Kinderhook Creek Resiliency Study

Villages of Valatie & Kinderhook, New York

Study

July 2021

Weston & Sampson

Weston & Sampson Engineers, Inc.
1 Winners Circle, Suite 130
Albany, New York 12205
tel: 518-463-4400 fax: 978-977-0100

In conjunction with:

VILLAGE OF VALATIE

Village of Kinderhook
Birthplace of our 8th President Martin Van Buren

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Hudson River Valley Greenway

Acknowledgements

Villages of Valatie & Kinderhook

Larry Eleby, Deputy Mayor, Valatie
Dorene Weir, Trustee, Kinderhook

Consultant Team

Weston & Sampson, PE, LS, LA, PC
Daniel P. Biggs, RLA, ISA, CERP - Principal-in-Charge
Rachelle McKnight, ISA, CERP - Project Manager

For more information about this document, contact:
Weston & Sampson, PE, LS, LA, PC
One Winners Circle, Suite 130
Albany, NY 12205

Contact: Daniel P. Biggs, RLA, ISA, CERP
518.463.4400

Background Materials, Photos and GIS data provided by:
Villages of Valatie & Kinderhook
Columbia County GIS
NYS GIS
Weston & Sampson, PE, LS, LA, PC

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EXECUTIVE SUMMARY

This study is intended to serve as a guiding document for the stabilization and restoration of the shoreline of the Kinderhook Creek in the Villages of Valatie and Kinderhook. It will be used to prioritize and allocate resources for projects to protect the area's unique parkland and village-owned properties, and to identify climate resiliency and mitigation measures to reduce the impact of future flooding and chaotic weather events.

The Kinderhook Creek Resiliency Study (KCRS) was developed by the Village of Valatie with funding provided by the New York State Hudson River Valley Greenway Natural Heritage Area Grant. The Village of Valatie retained Weston & Sampson in November of 2019 to provide planning and conceptual design services for shoreline improvements and public access along the Kinderhook Creek waterfront. The project area is limited to Village-owned properties along the creek and encompasses approximately 81 acres and 7,540 linear feet of shoreline.

The KCRS provides the Villages with appropriate recommendations and potential stabilization systems to prevent hazardous flooding along the site area and to protect existing parkland resources in the future. To accomplish these goals, the following tasks were performed:

- Assessment of the current conditions of the shoreline area.
- Evaluation of potential shoreline alternatives.
- Recommendations of potential stabilization systems.
- Determination of conceptual costs and exploration of possible funding sources to aid in implementation.
- Coordination with public officials and key stakeholders and public engagement services.

Stabilization systems were selected based on a careful analysis of the existing conditions of the shore, historic contextual factors, habitat features, public access, and adjacent land uses. Additional considerations included regulatory requirements, cost, and aquatic and terrestrial ecological impacts.

This KCRS includes the following major sections:

- Project overview, which outlines the background and purpose of the KCRS, and the data used to develop the plan.
- Existing conditions, which document the Kinderhook Creek's stabilization issues, and site factors related to the development of improvements along the creekfront.
- Shoreline types and stabilization recommendations for the defining shoreline features of the Kinderhook Creek.
- Shoreline improvement strategies, which include riparian biodiversity, ground stability, erosion control, public access, and engineered approaches.
- Regulatory expectations, maintenance requirements, costs, and potential funding sources.

Reference materials, mapping, public survey data, and cost estimate documentation are provided in the appendices of the KCRS, which are intended for use by the Villages during implementation.

OVERVIEW

This section includes a general overview of the project as well as a project background and context for the Kinderhook Creek Resiliency Study. This section also discusses visions and goals for the project and the methods of data collection.

1.1 Project Background & Study Area

The Kinderhook Creek Resiliency Study is a multi-disciplinary effort to simultaneously promote the creek as a public resource while planning for measures to protect the Villages' parklands and infrastructure from the detrimental effects of climate change. Recognizing the recreational and investment potential of the area, the Villages have allocated resources in revitalization planning of the area through previous studies and subsequent improvement projects. These planning and construction efforts, coupled with climate-change related weather disturbances, have necessitated the investigation of ways to protect the area from catastrophic impacts. The creek and surrounding landscapes have suffered from flooding in the last century from hurricanes and tropical storms, and in recent years the increased flooding of the Kinderhook Creek has resulted in unanticipated expenditures for the Villages to repair or reconstruct damaged infrastructure. Low-lying areas are prone to flooding from rainstorms and coincide higher flows along the creek. Increasingly, rainstorms following freezing weather in the winter months are creating unique flood conditions where ice is pushed up from flood waters, damaging the shoreline and pushing large chunks of ice up and onto adjacent lands. The Villages could expect increased property damage in the future if flooding and flood risks are not addressed along the Kinderhook Creek, and will lose valuable parkland to erosion over time.

The KCRS creates a strategy for restoring and enhancing the Kinderhook Creek. This endeavor provides a clear direction for future improvements along the shore, increases public access, enhances adjacent park areas, and informs planning decisions in the greater watershed. The project advances the 2016 Village of Kinderhook Comprehensive Plan Update. This plan identifies the creek as a valuable asset and promotes enhancing recreational opportunities. Careful implementation of improvements will preserve and protect the landscapes along the creek, ensuring previous investments in trails and infrastructure are not lost.

The project study area encompasses 7,540 linear feet of shoreline along the Kinderhook Creek in the Villages of Valatie and Kinderhook. The project area is limited to five Village-owned properties along the creek and totals approximately 81acres. Beginning at the northern portion of the creek in Valatie near Route 203 and Chatham Street bridge sits Beaver Cotton Mill Overlook. To the west of Beaver Cotton Mill is another parcel at Church and Main Street. Further south, on the west side of the creek is River Street Park, and to the east of the creek is Pachaquack Preserve. And finally, the Water Supply Property is located in Kinderhook, on the west side of the creek near the Hudson Street bridge. The individual properties and discussed in greater detail further in this report.

