Boardman River WATERSHED Prosperity Plan

September 2016

Prepared for
The Boardman River Watershed
Prosperity Leadership Team

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The members of the Boardman River Watershed Prosperity Plan Leadership Team were saddened by the loss of their friend, colleague, and former Leadership Team colleague Bryan Crough. The Prosperity Plan is respectfully dedicated to him in recognition of his commitment to and impact on the Traverse City area.

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Executive Summary

PURPOSE

The Boardman River Watershed Prosperity Plan (Prosperity Plan) is a vision and a roadmap for the future management of one of Michigan's most beautiful watersheds. It meets the community's desire to have a management plan for the river approved by the Michigan Department of Environmental Quality (MDEQ) and the U.S. Environmental Protection Agency (USEPA), but also goes well beyond traditional watershed studies and provides a blueprint for multijurisdictional cooperation to improve the environmental, economic, and social prosperity of the watershed region. It is one of the first intentional planning initiatives in Michigan to bridge the gap that often exists between natural resource protection and economic prosperity.

The Boardman River watershed is just beginning to undergo substantial change with the removal and modification of four dams on the river. The scale of dam removal is unprecedented in Michigan and elsewhere in the United States. The dam removal project will return 3.4 miles of the Boardman River to a free-flowing river and restore over 250 acres of wetlands. Returning the Boardman River to its natural flow will have a significant impact on water quality, fish and wildlife, recreation, and business opportunities. It will also present many new challenges and trade-offs in terms of resource use, economic prosperity, and quality of life in the region. The Prosperity Plan helps distinguish some of these needs and challenges, and identifies strategies for protecting and enhancing the watershed's ecological, social, and economic resources.

The plan defines prosperity for the watershed as achieving economic well-being for its residents, protecting and maintaining a high-quality environment (water, land, and air resources), supporting healthy lifestyles, helping people connect and engage with the environment and with each other, and offering a diverse range of social and cultural opportunities. In short, the watershed as a whole will prosper when all parts of the natural and human system are healthy and thriving.

DESCRIPTION OF THE WATERSHED

The Boardman River watershed is located within the Grand Traverse Bay watershed in northern Michigan. It encompasses parts of Grand Traverse and Kalkaska counties as well as 20 smaller municipalities (cities, villages, and townships). The watershed includes 180 miles of river and tributary streams, and covers 287 square miles. It makes up almost a third of the Grand Traverse Bay watershed land area and provides almost one-third of the tributary inputs of water to Grand Traverse Bay. It also contains the majority of the Grand Traverse Bay watershed population. As such, the Boardman River watershed plays a large role in the ecological health of Grand Traverse Bay.

Twenty named tributaries drain into the Boardman River, and there are numerous lakes throughout the watershed. The topography is largely glaciated with sandy soils, and the majority of the land use/land cover is upland forest (80 percent). There is also significant agricultural land use (12 percent), as well as urban areas, wetlands, and open water throughout the watershed.

The Boardman River is considered among the top 10 trout streams in Michigan and is a designated Natural River, which affords specific protections for preservation in a natural condition. Historically, the Boardman was a grayling fishery, with brook trout, rainbow trout, and brown trout introduced later in the 19th and 20th centuries. The river now has self-sustaining populations of Brown, Brook, and resident Rainbow Trout, as well as migratory Rainbow Trout and Chinook and Coho Salmon. The river flows into and through Boardman Lake, which supports typical warm water game fish populations.

The river played a significant role in the timber industry in the mid-to-late 1800s and early 1900s. The logging era was followed by construction of several dams that were built largely to provide power for the growing needs of Traverse City. Between 1867 and 1921, five dams were built on the river (the Union Street, Sabin, Keystone, Boardman, and Brown Bridge dams). The dams ranged in height from 9 to 41 feet and they influenced over 20 miles of the river's mainstem. These dams provided a significant amount of the city's power in the 20th century, but their usefulness declined over time. The City of Traverse City and Grand Traverse County (which own the dams) undertook a multiyear feasibility analysis beginning in 2005 to evaluate the economic, environmental, and social benefits or drawbacks to removing or modifying the remaining dams (the Keystone Dam washed out in 1961). With substantial input from the community and stakeholders, the analysis recommended that the Sabin, Boardman, and Brown Bridge dams be removed, and that the Union Street dam be modified (this process is under way and is the largest dam removal project in Michigan history).

WATER QUALITY DESIGNATED USES AND ISSUES

The Boardman River and its tributaries are protected under Michigan's water quality standards (WQS) for the following designated and protected uses:

- Agriculture
- Navigation
- Industrial water supply
- Warm water fisheries
- Coldwater fisheries
- Other indigenous aquatic life and wildlife
- Partial body contact
- Fish consumption
- Total body contact from May 1 to October 31
- Migratory routes for anadromous salmonids (trout and salmon)

Based on the MDEQ's 2014 *Integrated Report*,[1] the Boardman River and its tributaries are largely meeting water quality standards for designated uses (MDEQ 2014). The only exceptions are "Fish Consumption" in all waterbodies and the "Other Aquatic Life and Wildlife" designated use for Kids Creek, a major tributary to the Boardman River. Currently an approximate 4-mile section of Kids Creek near its confluence with the Boardman is not supporting this designated uses due to flow regime alterations, sedimentation/siltation, and other human caused substrate alterations, all caused by stormwater. Although a Total Maximum Daily Load (TMDL) plan for Kids Creek is not currently scheduled to be drafted as part of the MDEQ's 2016-2022 "Prioritization Framework for the Long-Term Vision for Assessment, Restoration, and Protection under the Clean Water Act Section 303(d) Program," it remains on the 303(d) non-attainment list as needing a TMDL. Additionally, there is an ongoing, multimillion dollar Kids Creek Restoration Project which has begun addressing many of the pollutants contributing to the creek's poor water quality.

Fish consumption advisories have been established by the Michigan Department of Community Health for certain fish species in all waterbodies of the state (not just the Boardman River) due to sources of PCBs and mercury generated outside of the watershed.

While the Boardman River and its tributaries are currently attaining water quality standards in most places, watershed plans must also address potential threats, problems, and concerns related to protected

[1] The MDEQ publishes a bi-annual *Water Quality and Pollution Control in Michigan Sections 303(d), 305(b) and 314 Integrated Report* that summarizes the assessment and status of the state's waterbodies in relation to their attainment of water quality standards.

water quality uses. While there have been historical inputs of toxic pollutants and thermal modifications from the dams, the highest priority sources of pollution or other stressors that currently affect or could affect the Boardman River watershed are sediment, nutrients, loss of habitat, and pathogens. Sediment inputs to the Boardman River likely come from road stream crossings, urban/suburban stormwater, construction activities, recreation access along the river and tributaries, forestry practices, and livestock in streams. The most likely sources of nutrient loads are failing septic systems, residential and agricultural fertilizer, and lack of riparian buffers. Loss of habitat, generally from development and suburban sprawl, has already and could continue to significantly impact water quality in the watershed. Finally, pathogen threats are due mainly to failing septic systems, stormwater runoff (particularly in urban areas), and livestock in streams.

Priority areas for protection and critical areas for restoration in the Boardman River watershed, along with the known or suspected pollutants or threats, were identified to help develop goals and objectives and to guide future monitoring, planning, and management efforts. These areas of concern were identified based on either current sources of pollutants or areas that are most susceptible to activities that could degrade water quality or valuable aquatic habitats.

Specific priority protection areas are (Figure 20):

- **Natural lands of high conservation value/priorities for protection.** The top priority areas for natural land protection are the Brown Bridge Quiet Area and the bottomlands for Brown Bridge, Boardman and Sabin dams. Additionally, groups like the Grand Traverse Regional Land Conservancy have developed specific criteria for conservation easements and nature preserves to ensure that lands acquired or put into easements are leveraging other protection areas and meeting broader watershed conservation goals.
- **Wild and Scenic designated areas along Boardman River.** These areas are a priority for maintaining and protecting designation status and high quality (see Figure 7 for a map of Natural River segments.
- **Boardman River channel from "The Forks" down to Brown Bridge Quiet Area.** Wildlife and aquatic habitat in this area need protection because of potential overuse from recreation.

Brown Bridge Quiet Area
Photo courtesy of: Grand Traverse Conservation District

In addition to the areas identified above, other general priority areas include:

- **Ridgelines and other areas with expansive viewsheds of the Boardman River** (privately owned) that provide wildlife habitat, contribute to the region's rural character and quality of life, and help recharge groundwater.
- **Headwaters of tributaries.** These areas are a priority for extending the Natural Rivers designation and its protective zoning to protect their wild and scenic properties. The top priorities for headwater protection are the north and south branches of the Boardman River.

Critical areas for the Boardman River watershed are the areas in which management measures need to be implemented to achieve load reductions identified in the plan. They also refer to locations where actions are needed to address ongoing sources of nonpoint source pollutants. The critical areas identified in this plan reflect the primary sources of nonpoint source pollution, including urban stormwater, dam removal activities, development and shoreline management, agriculture, transportation crossings, and malfunctioning septic systems. Critical areas are shown at two levels: general critical areas and acute critical areas. General critical areas represent broader areas where, in general, attention is needed. Acute critical areas are the priority locations where attention is needed first and foremost.

General Critical Areas:

- **Riparian corridors**. Areas within approximately 1,000 feet of Boardman River or tributaries that drain to the river.
- **Wetlands**. All wetlands and areas within 1,000 feet of wetlands identified in the National Wetlands Inventory for the Boardman River watershed.
- **City and village centers**. Urban areas that contribute significant stormwater runoff to the Boardman River and its tributaries. Although each urban area's individual contributions vary according to many factors, including total impervious surface, implementation of stormwater best management practices, and pollutant loadings, it is reasonable to assume they are all contributing nonpoint source pollutants to some extent, and therefore, should be continually managed to reduce their loadings.
- **Transportation Crossings**. The degree of severity of road-stream and other transportation crossings on the Boardman River and its tributaries varies; consequently, the impacts to the resources vary as well. Severe and moderate crossing sites are included as critical areas because of their potential to contribute large amounts of sediments and other nonpoint source pollutants.
- **Agricultural Lands.** Agricultural areas are included because water quality monitoring in other watersheds has shown higher levels of nitrates in areas where agricultural practices are hydrologically connected via groundwater or runoff. The application of nitrogen-rich fertilizers, particularly in sandy, well-draining soils, is suspected as one of the sources of these nitrates.

Acute Critical Areas:

1. **Bottomlands and impacted upstream areas from Brown Bridge, Boardman, and Sabin dam removals.** As dam removal projects are completed, concurrent restoration of the bottomlands and associated upstream impacted areas is critical to prevent soil erosion and sediment contribution, protect and enhance in-stream habitat, and control invasive species (see Figure 1 for location of dams).
2. **North Branch of the Boardman River from Kettle Lake Road downstream to the confluence of Failing Creek.** Water quality and ecological function in this stretch of the river is severely impacted for several reasons, including temperature and sediment.
3. **Inland lakes with hydrologic connection to the Boardman River and/or increased residential development, including Silver, Arbutus, and Spider lakes.** Development (historic and new) along these lakes may be causing increased pollutant contributions from greater amounts of impervious surface, bank erosion, and aging or undersized septic systems.

4. **Traverse City and surrounding urban area, roughly defined by the land area encompassed by South Airport Road, Garfield Avenue, US31 North to Grand Traverse Bay (includes Traverse City and Garfield Township).** This highly urbanized portion of the watershed in Traverse City contributes pollutants to the river and Grand Traverse Bay via stormwater runoff. While a number of stormwater reduction and filtration projects have been implemented, there is still a significant need to reduce the amount of oils, greases, litter, and other pollutants to the river in this portion of the watershed.

5. **Kids Creek subwatershed.** As discussed in Chapter 4.3, Kids Creek is the only impaired waterbody on MDEQ's 303(d) list. Water quality in the creek is severely impacted by stormwater and sedimentation. TWC launched a large-scale Kids Creek Restoration Project a number of years ago that included stormwater reduction BMPs on tributaries A and AA of the creek, streambank stabilizations, and "daylighting"[2] a portion of Tributary A (See Chapter 4.3 and Figure 14 for more detail). Restoration efforts must continue on Kids Creek to further aid in efforts for its removal from the impaired waters list.

[2] Daylighting means redirecting the stream to an above-ground channel instead of an underground culvert

6. **Boardman Lake shoreline.** The lake has had significant historic sediment contamination from previous industrial activities around the lake and is vulnerable to increasing sediment load as upstream dams are removed (see Figure 2 for Boardman Lake location).
7. **Severe streambank erosion sites and transportation crossings.** As previously described, the Grand Traverse Conservation District identified more than 600 eroded sites along the Boardman River and its tributaries in the Boardman River Watershed Report. Since 1993, more than 300 of the 600 identified sites have been restored, but there are still many severe road crossing and streambank erosion sites that need to be restored to protect and improve the Boardman River watershed ecosystem (Figures 16, 17, 17a, 17b). Particular attention should be around streambank erosion sites around the dams as they are removed.
8. **Village of Kalkaska.** As the second largest urbanized area in the watershed, the Village of Kalkaska contributes stormwater runoff from urban areas to the headwaters of the Boardman River. Monitoring in the area has indicated negative impacts on benthic macroinvertebrate communities.
9. **Agricultural lands – Fife Lake/Kingsley/Garfield Township areas.** Agriculture in the watershed is centered on these headwater areas and makes the potential nutrient and sediment inputs to these small streams a high priority.
10. **Small dam removal.** As stated earlier, dams are a known cause for thermal pollution to their downstream waterbodies. Survey results show at least 10 man-made small dams in the Boardman River and its tributaries, each with the potential to contribute to thermal pollution of downstream water (Figure 18). When feasible and with owner approval, these dams should be removed.

