5.2.2 Reach Descriptions and Restoration Strategies for Reaches of the Napa River

Reaches are described from north to south between Zinfandel Lane and Oakville Cross Rd. The detailed explanation of the different restoration approaches is contained in Section 6. Figure 6 shows the area of the channel corridor that would be affected by different restoration approaches, and shows the areas within the bankfull and banktop zones. For our purposes bankfull refers to the portion of the river channel that is typically occupied by the largest flows in an average year, while banktop refers to the highest point of the channel bank where it meets the flat land above the channel. Figure 10 shows the locations and recommended stabilization and restoration strategy for each reach. To assist the RDS in seeking funds for this work we have developed conceptual estimates of the cost of implementing four of the reaches where the most intensive effort is required (see Appendix C). Note that the conceptual plans, and our estimated costs for implementing them, are subject to refinement and revision as the project evolves.

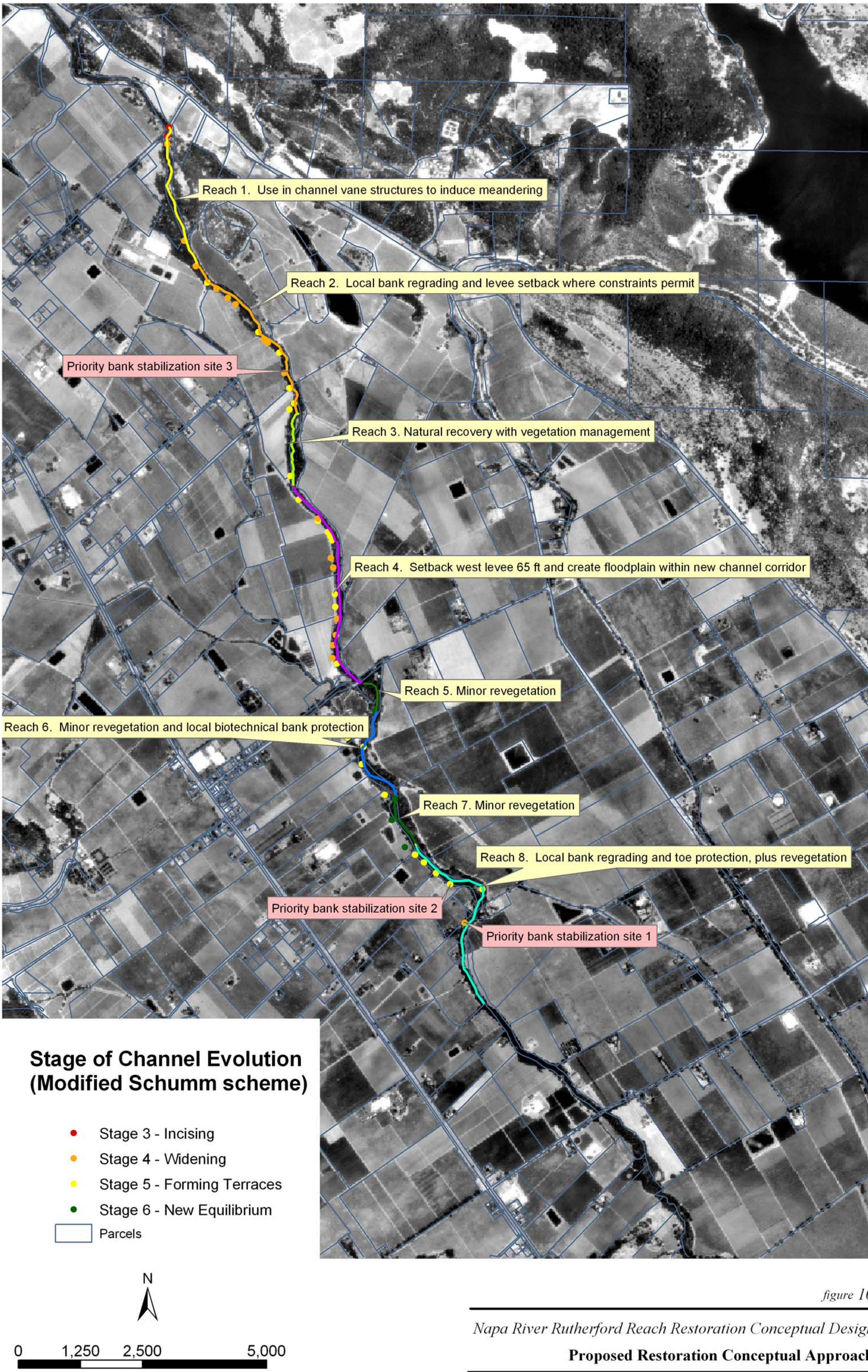


figure 10

Napa River Rutherford Reach Restoration Conceptual Design

Proposed Restoration Conceptual Approach

Proj. # 1638

5.2.2.1 Reach 1

The Guggenhime reach south of Zinfandel Lane

The channel in this reach is the most degraded of the four-mile Rutherford section of Napa River due to incision downstream of Zinfandel Lane Bridge, but is surrounded by some of the highest quality and most extensive riparian woodland. Incision elsewhere in the Rutherford reach has migrated through this reach. However, Zinfandel Lane Bridge forms a grade control structure, preventing bed lowering at this location. The river thus has a very steep gradient between the less incised reach above the bridge and the more incised reach downstream. The steep gradient has caused accelerated erosion. The upper portion of the reach is in Stage 3, with knickpoints below Zinfandel Lane Bridge. The majority of the reach is in Stage 4 (incised and widening) within dense riparian woodland. The length of this reach is 1,900 feet.

No action alternative

If no action is taken this reach will continue to incise and widen through erosion and mass failure on both banks, contributing excess sediment to the bottom of the channel between flood events, and the river downstream. The existing long pools and glides will be further deepened and made less diverse, and shallow spawning habitat will be lost to channel incision and burial from sediment. Assuming further incision does not migrate up into the reach from downstream, bank erosion and mass failure will eventually widen the channel, excess material will form point bars and a new floodplain, and the channel will become sufficiently wide and shallow to lower erosion rates, leading to natural recovery. Given the highly disturbed state of this reach natural recovery is estimated to take 100 years or longer.

Hard bank protection