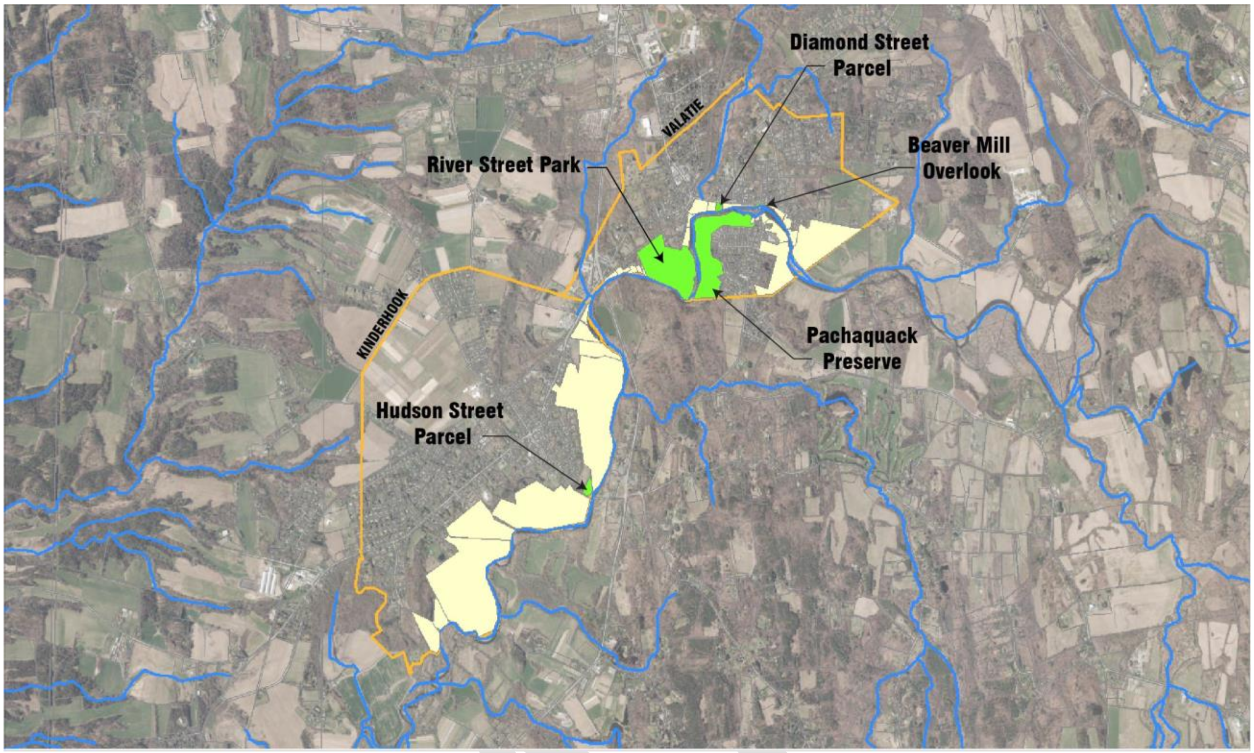

Figure 1: Properties assessed along the Kinderhook Creek

1.2 Context for Implementation

The Villages of Valatie and Kinderhook are primarily rural in character, with development limited to the envelope of the historic village boundaries, subdivisions, and individual houses along the roadways that thread through the region. The Kinderhook creek is largely buffered by woodlands and farmlands, protecting the visual character of creek corridor, and reducing stormwater runoff from impervious surfaces typical of urban and developed conditions. Unfortunately, upstream development, informal access, increasingly severe storms, and inadequate vegetative buffers contribute to erosion along the banks of the Kinderhook Creek. Climate change and development pressures across Columbia County are likely to make what is now a relatively minor issue worse in the years to come. It is therefore wise to look not only at the existing site conditions along the creek to develop stabilization solutions, but to develop policies at a landscape and regional scale to protect open space and reduce the deleterious effects of climate change.

1.3 Study Goals

The KCRS will help the Villages of Valatie and Kinderhook protect the creekfront from flooding while enhancing public access and enjoyment of the beautiful natural amenities of the area. To accomplish this goal, the following parameters were developed to guide the study:

Critical Success Factors	Performance Measures
1. Develop a study with useful qualitative and quantitative information that depicts future climate impact scenarios along the creek.	1. Gain insights by modeling design storm scenarios. Research potential impacts to the flora and fauna along the creek. Understand the risk to surrounding communities.
2. Assess the overall condition of the shoreline and relevant infrastructure and provide recommendations to address stabilization and public access concerns.	2. Provide digital composite inventory of creek conditions that include quantitative and qualitative analysis to address need and provide action plan for implementation.
3. Develop recommendations that address the changing climate and present adaptive strategies.	3. Identify opportunities for prioritizing projects and engage other departments to determine feasible strategies for implementation and maintenance.
4. Address the importance ecological restoration and flood protection as measures to protect public health and safety.	4. Include public process and information gathering that works with engaged stakeholders who are most likely to be impacted by flooding and the implementation of proposed projects.
5. Provide and present findings, recommendations, and implementation strategies that are new and innovative.	5. Documents synthesize all data and information gathered during the stakeholder and public input process and clearly articulate the need for stabilization and restoration of the creek.

1.4 Data Collection

This section describes the data used to assess current site conditions. Base mapping and data were obtained from publicly available GIS data, Google Earth imaging, and past studies. Data was also collected in the field. Methods of field data collection are described below.

1.4.1 Geographic Information Systems Data & Google Earth.

The desktop evaluation was conducted using ArcGIS Desktop 10.5.1. Imagery was collected from Google Earth[1] and used to support a desktop review of field conditions. This data was supplemented with field review data to ensure accurate reporting and analysis of current field conditions.

1.4.2 Previous Studies & Reports

Past studies and reports were reviewed as part of the study area analysis. Data was obtained from sources, including the Villages of Valatie, the NYS DEC, other project stakeholders, and publicly available data online. The documents reviewed are included in the reference section at the conclusion of this report.

[1] Google Earth data was obtained from https://earth.google.com/web/.

1.4.3 Field Data Collection Methods

Initial field assessments were conducted in the spring and summer of 2020. Shoreline conditions and typical management areas were observed and recorded on foot. Field data was recorded with a handheld GPS (Trimble Geo 7x Centimeter Edition) and a digital form. Extensive photographs were taken throughout the field assessment process. Field work photographs were provided to the Villages.

1.4.4 Stakeholder & Public Engagement

The project team conducted one public meeting and two in-person meetings with a Project Advisory Committee (PAC) comprised of project stakeholders. This group includes the following participants:

Stakeholder	Title / Affiliation
Larry Eleby	Deputy Mayor, Village of Valatie
Dorene Weir	Trustee, Kinderhook
Randall Schmit	Resident – Village of Valatie
Nate Becker	Resident – Village of Valatie
Ann Schaefer	Resident – Village of Valatie
Patrick Rodgers	Resident – Village of Valatie
Jim Dunham	unknown
Steve Matheke	unknown

The public engagement presentations resulted in the following major themes:

- This content is TBD – will be created after the August 12th presentation

EXISTING CONDITIONS

Section 2 documents vegetation composition, existing plant communities, ecosystem services, and cultural influences affecting the landscape in the study area. This section also provides an overview of site factors known to exist in the study area based on field studies, GIS mapping, and other data as referenced in Appendix A – Project Drawings.