OTHER NATURAL RESOURCE USES AND ISSUES

In addition to water quality designated uses, the Prosperity Plan team and community members identified other natural resource desired uses that are a key part of the watershed's prosperity. The highest priority natural resource uses and issues are:

- **Abundant healthy wetlands and aquatic habitat** to support the region's world-class fishery, provide other nature-based recreation activities, and contribute to the undeveloped character of the watershed. Restoring over 250 acres of wetlands through dam removal projects and increasing species and ecosystem diversity will be important in maintaining and improving wetlands and other aquatic habitat. Protecting existing wetlands and riparian areas from development impacts, particularly in the western part of the watershed, will also be critical to maintaining healthy aquatic systems.
- **Abundant, healthy upland wildlife habitat** to support game and nongame species and threatened or endangered species. The Michigan Natural Features Inventory identified 14 occurrences of threatened/endangered species in the watershed as well as 8 occurrences of species of special concern. Given the abundant and high-quality upland wildlife habitat in the watershed, the focus of the Prosperity Plan is on maintaining and protecting these important resources.
- **Natural resource education and interpretation** that engenders a stewardship ethic in people and creates lifelong champions and protectors of natural resources. There are already several outstanding opportunities for natural resource education in the watershed, including the Grand Traverse Conservation District's Boardman River Nature Center and 10 public parklands that contain 3,000 acres of land, a majority of which straddles the Boardman River or its tributaries. The Grand Traverse Regional Land Conservancy also owns and manages several preserves in the watershed, including the Howard and Mary (Dunn) Edwards Preserve near Brown Bridge. However, there remain many untapped opportunities to connect people both physically and emotionally to the river through information, hands-on activities, and volunteer opportunities.

ECONOMIC USES AND ISSUES

The economies of the communities in the Boardman River watershed are based largely on recreation, tourism, agriculture, forestry, services, light manufacturing, and oil and gas production. There is a significant disparity in economic prosperity, however, among these watershed communities. The western watershed, comprising Traverse City and surrounding communities (particularly Garfield Township), is fairly prosperous and supports almost 70 percent of the 2,410 businesses in the watershed. Communities in the eastern portion of the watershed (particularly Kalkaska County) capture less than 4 percent of the taxable value of commercial property in the watershed.

The Prosperity Plan team, informed by community members and previous planning efforts, identified four important economic uses for the watershed:

- **Strong "knowledge-based" economy.** A knowledge-based economy is one that is largely based on technology and human capital sectors, driven by innovation and globalization. Industries and job sectors such as engineering, science, process and system design, logistics, biotechnology, and health care management are a handful of examples of knowledge economy sectors that are helping grow local economies and create jobs. The Boardman River watershed region has existing clusters in education, health, recreation, and retail areas, and continuing to provide job opportunities and a quality of life that attract knowledge economy businesses and workers is an important part of the watershed's future economic prosperity.
- **Viable local agriculture.** The watershed has historically supported agriculture clusters in Blair, Paradise, Boardman, East Bay, Garfield, and Kalkaska townships, as well as around the Village of Kingsley. This strong local agriculture sector not only provides an important element of the regional economy, it also helps maintain rural character and open space in much of the watershed, which has been identified as an important objective in other planning efforts such as the Grand Vision.
- **Diverse business/jobs base.** The community has recognized that maintaining a diverse business and jobs base in the region is an important aspect of advancing economic growth and providing varied employment opportunities for workers with various skill levels.
- **Tourism-serving industry.** The Boardman River watershed, particularly the northwestern portion of Traverse City along Grand Traverse Bay, is a popular tourist destination for both Michigan travelers and out-of-state and international visitors. While Traverse City hosts the bulk of the tourism activity, the entire watershed, especially the central and eastern portion where the Pere Marquette State Forest is located, is an important recreation tourist destination, attracting people for its camping, fisheries, motorized and non-motorized trails, paddling, and hunting activities. The Traverse Area Recreation and Transportation (TART) trail system also boasts several miles of multiple-use walking and biking trails. This includes an east-west trail through the heart of Traverse City and a new spur south called the Boardman River Trail. The single track mountain biking trail is also within the watershed boundaries. Restoration of the Boardman River to a free-flowing river will offer substantial opportunities for growing the region's tourism-serving industries such as recreation guides, paddling and gear shops, lodging, and restaurants.

The Prosperity Plan identifies 17 indicators of prosperity and compares five different watershed communities and the state as a whole in terms of how well they are performing on those indicators. These measures will be an ongoing part of evaluating the impact of the Prosperity Plan's goals, objectives, and strategies as they are implemented.

COMMUNITY QUALITY-OF-LIFE USES AND ISSUES

In addition to water quality, natural resources, and economic uses, the Prosperity Plan identifies community quality-of-life issues that are a critical part of the region's prosperity. These are:

- **Abundant, diverse, and high-quality outdoor recreation amenities** that provide health and enjoyment benefits for residents and help attract visitors to the region. While the watershed is blessed with abundant and diverse recreational offerings, there are many opportunities for improving and expanding access to these assets that would help contribute to quality of life in the watershed. In particular, there are opportunities to physically connect the region's recreation resources (through trails, for example) and missed opportunities for cross-marketing and promotion of recreational offerings. There is also a need to direct some recreational activities to designated places and provide infrastructure that accommodates those uses in order to protect the watershed's natural resources from overuse.
- **Available entertainment and cultural opportunities, clustered in downtown areas,** which are important for attracting residents and visitors to the Boardman River watershed area. Maintaining existing areas in the western part of the watershed, and identifying and investing in augmented opportunities in other communities, particularly in the Kalkaska and Kingsley areas, are important uses of land and resources identified for the watershed.
- **Available multimodal transportation options.** Multimodal transportation options, such as expanded transit through the Bay Area Transit Authority, are an increasingly important part of maintaining a diverse job sector, providing access between jobs and affordable housing, and reducing environmental and health impacts associated with personal vehicle use.
- **Charming, walkable, compact downtowns.** From the small villages to Traverse City, communities in the watershed have consistently indicated their desire to maintain quaint and charming downtowns that are reflective of the northern character, coastal location, and both urbanized and rural settings. Providing charming and walkable downtown areas has been identified as a priority use in many of the related planning efforts for the region over the last several years, including the Grand Traverse Bay Watershed Protection Plan, the Grand Vision, and local community master plans.
- **High-quality education facilities.** The Boardman River watershed community recognizes the important role that education plays in attracting businesses, maintaining social strength, and protecting natural resources. Providing high-quality educational facilities throughout the watershed will help grow the local economy, attract and keep talented residents, and reduce social issues such as crime.

GOALS, OBJECTIVES, AND STRATEGIES

There are five major goals for the Boardman River watershed and 19 specific objectives that drive toward achieving those goals (Table ES-1).

TABLE ES-1. Boardman River Watershed Goals and Objectives

GOAL 1: Protect, restore, and enhance the high-quality water and other natural resources that are the backbone of social and economic prosperity in the watershed.
Objective 1.1: Reduce threats to water quality in the Boardman River and tributaries from stormwater and wastewater inputs.
Objective 1.2: .Restore and enhance wetlands and other aquatic habitat and improve fish passage.
Objective 1.3: Reduce erosion and minimize barriers to fish passage associated with transportation crossings along the Boardman River and its tributaries.
Objective 1.4: Control the spread and introduction of invasive species that threaten designated uses of the Boardman River and its tributaries.
Objective 1.5: .Maintain and improve forests and other key wildlife habitat corridors throughout the watershed.
GOAL 2: Grow a sustainable economy that benefits and strengthens all of the watershed communities.
Objective 2.1: Focus and support economic growth in the watershed's existing downtown hubs.
Objective 2.2: Encourage the growth of a diverse range of emerging and new business sectors and entrepreneurs.
Objective 2.3: Expand the tourism economy throughout the watershed.
Objective 2.4: Preserve and expand agricultural economic activity in the watershed.
GOAL 3: Improve the quality of life and advance greater social equity throughout the watershed to retain and attract businesses, a talented workforce, and student and retiree residents.
Objective 3.1: Advance educational opportunities for watershed residents to expand potential economic and social opportunities.
Objective 3.2: Provide affordable and regular transportation options within and between watershed communities in order to better accommodate workforce participants throughout the watershed.
Objective 3.3: Expand affordable housing opportunities throughout the watershed to accommodate the needs of the Traverse City worker market.
Objective 3.4: Protect scenic vistas, rural character, and key cultural and historic sites.
GOAL 4: Provide managed expansion and improvement of recreation opportunities in the watershed to attract a talented workforce, student and retiree residents, and visitors from around the world.
Objective 4.1: Manage and capture opportunities for diverse water-based recreation in the watershed.
Objective 4.2: Manage and capture opportunities for diverse land-based recreation in the watershed.
Objective 4.3: Promote recreation opportunities to residents and visitors.
GOAL 5: Through education and engagement efforts, create community ownership of the Boardman River Watershed Prosperity Plan and community capacity that will assure implementation of recommended actions and achievement of the goals and objectives.
Objective 5.1: Cultivate the development of local public and private watershed champions (both individual and organizational) through training, organizational capacity building, and opportunities for leading implementation efforts.
Objective 5.2: Foster an ongoing culture of prosperity stewardship among watershed residents by integrating stewardship learning into education at all levels, providing regular information to the public on the overall economic, ecological, and social health of the watershed, and providing organized opportunities for residents and businesses to participate in the implementation of the Boardman River Watershed Prosperity Plan.

Objective 5.3: Create a watershed prosperity stewardship ethic among visitors to the region so that they might help protect and promote natural resource protection and the region as a high-quality destination.

The Prosperity Plan identifies implementing strategies that residents, businesses, and communities in the Boardman River watershed will undertake to achieve the plan's goals and objectives. The strategies are broken down by five smaller watershed zones in addition to watershed-wide actions to help focus on specific geographies and consider the unique needs and resources of each part of the watershed. The actions will require collaboration among communities, and focus on building capacity of watershed stakeholders of all ages.

In an effort to successfully accomplish the goal of protecting and restoring the high-quality water and other natural resources that are the backbone of social and economic prosperity in the watershed, specific and tangible recommendations were developed based on the prioritization of watershed pollutants, sources, and causes, while also looking at the priority areas in the watershed. Water quality and environmental tasks were also divided into the following categories:

- Shoreline and Streambank Protection
- Stormwater
- Transportation/Stream Crossings (i.e. roads, railroads, etc.)
- Planning, Zoning, and Land Use
- Land Protection and Management
- Habitat, Fish, and Wildlife
- Human Health Strategies
- Hydrology and Groundwater
- Water Quality Monitoring
- Wetland
- Invasive Species
- Agriculture
- Wastewater and Septics

The total estimated cost of the implementation actions is more than $88 million (Table 42) over the next 10 years. As some of the proposed actions are further planned and designed, the total cost estimates will be updated. Of these total estimated costs, approximately $42.5 million is for water quality and environmental activities, $44 million for sustainable economic development activities, and $1.5 million for improved recreational efforts.

INFORMATION AND EDUCATION

Education and engagement were identified as one of the five primary goals of the Prosperity Plan (and related implementing strategies) and an information and education plan that identifies target audiences and summarizes information and education measures was developed. The IE Strategy will help increase awareness and understanding about the value of the watershed's aquatic and other natural resources in providing strong and prosperous communities. This plan follows the detailed IE Strategy developed for the Grand Traverse Bay Watershed Protection Plan that was developed in 2005 and lists more than 60 tasks. The common goal of that IE Strategy is to "Establish and promote educational programs that support effective implementation of watershed planning goals, objectives and tasks; and increase stewardship." The IE Strategy for the Boardman River Watershed Prosperity Plan encompasses virtually all of the discussed and listed goals, objectives, target audiences, messaging, and strategies/tasks in the Grand Traverse Bay Watershed Protection Plan. Specific tasks for the Boardman River watershed were also developed as part of the IE Strategy.

EVALUATION AND OVERSIGHT

As projects and tasks identified in the Prosperity Plan are implemented, they will be monitored and evaluated for success. An evaluation strategy will be used to measure progress during the Boardman River Prosperity Plan's implementation phase and to determine whether or not water quality is improving or getting worse. The timeline for the evaluation is approximately every five years, with ongoing evaluation efforts completed as necessary. An evaluation strategy for plan implementation will be used to determine progress in completing the water quality-related recommended actions and tasks identified in the plan to be conducted through a Boardman River Watershed Plan Implementation Team (BR-WPIT). It is anticipated that some members of the existing Prosperity Plan's Leadership Team will serve on this committee, as well as other local stakeholders interested in water quality issues.

It is essential to the success of this watershed planning effort that water quality in the Boardman River watershed be maintained and improve in critical areas. There must be no deterioration in the quality of the water throughout the watershed. An evaluation strategy was drafted to determine this by comparing water quality criteria with monitoring results. Parameters monitored and monitoring locations will be driven by the monitoring programs identified in the proposed comprehensive monitoring program.

CONCLUSIONS AND NEXT STEPS

The Boardman River watershed is a beautiful ecological, social, and economic asset for Michigan and its visitors. The watershed is home to many of the state's most important fish and wildlife species, supports a diverse array of service, agricultural, manufacturing, and resource extraction industries, and provides a wide array of opportunities for high-quality recreation and cultural activities.

The removal and modification of the Boardman River dams is one of the most significant dam removal projects in Michigan and the United States, and offers a rare and unique opportunity to restore aquatic habitat in the river and expand associated economic and recreational offerings. But capitalizing on the environmental and economic benefits of the existing and restored natural amenities in the watershed requires deliberate and long-term cooperation among and investment from residents, visitors, businesses, and decision makers to balance the sometimes competing needs of people and nature.

The Boardman River Watershed Prosperity Plan lays out a roadmap for monitoring, protecting, enhancing, and leveraging the region's natural, cultural, economic, and recreational assets in a manner that will maintain and improve the high quality of the Boardman River watershed's resources. The goals, objectives, and strategies identified in this plan will allow residents, visitors, businesses, and other stakeholders to engage in the management of the watershed's remarkable resources and make strategic investments that will help protect the resources and raise the level of prosperity for all watershed residents. The water quality and environmental recommendations outlined in Chapter 10 of the Prosperity Plan will provide guidelines to all types of organizations for taking action during the implementation phase of the project and will be a useful tool in addressing current and future water quality threats to the watershed.

Work will continue on the monumental dam removal process that will bring substantial ecological, economic, and recreational improvements and opportunities to the watershed. This work will include not only dam removal efforts, which are slated to be completed by 2018, but streambank stabilizations, invasive species management, and land protection that go along with it as well. Additionally, continued invasive species monitoring, erosion control, and instream habitat improvements will be necessary over the next 10 years.

TWC will continue work on their Kids Creek Restoration Project, targeting restoration and water quality improvement in the watershed's only impaired water body. This work is already well under way and will be a critical element of improving water quality in the Boardman River watershed. Planned tasks in the next several years include a variety of Low Impact Development installations throughout the Kids Creek subwatershed designed to improve the quality and reduce the quantity of stormwater runoff into the creek.

Additional future efforts for the Boardman River watershed include:

- Building partnerships and seeking funding for implementation activities.
- Conducting urban stormwater improvement BMPs in Traverse City.
- Restoring and improving severe transportation crossings and streambank erosion sites.
- Working with local communities to improve water quality-related zoning ordinances.
- Participation in regional and local planning efforts to ensure habitat connectivity and water quality issues are considered.
- Ongoing monitoring to assess environmental conditions.
- Implementing information and education initiatives.

