments in one location results in a transfer of flood water, stream sediments, and erosive energy to another location. Structural flood works to protect encroachments can increase flood elevations and velocities and trigger a sequence of channel adjustments and erosion in adjacent and downstream locations, especially when placed in and adjacent to sensitive (i.e., high-bed load, alluvial) stream types. Avoiding new development and removing existing structures within and abutting floodplains and river corridors will begin to mitigate these impacts. The following are examples of actions that would be included in an "avoidance" best practice:

(A) **Land use planning and regulation.** Best management practices for planning developments exempt from municipal regulation or those subject to Act 250/Section 248 are guided by the "No Adverse Impact" standard for flood hazard areas and river corridors as established in this Procedure and the Flood Hazard Area and River Corridor Rule. The adoption of local land use plans and regulations are also critical best management practices. Municipalities are compliant with the provisions of the NFIP by adopting minimum regulatory standards as set by FEMA. This Procedure, however, recommends the best practice of adopting land use bylaws with development standards which exceed the minimum requirements of the NFIP. The Department highly recommends that municipalities submit proposed bylaw language to their Regional Planning Commission and the River Corridor and Floodplain Protection Program for review and comment. The Program has published model bylaws for municipal regulation of development in flood hazard areas, river corridors, and river corridor protection areas on its web pages.

See: http://www.watershedmanagement.vt.gov/rivers/htm/rv_floodhazard.htm

(B) **Land conservation.** River corridor and floodplain protection, in the form of an easement or fee purchase, often represents a feasible alternative to channelization practices. The DEC has designed river corridor easements to augment municipal bylaws. Zoning may avoid future encroachment and minimize fluvial erosion hazards, but does not restrict channel straightening and armoring practices that transfer flood-related erosion to downstream locations.

Obtaining an easement to protect rather than stop the erosion process and allow floodplains to reestablish in selected locations is a best management practice to protect soils, property, and infrastructure at the location of the easement and at properties lower in the watershed. Wherever feasible, the capture and storage of water, sediment, and debris in natural floodplain features will reduce flood hazards and promote the ecological health of our rivers (ANR *Guide to River Corridor Easements 2010*).

Securing a river corridor easement may be the most viable river management alternative if: (i) the sediment deposition process is dominating and/or is critical to the development and maintenance of equilibrium channel forms (i.e., stable meanders, river beds and banks); (ii) channel and corridor constraints do not currently limit meander and channel slope adjustments; (iii) existing and future proposed activities have been identified that would constrain or otherwise threaten the attainment of equilibrium conditions; and (iv) protecting the erosion/deposition process in the easement area may help minimize the erosion hazards to downstream areas.

See: http://www.watershedmanagement.vt.gov/rivers/docs/rv_RiverCorridorEasementGuide.pdf

(C) **Removal of structures.** Each year, whether from flood damage, disuse, or disrepair, determinations are made that certain structures require major investments to restore the function for which they were originally built. In these situations, best practice involves an alternatives analysis to determine the feasibility of moving or deconstructing an encroachment within or abutting the river corridor or floodplain. For instance, there is typically a high benefit-cost ratio for removing a repetitive-damage structure. State and federal agencies have maintained buy-out and restoration programs and typically require the long-term protection of the site upon removal of the structure.

Planning programs which identify and target derelict and vulnerable structures for removal, based on documented flood and fluvial erosion hazard mitigation objectives, will be most successful in obtaining funding assistance for the removal of structures.

In addition to home buy-outs, there may be road setbacks that are worthy of consideration, including those roads abutting the meander belt which may be as or more vulnerable than infrastructure within the meander belt of a river. Systemic restoration of floodplain function may also be achieved through the removal of derelict dams and under-sized stream crossings, which often restores the sediment transport functions critical to stream bed elevations and floodplain connectivity. Berm and levee removals have perhaps the highest benefit-cost ratio. Some levees are still protecting residences and infrastructure, but many others, particularly old berms, protect very little in comparison with the increased risk they create from increasing flood heights and velocities.