2.1 Historical Context

Europeans first settled in the Columbia County area at Stuyvesant Landing and at the mouth of Stockport Creek around 1624 to 1640. These were likely temporary settlements for fur-trading between the Dutch and Native Americans. It was not until the 1650's when permanent settlements were established at places where transportation and waterpower were possible[2]. In 1687 Kinderhook was chartered as a township. The village of Kinderhook was incorporated in 1838[3] and Valatie was incorporated in 1856[4].

2.2 Shoreline Stabilization Issues

Ground stability and erosion issues are present along the banks of the Kinderhook Creek. Shore instability along the Kinderhook Creek is generally due to one or more of the following factors:

- Bank undercutting due to rushing water.
- Bare soil conditions (no vegetation).
- Water encroachment behind shallow concrete revetments or riprap.
- Trees collapsing into the creek.
- Walking paths down to the creek, leaving the path bare of vegetation, compromising tree roots.

Areas of particular concern include:

- Tree decline and creekbank erosion
- Insufficient vegetative buffer and steeply sloped edges
- Potential for development encroachment on private properties

2.3 Site Factors

The following is a review of relevant site factors that will contribute to the success of creekbank stabilization improvements in the study area. Site analysis mapping and documentation further describing these items can be found in Appendix A - Project Mapping and Appendix B – Site Documentation.

2.3.1 Soils & Topography

Several US Geologic Survey (USGS) soil classifications are found on the streambanks of the Kinderhook Creek. The most common soil types are:

- Hoosic gravelly sandy loam (HoC/HoD): Found in terraces and outwash plains, with sandy and gravelley glaciofluvial deposit parent materials. High drainage capacity.

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[2] (Hudsonia Ltd., 2018)
[3] (Bielinski, 2019)
[4] (Lizzi, n.d.)

- Fluvaquents-Udifluvents complex, frequently flooded (Fn): Comprised of alluvium parent material with highly variable textures. Typically found in floodplains with frequent ponding.
- Knickerbocker fine sandy loam, 3 to 8 percent slopes (KrA): All areas where this soil is found are prime farmlands. The parent material is of sandy glaciofluvial or deltaic deposits.
- Occult loam (Om): Loamy over sandy alluvium parent materials that are well-drained and considered prime farmland.
- Nassau channery silt loam, undulating, rocky (NaB): Found in shallow dry till uplands in farmland of statewide importance. Parent material is channery loamy till derived mainly from local slate or shale.
- Udorthents, smoothed (Ue): Consists of loamy fill parent material that has a moderately low to high capacity to transmit water (USDA, 2020).

The topography in the study area varies. In general, there is somewhat moderate sloping of land from the outer perimeter of the project area to the streambank corridor, depending on the project location. However, much of the streambank is comprised of steep slopes (>50%) and provide an abrupt change from the creek to the upland area. The steepest sloped area occurs at the Beaver Cotton Mill waterfall (60%) with an approximate 22-foot drop. Here the parking area and overlook are very flat. On the other side, Hudson Street Bridge is generally flat (≤5%) with the pump station elevated. On the other side of the fence the grade drops a bit and there appears to be a small stream leading into Kinderhook Creek. The slopes here range from 5% to 20%.

2.3.2 Land Use

<u>Land Use</u>

Land use is defined by the New York Geographic Information Clearinghouse as activities, management strategies, and/or economic purposes placed upon the land by people or land managers (NY GIS, 2020). The most commonly occurring land uses within the study area are:

- Forested areas for passive recreation occur at River Street Park and Pachaquack Preserve.
- Open lands for municipal use are found at the Diamond Street and Hudson Street Bridge parcels.
- Passive recreation is found at Beaver Cotton Mill Overlook.

<u>Ownership</u>

All parcels within the study area are owned by either the Village of Valatie or the Village of Kinderhook.

2.3.3 Habitat & Wetland Resource Areas

The study area is entirely within the Lower Hudson River Watershed, to the east of the Hudson River. Kinderhook Creek is one of the three major streams draining to the Hudson River. The landscape has not been majorly altered over time with many of the original tributaries remaining. These tributaries provide rich habitat value in the wetland areas. Wetlands, defined by saturated soils, high water tables, and plants adapted to wet locations, serve an essential role in the absorption and percolation of water into the ground. They are also critically important flood mitigation tools, and provide a wide variety of forage, shelter, and breeding sites for wildlife. The largest and most significant wetland landscape occurs within Pachaquack Preserve and along River Street Park. There is also a floodplain forest in Pachaquack Preserve, encompassing about two acres.

Much of the project area is open space, which provides floodplain functions, vegetated buffers, and riparian[5] habitat connectivity. Riparian corridors are important areas for wildlife habitat because many species live both on land and in the water. Transition zones between the water and land are typically very diverse – these areas exist in a dynamic equilibrium governed by the changing currents of the stream and flux of the shoreline over time. Shoreline vegetation provides forage and shelter for a wide range of aquatic and terrestrial species. Botanically diverse riparian edges provide seeds, nuts, buds, and fruits. Fisheries rely on shade and woody debris from shoreline trees and shrubs – healthy fish and their fry[6] in turn provide food for a variety of mammalian, amphibian, and avian species (Cohen, 2014).

Refer to Appendix A – Project Mapping for mapping of habitat and wetland resources in the study area.

2.3.4 Vegetation

Existing vegetation in the study area is robust; the majority of the project area is comprised of forested parklands and open space. Existing tree, shrub and herbaceous species are affected by erosion and storm damage but are capable of rebounding and recolonizing over time. Key areas of concern are the overall lack of species diversity, a lack of an adequate shrub layer and emerging proliferation of non-native and invasive species, particularly along the edge of the creek.

The clearing of the creekbank for views, access, and trails in certain locations has resulted in a plant species mix adapted to disturbance, which includes a host of invasive and nuisance species.

The condition of trees in the study area varies widely due to the difference in site conditions, maintenance, and proximity to flooding and erosional factors. In some instances, trees are simply declining due to age. As trees grow older, they are less able to compartmentalize injuries, resist decay, and retain branches. Another characteristic to note is the presence of pests and disease among the riparian forest canopy. For example, many ash trees are experiencing the detrimental effects of the emerald ash borer.[7]

2.3.5 Climate Change

Climate change has the potential to affect the Kinderhook Creek and surrounding rural environment, which could have major implications for the Village's management of existing parklands and redevelopment of districts within the floodplain. Below is a brief discussion of recent climate change, predicted change, and the implications for the project area.