Chapter 1. Introduction

BACKGROUND AND PURPOSE

In 2011, a diverse group of stakeholders came together to develop an innovative, collaborative plan for integrating environmental, economic, and social prosperity in the Boardman River watershed. The Boardman River Watershed Prosperity Plan (Prosperity Plan) is one of the first intentional planning initiatives in Michigan to bridge the gap that often exists between natural resource protection and economic prosperity. The project was founded on a philosophy of community collaboration and building strong partnerships for the development and implementation of the Prosperity Plan's strategies.

The Boardman River watershed has just begun to undergo substantial change with the removal of the Brown Bridge Dam and pending removal of the Boardman and Sabin dams and modification of Union Street Dam. Collectively, the dam removal projects will be the largest in Michigan (and one of the most significant in the United States), and will allow the Boardman River to return to a more natural state as a free-flowing, coldwater river. Dam removal on this scale is unprecedented in Michigan and presents an enormous opportunity to proactively plan for the related ecological, community, and economic needs of the broader watershed and its communities. Returning the Boardman River to its natural flow will have a significant impact on water quality, fish and wildlife, and recreation, and will also present many new opportunities and challenges for the watershed's economic well-being and quality of life.

WHAT IS PROSPERITY?

If this is a watershed prosperity plan, how does one define prosperity? The Merriam-Webster dictionary defines prosperity as (Merriam-Webster N.d):

> ***The condition of being successful or thriving;***
> ***especially: economic well-being***

Beyond the economic context of financial achievement or degree of affluence, some people define prosperity in terms of personal health or having a less stressful lifestyle and a sense of well-being. In the Boardman River watershed, prosperity is defined as all of the above and more.

The young Traverse City professional who understands that part of her pay is a view of the Grand Traverse Bay may feel a sense of prosperity because she lives in a city with exciting nightlife and access to a variety of year-round outdoor recreation venues. For the man who works for a local auto body shop and has a small house in South Boardman, prosperity is being able to fish and hunt in his backyard preserve after work. The waitress who serves coffee in a Kalkaska restaurant enjoys the prosperity of having a job close to her family, the ability to send her kids to the same school she graduated from, and opportunities to enjoy nearby outdoor adventures. And finally, prosperity is felt by the elderly couple who live in a quaint house in Kingsley and are always playing host to their children and grandchildren from downstate because they, too, want to spend time in this great region. Prosperity is experienced in many ways.

This watershed plan is unique in that it goes beyond traditional watershed planning and integrates all resources in the watershed – environmental, economic, and community – into a comprehensive plan for advancing prosperity, in all its forms, for the region.

Chapter 2. Description of Boardman River Watershed

2.1 HISTORY

The Boardman River was formed by glaciers that covered northern Michigan approximately 10,000 years ago. It was originally a tributary of the Manistee River and flowed southwest to Lake Michigan. Over time, streams cutting through glacial deposits changed the course of the river and allowed it to flow north and empty into Grand Traverse Bay.

Early European settlers called the river the "Ottawa" after the local band of Native Americans. In 1848, Captain Harry Boardman came to the area and established a sawmill for his expanding timber operations. The captain used a natural lake on the Ottawa River to store the logs for his sawmill, and this natural lake became known as "Boardman's Lake." Eventually locals began calling the entire river Boardman River. In 1852 Captain Boardman sold his timber rights to Perry Hanna and Tracy Lay, major timber barons at the time. As the timber and logging industry on the Boardman River grew, it played a vital role in the economic growth of the region. While this contributed to the growth of local cities and economies, it was devastating to the river's aquatic habitat, contributing to the extirpation of Michigan grayling, a once-plentiful fish in the river and native species in Michigan.

Photo courtesy of: Grand Traverse Conservation District

The logging era was followed by construction of several dams to provide power for the growing needs of Traverse City. Originally, these hydroelectric dams supplied much of the city's electrical power, but their usefulness declined over time. When they were decommissioned in 2005, these dams were providing less than 4 percent of the power used by Traverse City Light & Power (TCLP) customers each year.

Today, the Boardman River is a primary contributor to the quality of life for the surrounding cities and townships. It is a major recreational draw for both locals and visitors, with estimates of as many as two million user days logged on the Boardman River annually for recreation purposes. Many of these visitors come to paddle, fish, and hike. The river is one of the top ten trout streams in Michigan, and 36 river miles are designated as a Blue Ribbon trout stream.

2.2 PHYSICAL DESCRIPTION

Location and Size

The Boardman River is located in Grand Traverse and Kalkaska counties in northwest Michigan and includes 180 miles of river and tributary streams (Figure 1). It rises in the Mahan Swamp in north central Kalkaska County and flows in a southwesterly direction for 40 miles, then turns north for nine miles and empties into Grand Traverse Bay in Traverse City. The watershed covers 287 square miles and drains 182,800 acres of land. The Boardman is a subwatershed of Grand Traverse Bay. It makes up almost a third of the Grand Traverse Bay watershed land area and provides almost one-third of the tributary inputs of water to Grand Traverse Bay. It also contains the majority of the Grand Traverse Bay watershed population. As such, the Boardman River watershed plays a large role in the ecological health of Grand Traverse Bay.

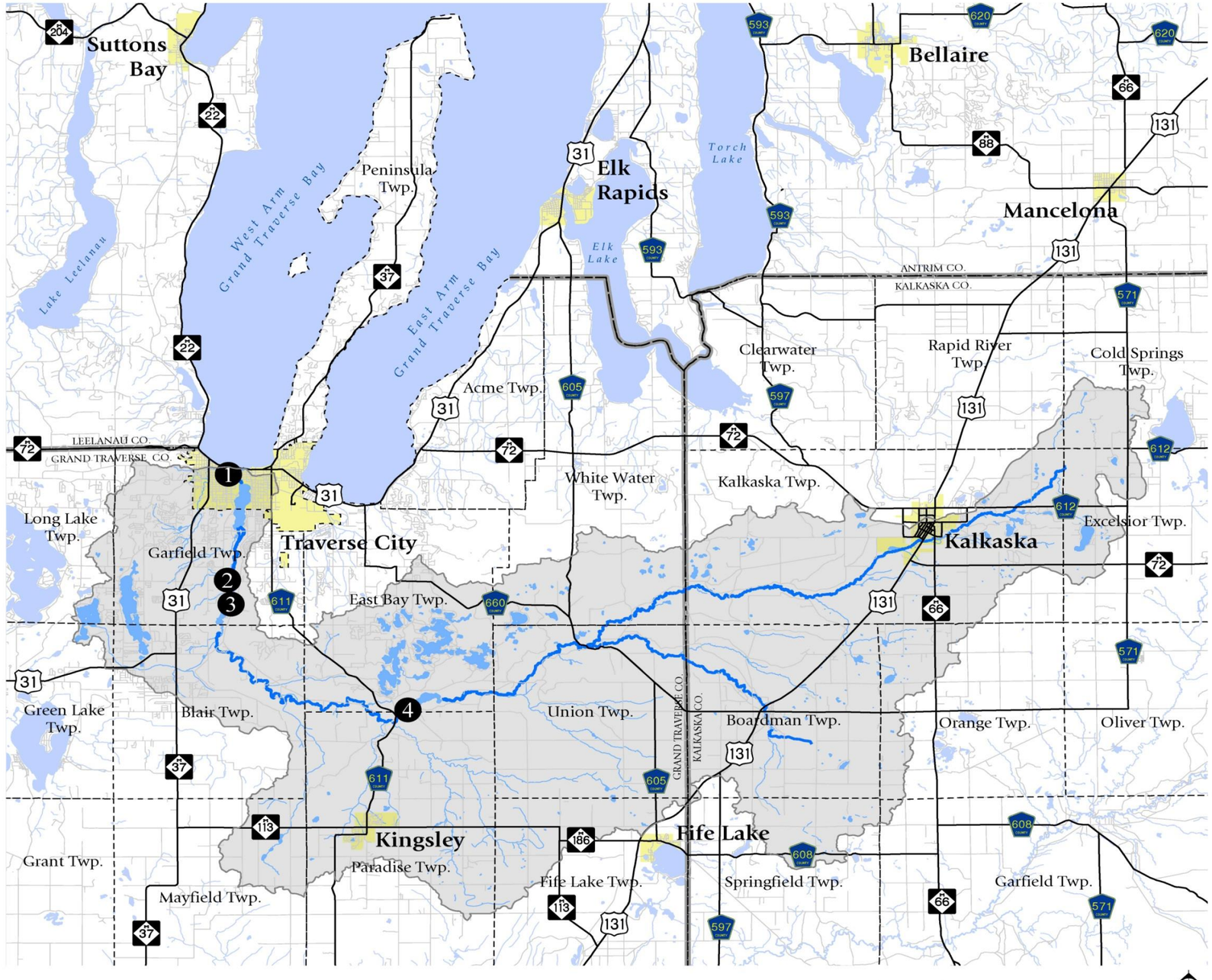
THE BOARDMAN RIVER WATERSHED

Regional Context

Data Sources: Michigan Geographic Data Library, Michigan DNR

- Boardman River Watershed
- City or Village
- County Boundary
- Township Boundary
- Major Road
- Major Road
- Boardman River

1. Union Street Dam/Boardman Lake
2. Sabin Dam/Sabin Pond
3. Boardman Dam/Boardman Pond
4. Former Brown Bridge Dam/ Brown Bridge Pond



SOURCE: Beckett & Raeder Inc., 2012

FIGURE 1. Boardman River Watershed

Tributaries and Lakes

The Boardman River begins in the Mahan Swamp in Kalkaska County as the North Branch. As it travels south and west and then north again, it gains water inputs from 19+ tributaries (Table 1, Figure 2). The Boardman River system contains approximately 180 linear miles of mainstem and tributary streams.

The watershed also has numerous lakes, some of which are hydrologically connected to the Boardman River. These lakes provide warmwater fishery habitat as well as swimming and boating opportunities. Some of the moderate-to-large lakes in the watershed (30 acres or greater in size) are listed in Table 2.

TABLE 1. Boardman River Tributaries

Stream	Linear Miles
Mainstem	26.0
North Branch	23.5
South Branch	10.0
Tributaries	
Albright Creek	2.5
Bancroft Creek	3.5
Beitner Creek	3.5
Carpenter Creek	6.0
Crofton Creek	3.5
East Creek	3.5
Failing Creek	3.0
Hauerstein Creek	1.5
Jackson Creek	5.0
Jaxon Creek	5.5
Kids Creek	3.5
Miller Creek	4.5
No Name Creek	2.0
Palmer Creek	1.5
Parker Creek	1.5
Swainston Creek	5.0
Taylor Creek	5.0
Twenty-Two Creek	3.5
Vipond Creek	2.5
Unnamed Tributaries	54.0
Total	**180.0**

SOURCE: MDNR, 2002

THE BOARDMAN RIVER WATERSHED

Boardman River Tributaries & Inland Lakes

Data Sources: Michigan Geographic Data Library, Michigan DNR, Grand Traverse Conservation District

- Boardman River Watershed
- City or Village
- County Boundary
- Township Boundary
- Major Road
- Major Road
- Boardman River

Tributaries:

1. Mainstream
2. North Branch
3. South Branch
4. Kids Creek
5. Miller Creek
6. No Name Creek
7. Beitner Creek
8. Jaxon Creek
9. Swainston Creek
10. East Creek
11. Jackson Creek
12. Bancroft Creek
13. Parker Creek
14. Carpenter Creek
15. Twenty Two Creek
16. Taylor Creek
17. Albright Creek
18. Crofton Creek
19. Failing Creek
20. Vipond Creek
21. Palmer Creek
22. Hauenstein Creek

Major Inland Lakes:

- A Bass Lake
- B Silver Lake
- C Boardman Lake
- D Boardman Pond
- E Arbutus Lake
- F Brown Bridge Pond
- G Spider Lake
- H Rennie Lake
- I Island Lake
- J Crawford Lake

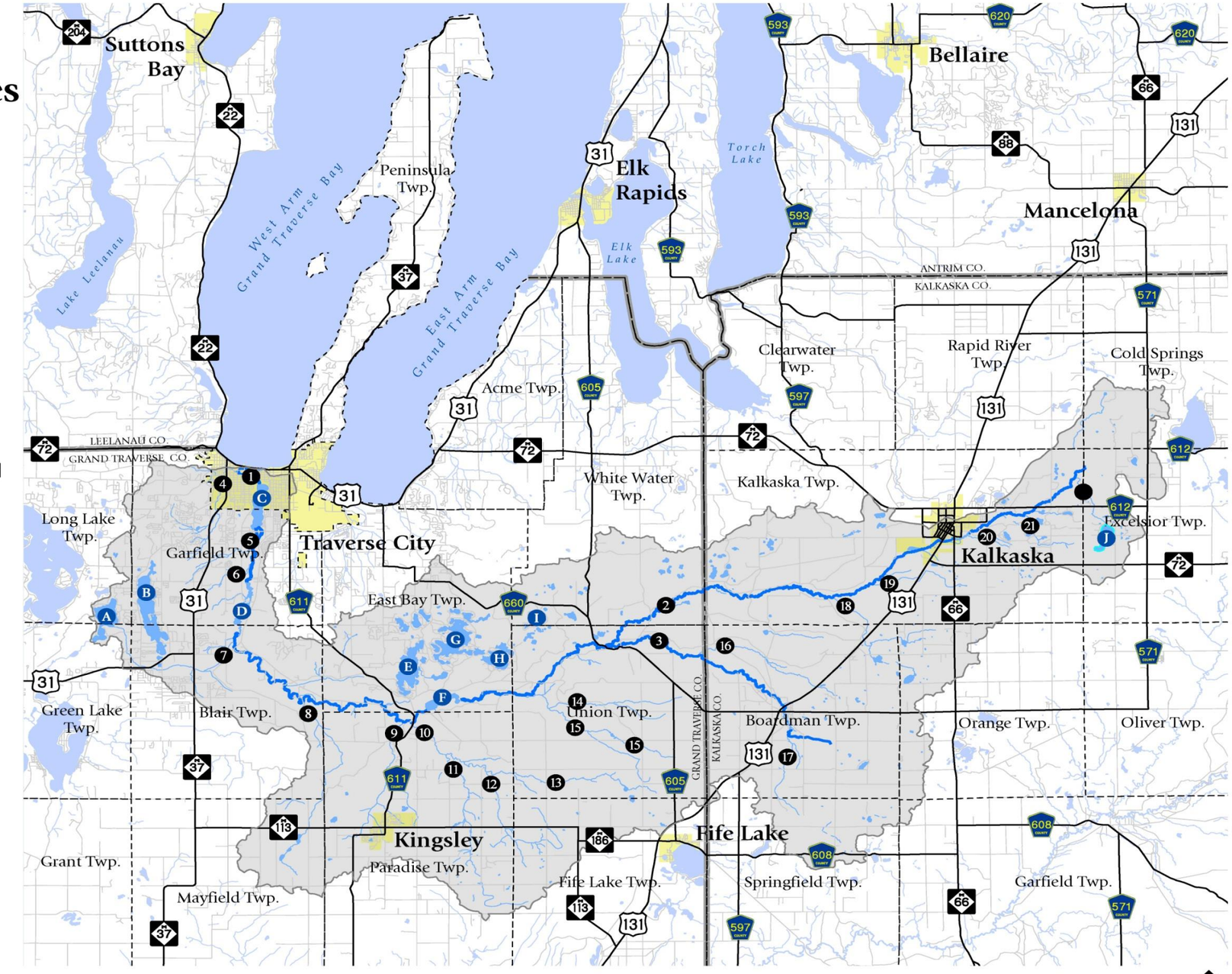


FIGURE 2. Boardman River Tributaries and Inland Lakes

SOURCE: Beckett & Raeder Inc., 2012

TABLE 2. Moderate-to-Large Lakes in the Boardman River Watershed

Lake	Acres	Township
Arbutus Lake	377	East Bay
Bass Lake	40	Orange
Chandler Lake	51	East Bay
Dollar Lake	30	Whitewater
Guernsey Lake	40	Kalkaska
High Lake	47	East Bay
Indian Lake	60	East Bay
Island Lake	138	Kalkaska, Whitewater, and Union
Long Lake	72	Springfield
Mud Lake	50	Boardman and Kalkaska
North Selkirk Lake	34	Kalkaska
Rennie Lake	238	East Bay and Union
South Selkirk Lake	43	Kalkaska
Spider Lake	444	East Bay
Spring Lake	41	East Bay
Tibbets Lake	34	East Bay