(3) **River and Riparian Management.**

(A) **River management meeting equilibrium and connectivity standards.** DEC has prepared a compendium of *Standard River Management Principles and Practices* to support more effective flood recovery implementation; improve the practice of river management; and codify best river management practices in Vermont. The document compiles the most current river management practices based on the best available science and engineering methods to create consistent practice and language for risk reduction while maintaining river and floodplain function. Best practices are established to address common flood damages, including:

(i) Erosion of banks adjacent to houses and infrastructure;
(ii) Erosion of road embankments;
(iii) Channel movement across the river corridor;

(iv) River bed down-cutting that destabilizes banks, undermines structure foundations, exposes utility crossings, and vertically disconnects rivers from adjacent floodplains;
(v) River bed sediment build-up that can increase flood depths, initiate channel movement and avulsion, and lead to bank erosion;
(vi) River bed filling with large woody debris that can increase flood depths, initiate channel movement and avulsion, and lead to bank erosion; and
(vii) Bridge and culvert failure.

See: http://www.watershedmanagement.vt.gov/permits/htm/pm_streamcrossing.htm

In addition to the standard river management practices, the *Principles and Practices* document includes a site screening and problem identification process as well as methods for conducting an alternatives analysis. Other best practices for restoring stream channels and floodplains toward equilibrium conditions are identified in River Corridor Plans completed using Phase 1 and Phase 2 Stream Geomorphic Assessment data. The ANR River Corridor Planning Guide offers methods for creating best practices around:

(i) Actively restoring and protecting floodplain functions and features;
(ii) Removing constraints to the natural sediment and hydrological regimes (e.g., berms, derelict dams, or undersized culverts)
(iii) Maintaining those stream dimensions, pattern, and slope presently in equilibrium condition; and
(iv) Reconstructing the channel dimensions, pattern, and slope associated with equilibrium conditions.

River corridor plans identify reach-specific restoration projects, including: stabilizing streambanks (i.e., on a laterally-adjusting, equilibrium stream); arresting head-cuts and nick-points; removing berms and other constraints to flood and sediment load attenuation; removing/replacing structures (e.g. undersized culverts, constrictions, low dams); restoring incised reaches; and restoring aggraded reaches. Where feasible, river corridor best management practices include the removal of structures and modification of landforms that constrain or obstruct fluvial processes to restore and maintain vertical connectivity between a channel and adjacent floodplains. Opportunities to couple active restoration with river corridor protection are a recommended best practice.

See: http://www.watershedmanagement.vt.gov/rivers/docs/rv_rivercorridorguide.pdf

(B) **Restoring and maintaining riparian buffers.** This Procedure: (i) defines a 50 foot setback extension on either side of the meander belt component of a river corridor to provide space for buffers adjacent to the stream when meanders have reached an equilibrium slope and planform, and (ii) recommends the maintenance of a 50 foot vegetated buffer as measured from the top of bank or top of slope, consistent with the Agency's Riparian Buffer Guidance (2005).

The 50 foot distance was chosen as the minimum ANR recommended vegetated buffer distance within the river corridor to give resistance to flood water velocities in the near-bank region and increase the stream bank stability necessary to achieve and maintain equilibrium conditions. Other buffer functions and distances are spelled out in the Guidance and supported in the ANR Riparian Buffers and Corridors Technical Papers (2005). The Agency may recommend vegetated buffers larger than 50 feet on existing channels

to ensure that other buffer functions are maintained and protected.

The State encourages and promotes buffers adjacent to streams and rivers (10 V.S.A. § 1421) and defines a "buffer" as an undisturbed area consisting of trees, shrubs, ground cover plants, duff layer, and generally uneven ground surface that extends a specified distance horizontally across the surface of the land from the top of the bank of an adjacent river or stream (10 V.S.A. § 1422(10)). The Agency encourages landowners and municipalities to consider and utilize the broader compendium of best practices for managing, protecting, and restoring buffers as contained and referenced in the Agency's Riparian Buffer Guidance and Technical Papers.