<u>Precipitation</u>

Precipitation patterns have changed with more extreme droughts and rainfall intensities. The amount of precipitation associated with a 24-hour storm having an average return period of 100-year has increased from approximately 6.7 inches in 1961 (U.S Department of Commerce, 1961) to 7.88 inches in 2015 (NOAA Atlas 14, Volume 10, 2015). Projections of climate-change related precipitation events in the region indicate that by 2050, annual precipitation could increase by 3-12% per year with one additional 1 and 2-inch storm (NYS Energy Research & Development Authority, 2011).

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[5] Where the land connects to a stream or river. Riparian habitats are critical for wildlife and plants.
[6] Juvenile fish capable of feeding themselves.
[7] A beetle native to north-eastern Asia that feed under the bark of ash trees, killing the tree.

Increased heavy precipitation events will make the likelihood of flooding, erosion, and damage to Village properties more likely. Fortunately, the project area currently has limited impervious surfaces, including roadways, parking lots, buildings, and sidewalks. These types of land cover increase the velocity of stormwater as if flows over the landscape and does not permit the infiltration of stormwater into the ground. It is therefore important to consider how the Villages of Valatie and Kinderhook might incorporate green infrastructure, floodplain protection, and expanded open space into the long-range plan for the Kinderhook Creek to reduce the impact of severe precipitation events. Development pressure on private lands poses a substantial challenge, as increased impervious surfaces and loss of open space will exacerbate flooding, fragment habitat, destroy productive farmland, and cause more severe flooding along the creek.

For additional information about how precipitation is likely to change in the project area, refer to FEMA and design flow reporting in Appendix B – Project Documentation.

2.3.6 Erosion Dynamics

Land development and shoreline modifications can alter patterns of erosion and sediment deposition over time along a stream corridor. Areas with lower flow velocities, shallow water depths, and inlet geometry will accumulate detached sediments as they travel downstream. Invasive and opportunistic aquatic vegetative species gradually increase the depth of organic materials in the creek bed and can also alter currents. When storms and flash floods occur, erosion can happen rapidly and change depositional patterns.

Ice is a factor in erosional processes as well. Stream currents, temperature fluctuations, and winds all influence the movement of ice along the Kinderhook Creek. As the ice pushes up against the banks of the shore, sediments and riparian vegetation can be dislodged and carried into the creek.

2.3.7 Water Quality

The Kinderhook Creek continues to support unique ecological resources, despite climatic and land use changes over time. Ongoing threats to sensitive habitat include sedimentation, altered flows, temperature variations, and pollution (DOS Office of Planning and Development, 2012).

Runoff in developed areas flows over roadways, parking lots, maintained grass areas (with fertilizer and animal feces) and picks up various pollutants, such as phosphorus, along the way. This pollutant-laden stormwater then enters the Kinderhook Creek and negatively affects water quality. In agricultural landscapes, fertilizer and pesticide runoff can negatively impact the biotic resources of the creek. Nitrogen and phosphorous accumulations contribute to the excessive growth of algae and other aquatic plants, thereby consuming oxygen in a process called eutrophication[8]. When oxygen levels are depleted, fish populations suffer, and other trophic systems are affected. Studies of chemicals in the tissues of aquatic invertebrates have shown the Kinderhook Creek to have elevated levels of DDE, PCBs, pyrene, selenium, nickel and copper (Vispo, 2004). Statewide, New York's rivers and streams are most threatened and impaired by agricultural activities and municipal discharges and sewage (EPA, 2017). The EPA assessment of the waterbody condition is listed as "good", and currently, no plans are in place to protect or restore water quality along the Kinderhook Creek.

[8] Eutrophication is a result of an over-enrichment of nutrients that lead to an overgrowth of plant and algae materials, which decompose and produce large amounts of carbon dioxide and consume oxygen in marine systems.

Proactive measures can be taken to reduce pollution, which often provide co-benefits such as increased habitat quality, enhanced aesthetics, and soil conservation. In an agricultural setting, expanding natural vegetative buffers (forests and shrub landscapes) provides a barrier to overland flows and the root capacity to absorb water. Cover crops reduce exposed soils and keep the land's surface intact and keep nutrients in place. Finally, perennial crops and organic farming strategies can lower nutrient and pesticide loads while decreasing the need for intensive land management practices that reduce soil productivity and biodiversity.

Where the land is developed, several opportunities exist to improve groundwater infiltration and reduce pollutants. Green infrastructure is an excellent way to keep rainfall runoff on-site, and can achieve the following benefits:

- Reduction of stormwater runoff flows that would otherwise contribute to a combined sewer overflow event, polluting the area's streams.
- Increased rainfall filtering and groundwater recharge, more closely mimicking the natural hydrologic cycle.
- Improved aesthetics by planting perennials, shrubs, and trees as part of the green infrastructure practices that remove nutrients and contaminants in the runoff.

Wherever possible, techniques should be used to improve water quality in the study area, utilizing best management practices and green infrastructure (rain gardens, sidewalk tree wells, permeable pavements) to capture flows before they reach the creek.

SHORELINE TYPES & STABILIZATION RECOMMENDATIONS

Erosion is a natural process that occurs on the shores of rivers, streams, and lakes. In a natural setting, flooding, ice, and waves work to change the character of the shore and the alignment of the water feature. Where there is no threat to public health and safety, this process can be allowed to unfold on the timeline prescribed by the weather and the geologic, aquatic, and landscape features of the water body. It is when the erosion of the shore creates hazards not only to human health but to the infrastructure adjacent to the water body that interventions must be considered.

Incorporating climate resilience into design can help mitigate the impacts storm-related flooding. The entire Kinderhook Creek corridor area is classified as a New York Heritage Program Important Area for animals. This is important as it links up to the Hudson River corridor. A corridor is a physical landscape connection that includes natural drainage system corridor and shorelines, forest systems, and flyways. These vital linkages allow for the transportation of plants and wildlife and connect fragmented landscapes. Protecting and reestablishing corridors relates to climate change as they help preserve ways for species migration.

It is critical to also incorporate long-range planning for the acquisition of riverfront property to expand the network of parklands that can absorb anticipated flooding and protect urban infrastructure. The Villages may want to establish a task force to begin the conversation with potentially impacted and/or interested landowners within the floodplain to see if there is a way to elevate these structures to protect them from anticipated climate-related flooding and damage.