Stabilizing the banks of a Stage 4 reach is very difficult as channel incision can undercut any bank protection. Hard stabilization would therefore require grade control (the installation of hard sills in the river bed to prevent lowering). Any grade control would have to be keyed into the banks to prevent outflanking by bank erosion, requiring extensive earthworks. Hard stabilization of this reach would therefore be difficult and expensive. Hard engineering would also be prone to failure in this reach since it would not address the fundamental problem of flow confinement leading to excess erosive energy. Stabilization of the banks could potentially lead to increased rates of channel incision.

Biotechnical bank protection

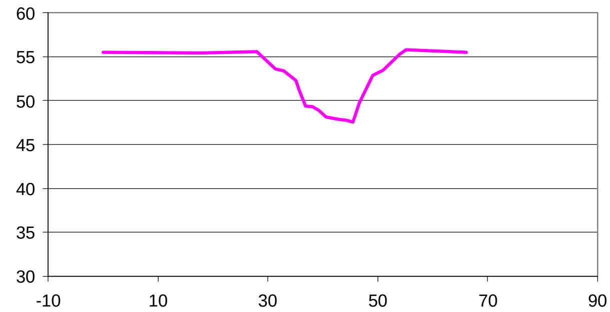
Biotechnical protection would require a degree of reinforcement from hard structures owing to the high shear stresses present in this reach during high flows. Stabilizing this reach would perpetuate the cause of instability; flow confinement. Problems would be as for hard bank protection.

Setbacks

Bank top setbacks would increase channel width, reduce flow depths and excess energy during high flows, and provide a sustainable restoration alternative for this reach. However, they would involve the destruction of large numbers of mature riparian trees and destruction of one of the best areas of riparian woodland on the river. Loss of mature riparian canopy would open the river up to potential warming problems, impacting already degraded aquatic conditions.

Preferred conceptual approach - assisted natural recovery and channel meandering

Although this area is quite degraded, the presence of a wide riparian corridor means that there is scope for assisted natural recovery. In this reach we recommend that rock or wood barbs are constructed in the straight channel to induce meandering, by focusing erosion onto specific areas where it can be tolerated and generating deposition on opposing banks. Meandering will lower the channel slope, preventing further channel incision and creating more natural and diverse channel habitat with riffle-pool sequences replacing the current continuous pools and glides. Combined with the surrounding riparian woodland the resulting reach will have great ecological potential. We recommend that the vegetation is managed to remove Arundo identified by the Napa County survey, and that where the riparian cover permits local terracing and regrading is carried out to create a floodplain. The recommended restoration conceptual alternative is a variation of 4D and E (page 39), with channel widening occurring 'naturally' through bank erosion. This option will replace accelerated erosion and mass failure on both banks with more accelerated erosion on outside bends and deposition on point bars on the inside of bends. Bank erosion will progressively cause riparian trees to be lost, but they will contribute large woody debris to the river and the riparian corridor is sufficiently wide for these losses to have little impact. The river will still be shaded by mature trees on the outside bend, and more diverse stands of vegetation will develop on point bars on the inside bends, enhancing aquatic and riparian habitat. It is anticipated that the net effect will be no increase in sediment yield from the reach, with potential for reduced sediment yield due to increased sediment storage on point bars.