This Procedure points to the best practices for encouraging and promoting stream bed and bank stability and reducing flood flow velocities, including the near complete avoidance of earth-moving activities; the storage of materials; the removal of trees, shrubs, or groundcover; and mowing. Stream channelization to protect riparian vegetation from erosion is not a best practice. If a mature tree canopy and larger, non-hazardous deadfall and windblown trees in the stream and riparian area are retained, then the removal of lower limbs (i.e., to facilitate river viewing) and other vegetation management may have negligible effects on the equilibrium functions of a riparian buffer.

See: http://www.anr.state.vt.us/site/html/buff/anrbuffer2005.htm.

9.0 DEFINITIONS

"Accessory structure" means a structure which is: (1) detached from and clearly incidental and subordinate to the principal use of or structure on a lot, (2) located on the same lot as the principal structure or use, and (3) clearly and customarily related to the principal structure or use.

"Act 250 floodway" means a hazard area with inundation and fluvial erosion components. The inundation component is the special flood hazard area as mapped by the FEMA and includes the FEMA-designated floodway and flood fringe. The fluvial erosion component is the river corridor as mapped by the Agency.

"Act 250 floodway fringe" means an area which is outside a floodway and is flooded with an average frequency of once or more in each 100 years as determined by the Secretary of Natural Resources with full consideration given to upstream impoundments and flood control projects. The "Act 250 floodway fringe" is synonymous with the FEMA-designated flood fringe for the purposes of this Procedure.

"Agency"* or *"ANR" means the Vermont Agency of Natural Resources.

"Annual flood" means a discharge (Q) or flood flow event that occurs at a high frequency, i.e., there is greater than a 50% chance of a flood stage (<Q2) of at least this level occurring in any given year.

"Base Flood" means the flood having a one percent chance of being equaled or exceeded in any given year (commonly referred to as the "100-year flood").

"Base Flood Elevation" (BFE) means the elevation of the water surface elevation resulting from a flood that has a one percent chance of equaling or exceeding that level in any given year. On the Flood Insurance Rate Map the elevation is usually in feet, in relation to the National Geodetic Vertical Datum of 1929, the North American Vertical Datum of 1988, or other datum referenced in the Flood Insurance Study report, or the average depth of the base flood, usually in feet, above the ground surface.

"Basement" means any area of the building having its floor elevation below ground level on all sides including crawlspaces.

"Base Layer/Base Map" means the river corridors derived from an ArcGIS analysis of topographic data to calculate valley geometry (slope and width) and an analysis of hydrographic data to calculate hydraulic geometry and meander belt widths. Human-imposed confining features, including railroads and federal aid highways were established as artificial valley walls and used to delineate the location of the meander belt on the base layer. .

"BFE" see Base Flood Elevation.

"Below Ground Improvement" means a private, functioning potable water or wastewater system providing service to a habitable structure or an underground public utility that is functioning and providing a public service.

"Buffer" means an undisturbed area consisting of trees, shrubs, ground cover plants, duff layer, and generally uneven ground surface that extends a specified distance horizontally across the surface of the land from the mean water level of an adjacent lake or from the top of the bank of an adjacent river or stream, as determined by the Secretary of Natural Resources (10 V.S.A. § 1422(10)).

"Channel" means an area that contains continuously or periodic flowing water that is confined by banks and a streambed.

"Channel Slope" means longitudinal stream bed profile or the vertical drop of the stream bed from upstream to downstream in relationship to adjacent floodplain features.

"Channelization" practices conducted in a stream channel and/or the floodplain, including straightening, berming, dredging, and/or armoring, which alter flow depths, slope, and velocities and the sediment regime of the stream.

"Compensatory storage" means a volume not previously used for flood storage and which shall be incrementally equal to the theoretical volume of flood water at each elevation, up to and including the base flood elevation, which would be displaced by the proposed project. Such compensatory volume shall have an unrestricted hydraulic connection to the same waterway or water body. Further, with respect to waterways such compensatory volume shall be provided within the same reach of the river, stream, or creek.