This section analyzes the study areas, describing the existing conditions and proposed improvements for each area including specific shoreline stabilization measures to be implemented. Additional information about site conditions described during the field analysis portion of the study can be found in Appendix A – Project Mapping.

3.1 River Street Park

3.1.1 Existing Conditions

The River Street Park (Tax ID 44.6-1-15-.110) is located at the terminus of River Street, which branches to the south from Route 9 in the Village of Valatie. The property spans 39 acres and has approximately 2,700 linear feet of frontage along the Kinderhook Creek. An extensive network of trails traverses the property and visitors frequently set up along the creek's shores to fish. The wastewater treatment plant is located at the northwestern corner of the property.

Figure 2: Lovely views of the Kinderhook Creek from the shores of the River Street Park.

Shoreline features are largely comprised of dense vegetation on earthen banks with varied steepness. The vegetation is primarily herbaceous and forested with few shrubs. The lack of a shrubby species is problematic – herbaceous species do not provide the same soil stabilization and streamflow velocity reduction as larger woody plants. Invasive species are prolific, which is typical of riparian corridors in the state of New York. In many areas a relatively flat earthen bank is immediately adjacent to the creek, before transitioning to a steep (often vertical) slope. These steep slopes have been scoured and undercut by rushing waters and will continue to do so without stabilization measures. Where the slopes are undercut the roots of trees are exposed. Over time it is expected these trees will eventually collapse into the water. If at that time the tree is not cleared from the creek, sediment will slowly accumulate on the downstream side of the tree's structure. The decomposing tree also provides basking spots for turtles, a rich array of microorganisms for aquatic species, and sheltered spots for spawning fish.

In a few locations, gravel shelves are found adjacent to the shore. These stretches are likely under water when spring rains and snow melt raises the water levels of the creek. Sparse herbaceous vegetation is present and reflective of the species composition found inland.

There are several trails that traverse the park, but the trail parallel to the creek is perilously close the destabilized shore. Without railings this may pose a safety hazard to visitors who attempt to descend the banks to reach the creek. There are a few locations that provide informal access to the creek and benches for visitors to relax and enjoy the view. Increased foot traffic at these locations will contribute to the collapse of the shore without stabilization measures.

Figure 3: Gravel expanse adjacent to the shore.

3.1.2 Proposed Improvements

It is critical to establish adequate vegetation between intensive land use areas and the water's edge. Restoration of the shoreline and expanded areas of shoreline stabilization plantings are needed where inadequate vegetative buffers exist, and the slopes are too steep to adequately support a healthy vegetative riparian corridor. Where possible, regrading of existing steep slopes to accommodate a wider vegetative buffer is highly recommended. Shallower slopes expand the area over which floodwaters must travel, and vegetation establishment will be more successful where the slope is shallow enough to secure the roots. Where there is insufficient area to regrade the slope, a tiered system of vegetated riprap or vegetated timber cribbing is recommended. Low-lying native species may be established where viewsheds are desired; however, intermittent stands of trees should also be considered to shade out invasive species and to provide stable shoreline conditions.

Where the collapsed trees pose no public safety threat or damage to existing infrastructure, these trees are recommended to remain. Sediment collects behind the trees and eventually fills in while adding to the shoreline.

Finally, vegetated berms are recommended to protect the wastewater treatment plant at the River Street Park from severe flood scenarios. Sloped berms planted with herbaceous and shrubby vegetation can reduce the energy of water as it meets the shore. Waters will break along the berm as they become shallow against the slope. Maintenance of the berms long term is required for the structures to remain effective. Trees and large shrubs can compromise the integrity of the berm, and wildlife may burrow into the slopes, undermining the system.

3.2 Pachaquack Preserve

3.2.1 Existing Conditions

The preserve (Tax ID 44.6-1-46.200) is located to the west of the Rt. 203/Chatham Street bridge in the Village of Valatie. It can be accessed via Elm Street – a parking area with trash cans and a pavilion welcomes visitors. The site contains unique and varied ecological communities and shoreline types. The Pachaquack encompasses 41 acres and has approximately 4,000 linear feet of frontage along the Kinderhook Creek.

The preserve has a network of trails and several points of access down to the creek. In the eastern portion of the preserve the shore is very steep, high, and exposed down to the bedrock. The landscape at the top of the bank is comprised of hemlock trees and undulating terrain. The distance to the shore along the vertical slope is lengthy in some locations. Washouts are common where vegetative cover is insufficient. A trail is sited extremely close to the top of this bank without any railing. This could be a fall hazard for visitors to the preserve. A switchback trail guides visitors down to the creek near the parking area. The trail is quite steep, and since it is simply a dirt footpath it can become slippery during rain events. Erosion of the trail and surrounding terrain in steep sections is found throughout the preserve.

Figure 4: Steep, unprotected slopes in the eastern section of the preserve.

The shore is variable along the length of the preserve. Some stretches are comprised of rocky outcroppings with sand and gravel margins adjacent to the water. These sites are stable – gravel and sediment will shift over time but the shore itself is unlikely to change. Other sites are similar to what is found at the River Street Park on the northern banks of the Kinderhook. The shores tend to be held together with a range of tree species typically found in riparian systems (cottonwood, maple, and sycamore). Grasses, wildflowers, and vines (primarily non-native) are in abundance, but woody understory species are lacking. When flooding occurs, the herbaceous species lay flat, subsumed by the rush of water. The stems and root systems of riparian shrubs are flexible and strong and can withstand fluctuations in water levels and intermittent flooding. A berm was observed along the shore in one location. The berm is unvegetated – it is unclear if it was constructed or if over time sediment has accumulated in this uniform shape.

Figure 5: Berming and undercutting of the bank.

Where the shore lacks a bedrock ledge, severe undercutting and collapse of the shore is pervasive. The steep vertical distance makes this problem even more pronounced; where the shore has been washed away pioneering vegetation has a difficult time establishing. This problem persists downstream beyond preserve property - it is therefore common to find spans of barren slopes with a lipped top of bank slowly receding into the upland forest.

Figure 6: Steep, collapsing shoreline along on the southern side of the Kinderhook Creek.

In the western portion of the preserve a wide dirt and grass trail is sited immediately above the lip of the shore. The lack of railing presents a fall hazard, though less so than in the eastern portion of the property because a corridor of vegetation is fairly dense. Formal access to the creek does not exist, though a singular bench with a view is sited along the trail overlooking the creek. The trails cross back through the woods to guide visitors back to the parking lot. The woodlands were filled with herbaceous material (phlox) during the time of the field visit.