SOURCE: MDEQ. Michigan Surface Water Information Management (MiSWIM) System, N.d.

Boardman River Dams

Between 1867 and 1921, five dams (Union Street, Sabin, Keystone, Boardman, and Brown Bridge) were built on the river ranging from 9 to 56 feet in height (Figure 1). The Boardman River dams and their influence cover more than 20 miles of the river's mainstem.

Beginning at the river mouth in Traverse City, the dams are:

1. **Union Street Dam**. Owned by the City of Traverse City, the dam was built in 1867 to supply power to a flour mill. It now maintains the water level of 339-acre Boardman Lake and is a physical barrier to migration of the invasive sea lamprey into the river system. It has a fish ladder to accommodate migrating salmon and trout species. The dam has a height of 10 feet, a head of 9 feet, and is 200 feet long. Boardman Lake includes about 40 private parcels, two parks, and a boat ramp. Current plans are to modify this dam to allow better management of fish passage while continuing to serve as a barrier to sea lamprey and other aquatic invasive species.
2. **Sabin Dam**. Built in 1906 and owned by Grand Traverse County, Sabin Dam was used by Traverse City Light & Power (TCLP) to generate hydropower until being decommissioned in 2005. TCLP's determination about the economic viability of the Sabin, Boardman, and Brown Bridge dams was the trigger for the process to decommission them and begin the engineering and feasibility study and public process to determine the fate of the dams. The dam impounds 40 acres of water, has a height of 32 feet, a head of 20 feet, and is 921 feet long.
3. **Boardman Dam**. This dam was built in 1884, is owned by Grand Traverse County and was also used to generate power by TCLP. It has a height of 56 feet, a head of 41 feet, and is 900 feet long. Its impoundment covers 103 acres with 27 parcels that border or have access to the impoundment.
4. **Keystone Dam**. Built in 1909 by Queen City Electric, the Keystone Dam was washed out in 1961 (Anderson 2012).

5. **Brown Bridge Dam**. The dam was built in 1921 and was owned by the City of Traverse City. It was used for hydropower generation by TCLP prior to decommissioning. The dam, which used to impound 191 acres of water, was removed by the city in the fall of 2012.

In total, these dams impound(ed) approximately 434 acres of bottomlands and impact almost 20 miles of river from the uppermost dam (Brown Bridge), to the mouth of the river. TCLP ceased power generation at Brown Bridge, Boardman, and Sabin dams due to lack of economic viability, and the city and the county (as owners of the dams) undertook a multiyear feasibility analysis and community engagement process to evaluate the environmental, economic, and social benefits and detriments of retaining, modifying, and/or removing the Boardman River dams.

Between 2006 and 2008, the Boardman River Dams Committee (BRDC) contracted with Environmental Consulting & Technology (ECT) to conduct a Boardman River Feasibility Study (ECT 2009) to examine and evaluate a range of alternatives for the Union Street, Sabin, Boardman, and Brown Bridge dams. ECT and its subcontractors conducted a series of engineering and environmental feasibility analyses, and evaluated the socioeconomic and cultural implications of various alternatives, including repairing/retaining, modifying, or removing the existing dams. In addition, the BRDC conducted substantial public outreach and engagement as part of the feasibility analysis process. This input was a significant source of information for the development of the Prosperity Plan, and helped shape the identification of uses, potential challenges, and opportunities in the Boardman River watershed (ECT 2009).

The feasibility studies comprehensively characterized baseline conditions and potential impacts on the Boardman River and its riparian corridor, including the potential effects on wetlands, terrestrial habitat, wildlife, fisheries, recreation, socioeconomics of the Boardman River region, and safety. The studies also examined engineering feasibility.

After substantial technical analysis and community input, the city and county decided to remove the Sabin, Boardman, and Brown Bridge dams and modify the Union Street Dam. As stated above, Brown Bridge Dam was removed in 2012. Boardman and Sabin dams are slated for removal in 2017 and 2018, respectively.

Collectively, the dam removal projects will be the largest in Michigan (and one of the most significant in the United States), and will allow the Boardman River to return to a more natural state as a free-flowing, coldwater river. The project will restore more than 3.4 miles, reconnect 160 miles of high-quality river habitat, and restore more than 250 acres of wetlands and nearly 60 acres of upland habitat. The dam removal process on the Boardman River is unique because of its unprecedented level of community input – granting equal consideration for the first time ever to ecological, economic, social, and cultural factors and providing a well-documented case study of how citizen empowerment, education, and capacity-building can cultivate and sustain a grassroots stewardship ethic around the restoration of a coldwater river.

Physical Characteristics of the River

The Boardman River has a fairly stable stream flow, largely because it is sustained by groundwater discharging to the river from permeable glacial soils. U.S. Geological Survey (USGS) records over a 16-year period (1998 to 2001) show an annual average discharge between 90.4 and 131.7 cubic feet per second (cfs) just above Brown Bridge near Ranch Rudolf. In 2014, the average annual rate was significantly higher, at 153.4 cfs. Average monthly spring flow between 1998 and 2013 was 172 cfs, decreasing to minimum summer flows between 92 to 125 cfs (USGS Nd). Spring runoff normally raises the stage heights, or the maximum safe water level that will not overflow the river banks or cause any significant damage, from two to four feet in the upper and lower reaches, respectively (MDNR 2002).

The physical character of the river and quality of the in-stream habitat is quite different upstream of the four Boardman River dams compared to below the dams. Upstream of the former Brown Bridge impoundment the river has been a high-quality, healthy, coldwater fishery. Summer temperatures before removal of Brown Bridge Dam ranged from minimums of 49.2°Fahrenheit in June to 50.6°F in August to maximums of 70.5°F in June to 65.9°F in August (TWC February 2013). Habitat quality in this stretch is high quality with adequate woody debris, abundant gravel, and stable banks. The average width of the river in this stretch of the river to the confluence of the North and South branches is between 25 and 60 feet, and mean annual water discharge is 112 cubic feet per second (ECT 2009, A Report on the Boardman River Fisheries Habitat; USGS 2012). Habitat features such as riffles, bars, and pools are present throughout this section of the river.

Photo courtesy of: Grand Traverse Conservation District

Below the former Brown Bridge impoundment, the river had significantly less woody debris, warmer temperatures (reaching maximum temperatures of 71.8°F and 74.2°F at a Brown Bridge Road monitoring station in 2012), a mix of mostly sand with some cobble and gravel substrate, and slower velocity. Downstream of the Union Street Dam the river is mostly sandy substrate, with velocities of 0.16 to 0.33 feet per second (ECT 2009, A Report on the Boardman River Fisheries Habitat; TWC February 2013). Annual mean water temperature measured at Traverse City is 41°F (USGS 2012). Above the Boardman Dam, the river gradient increases significantly and velocity and turbulence increase, with some rapids just upstream of Boardman Pond (InterFluve and AMEC 2012).

Watershed Topography

The Boardman River watershed is largely defined by glaciated topography and sandy soils. The river originates in a large swamp area at an elevation of 1,090 feet above sea level and drops to an elevation of 580 feet at the west arm of Grand Traverse Bay on Lake Michigan. The topography of the river valley is mostly flat sandy plains, with small shallow depressions throughout (Figure 3).

Geology

The watershed encompasses a wide variety of landforms due to three glacial ice advances and retreats during the Wisconsinan glaciation of the Pleistocene Epoch. The river valley is composed of flat, sandy outwash plains. North and south of the river, the basin is bound by the Port Huron Moraine, and includes lakeplain in the northwest portion of the watershed in the Traverse City areas (ECT 2009).

Soils

Soils in the Boardman River watershed are made up of glacial outwash deposits that are highly permeable and have low nutrient availability. There are also areas of peat and muck soils at the river's headwaters north of Kalkaska, and morainal deposits that have evolved into sandy loam soils with sand and reddish clay substrata (ECT 2009). Figure 4 illustrates the distribution of dominant soil types throughout the watershed.

THE BOARDMAN RIVER WATERSHED

Local Topography

Data Sources: Michigan Geographic Data Library, Michigan DNR

- Boardman River Watershed
- County Boundary
- Township Boundary
- Major Road
- Boardman River

Elevation (ft)

450 725 1000 1275 1550

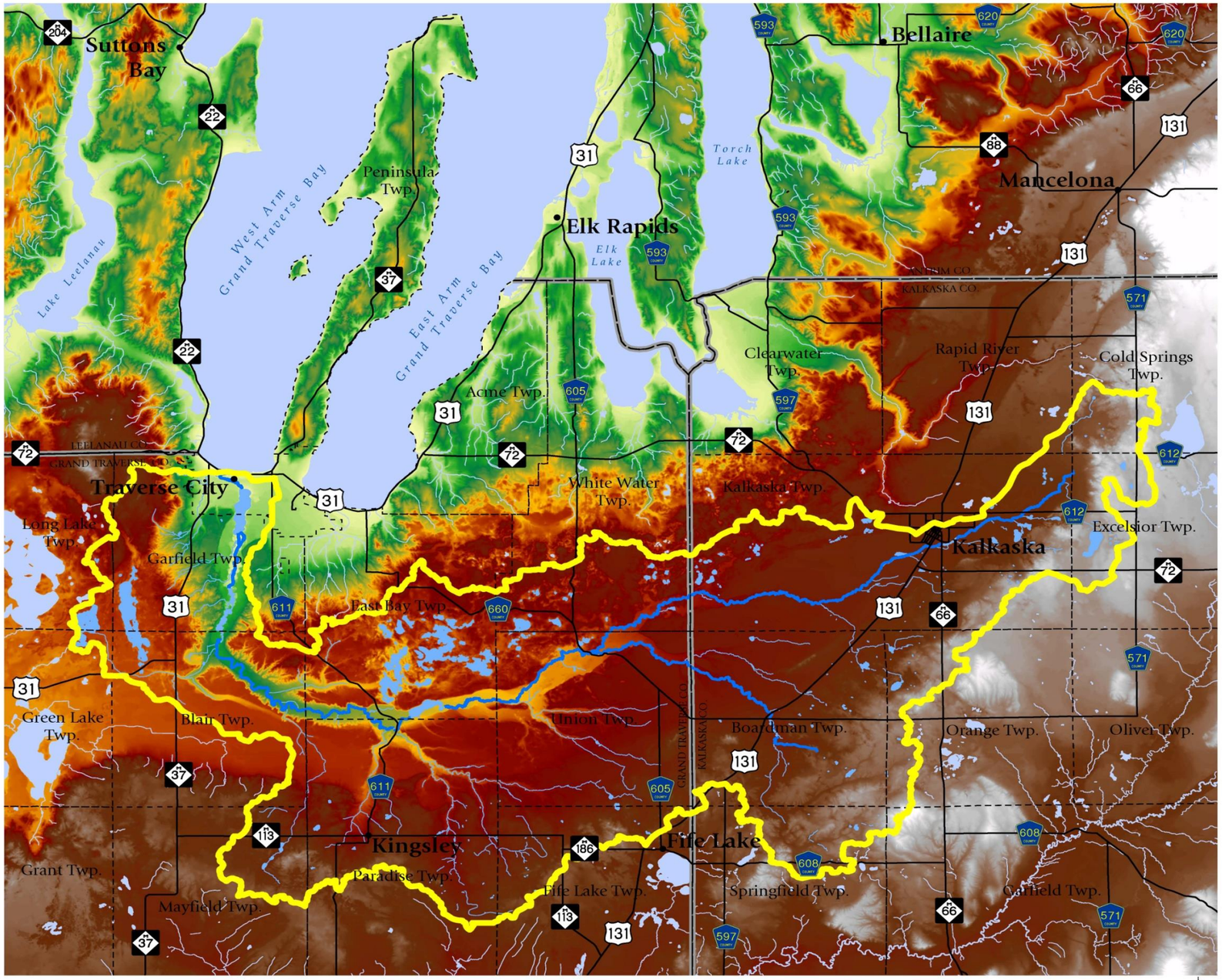


FIGURE 3. Boardman River Watershed Topography

SOURCE: Beckett & Raeder Inc., 2012, using data from the Northwest Michigan Council of Governments