"Critical facilities" means facilities that provide services or functions related to public health and safety during emergency response and recovery and facilities that must be protected to a higher standard to protect public health and safety.

"Designated center" means a downtown, village center, new town center, growth center, or neighborhood development area designated pursuant to 24 V.S.A. Chapter 76A.

"Development" means any human-made change to improved or unimproved real estate including buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations, or storage of equipment or materials.

"Equilibrium conditions" means the width, depth, meander pattern, and longitudinal slope of a stream channel that occurs when water flow, sediment, and woody debris are transported by the stream in such a manner that it generally maintains dimensions, pattern, and slope without unnaturally aggrading or degrading the channel bed elevation.

"FEMA" means the Federal Emergency Management Agency.

"Fill" means any placed material that changes the natural grade, increases the elevation, or diminishes the flood storage capacity at a site. Temporary storage of material is not considered fill.

"FIRM" see Flood Insurance Rate Map.

"Flood" means (1) a general and temporary condition of partial or complete inundation of normally dry land areas from: (A) the overflow of inland or tidal waters; (B) the unusual and rapid accumulation or runoff of surface waters from any source; or (C) mudslides which are proximately caused by flooding and are akin to a river of liquid and flowing mud on the surfaces of normally dry land areas, as when earth is carried by a current of water and deposited along the path of the current; or (2) the collapse or subsidence of land along the shore of a lake or other body of water as a result of erosion or undermining caused by waves or currents of water exceeding anticipated cyclical levels or suddenly caused by an unusually high water level in a natural body of water, accompanied by a severe storm, or by an unanticipated force of nature, such as flash flood or abnormal tidal surge, or by some similarly unusual and unforeseeable event which results in flooding.

"Floodplain" means any land area susceptible to being inundated by water from any source (see definition of *"Flood"*).

"Flood fringe" means the area that is outside of the regulatory FEMA-designated floodway but still inundated by the designated base flood (the flood having a one percent chance of being equaled or exceeded in any given year).

"Flood hazard" means those hazards related to inundation damages.

"Flood hazard area" means the land in the floodplain within a community subject to a one percent or greater chance of flooding in any given year. The term has the same meaning as "area of special flood hazard" under 44 C.F.R. § 59.1.

"Flood Insurance Rate Map" (FIRM) means an official map of a community on which the Federal Insurance Administrator has delineated both the special flood hazard areas and the risk premium zones applicable to the community.

"Flood insurance study" means an examination, evaluation, and determination of flood hazards and, if appropriate, the corresponding water surface elevations or an examination, evaluation, and determination of mudslide (i.e., mudflow) and/or flood related erosion hazards.

"Flood proofing" means any combination of structural and non-structural additions, changes, or adjustments to structures which reduce or eliminate flood damage to real estate or improved real property, water and sanitary facilities, structures, and their contents.

"FEMA--designated floodway" **or** ***"regulatory floodway"*** means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot at any point as depicted on Flood Insurance Rate Maps published by FEMA. Flood hazard areas and floodways may be shown on separate map panels.

"Fluvial erosion hazards" means those hazards related to the erosion or scouring of riverbeds and banks during high flow conditions of a river.

"Functionally dependent use" means a use which cannot perform its intended purpose unless it is located or carried out in close *proximity to water (e.g., bridges and public accesses to the water).*

"Habitable Structure" means any enclosed roofed structure; residential, commercial, or industrial; public or private, that is fit for people to enter and utilize.

"Handbooks" mean the Phase I-III Vermont Stream Geomorphic Assessment (SGA) Handbooks DEC, 2009)

"Historic Structure" means any structure that is: (1) listed individually in the National Register of Historic Places (a listing maintained by the Department of the Interior) or preliminarily determined by the Secretary of the Interior as meeting the requirements for individual listing on the National Register; (2) certified or preliminarily determined by the Secretary of the Interior as contributing to the historical significance of a registered historic district or a district preliminarily determined by the Secretary to qualify as a registered historic district; (3) individually listed on a state inventory of historic places in states with historic preservation programs which have been approved by the Secretary of the Interior; or (4) individually listed on a local inventory of historic places in communities with historic preservation programs that have been certified either: (A) by an approved state program as determined by the Secretary of the Interior or (B) directly by the Secretary of the Interior in states without approved programs.