Figure 7: Woodland phlox along the upland trail in the western portion of the property.

3.3.2 Proposed Improvements

Many trees along the wooded shoreline are in fair condition and a fair degree of diversity exists in the more heavily wooded riparian zones. A healthy riparian corridor has space for root growth, species diversity, symbiotic mycorrhizal[9] relationships, recycling of nutrients, and shade. In areas where insufficient space is available for the riparian forest, trees are exposed to erosional factors and eventual collapse into the stream. Sporadic loss of trees in this condition is part of the natural cycle of shoreline conditions and should only be considered a detriment if the fallen trees pose a threat to public safety.

In areas where an increased width of the riparian woodland buffer is desired, including areas with steep slopes, additional plantings may be installed in a phased method. The extensive root systems of trees are a critical component of slope stabilization and added layer of mixed overstory and understory plantings will attract a wider range of birds and other wildlife. Tree canopy shading may also inhibit invasive encroachment in the shrub layer. Each year a row of trees, shrubs, and herbaceous native plants can be installed behind the existing woodland corridor. Over time, the width and resiliency of the vegetative buffer will gradually increase. Plant species must be carefully chosen to accomplish objectives specific to each site. If adequate room is present at the restoration site, a layer of shade tolerant herbaceous material may be planted between the shrub layer and adjacent upland landscape.

A long-term pest management and tree replacement strategy is recommended for the woodland area to ensure the forest can remain productive. Wooly adelgid were observed on hemlocks and ash appeared to be in decline. Losing these species will result in the loss of valuable mast in the landscape.

[9] Mycorhizzae - a symbiotic relationship occurring in the root zone between a vascular plant and fungi

3.3 Sewer Property at Diamond Street

3.3.1 Existing Conditions

This property is composed of two parcels (Tax ID 44.6-1-51 and Tax ID 44.6-1-52) with a combined area of 0.6 acres. It can be accessed via Diamond Street off Main Street, which travels through the center of the Village of Valatie. The site is currently vacant and is comprised of a paved access drive, a small parking area, and a pump station operated by the Village. A steep hill with mature trees and lawn descends from Main Street to the bank of the creek, which is populated with a variety of invasive and indigenous vines, trees, and shrubs.

Three drainpipes/culverts protrude through the face of the bank. The drain to the east is constructed with a concrete lip – the water then descends over a series of bedrock ledges to the creek below. The middle pipe is steel and is significantly deteriorated. It extends directly from the slope with no stabilization measures below. The grade has eroded over time into an earthen trench. The westernmost pipe is PVC and does not have stabilization measures at the outfall but appears to be more recently installed.

There is no formal access down the bank to the Kinderhook Creek, and the views are obstructed by the vegetation. There is evidence of people descending the banks from time to time to reach the creek. A concrete platform with a manhole is located at the base of the slope. Waterfowl were found to use the platform to sun themselves and rest.

3.3.2 Proposed Improvements

Note – content to be replaced with Church and Main information.

3.4 Beaver Cotton Mill Overlook

3.4.1 Existing Conditions

This property (Tax ID 44.6-1-77.100) is located immediately east of the Rt. 203/Chatham Street bridge in the Village of Valatie. It can be accessed via a public parking lot with an entrance on Main Street. This scenic spot was originally the site of the famous Cotton Mill, which was consumed by a fire in 1888[10]. This site offers extraordinary views of the Kinderhook Creek, Beaver Pond and Beaver Falls and is located in the heart of the Village. The shoreline is composed of exposed bedrock with a limited margin of trees and herbaceous vegetation of at the crest of the bank. A railing prevents visitors from directly accessing the rock face down to the falls, but people can access a small remainder of the original foundation of the Beaver Cotton Mill. Shoreline stabilization is a concern to the north and west of the overlook, where slopes are extremely steep and insufficiently vegetated. Several trees at the top of the slope along the southern side of the parking lot were also noted to be in decline. Trees stabilize slopes with their extensive root systems and help to absorb stormwaters before they reach the slope and cause significant erosion along the shore.

[10] Beaver Cotton Mill History: https://www.valatievillage.com/history

Figure 8: View of the Beaver Falls in January.

3.4.2 Proposed Improvements

To stabilize portions of the slope and increase stormwater infiltration, the parking lot trees are recommended to be replaced and the lawn areas to be vegetated with low-growing shrubs and herbaceous plants to maintain views to Beaver Falls. There is also opportunity to replace the asphalt parking area with porous paving to further meet stormwater goals by incorporating green infrastructure practices.

3.5 Water Supply Property at the Hudson Street Bridge

3.5.1 Existing Conditions

This parcel is located at the northwest corner of the Hudson Street bridge in the Village of Kinderhook. The property encompasses 2.1 acres and has approximately 150 feet of frontage along the Kinderhook Creek. A pump station is situated in the western portion of the property. The bridge abutment is situated immediately south of the property and is bordered by a gently sloping lawn area. This area must remain clear of vegetation to protect the structure of the abutment. As the lawn transitions to shore edge an assortment of large riprap is found along the bank. The slope behind the riprap is very steep and subject to scouring. Limited herbaceous vegetation is found along the shores adjacent to the bridge.

A small inlet of shallow water is found along the banks of the creek, behind which extends a forested riparian buffer. The topography is gradual in slope, with a drainage depression from the inlet north toward an agricultural landscape. The inlet can be accessed via a trail through the forested shoreline adjacent to the creek. Emergent wetland species are found in the inlet and other species may emerge as the season progresses. There is no formal boating launch at the inlet and the trail is a narrow footpath. The woodland adjacent to the shore is mature but limited in width. The greater the width of the riparian buffer the better the flood protection.

Figure 9: Riprap with steep edge to the south of the inlet.

Figure 10: Existing footpath down to the inlet.

3.5.2 Proposed Improvements

Construction of a kayak/canoe launch is recommended to ensure safe access for visitors, stabilizing the adjacent slope and expanding recreational activities along the creek. In addition, the riparian area should be evaluated further for species composition and the potential removal of invasive species with replacement of native plant materials. Invasive plant removal strategies must be accompanied by immediate replanting to maintain the integrity of the riparian area.