THE BOARDMAN RIVER WATERSHED

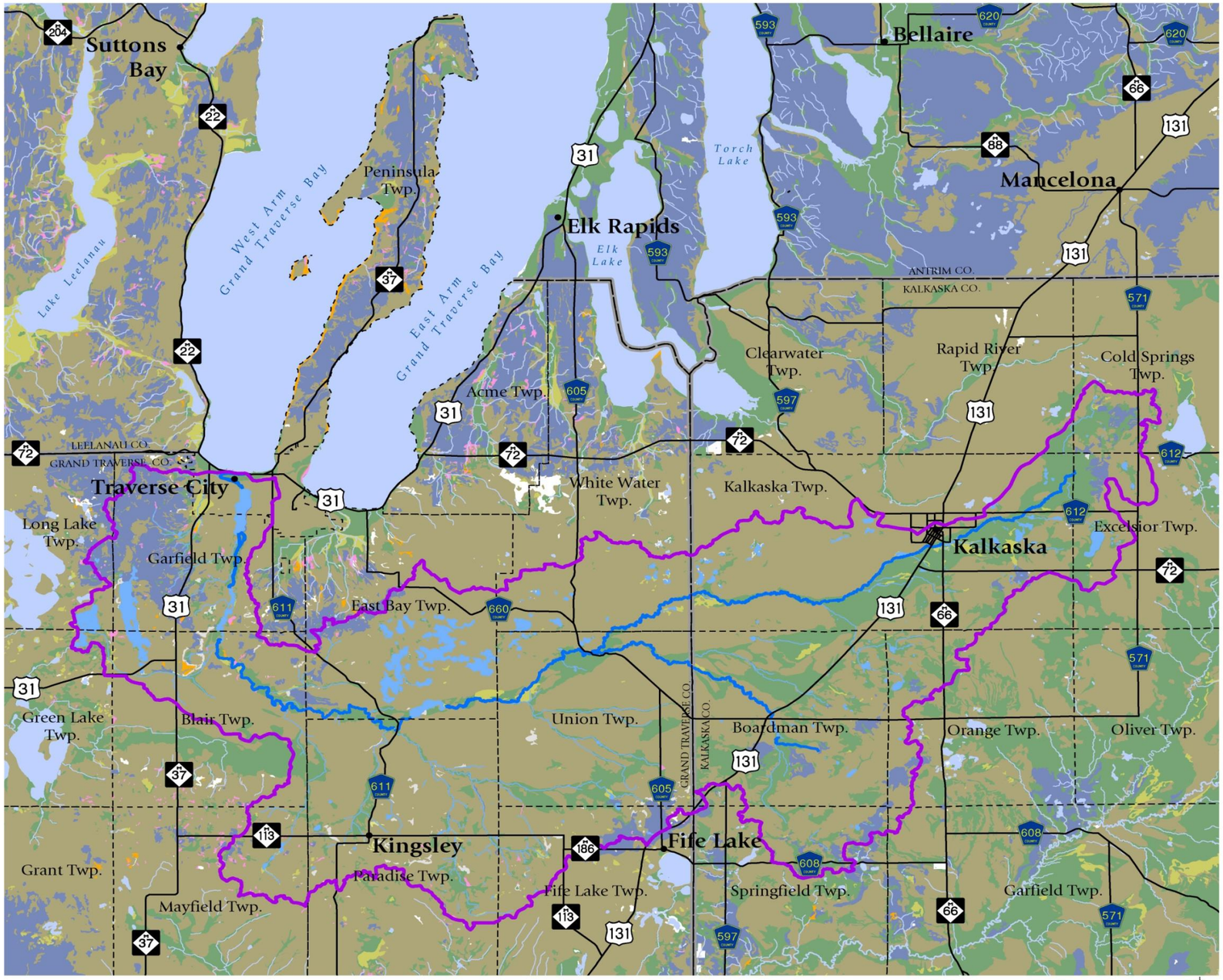
Distribution of Dominant Soil Orders

Data Sources: Michigan Geographic Data Library, Michigan DNR, Natural Resources Conservation Service

- Boardman River Watershed
- County Boundary
- Township Boundary
- Major Road
- Boardman River

Soil Taxonomy Order:

- No Data
- Alfisols
- Entisols
- Histosols
- Inceptisols
- Mollisols
- Spodosols



SOURCE: Beckett & Raeder Inc., 2012, using data from the Natural Resources Conservation Service

FIGURE 4. Distribution of Soil Orders in the Boardman River Watershed

Land Use/Land Cover

By far the largest land cover in the watershed is forest (most of which is located in the Pere Marquette State Forest), although where soils are more productive and slopes are more gentle (for example, in the southern and western portions of the watershed) there has been a fair amount of agricultural use of the land (Table 3, Figure 5). Urban areas are centered in Traverse City, Kalkaska, and Kingsley. Over the years, nonproductive farms have converted to tree farms, and there has been a significant amount of oil and gas exploration and production throughout the northern part of the watershed (MDNR 2002).

Agricultural land use makes up just under 12 percent of the Boardman River watershed. Agricultural activities consist mainly of row crops, including potatoes, hay, corn, and small grains, but also include a very limited amount of pasture and orchards/vineyard activity (TWC 2005).

TABLE 3. Boardman River Watershed Land Use/Land Cover

Land Use/Land Cover Type	% of the Watershed
Upland forest	80.3
Agriculture	11.5
Urban	4.8
Open water	2.2
Wetlands	1.2

SOURCE: Beckett & Raeder Inc., 2012, using data from the Northwest Michigan Council of Governments.

Climate

The Boardman River watershed has a climate that is significantly impacted by its proximity to Lake Michigan and Grand Traverse Bay. Its coastal location results in warm, relatively mild summers and often significant lake-effect snowfall during the winter months. Average annual rainfall in Traverse City between 1981 and 2010 was just over 32 inches, and annual snowfall averaged almost 100 inches. In Kalkaska, at the east end of the watershed, annual precipitation averaged 32 inches and annual snowfall over 135 inches a year between 1981 and 2010 (NOAA, N.d.).

THE BOARDMAN RIVER WATERSHED

Land Cover

Data Sources: Michigan Geographic Data Library, Michigan DNR, NWMCOG

- Boardman River Watershed
- City or Village
- County Boundary
- Township Boundary
- Major Road
- Boardman River

Land Cover Type:

- Urban
- Agriculture
- Forest
- Wetlands
- No Data

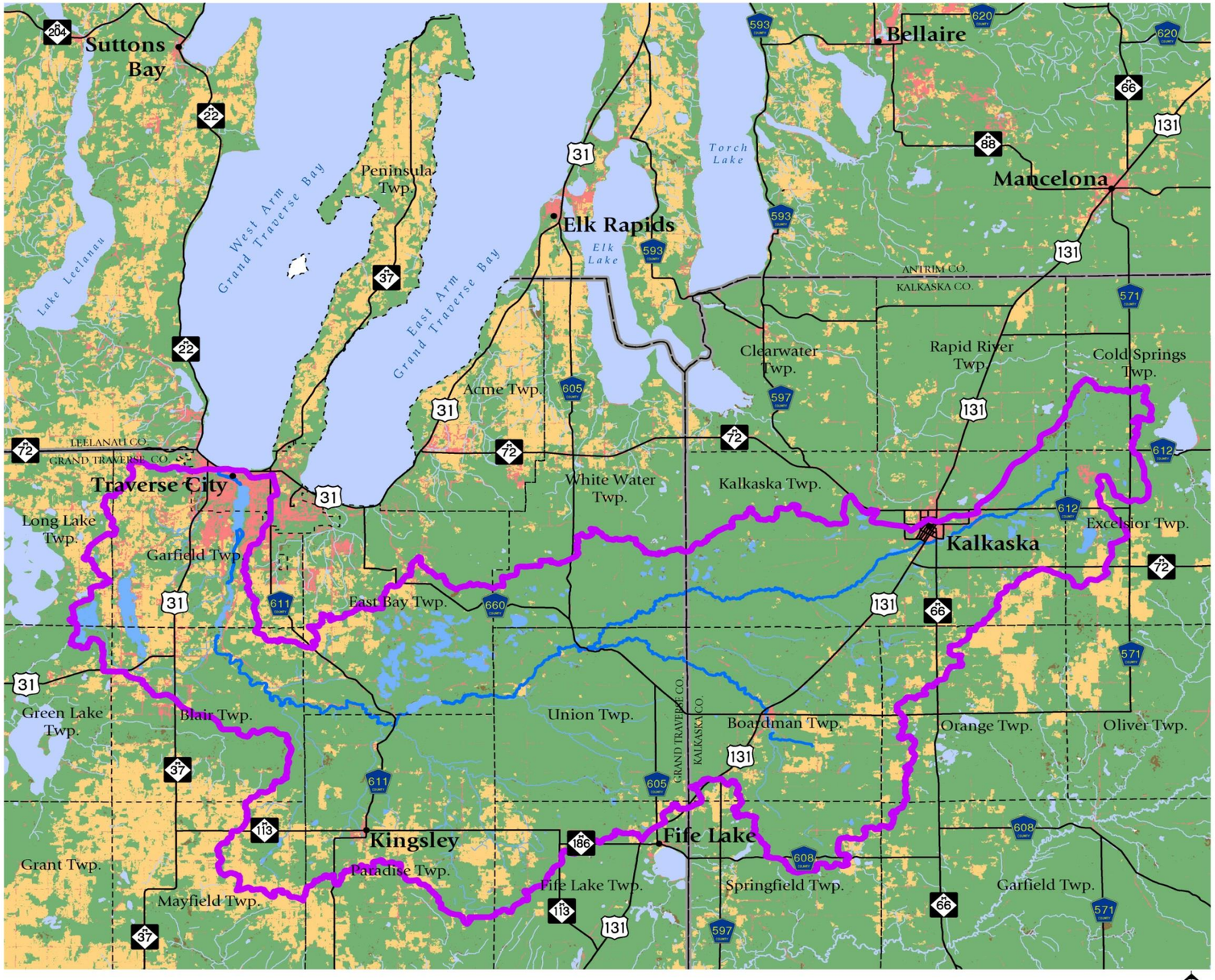


FIGURE 5. Boardman River Watershed Land Cover Map

SOURCE: Beckett & Raeder Inc., 2012, using data from the Northwest Michigan Council of Governments

2.3 ECOLOGICAL/ENVIRONMENTAL CONDITIONS

Terrestrial Habitat

As part of the recently completed feasibility study for the Boardman Dams project, Environmental Consulting & Technology (ECT) completed a comprehensive data review and characterization of terrestrial habitat and land cover in the Boardman River watershed. According to this analysis, the watershed falls within three landscape ecosystem districts.[3]

More than two-thirds of the watershed is within the Highplains District, Grayling Subdistrict, which is characterized by:

- "Pre-settlement communities of jack pine (*Pinus banksiana*) and red pine (*P. resinosa*) with some white oak (*Quercus alba*) and northern pin oak (*Q. ellipsoidalis*) on the dry outwash deposits. Most of these communities are dominated by jack pine and northern pin oak today.
- Pre-settlement communities of eastern white pine (*P. strobus*) and eastern hemlock (*Tsuga canadensis*) on wet/poorly drained outwash sands. Today these forests are generally dominated by trembling aspen (*Populus tremuloides*), red maple (*Acer rubrum*), and eastern white pine.
- Willow (*Salix spp.*), tag alder (*Alnus rugosa*), northern white cedar (*Thuja occidentalis*), and mixed conifer swamps and emergent marshes in the wettest outwash deposits. Directly adjacent to the river, these communities also contain ninebark (*Physocarpus opulifolius*), northern red oak (*Q. rubra*), highbush cranberry (*Viburnum trilobum*), dogwood (*Cornus spp.*), northern white cedar, balsam fir (*Abies balsamea*), eastern hemlock, tamarack (*Larix laricina*), trembling aspen, and white birch (*Betula papyrifera*).
- Northern hardwood forest communities dominated by American beech (*Fagus grandifolia*), sugar maple (*A. saccharum*), eastern hemlock, American basswood (*Tilia americana*), northern red oak, and eastern white pine on well-drained sandy loam end moraine deposits. Northern pin oak and jack pine communities on excessively well-drained sand end moraine deposits." (ECT 2009)

The westernmost portion of the watershed falls under the Newaygo District and is characterized by the following species:

- "Pre-settlement communities of eastern white pine on excessively well drained outwash soils. Following extensive logging, these forests are dominated by white and black oak (Q. velutina) and locally by jack pine on the driest soils.
- Black and white oak and bigtooth aspen (Populus grandidentata) communities on excessively well-drained, sandy end moraine deposits.
- Along stream edges with wetter soils, northern white cedar, eastern white pine, balsam fir, and trembling aspen predominate." (ECT 2009)

[3] The information in this section is taken from the *Boardman River Feasibility Study* (Ann Arbor, Mich.: Environmental Consulting & Technology, Inc., 2009). In addition, see D.A. Albert, S.R. Denton, and B.V. Barnes, *Regional Landscape Ecosystems of Michigan* (Ann Arbor, Mich.: University of Michigan, School of Natural Resources, 1986), which characterized specific "districts" of ecosystems in the state.

Finally, the northwest portion of the watershed is included in the Williamsburg and Traverse City subdistricts of the Leelanau District. This area is characterized by the following:

- "The Williamsburg Subdistrict is mostly steeply sloping end moraine with well-drained soils supporting northern hardwood forests dominated by sugar maple, American beech, eastern hemlock, and American basswood.
- The Traverse City Subdistrict is an interesting mix of moderately sloping, coarse-textured drumlins [elongated hills] over ground moraine and flatter lacustrine deposits. Soils are mostly well-drained and gravelly sand to gravelly sandy loam in texture. Presettlement communities included eastern white pine, eastern hemlock forest, eastern white pine-red pin forest, beech-sugar maple-hemlock forest, mixed conifer swamp, and cedar swamp. Most of the area has been altered by urban development or clearing for cherry and apple orchards, vineyards, and row crops. However, some depressions between the drumlins still support swamps and small lakes, and some northern hardwood forest remnants still occupy the steep slopes of the drumlins." (ECT 2009)

Wetlands

Numerous studies have documented pre-settlement and current wetland vegetation in the Boardman River watershed, and both state and local governments within the watershed have completed significant inventory and mapping work. Figure 6 shows the distribution and major classification type of wetlands in the watershed.