"Improvement" means a habitable structure, accessory structure, public utility, public transportation infrastructure, or a private road, bridge, culvert, or utility (i.e., potable water well or waste water system) providing for the use of or primary access to residential and/or commercial property. For the purpose of this Procedure, "existing improvements" are those in existence as of the date this Procedure was adopted.

"Infill development" means construction, installation, modification, renovation, or rehabilitation of land, interests in land, buildings, structures, facilities or other improvements in an area that was not previously developed but it surrounded by existing development.

"*Letter of Map Amendment" (LOMA*) is a letter issued by FEMA officially removing a structure or lot from the flood hazard area based on information provided by a certified engineer or surveyor. This is used where structures or lots are located above the base flood elevation and have been inadvertently included in the mapped special flood hazard area.

"Lowest floor" means the lowest floor of the lowest enclosed area of a building, including the basement, except an above grade unfinished or flood resistant enclosure, usable solely for parking of vehicles, building access, or storage in an area other than a basement area is not considered a building's lowest floor provided that such enclosure is not built so as to render the structure in violation of the applicable non-elevation design requirements of 44 C.F.R. § 60.3.

"Meander belt" means the land area on either side of a watercourse extending laterally across the river valley which represents a minimal corridor for the lateral meander extension and migration necessary to maintain an equilibrium slope and minimize vertical channel instability and erosion over time.

"New construction" means structures for which the *start of construction* commenced on or after the effective date of the floodplain management regulation adopted by the community and includes any subsequent improvements to such structures.

"NFIP" means the National Flood Insurance Program.

"Redevelopment" means construction, installation, modification, renovation, or rehabilitation of land, interests in land, buildings, structures, facilities, or other improvements in a previously developed area. The term includes substantial improvements and repairs to substantially damaged buildings.

"Replacement structure" means a new building placed in the same location, footprint, and orientation as the pre-existing building.

"River corridor" means the land area adjacent to a river that is required to accommodate the dimensions, slope, planform, and buffer of the naturally stable channel and that is necessary for the natural maintenance or natural restoration of a dynamic equilibrium condition and for minimization of fluvial erosion hazards, as delineated by the Agency in accordance with the ANR River Corridor Protection Procedures.[38] 10 V.S.A. § 1422(12).

"River corridor protection area" means the area within a delineated river corridor subject to fluvial erosion that may occur as a river establishes and maintains the dimensions, pattern, and profile associated with its dynamic equilibrium condition and that would represent a hazard to life, property, and infrastructure placed within the area. The river corridor protection area is the meander belt portion of the river corridor without an additional allowance for riparian buffers.

"Secretary" means the Secretary of Natural Resources or his or her authorized representative.

"Sediment regime" means the size, quantity, sorting, and distribution of sediments, which may differ between stream types due to their proximity to different sediment sources, their hydrologic regime, their stream, riparian and floodplain connectivity, and valley and stream morphology.

"Special flood hazard area" is synonymous with "flood hazard area" and "area of special flood hazard" (44 C.F.R. § 59.1) and is the floodplain within a community subject to a one percent or greater chance of flooding in any given year. This area is usually labeled Zone A, AO, AH, AE, or A1-30 in the most current flood insurance studies and on the maps published by FEMA. Base flood elevations have not been determined in Zone A where the flood risk has been mapped by approximate methods. Base flood elevations are shown at selected intervals on maps of special flood hazard areas that are determined by detailed methods. Please note, where floodways have been determined they may be shown on separate map panels from the Flood Insurance Rate Maps.