3.6 Riparian Biodiversity

The natural cycle of growth and decay can be a boon for a host of organisms. Fallen trees in the waterway can support a variety of life, providing shelter for spawning fish and feeding sites for aquatic invertebrates. If the presence of these snags[11] does not pose a hazard to recreational creek users, they should be allowed to decompose in place. An additional benefit to leaving collapsed trees in place in the stream is the natural restoration of the shore behind the snag. Undercutting was observed in a few locations during field work – these areas could be restored by selectively allowing dead trees to remain in place in the water. Over time, sediment will accumulate behind the structure of the tree. This sediment can be allowed to naturally revegetate, or a more active approach may be used to re-establish native vegetation and a desired gradual slope at the bank.

Deadwood[12] and snags provide a crucial role in any healthy ecosystem. Deadwood provides habitat for detritivores and decaying organisms, while snags provide habitat for a variety of species, depending on the height of the snag (French, 2018). Even snags as low as 5 -15 feet can provide nesting habitat. Trunk hollows can be made from tree stumps rather than completely removing every dead or damaged tree on the site. Identify suitable trees and prune back the canopy as necessary. If possible, retain any existing hollows, and create new holes and cavities where feasible. This can be done in branches, trunks, and stumps.

Numerous strategies can be implemented to protect and enhance wildlife habitat along the Kinderhook Creek. Mowing/cutting times should consider the lifecycles of the animals and insects that depend on the plants for forage and shelter. Pruning after flower and seed cycles allows for the replenishment of the seed bank in the soil, and opportunities for feeding on nectar and fruits. Localized noise disturbances can have detrimental effects on wildlife, particularly during the breeding season. Routine management practices should be avoided during nesting and peak activity periods, to reduce disruptions and damage to breeding sites. While these strategies are useful for localized protection, the conservation of open space is the best way to ensure species have the resources necessary to migrate, breed, find shelter and food, and to be resilient to the changes occurring on a climatic level.

PUBLIC ACCESS

As the Villages move forward with the design of shoreline improvements, the concerns and visions received through the public engagement process of this study should be considered. Often, projects take many years to fully implement. It is therefore relevant to plan to engage the community further as designs develop.

4.1 Pathway Improvement

To prevent further erosion along the banks and protect environmental resources, several measures can be implemented to promote path and park design. These include proper buffer plantings to prevent off-path access, specific call outs for access to fishing and boating, and informational signage to prevent intrusion into sensitive areas.

[11] Snag – decaying or dead standing tree
[12] Deadwood – a dead branch or other part of a tree

Pathway design within the study area is contextual. In some locations (River Street Park, Pachaquak Preserve) the relocation of the trail to allow for an expanded vegetated buffer is appropriate. Some sites may be appropriate for a path leading to the shore or designated fishing sites. In all cases, constructing inclusive, accessible path systems wherever possible should be a top priority. Improvements should be welcoming to as wide a demographic as possible.

4.2 Creek Access

It is important to provide formalized locations for creek access at regular intervals and at popular locations. These access points can be designed to accommodate foot traffic, soft launches, or fishing. Structured creek access can be accomplished with the installation of wood deck overlooks or hard scape areas with a small natural retaining wall along the shore. Formalized creek access will prevent erosion issues resulting from intermittent non-built entry points. Property owners along the creek should be encouraged to partner with the Villages to provide easements for creek access to allow the public to engage with the waterfront along the length of the Kinderhook Creek.

Providing structured access routes to shoreline restoration areas will increase efficacy of monitoring and management and will provide the public with recreational and educational opportunities. Increased access can be problematic if natural resource areas are not fully understood. The most efficient means of protection is often education. People are more likely to protect rather than disturb sensitive resource areas if they understand the value of these habitats. A thoughtfully designed interpretive signage program highlighting important ecological resources can be installed at active and established restoration locations.

LOGISTICS

5.1 Anticipated Regulatory Requirements

The following is a list of anticipated permits required to implement the recommendations for shoreline stabilization in the study area. Additional permits may be required as information is revealed during the design development phase and extensive site analysis is performed.

<u>NYS Department of Environmental Conservation</u>
Protection of Waters (ECL Article 15, Title 5)
Freshwater Wetlands (ECL Article 24)
State Environmental Quality Review Act (SEQR)

<u>US Army Corps of Engineers</u>
Section 408 – Permit for the alteration or use of a Civil Works Project

<u>US Environmental Protection Agency</u>
National Environmental Policy Act (NEPA)
Section 401 – Water Quality Certification
Section 404 – Permit for discharge of dredge or fill

<u>US Fish and Wildlife Service/NOAA Fisheries</u>
Endangered Species Act Formal Consultation & Biological Opinion
Fish and Wildlife Coordination Act (FWCA) Report

<u>State Historic Preservation Office</u>
Determination of Significance

5.2 Shoreline Maintenance & Monitoring

Management of the Kinderhook Creek shoreline involves a network of Village staff, non-profit and volunteer groups. All entities will ideally work towards the same overall goals in a coordinated manner. In each management area, the entity responsible for a particular management activity must be identified. An ongoing management framework should seek to:

- Be realistic about what the Village's staff can take on, with current machinery, tools and staff resources available.
- Strategize investments to maximize impact of available funding.
- Strategize non-profit, NGO, and volunteer group efforts to maximize implementation of long-term goals.

Management activities along the Kinderhook Creek shall be guided by this plan and organized by the Villages of Valatie and Kinderhook. Most routine, weekly/monthly practices are best completed by Village staff. In addition, recurring periodic maintenance activities, such as shoreline vegetation cutting, or yearly meadow mowing can also be completed by Village staff. When more detailed periodic maintenance activities, like invasive species removal or one-time project-based work is required, these activities are best taken on by either a nonprofit group (with volunteers) or by Village-hired contractors. The challenge with Village-hired contractors is that the funding and procurement process may not best correlate with when the work should occur in the field for ecological objectives. For this reason, non-profit groups may be best suited for some of the more detailed periodic maintenance and project-based work tied to detailed maintenance activities.

To promote the success of the selected stabilization improvements, the following monitoring measures (at minimum) should be taken:

<u>Follow-up Inspections</u>

All disturbed areas will be monitored to determine the success of the utilized erosion control. Inspections will occur after the first and second growing seasons to monitor revegetation in certain locations throughout the project area. Success will be measured by the density and cover of non-invasive vegetation and how it compares to the surrounding undisturbed areas. Photographs of the areas where erosion controls were utilized shall be taken annually in the spring. A visual assessment of the control success can be achieved by comparing the photos from subsequent years.