Typical cross section (distances in meters)

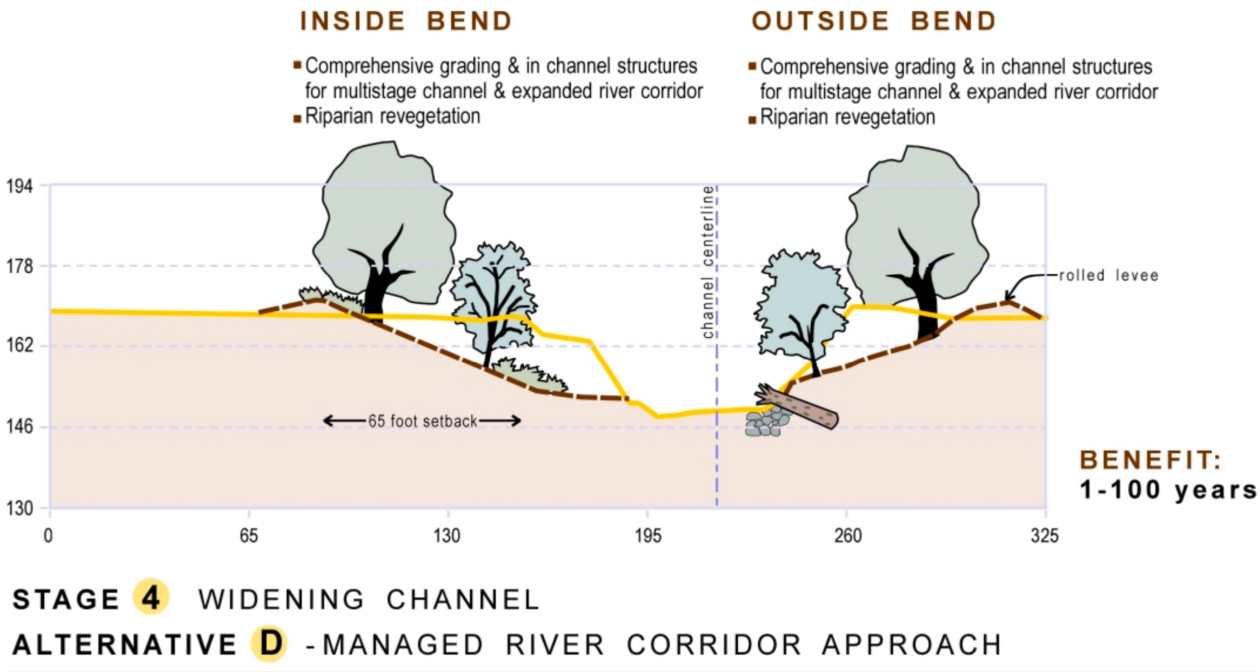


Figure 11. Typical existing conditions and conceptual design for Reach 1

5.2.2.2 Reach 2

From the northern portion of the C Mee property, through the Frogs Leap property to the northern boundary of the Sutter Home property (west bank) and Quintessa property (east bank).
This reach is confined and leveed, though not to the same extent as Reach 1. The reach is mostly classified as 'early' Stage 5, with some portions of Stage 4. In addition to the major area of bank collapse identified above, this reach suffers from small-scale bank and levee erosion on both sides. Point bars are beginning to develop in the Stage 5 sub-reaches, but the channel is still widening through bank erosion and mass failure. High flows do not have sufficient overflow space to dissipate excess erosive energy, and this energy is expended as bank erosion, resulting in increased fine sediment inputs to the river, and subsequent downstream deposition. Reach 2 is closer to natural recovery than Reach 1, and has a more developed riparian corridor of mature trees, posing a greater constraint on bank regrading or setback activities in some sub-reaches.