"Start of construction" includes substantial improvements, and means the date the building permit was issued provided the actual start of construction, repair, reconstruction, rehabilitation, addition placement, or other improvement was within 180 days of the permit date. The actual start means either the first placement of permanent construction of a structure on a site, such as the pouring of slab or footings, the installation of piles, the construction of columns, or any work beyond the stage of excavation. Permanent construction does not include land preparation, such as clearing, grading and filling; nor does it include the installation of streets and/or walkways; nor does it include excavation for a basement, footing, piers, or foundations or the erection of temporary forms; nor does it include the installation on the property of accessory buildings, such as garages or sheds not occupied as dwelling units or not part of the main structure. For a substantial improvement the actual start of construction means the first alteration of any wall, ceiling, floor, or other structural part of a building, regardless of whether that alteration affects the external dimensions of the building.

[38] These Procedures incorporate the river corridor delineation process defined in the ANR Flood Hazard Area and River Corridor Technical Guide available at: http://www.watershedmanagement.vt.gov/rivers/htm/rv_restoration.htm

"Structure" means a walled and roofed building, as well as a manufactured home, including gas or liquid storage tanks.

"Substantial damage" means damage of any origin sustained by a structure whereby the cost of restoring the structure to its before-damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred.

"Substantial improvement" means any reconstruction, rehabilitation, addition, replacement, or other improvement of a structure for which a building permit is issued after the date of adoption of this Procedure, the cost of which, over five years, cumulatively equals or exceeds 50 percent of the market value of the structure before the "start of construction" of the improvement. This term includes structures which have incurred "substantial damage", regardless of the actual repair work performed. The term does not, however, include either: (1) any project for improvement of a structure to correct existing violations of state or local health, sanitary, or safety code specification which have been identified by the local code enforcement official and which are the minimum necessary to assure safe living conditions or (2) any alteration of a "historic structure", provided that the alteration will not preclude the structure's continued designation as a "historic structure".

"Utility network" means above or below ground linear facilities subject to 30 V.S.A. § 248 or 248a.

"Watercourse" means any perennial stream and shall not include ditches or other constructed channels primarily associated with land drainage or water conveyance through or around private or public infrastructure.

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*Publications of the Vermont Agency of Natural Resource, River Management Program staff are published at: http://www.watershedmanagement.vt.gov/rivers.htm

Dated this 9th day of December 2014 at Montpelier, Vermont.

David K. Mears, Commissioner
Department of Environmental Conservation

Appendix A

Exception to the River Corridor No Adverse Impact Standard for Improvements Between Existing Improvements (See Section 7(a)(2)(B)(iv)(b))

(a) **Background.** In situations where existing improvements within the river corridor are in close proximity to one-another, there may be constraints (i.e., river channel management) on the extent of lateral river channel migration. Improvements between existing improvements in close proximity to one another are not expected to increase the existing risk of fluvial erosion hazards because the new improvements, while potentially at risk themselves, will not result in further channelization practice.

(b) **Standard.** Improvements may be admissible between existing improvements, but must not: (i) increase the existing level of fluvial erosion hazard or (ii) result in an increase in the length of channel management or bank stabilization measures that may be sought to protect the existing improvements in the future (in the event such property is threatened by fluvial erosion). To meet these performance standards, improvements may be permitted within the river corridor under the following conditions:

(1) Improvements must be located no closer to the river than a line as drawn between the two points nearest to the top of the bank (as measured horizontally) of the two existing, adjacent, above ground improvements, and

(2) Improvements must be located between or behind existing above ground improvements, which are no further than 300 ft. from one-another (Figure 4). The area behind existing above ground improvements shall be determined by finding the most upstream point and the most downstream point of the two improvements and then drawing a line from each of those two points away from and perpendicular to the river.