As part of its recent feasibility study for the Boardman River, ECT reviewed local and state wetlands inventories to characterize wetlands in the watershed. According to its analysis of vegetation data compiled by the Michigan Department of Natural Resources, the Michigan Natural Features Inventory, and Michigan State University Extension (circa 1800), ECT determined that six major types of pre-settlement wetlands occurred within the Boardman River watershed at that time:

- Black ash swamps
- Cedar swamps
- Mixed conifer swamps
- Mixed hardwood swamps
- Muskeg/bogs
- Shrub swamps/emergent marshes

ECT's analysis of composite wetlands maps, generated from 1978 aerial photo interpretation in the National Wetlands Inventory (NWI), Michigan Resource Information System (MIRIS) Land Use/Cover, and U.S. Department of Agriculture Soil Survey Hydric Soils data sets, show that many of the watershed's pre-settlement wetlands remain today. The watershed currently includes a diversity of wetlands types associated with lakes, the river and its tributaries, and depressions across the landscape, according to the NWI and MIRIS data sets (NWI. N.d.). As illustrated in Figure 6, current wetlands are dominated by wooded, scrub shrub, lowland, emergent, and floating/submerged aquatic bed vegetation. They exhibit a variety of hydrological regimes from briefly inundated to permanently flooded (ECT 2009).

THE BOARDMAN RIVER WATERSHED

National Wetlands Inventory

Data Sources: Michigan Geographic Data Library, Michigan DNR, National Wetlands Inventory 2010

- Boardman River Watershed
- City or Village
- County Boundary
- Township Boundary
- Major Road
- Minor Road
- Boardman River

Wetland Type:

- Forrested/Shrub
- Emergent

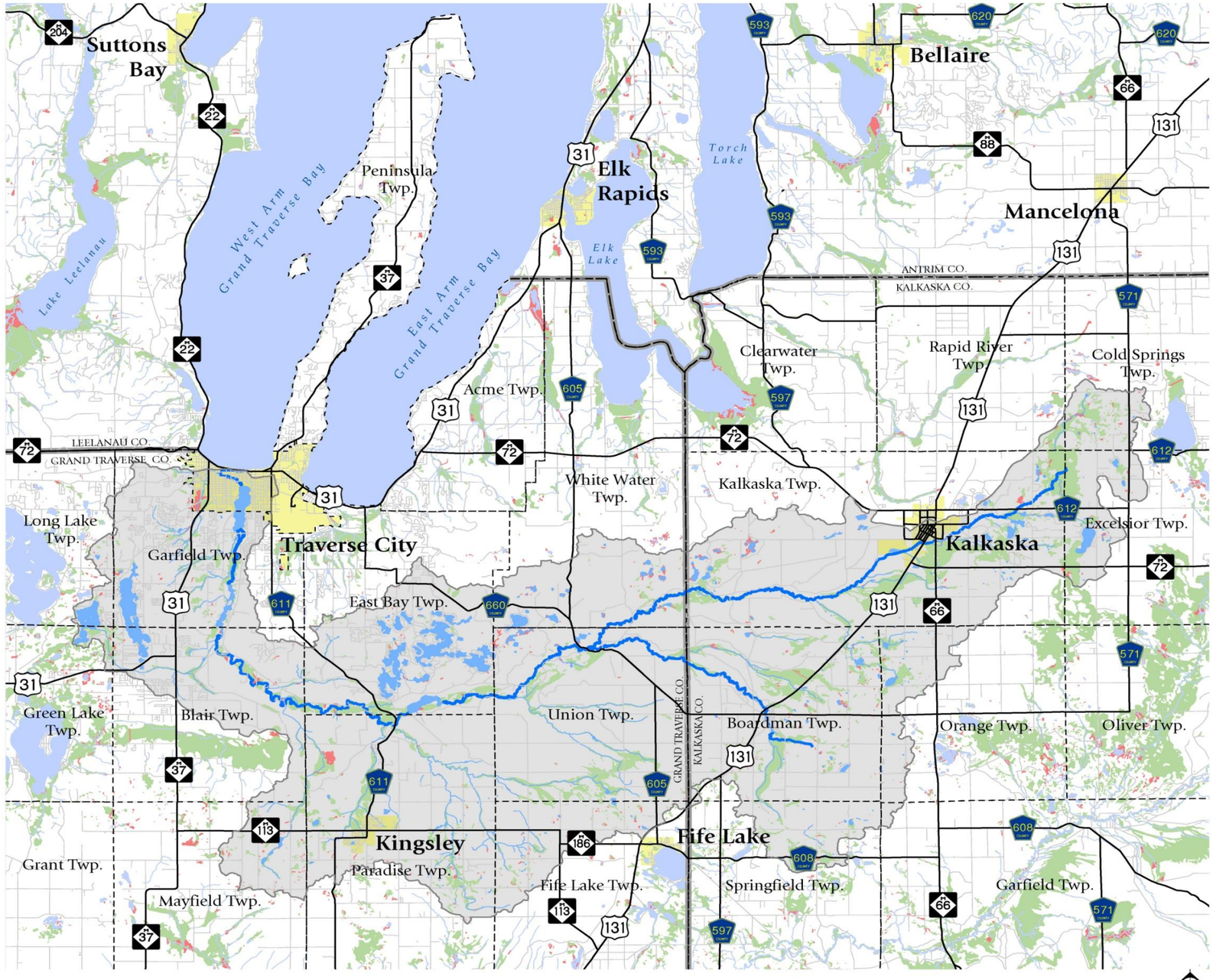


FIGURE 6. National Wetlands Inventory Classification for the Boardman River Watershed

SOURCE: Beckett & Raeder Inc., 2012, using data from the National Wetlands Inventory (NWI N.d.)

Fisheries

The Boardman River is considered among the top ten trout streams in Michigan. It is also a Michigan designated Natural River, one of only 16 rivers/river segments designated as such in the State (Figure 7; more information in Chapter 3). This designation affords it specific protections for preservation in a natural condition, including setbacks for structures and septic systems, minimum lot sizes, and prohibition on filling or building within the 100-year floodplain or wetlands. An in-depth discussion of the Natural River Designation and its protections to the river is found in Chapter 3.4 Natural Rivers Designation and Impact on Zoning.

Approximately half of the streams in the river system flow through lands in public ownership. The Boardman River, like most Michigan coldwater streams in the northern Lower Peninsula of Michigan, was historically a grayling river until the late 1800s. Brook Trout, most likely raised from fish taken in Michigan's Upper Peninsula, were first planted in the Boardman River in 1888. Rainbow Trout (imported from California) were first planted in the late 1890s. Brown Trout were not introduced to the Boardman River until the early part of the 20th century (Michigan State Board of Fish Commissioners 1915). The river now has self-sustaining populations of Brown, Brook, and resident Rainbow Trout. Migratory Rainbow Trout (steelhead), Chinook Salmon, and Coho Salmon are stocked in the Boardman River near its mouth below the Union Street Dam primarily to support the Great Lakes sport fishery. Nearly all of the Boardman's numerous tributaries are top-quality, coldwater trout waters and important nursery streams, with the more sizeable ones supporting considerable trout fishing of their own. Inland lakes are mostly warm water, with Boardman Lake and the remaining dam impoundments considered 'cool-water' systems, supporting both cold and warm water fish seasonally.

The dam removal and subsequent river restoration (discussed previously in Chapter 2.2) will provide an opportunity to transfer lake sturgeon to historical upstream spawning areas in the Boardman River. Sea lamprey upstream migrations into the Boardman River have been limited in the past to the barrier posed by the Union Street Dam near the mouth. However, sampling has confirmed that sea lamprey have been able to ascend the river above the Union Street Dam and modifications to the dam will be needed to block sea lamprey before the next dam upstream (Sabin Dam) is removed. Twelve lakes ranging in size from a few acres to 60 acres drain into the Boardman River (Figure 2). Although the warmer waters from these lake outlets influence water temperatures for a short distance downstream, spring seepage soon cools the water sufficiently to support a variety of coldwater fish species.

Photo courtesy of:
Grand Traverse Conservation District

The mainstem west of "The Forks" (where the North and South branches of the Boardman converge) flows downstream through the former Brown Bridge Dam impoundment then through the Boardman and Sabin dams. Historically, the river has had increased water temperatures both in the impounded areas behind the dams and some distance downstream due to the large, relatively shallow backwater ponds created by these three dams. These impoundments are classified as top-quality warm-water lakes (MDNR 2002).

Above the former Brown Bridge Dam, the Boardman River is a top-quality, moderate-sized trout stream flowing through the Pere Marquette State Forest. It contains excellent populations of small to moderate-sized Brook and Brown Trout. Brown Trout in the 10 to 13 inch size range are abundant. Considerable public ownership and scenic terrain make the stream a pleasant one to fish. The bottom is firm sand and gravel and the stream is relatively swift.

Before the former Brown Bridge Dam was removed, the stream widened below the dam but still had a rapid flow over a gravel and sand bottom. Brown trout dominated the fish population. Their numbers are somewhat less than their food supply will support, as natural reproduction was impaired by Brown Bridge Dam, but populations of both brook and brown trout are anticipated to increase now that the dam has been removed. With the dam removals under way, the river between the former Brown Bridge Dam and its mouth will be one of Michigan's finest trout streams. Its size, physical characteristics, and water quality compare favorably with the Little Manistee River.

As it moves downstream, the river flows into Boardman Lake, a 259-acre natural lake within the Boardman River whose lake level is artificially elevated by Union Street Dam to a current surface of 340 acres. The lake supports typical warm-water game fish populations (ECT 2009). The river below Boardman Lake suffers from municipal development in Traverse City, but still receives substantial runs of steelhead, Lake Trout, and salmon seasonally upstream to the Union Street Dam. The Boardman Dam restoration effort will remove the upper three dams – Sabin Dam, Boardman Dam, and Brown Bridge Dam (removed already) – and modify the lowermost dam near Union Street. Modification of Union Street Dam, 1.5 miles from the mouth of the river, will allow better management of fish passage and aquatic invasive species control. When complete, the project will biologically and, to a large extent physically, reconnect the entire Boardman River watershed with the Great Lakes.

As a 2006 report by the U.S. Army Corps of Engineers points out, all four dams are damaging the ecosystem of the area through habitat fragmentation, habitat degradation, thermal disruptions, and induced species disruptions from competition between coolwater or warmwater species with existing coldwater trout and sculpin species (USACE 2006). The effect of these impacts is a reduction in trout populations immediately upstream and downstream of the Boardman dams. In total, the dams impound about 434 acres and impact almost 20 miles of river. Removing the dams will restore about 250 acres of wetlands that provide fish spawning habitat, filter out contaminants, and store potential floodwaters. In addition, a journal article specifically related the degrading effects of the Brown Bridge Dam to low abundance and diversity of specific fish species downstream of the dam (Lessard and Hayes 2003).

According to the feasibility study for the dam removal project, some of the most productive aquatic habitat within the entire Boardman River watershed is buried beneath impoundments created by the dams. As these river miles return to a free-flowing state, restored coldwater habitat and natural river morphological patterns will quickly emerge. As evidenced by the removal of Brown Bridge Dam in 2012, riffles, runs, and pools quickly developed featuring a healthy and diverse bottom-substrate of sediment, cobble, and gravel that will benefit numerous species including Brook, Brown, and Rainbow Trout, Walleye, and Northern Pike. What is often missing in these newly reclaimed rivers, and must be planned for post-dam removal, is the need to add a diverse mixture of wood, including logs and branches. Habitat diversity is critical to a healthy coldwater river system.

The completed project could also make it possible to restore migratory runs of native Lake Trout and Lake Sturgeon, as well as muskies, but the decision on whether to allow passage of these species has not yet been made. Many native wildlife species that rely on the riparian corridor and associated habitat will also benefit. A full listing of aquatic and terrestrial species, along with supporting technical data, analysis of alternatives, hydraulic analysis, and basic survey, structural, and design information, can be referenced in the feasibility study prepared by ECT (2009).

THE BOARDMAN RIVER WATERSHED

Natural River Designation Plan

Data Sources: Michigan Geographic Data Library, Michigan DNR

- Country Scenic
- Wild Scenic
- Boardman River Watershed
- City or Village
- County Boundary
- Township Boundary
- Major Road
- Minor Road
- Boardman River

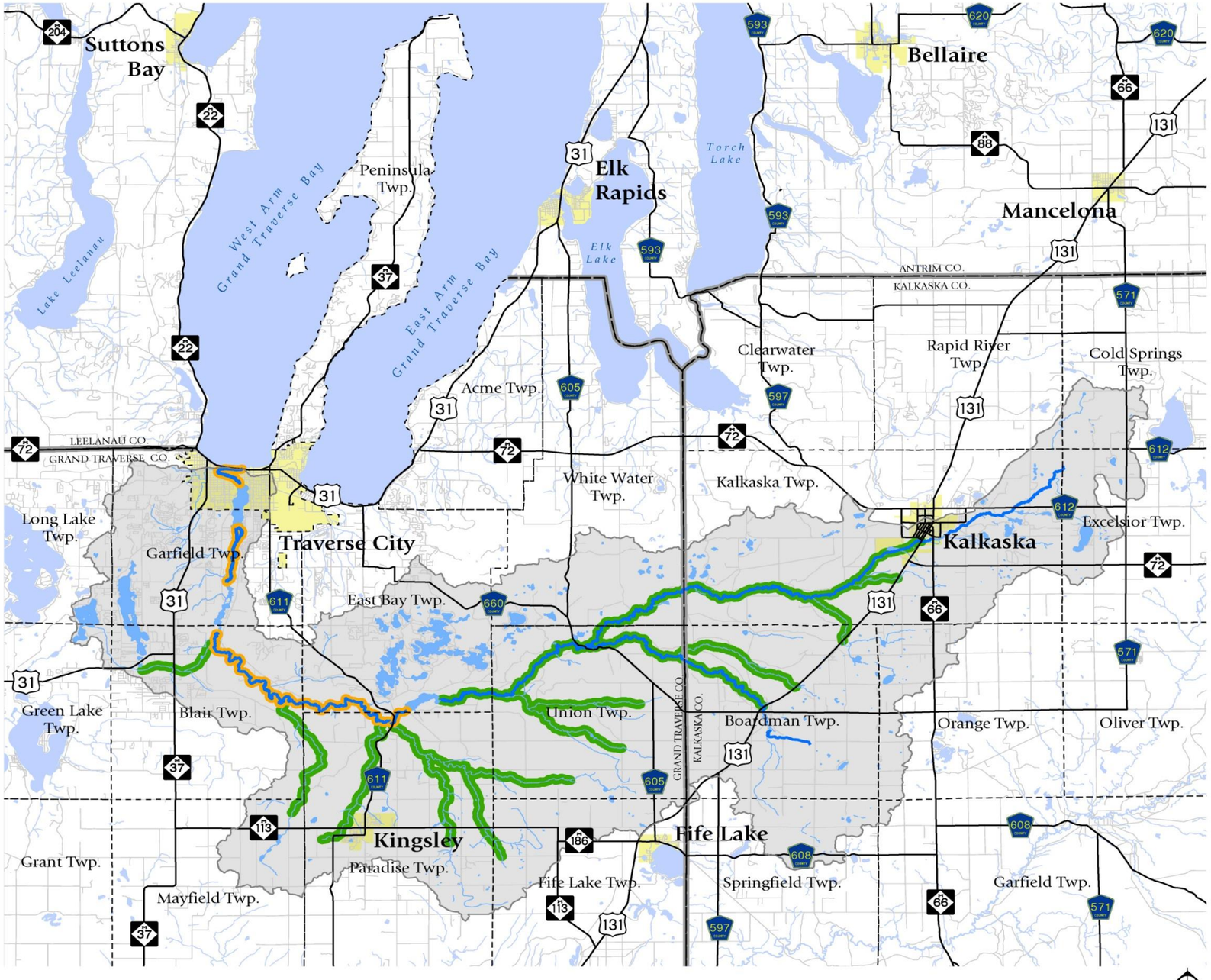


FIGURE 7. Boardman River Natural River Segments

SOURCE: Beckett & Raeder Inc., 2012, using data from the Michigan Department of Natural Resources

Air Quality

The MDEQ monitors air quality throughout the state. The entire state of Michigan, including Grand Traverse and Kalkaska counties, is in compliance with the National Ambient Air Quality Standards for carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), and particulate matter less than 10 microns (PM10). Several counties in Michigan are currently in nonattainment status for annual and 24-hour PM2.5 (very small particles, generally from combustion activities, such as motor vehicles, power plants, and wood burning), although the state has requested that the U.S. Environmental Protection Agency re-designate these areas as having attained the standard. Both Grand Traverse and Kalkaska counties are in compliance for all air quality standards (MDEQ 2011).