No-action alternative

Under a no-action alternative this reach will continue to widen and point bars will eventually develop into a new floodplain. The river corridor will widen through bank erosion until excess energy is dissipated on the new floodplain, at which point the channel will reach a new equilibrium condition and erosion will slow (estimated time 50 years). Bank erosion will contribute significant amounts of fine sediment into the system, with associated higher levels of suspended sediment concentration and downstream deposition. Bank erosion will encroach on the riparian corridor and adjacent land.

Local hard bank protection

Less bank protection would be needed to stabilize Reach 2 than Reach 1. Hard bank protection will reduce the bank erosion rate locally, but will not solve the underling problem of confined flow and excess energy. Reducing the ability of the river to expend excess energy on the banks may lead to increased vertical scour of the bed, creating deep continuous pools and potentially undermining the banks further. It will also potentially pass the problem downstream to unprotected reaches.

Banktop setbacks and regrading

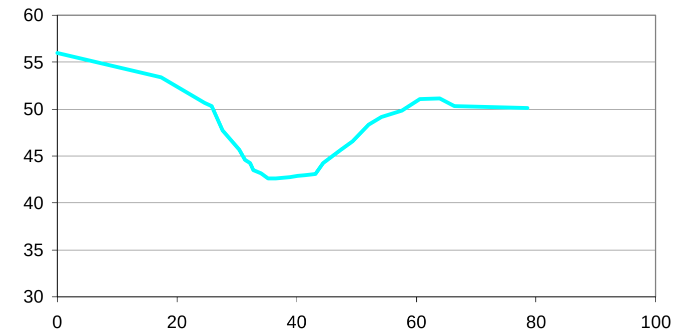
Setbacks will provide the river with sufficient width to create a new floodplain, relieving erosive energy during high flows and so returning erosion (and subsequent downstream sedimentation) rates to natural levels. Setbacks will allow a sustainable river corridor to develop, and will lead to more diverse channel conditions with long continuous pools replaced by riffle-pool sequences. However, while banktop setbacks will directly solve the underlying problem in this reach, a program of full levee setbacks here will damage or destroy the existing riparian corridor where it exists. In Reach 2 the riparian corridor is wider and more ecologically valuable than in reach 1, providing shade and habitat. It is also less vulnerable to bank erosion, due to the slightly wider channel in this reach. Setbacks will also carry a high economic cost, due to construction and loss of land.

Biotechnical protection

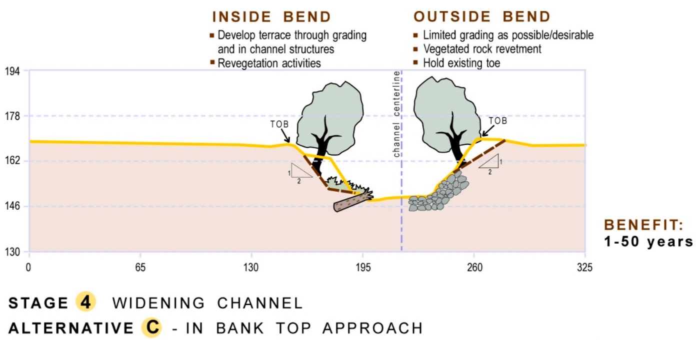
Less bank protection would be needed to stabilize Reach 2 than Reach 1. Biotechnical protection that successfully prevents bank erosion poses the same risks as outlined for hard protection; though locally more environmentally friendly than hard protection, biotechnical protection in this reach will not solve the underlying problem of excess erosive energy. However, in wider portions of the reach local biotechnical protection would have some beneficial effects at absorbing energy and reducing erosion hot spots on outside bends, without deflecting erosive stress onto neighboring banks. In-stream biotechnical structures such as log weirs could also increase channel habitat diversity by creating local patterns of deposition and scour. The advantage of using biotechnical solutions rather than extensive setbacks in this reach is that they preserve the existing riparian corridor, which would be severely impacted or destroyed by extensive setbacks or bank regrading.

The preferred alternative restoration approach

We recommend a combination of biotechnical stabilization of local areas of high erosion, use of biotechnical structures such as weirs to increase channel diversity, and limited bank regrading and the creation of embayments (local small scale terraces with setbacks) where constraints allow, with the objective of reducing overall erosive forces in the reach and increasing channel habitat potential. All work should be accompanied by revegetation using appropriate native species. The recommended restoration conceptual alternative is 4C and 5C (page 39 and page 40) and 4D and 5D. This reach has a length of 4,100 feet. The proposed alternative would restore more natural function to the river while working within the constraints of preserving the mature riparian canopy. This reach has potential for even further improvement if west side tributary and back channels that existed historically can be restored, and we recommend that an analysis of historic and current tributary channel conditions, and a conceptual plan for their restoration, be carried out.