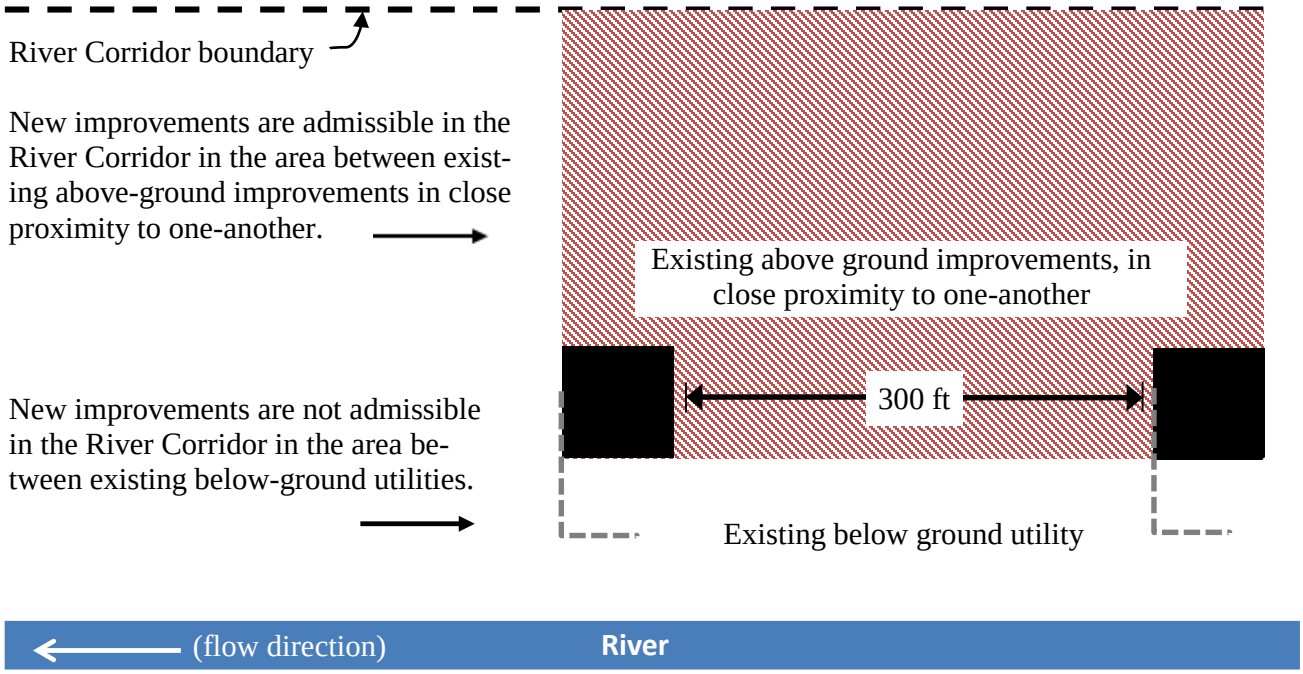

Figure 4. Red cross-hatched are showing where new improvements may be permitted between two existing above ground improvements no more than 300 feet apart. This area for acceptable improvement may be considered in tandem with the shadow areas defined in Appendix B.

Appendix B

Exception to the River Corridor No Adverse Impact Standard for Improvements in the Down-River Shadow of an Existing Improvement (See Section 7(a)(2)(B)(iv)(b))

(a) **Background.** In situations where there is an existing improvement within the river corridor, isolated from other improvements, there may be constraints on the extent of lateral river channel migration. Limited improvements in the shadow of existing improvements, while potentially at risk themselves, are not expected to increase the level of fluvial erosion hazard.

(b) **Standard.** Improvements must not: (i) increase the existing level of fluvial erosion hazard, or (ii) result in an increase in the length of channel management or bank stabilization measures that may be sought to protect existing improvements in the future (in the event such property is threatened by fluvial erosion).

(1) To meet these performance standards, proposed improvement limited to accessory structures, additions to existing habitable structures, or utilities may be permitted within the river corridor under the following conditions:

(A) Limited improvements must be located no closer to the river than any existing above ground improvement as measured horizontally from the above ground point of the improvement nearest to the top of bank, and

(B) Limited improvements must be located behind the existing above ground improvement or may extend down valley from the existing above ground improvement up to 50 ft. from the most river-proximal, down-valley corner of the existing above ground improvement (Figure 5). The area behind an existing above ground improvement shall be determined by finding the most upstream point of the existing improvement and the point 50 ft. from the most river-proximal, down valley corner of the existing improvement and then drawing a line from each of those two points away from and perpendicular to the river.