In addition, the MDEQ in collaboration with local partners uses air quality monitoring data to issue voluntary "Action! Days" when unhealthy pollution levels for ozone and PM2.5 are projected to occur. These are the two criteria pollutants that sometimes have concentrations higher than what is considered healthy, particularly for sensitive groups. Action! Days are alerts when air quality is expected to reach the status of "Unhealthy for Sensitive Groups" or above on the Air Quality Index (AQI). The Traverse City Region has had no Action! Days in 2012, and only one day in 2011. Kalkaska County is included in the Houghton Lake Michigan Air Sampling Network monitoring area. In 2011, the AQI for Houghton Lake indicated that the area had 345 "good days," 15 "moderate days," and one "unhealthy/sensitive" day for ozone and fine particulates (MDEQ 2011).

2.4 WATER QUALITY

Water quality monitoring in the Boardman River watershed (including surface water chemistry, benthic, and sediment analyses) has indicated generally high water quality, but water quality standards or threshold values for contaminants have occasionally been exceeded. There have been numerous monitoring efforts, including regular and/or periodic assessments by the MDEQ and more targeted, specific studies by various organizations.

Boardman Lake Watershed Study

In 2003, The Watershed Center Grand Traverse Bay (TWC) worked with the Great Lakes Environmental Center (GLEC) to develop a comprehensive watershed management plan for Boardman Lake, a natural lake located within the Boardman River (TWC and GLEC 2003). The plan identified more than 40 sites of environmental contamination in the watershed, more than three-quarters of which were uncontrolled or "active" at the time the watershed plan was developed. The study also found significant loss of wetlands throughout the watershed, several sediment hot spots in the lake, bacterial and nutrient contamination in several culverts and tributaries, and evidence of poor aquatic organism populations.

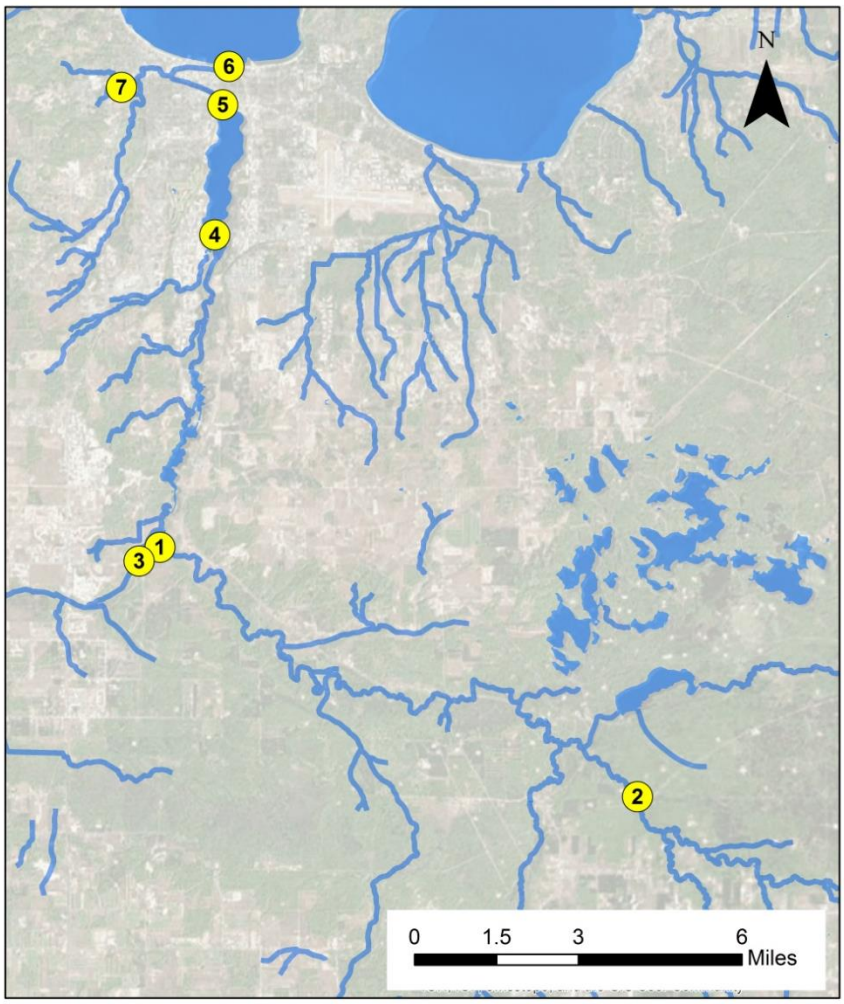
The plan recommends several land use and land management strategies to help minimize the impacts of impervious surface and runoff, including the use of low-impact development stormwater treatment techniques, stronger erosion control, and stormwater ordinances. It also calls for clean-up of materials (such as tires, drums, scrap metal, and debris) at various locations within Boardman Lake, protection and restoration of wetlands, and further investigation of nutrient, bacterial, or chemical pollution sites identified in the study.

Since completion of the plan for Boardman Lake, watershed communities have made progress in addressing some of the priority issues and water quality threats identified, including contaminated sediment cleanup efforts near the Cone Drive Operations plant adjacent to Boardman Lake.

Water Chemistry

Water chemistry analyses have been performed historically at several locations along the Boardman River. Figure 8 identifies several of these sites where water chemistry data has been published.

1. Boardman River at Beitner Road
2. East Creek (trib to Boardman) at Mayfield Rd
3. Beitner Creek at Beitner Rd
4. Boardman River at South Airport Rd
5. Boardman River d/s Boardman Lake
6. Boardman River Mouth
7. Kids Creek



THE BOARDMAN RIVER WATERSHED

Water Quality Sampling Locations

Data Sources: Michigan Geographic Data Library, Michigan DNR

Site Location
Streams and Rivers
Lakes

SOURCE: The Watershed Center, 2016

FIGURE 8. Water Chemistry Sampling Sites on the Boardman River

Nutrients such as nitrogen and phosphorus are often the culprit for water quality problems in surface waters. Throughout the Boardman River, nutrients are relatively low and have been on a continual decline since the 1960s. A historical trend station was placed in the Boardman River at Beitner Road by the MDEQ in the 1960s, which gathered a wide variety of data over the years (Figure 8, site 1). A summary of total phosphorus and total nitrate/nitrite results show the gradual decline of nutrients at this station since it was installed (Table 4). Total phosphorus has fallen from 0.029 mg/L from the historical record to more recent levels of 0.007 mg/L. Additionally, total nitrate/nitrite levels have fallen from 0.314 mg/L to 0.228 mg/L.

Nutrient results for total phosphorous (Table 4) and total nitrate/nitrite (Table 5) are available at other locations along the Boardman River (Figure 8) for a variety of years. In general, total phosphorous is low throughout the watershed, with variations depending on specific locations measured. The tributaries of East Creek and Beitner Creek had extremely low total phosphorous levels (0.007mg/L and 0.001mg/L, respectively). In contrast, higher readings were observed at the mouth of the Boardman River (0.021-0.054mg/L). Total phosphorus levels along Kids Creek, the largest tributary to the Boardman River, averaged 0.027 mg/L (Table 4).

Nitrogen samples were more difficult to compare because the numerous sources of information did not all measure the same form of nitrogen. Nitrogen in the form of nitrate/nitrite was used because it was the most abundantly measured form at the largest number of sites (Table 5). Values of nitrate/nitrite seem to vary depending on the year and location measured, with no obvious trends detected.

TABLE 4. Boardman River Total Phosphorous (mg/L)

Site	1968	1972/3	1992	1998	2000	2003	2006	2009	2011
1- Boardman River at Beitner Road	0.029					0.013	0.011	0.010	0.007
2-East Creek at Mayfield Road				0.007					
3-Beitner Creek at Beitner Road				0.001					
4-Boardman River at S. Airport Rd		0.009			0.013	0.021			
5-Boardman River d/s Boardman Lake						0.034			
6-Boardman River mouth		0.054	0.029		0.045	0.024		0.021	
7a-Kids Creek at M32/US31						0.064			
7b-Kids Creek 0.5 mi d/s Silver Lake Road						0.020			
7c-Kids Creek u/s 11th Street				0.024		0.024			
7d-Kids Creek at Oak Street						0.024			
7e-Kids Creek Trib A (at Cedar Run Road)				0.009					
7f-Kids Creek Trib A (at 6th St)						0.024			

SOURCES: MSWIMS N.d.; Auer et. al 1975; City of Traverse City 1992; MDEQ 2002; GLEC 2001; MDEQ 2008; TWC 2004; TWC 2010

TABLE 5. Boardman River Total Nitrate/Nitrite (mg/L)

Site	1968	1972/3	1992	1998	2000	2003	2006	2009	2011
1- Boardman River at Beitner Road	0.31						0.21	0.23	0.22
2-East Creek at Mayfield Road				0.68					
3-Beitner Creek at Beitner Road				1.02					
4-Boardman River at S. Airport Rd		0.25			0.24	0.14			
5-Boardman River d/s Boardman Lake						0.29			
6-Boardman River mouth		0.36	0.76						
7a-Kids Creek at M32/US31						0.84			
7b-Kids Creek 0.5 mi d/s Silver Lake Road						0.78			
7c-Kids Creek u/s 11th Street				0.47		0.62			
7d-Kids Creek at Oak Street						0.48			
7e-Kids Creek Trib A (at Cedar Run Road)				0.16					
7f-Kids Creek Trib A (at 6th St)						0.16			

SOURCES: MSWIMS N.d.; Auer et. al 1975; City of Traverse City 1992; MDEQ 2002; GLEC 2001; MDEQ 2008; TWC 2004; TWC 2010

Readily available and summarized water quality information is lacking for inland lakes in the Boardman River watershed, especially in recent years. However, a study done in 1986 contains information for eight inland lakes in the watershed (Cummings et.al 1990). Total phosphorus, organic nitrogen, and hardness values are summarized in Table 6.

TABLE 6. Inland Lake Total Phosphorous, Organic Total Nitrogen, and Hardness

Lake	Total Phosphorous (mg/L)	Organic Total Nitrogen (mg/L)	Hardness (mg/L)
Arbutus Lake	0.01	0.49	140
Bass Lake	0.02	0.57	42
Brewster Lake	0.03	0.48	160
Grass Lake	n/a	0.88	120
Rennie Lake	bdl*	0.48	99
Sand Lake No. 1	0.01	0.78	110
Silver Lake	0.01	0.38	100
Spider Lake	bdl*	0.58	98

*bdl=below detectable levels

SOURCE: Cummings et. al 1990

Additional water quality information for inland lakes can be found on the State's Michigan Clean Water Corps (MiCorps) website (https://micorps.net/lake-monitoring/). This site has a searchable database from data entered through MiCorps' Cooperative Lakes Monitoring Program. Searchable parameters include secchi disk, phosphorus (spring overturn, late summer), chlorophyll, dissolved oxygen, aquatic plants, and exotic plants (https://micorps.net/data/view/lake/). Existing information on various water quality parameters can be found for Arbutus Lakes 1-5, Chandler Lake, Island Lake, and Spider Lake (Table 7).

TABLE 7. Other Available Inland Lake Water Quality Data

Lake	Secchi Disk	Phosphorous (spring)	Phosphorous (summer)	Chlorophyll	Dissolved Oxygen
Arbutus Lake 1	x				
Arbutus Lake 2	x	x	x	x	x
Arbutus Lake 3	x				
Arbutus Lake 4	x				
Arbutus Lake 5	x				
Chandler Lake	x				
Island Lake	x	x	x	x	x
Spider Lake	x	x	x	x	

SOURCE: https://micorps.net/data/view/lake/

Boardman River Baseline Monitoring Project Pre-dam Removal (2013)

This project conducted sampling at two sites (Grasshopper Ranch above Brown Bridge Dam and Brown Bridge Road below the dam) on the Boardman River prior to the removal of Brown Bridge Dam. The Watershed Center measured stream discharge, water quality parameters (total suspended solids, phosphorus, and nitrates), and temperature through a partnership with the Grand Traverse Conservation District. Total suspended solids (TSS) loading to the river was greater at Grasshopper Ranch before the dam was removed, indicating the dam was acting as a sediment sink. Phosphorus levels were almost entirely "nondetect" (less than 0.01mg/L), with the highest measurement of 0.08mg/L during spring runoff. Nitrate levels at the two monitoring locations ranged from 0.13 to 0.52mg/L at Grasshopper Ranch, and 0.06 to 0.43mg/L at Brown Bridge Road. The Watershed Center continues to maintain the monitoring infrastructure and conducts some sampling of the parameters above now that Brown Bridge Dam has been removed (TWC 2013).

Photo courtesy of Frank Dituri

Michigan Water Chemistry Monitoring: Great Lakes Tributaries (1998–2005)

The Boardman River at Beitner Road in Garfield Township is a MDEQ tributary monitoring program integrator site. Integrator sites are monitored intensively (12 times/year) on a staggered five-year cycle. During non-intensive monitoring years, these sites are monitored four times a year. Minimum, maximum, mean, and median values for various water chemistry parameters at the Boardman River monitoring site are shown in Table 8.