<u>Pre-and Post-Storm Event Inspections</u>

Best practice standards recommend inspection of all erosion controls to ensure they have been properly installed and are secure before all major storm events. A major storm is defined as a storm predicted by the National Office of Atmospheric Administration (NOAA) Weather Service with warnings of flooding, severe thunderstorms, or similarly sever weather conditions or effects. For the purposes of this monitoring plan, inspections are recommended for storms producing more than 0.5 inches of rainfall. After the storm event, the erosion controls shall be inspected to ensure the structural integrity of the Best Management Practice (BMP) is intact and to determine if sediment needs to be removed from the BMP.

5.3 Prioritization & Funding

<u>Prioritization</u>

A multi-faceted shoreline stabilization plan requires many different levels of phasing throughout project development and construction. Several factors influence project phases, including but not limited to complexity of shoreline improvements, property acquisitions, level of regulatory permitting required, difficulty of construction, and most importantly, the amount of available funding.

If feasible, for cost and time savings, it is recommended that each project be implemented in one phase. However, in most cases, a single phase is not possible due to funding constraints, or the approval processes required for various sections of the project. As a result, a framework of three phases of implementation is recommended per project. If it is determined that some of these phases can be combined, it would result in more cost- and time-effective implementation.

Shoreline stabilization phasing recommendations are primarily organized by severity of existing erosion, followed closely by the project's benefit to users and momentum to continue future project phases, anticipate approvals, and to identify potential funding. Each phase is intended to generate interest in expanded/improved parkland amenities, increase monetary and social investment in Village's creekfront open spaces, and to create a sustainable strategy for future generations. Finally, where possible, phases should be combined with other improvements to leverage and enable efficiency of implementation.

Prior to the implementation of a project, a Feasibility Analysis should be completed specific to the project area and recommended improvement strategies to identify potential site constraints. The Feasibility Analysis should clearly define the project intent; include a site-specific survey of topography, shoreline conditions, and site elements; confirm necessary permits; develop an implementation schedule and public outreach strategy; and refine the project budget/cost estimate. Utilizing the refined cost estimate and additional information revealed from land surveys, the Villages can seek out and procure funding from grants, partnerships, etc. A detailed overview of funding strategies is included at the end of this section.

Overall, the project team recommends the implementation of the projects identified in this study in the following order:

<u>Tier 1 Projects – High Priority</u>

- Pachaquack Preserve

<u>Tier 2 Projects – Mid Priority</u>

- Beaver Cotton Mill Overlook
- River Street Park

<u>Tier 3 Projects – Low Priority</u>

- Hudson Street Bridge Parcel

Pachaquack Preserve is identified as a high priority tier 1 project because the park's existing shoreline infrastructure is deteriorating rapidly and the trees adjacent to the shore are subject to collapse into the stream. The preserve is a cherished resource and is heavily used for fishing and passive recreation. Since the recommended shoreline improvements are comprised of mixed bioengineered elements that can be designed for the aesthetic, ecological, and community benefit of the project will be substantial.

Riparian buffer expansion is a relatively inexpensive shoreline improvement that can be implemented gradually with private/public partnerships and existing Village staff resources. Expansion of the woodland area in the Pachaquack Preserve can be accomplished with planting strategies, while implementing a long-term program for woodland pest management and tree replacement. These restoration efforts will be immediately visible, and with the proper outreach, can be excellent catalysts for future projects.

Depending on the desires of the Villages, it may be most advantageous to prioritize one project over another and deviate from the recommendations of this plan. This may be especially true if funding sources emerge that will facilitate the development of a specific project. If the project aligns with the goals of the Villages and improves the overall flood resilience of the creek, priorities can be reconsidered and adapted. It is important to recognize that climate change, while not immediately recognizable, will be a destabilizing force in the decades to come. Valuable infrastructure, natural resources, and indispensable public space is threatened with flooding and the loss of riparian biodiversity, resulting pests and invasive species proliferation. The intent of this report is to serve as a starting point for the Villages to begin a dialogue with leaders, stakeholders, and residents about a strategy for adaptation in a changing world. Investment now in the protection, restoration, and conservation of open space in the region will pay dividends in the future as the continuing effects of climate change become more visible over time.

Funding

Revenue enhancement is one key component of financially sustainable implementation plan. The Villages should continue to pursue funding strategies that include:

- Exploring alternative funding sources that strategically align with targeted improvements.
- Expanding alternative funding for strategic initiatives through grants.
- Exploring additional Community Partnerships.
- Exploring additional opportunities for (and use of) sponsorships.

Below is a list of potential funding sources that may assist with the implementation of the recommendations:

- Office of Parks, Recreation and Historic Preservation Outdoor Recreation, Acquisition, Development and Planning grants.
- Hudson River Valley Greenway water trail and community grant programs.
- NYS Parks program grants.
- NYS Department of State Waterfront Resilience and Local Waterfront Revitalization Program grant programs.
- The Outdoor Recreation Legacy Partnership Program (ORLP) offers grants to improve local parks and outdoor recreation areas. The program is funded through the Land and Water Conservation Fund (LWCF).
- Public-Private Fundraising: The Villages could work with non-public entities or the general public to raise funds through private fundraising or grant sources available only to the non-public entities to match public funds for creekfront improvements. It could be possible to provide some memorial that acknowledges the contribution.
- Donations: The Villages could work to acquire donated funds or materials and services from local companies or residents to support restoration projects. Acknowledgement of supporting companies or individuals could be included along the creekfront as desired.

A Feasibility Analyses should be completed for the specific projects identified above that will aid in determining which funding strategies and sources will be most applicable for each project.

5.4 Next Steps

As first step towards implementing the recommendations of this study, the Villages should come together to review and ultimately accept and approve the plan. Once approved, with the assistance of residents, businesses, Village staff and state officials, the Village can undertake the following steps. The steps do not need to be in the order listed here, but this order is recommended to ensure adequate funding and permitting is established to help the projects progress smoothly:

- Prepare a Feasibility Analysis for the specific project and project area that the Village is currently pursuing, including the preparation of site surveys and geotechnical investigations where stabilization measures are proposed.
- Conduct a vegetation survey to determine where invasive species are causing significant deterioration of the shoreline and adjacent uplands and come up with an action plan for the removal of these species a subsequent restoration with native plantings.
- Conduct a tree survey in sites where tree decline is noted and is likely to cause erosion and collapse of the shore. Remove trees where appropriate and re-plant with native species that are expected to be resilient to changing climatic conditions and will improve overall biodiversity by providing forage and nesting opportunities for a variety of species.
- Conduct a Phase 1A Archaeological Assessment in the study area to determine where sensitive pre-historic and historic resources may be sited (this may be completed as one comprehensive assessment of the entire shoreline or broken up and included as part of the Feasibility Analysis for each project).

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