(2) To meet these performance standards, existing below ground improvements may be considered in defining a shadow area for new and replacement below ground improvements (Figure 5). New and replacement below ground improvements that meet (b)(1) above or the following conditions may be admissible within the river corridor:

(A) Any below ground improvement must be located no closer to the river than any existing below ground utility as measured horizontally from the below ground point of the existing utility nearest to the top of bank;

(B) Any below ground improvement must be located behind the existing above ground improvement or may extend down valley from the existing below ground utility up to 50 ft. from the most river-proximal, down-valley corner of the existing below ground improvement (Figure 4). The area behind an existing below ground improvement shall be determined by finding the most upstream point of the existing improvement and the point 50 ft. from the most river-proximal, down valley corner of the existing improvement and then drawing a line from each of those two points away from and perpendicular to the river.

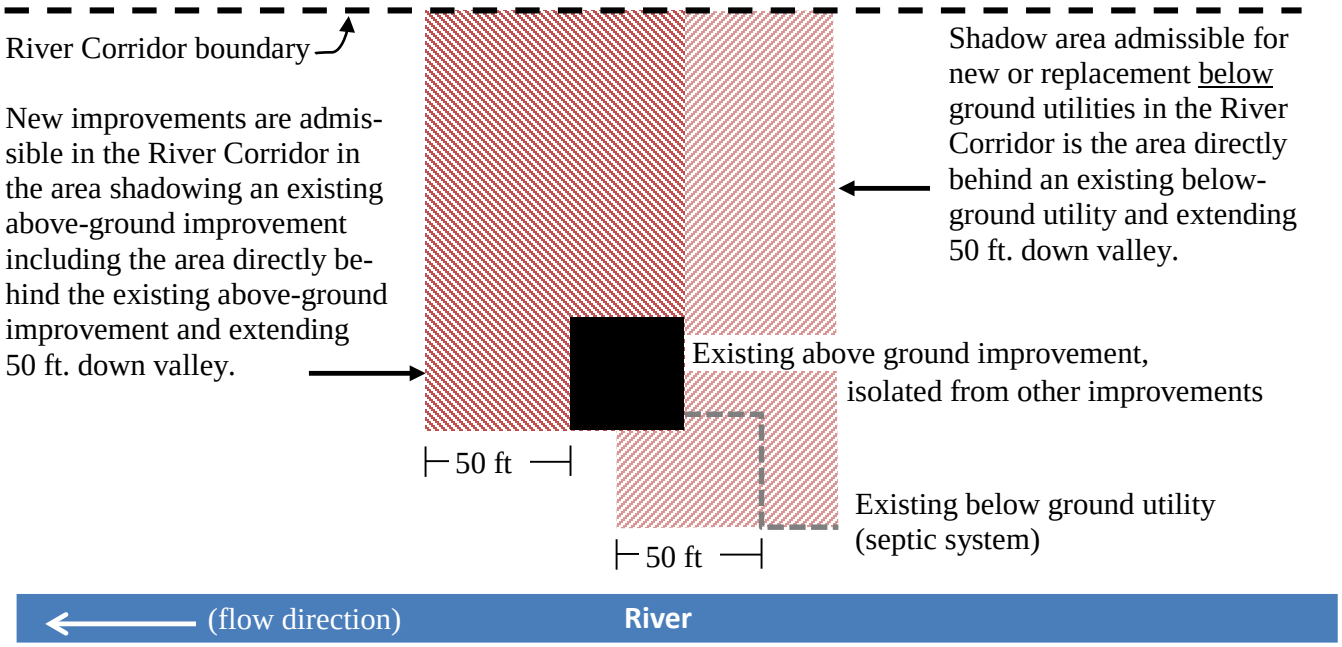

Figure 5. Red cross-hatched areas where new above and below ground improvements may be permitted within 50 feet of the most downstream, river-proximal edge of an existing improvement. The 50 foot shadow area is measured in the down valley direction from the furthest downstream edge of the existing improvements. Shadow areas do not extend in the upstream direction.