Typical cross section (distances in meters)



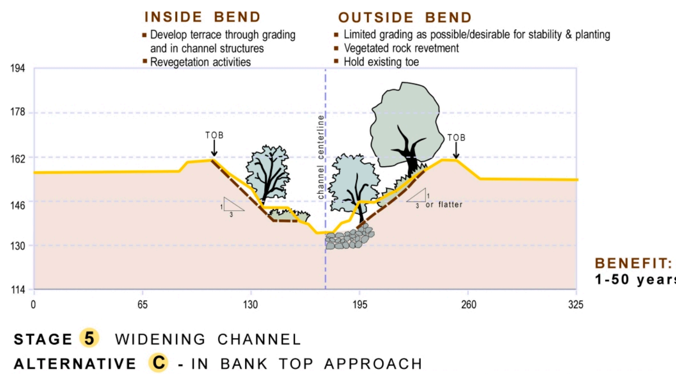


Figure 12. Typical existing conditions and conceptual design for Reach 2

5.2.2.3 Reach 3

This reach lies within the riparian woodland between the C Mee (west bank) and Carpy Connoly properties (east bank).

This reach is in stage 5 and is close to reaching a natural equilibrium level. Bank erosion has widened the channel, reducing flood depths and so erosive energy. Bank material has formed point bars and a new floodplain between the old bank top terraces. This reach has a good riparian cover on both sides, and is valuable habitat. This reach is 2,000 feet long.

No-action alternative

Under no action this reach will continue to experience some bank erosion as final widening occurs. The eroded material will largely stay in-reach, as new floodplain deposits. Recovery to Stage 6 will take place in an estimated 25 to 50 years.

Local hard bank stabilization

The magnitude of erosion, the type of land being lost, and the volume of sediment generated from the reach does not justify hard bank stabilization. The impact of installing hard protection, and its effect on the channel processes, would exceed any benefit.

Biotechnical stabilization

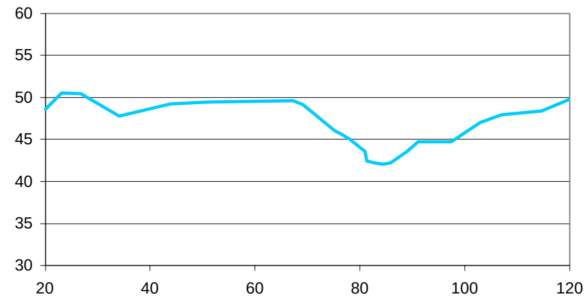
The magnitude of erosion, the type of land being lost, and the volume of sediment generated from the reach does not justify biotechnical bank stabilization.

Setbacks

The channel has almost reached equilibrium width in this reach, and the benefit of slightly accelerating recovery does not justify the damage to riparian cover and potential sedimentation problems caused by bank earthworks.

Preferred alternative

This is a suitable reach for natural recovery, with some assistance in the form of Arundo removal, and native planting in places. The recommended restoration alternative is 5E (6.5.5, page 40).



Typical cross section (distances in meters)

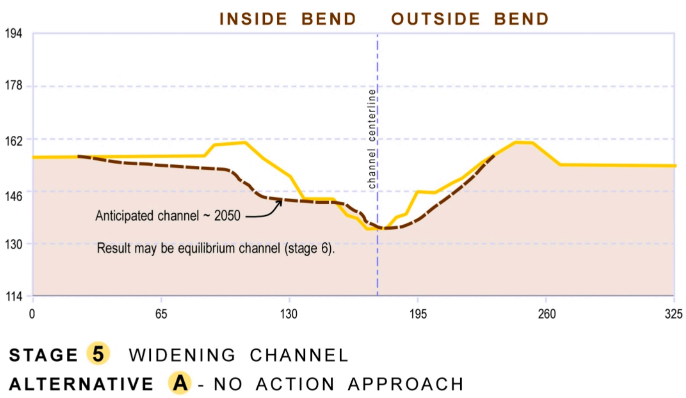


Figure 13. Typical existing conditions and conceptual design for Reach 3