TABLE 8. Boardman River Water Quality Trends 1998–2005

	Minimum	Maximum	Mean	Median
Mercury (ng/liter)	0.55	3.83	1.04	0.77
Chromium (µg/liter)	0.03	0.42	0.07	0.04
Copper (µg/liter)	0.17	0.73	0.29	0.31
Lead (µg/liter)	0.04	0.41	0.10	0.07
Total Suspended Solids (mg/liter)	2	17	5	4

SOURCE: MDEQ 2008.

In addition, the Boardman River station was sampled to determine whether any of the values exceeded Rule 57 Water Quality Standards for mercury, chrome, lead, and copper. Rule 57 Water Quality Standards list water quality values to protect humans, wildlife, and aquatic life (often listed as Human Noncancer Value, Human Cancer Value, Wildlife Value, etc.). In four separate samples, values for metals analyzed were low enough that none of the Rule 57 values were ever exceeded.

Boardman Lake Watershed Study (2003)

As part of the Boardman Lake Watershed Study, The Watershed Center evaluated surface water quality from 13 tributaries, 3 culverts and storm drains, the river mouth at Grand Traverse Bay, and Boardman Lake. Sites were sampled and tested for *Escherichia coli* (some locations), total phosphorus, and total nitrogen. Four tributaries and one culvert were found to be above MDEQ standards for *E. coli* colonies per 100ml water.[4] No samples were above USEPA Ambient Water Quality Criteria for total nitrogen (0.003–7.33mg/L). Six tributaries (just south of Sabin Dam, near the Keystone Dump, and at the mouth of

[4] MDEQ standards are <130 *E. coli* per 100 ml, as a 30-day geometric mean, and 300 *E. coli* per 100ml, as a geometric mean of three or more samples taken during the same sampling event.

Kids Creek), eight culverts (at Cass Street bridge, just downstream of Union Street, Front Street bridge, and Boardman and Front streets), and the mouth of Grand Traverse Bay exceeded the USEPA Nutrient Criteria range of values for total phosphorous (0–20 µ/L). Two of these sites, between Cass and Union streets, had levels five to seven times the USEPA range of values for phosphorus. The study cited historic data from various studies on the Boardman River from 1967 to 1993 that showed phosphorus levels between 0 and 340 µg/L with a mean of 86.0 µg/L (TWC and GLEC 2003).

The Boardman Lake Watershed Study also included sampling and analysis of metals in surface waters in Boardman Lake and near the mouth of Grand Traverse Bay. Concentrations of ten metals were evaluated: arsenic, barium, cadmium, chromium, copper, lead, mercury, selenium, silver, and zinc. The project team did not find any sample concentrations that exceeded the MDEQ Rule 57 Water Quality Standards for human non-cancer or wildlife values. Four samples were above the non-detect level, but were still well below state standards. One sample at the Lear Corporation resulted in a barium concentration of 0.96mg/L, which exceeds the final chronic value (0.781mg/L) for aquatic life in Boardman Lake (TWC and GLEC 2003).

Benthic Macroinvertebrate Monitoring

The MDEQ has been monitoring benthic macroinvertebrates at a variety of locations along the Boardman River since the 1980s. Assessments were done using the Procedure 51 (P51) method, which scores both the macroinvetebrate communities and habitats at each station with metrics that rate on a scale from excellent to poor. Only macroinvertebrate scores are included in the reports summarized here, with possible scores ranging from -9 to 9. Stations with a score greater than or equal to 5 are considered "excellent." Stations with a score less than or equal to -5 are classified as "poor." Stations with a score of -4 through 4 are classified as "acceptable" (minimally to moderately impaired). Reports were summarized and include information for P51 surveys for 23 locations along the Boardman River (Table 9) and tributaries, as well as another nine locations in Kids Creek (Table 10), a major tributary to the Boardman River.

In general, all locations monitored scored acceptable or above, with the exception of Kids Creek. At locations where scores were available for more than one year, scores increased (improved) in later years. "Excellent" scores were noted for three locations on the North Branch Boardman River, two locations on the South Branch Boardman River, Twenty-two Creek, Jackson Creek, East Creek, and Parker Creek (Table 9).

Kids Creek scores were notably less than those for the other sections of the Boardman River, with no sites scoring above 2. Kids Creek is a highly urbanized stream and is on the State's Impaired Waters List due to poor macroinvertebrate communities (see Chapter 5.5 for more details). Sampling locations at 11th and Oak Streets scored "poor," as did Tributary A of Kids Creek by Elmwood Avenue (Table 10).

TABLE 9. Boardman River and Tributaries P 51 Macroinvertebrate Scores

	1998	2003	2008	2011	2013
North Branch of Boardman River					
at Nash Road/CO 612	5	4			
US 131 in Kalkaska			5		
two-track off US 131			4		
at Boardman River Road			7		
at Broomhead Road		4			
South Branch of Boardman River					
at Boardman River Road	0				
powerline off S. Branch Road			3		5
at Broomhead Road		5			
Twenty-two Creek off Mayfield Road			5		
Swainston Creek u/s* RR in Mayfield		-1			
Jackson Creek					
d/s** of Wood Road			3		
at Marsh Road			6		
East Creek at Mayfield Road	3		4		5
Unnamed Tributary to Jaxon Creek at West Blair Twp Hall					0
Beitner Creek at Beitner Road	0				
Bancroft Creek d/s** Sparling Road	3				
Parker Creek d/s** Knight Road	5				
Miller Creek at Cass Road		-2		2	
Jacks Creek at Cass Road		0		1	
Boardman River					
off private road across from Sleights Road			2		
at Brown Bridge Dam Road***					4
at Boardman Plains Road					0

P 51 scoring guide: -9 to -5 = poor; -4 to 4 = acceptable; 5 to 9 = excellent
*u/s=upstream
**d/s=downstream
***sampling locations immediately downstream of former Brown Bridge Dam impoundment where an uncontrolled release took place in 2012

SOURCES: MDEQ 2002; MDEQ 2008; MDEQ 2009; MDEQ 2012; MDEQ March 2015

TABLE 10. Kids Creek P 51 Macroinvertebrate Scores

	1998	2003	2008	2011	2013
at M37/US31 (station #31)			0		
0.5 miles d/s* of Silver Lake Road (station #32)			-4		-2
u/s** 11th Street	-6	-5			
at Oak Street		-7			
Tributary A					
u/s** Elmwood Avenue				2	
d/s* Elmwood Avenue				-5	
Tributary D (US31/M37)				2	

P 51 scoring guide: -9 to -5 = poor; -4 to 4 = acceptable; 5 to 9 = excellent
*d/s=downstream
**u/s=upstream

SOURCES: MDEQ 2002; MDEQ 2008; MDEQ 2009; MDEQ 2012; MDEQ March 2015

AuSable Institute Benthic Communities Research

- **Boardman River Dam Removal Macroinvertebrate Surveys.** The Au Sable Institute of Environmental Studies has conducted numerous macroinvertebrate studies since 2008. Researchers with the institute are evaluating the effects of dam removal activities on the benthic communities in the watershed, including the recovery of benthic communities in re-established riffle areas below the dams after drawdown and removal (Au Sable N.d.: 2008 - 2013 results available online at http://ausable.org/research/ boardman_river_restoration_research/). A 2015 report issued by the Au Sable Institute's Dr. Dave Mahan summarizes the past 8 years of research (Mahan 2015). The report states:
    - For most of the stream channel, the dominant organisms are characteristic of high water quality
    - Reservoirs can have a negative impact on the typical riverine biota with mayflies predominating above Brown Bridge Dam and mollusks and net-spinning caddisflies below
    - There has been significant recovery of the macroinvertebrate community to a more natural state at the newly formed riffle sites located within the former Brown Bridge impoundment
    - Invertebrate communities downstream from Brown Bridge Dam were greatly reduced in EPT, sensitive organisms and numbers of organisms directly following dam removal (2013), although recent sampling (2014, 2015) confirmed a significant recovery in the macroinvertebrate community
    - In the two years following dam removal, the insect community at the impacted sites (mean of 4 locations) has become similar to the reference sites (mean of 2 locations).

- A Stream Quality Survey of the Upper Boardman River and Selected Tributaries, Northwestern Michigan, Utilizing Benthic Macroinvertebrates. Au Sable Institute conducted benthic macroinvertebrate stream surveys at nine sites in the upper Boardman River in 2010 and compared the findings to previous biological monitoring done by the MDEQ at the same sites. Researchers found that overall stream quality in the upper Boardman River watershed has declined slightly over the years, but is still very high quality. Some of the more rural sites have maintained “approaching excellent” or “excellent” ratings, but a few of the urbanized locations (particularly in downtown Kalkaska) have had more variable stream quality (McElrath and Mahan 2010).
- Other Au Sable Institute of Environmental Studies Reports

- **2010:** *Thomas McElrath*, Covenant College – A stream quality survey of the upper Boardman River and selected tributaries, northwestern Michigan, utilizing benthic macroinvertebrates; *Nathan Sather*, Bethel University – Riffle community recovery after reestablishment of a swift river channel following reservoir drawdown at the Boardman River, Traverse City, MI (2); *Aaron A. Koning*, Wheaton College - Benthic Macroinvertebrate Communities of Riffle Habitats of the Boardman River, Northern Michigan
- **2011:** *Jacob Boone*, Spring Arbor University - A comparison of stream health based on aquatic macroinvertebrate assemblages above and below a future dam removal site on the Boardman River, Michigan; *Michelle LaForge*, Wheaton College - A benchmark macroinvertebrate analysis of the Boardman River prior to dam removal; *Nathan Sather*, Bethel University – Riffle community recovery after reestablishment of a swift river channel following reservoir drawdown at the Boardman River, Traverse City, MI (3)
- **2012:** *Michelle LaForge*, Wheaton College - Macroinvertebrate assessment of the Boardman River prior to the removal of the Brown Bridge Dam, Michigan, USA; *David Petry*, Bethel University - Effects of Keystone Pond drawdown on riffle macroinvertebrate communities
- **2013:** *Christian Hays*, Cedarville University - Effects of reservoir drawdown on riffle macroinvertebrate communities; *David Petry*, Bethel University - Response of Boardman River water temperature and insect communities and to dam removal**;** *Nathan Hadley*, Wheaton College - Comparing effects of existing and recently removed dams on macroinvertebrate communities; *Jonathan Shoaff*, Cornerstone University - Effects of Brown Bridge Dam removal on downstream macroinvertebrate populations
- **2014:** *Davis Guebert*, Wheaton College - Macroinvertebrate rates of recovery after dam removal on the Boardman River; *Joel Betts*, Calvin College - Recovery of the new stream channel above Brown Bridge Dam on the Boardman River, Northern Michigan; *Annaka Scheeres*, Calvin College - Effects of reservoir drawdown on benthic riffle macroinvertebrate communities; *Jonathon Shoaff*, Cornerstone University - Recovery of downstream macroinvertebrate populations following removal of a hydroelectric dam
- **2015:** *Bradley Dawson and Mason Tennell* - Rapid Recovery of Aquatic Insects Following a Michigan Dam Removal; *Jessica Tinklenburg and Dakota Wrinkle* - Assessment of Stream Recovery Following Dam Removal by Using Benthic Macroinvertebrates as Stream Quality Indicators

A Biological Survey of Selected Grand Traverse Bay and Lake Michigan Tributaries in Antrim, Charlevoix, Grand Traverse, Kalkaska, and Leelanau Counties, Michigan (July–August 2003)

The MDEQ surveyed the benthic macroinvertebrate community and habitat at 34 sites in Grand Traverse Bay and Lake Michigan watersheds in northern Michigan. The macroinvertebrate community at two sites in Kids Creek (at 11th Street and the corner of Front and Oak Streets) were rated "poor" during this assessment. The likely causes of poor macroinvertebrate communities in these locations are excessive storm water inputs and sedimentation (MDEQ 2008).

Boardman Lake Watershed Study (2003)

Benthic surveys using Procedure 51 methods along the Boardman River and tributaries in the Boardman Lake watershed were conducted as part of the Boardman Lake Watershed Study. Benthic scores ranged from -1 to 0 (≤-5 = poor; -4 to -1 = acceptable tending toward poor; 0 = acceptable), and habitat scores were rated as "good" at each site. The MDEQ does not have an established protocol for lake habitats and the benthic scoring keys from the wadeable streams protocol are not applicable to lake sites. However, the study team still took sediment samples from Boardman Lake to qualitatively characterize benthic populations. At all sampling sites in Boardman Lake, zebra mussels dominated the benthic community (TWC and GLEC 2003).

Sediment Monitoring

Great Lakes Environmental Center Sediment Monitoring (2011)

The Great Lakes Environmental Center (GLEC) sampled surface sediments from three sampling locations as a follow-up to a MDEQ analysis in 1997. GLEC found elevated concentrations of contaminants in the sediments in Boardman Lake and the Boardman River. This analysis determined that sediments in some areas are toxic to sediment-dwelling freshwater organisms (GLEC 2011).

In addition, GLEC was contracted to do sediment sampling in Brown Bridge, Sabin, and Boardman ponds in May 2011 as part of the dam removal/modification process. That analysis indicated that none of the metal concentrations in the three ponds exceeded USEPA probable effect concentration (PEC) levels, or levels where harmful effects to sediment-dwelling organisms are expected to occur frequently. Several metals did exceed the threshold effect concentrations (TECs), or levels where effects on sediment-dwelling organisms are not expected to occur. The USEPA often sets ecological screening levels at the TEC levels. Arsenic and cadmium exceeded TEC levels at Brown Bridge and Boardman ponds. Brown Bridge Pond also had TEC exceedances of copper, zinc, chromium, and lead in some sampling locations. All metals were below the TEC level in Sabin Pond. None of the samples collected from the Brown Bridge, Sabin, or Boardman ponds had detectable samples of organochlorine pesticides, PCBs, or semi-volatile organic compounds (GLEC 2011).

Grand Traverse Bay Macrophyte Bed and Sediment Survey (2010)

The Watershed Center conducted a macrophyte bed survey in Grand Traverse Bay in 2009 to compare growth and densities of macrophytes to studies conducted more than 10 years earlier. The study indentified macrophyte bed size and distribution and included an analysis of sediment and water samples from three areas in the bay. The intent of the study was to gain a better understanding of the ecosystem dynamics between invasive species (zebra/quagga mussels), phosphorus cycling, and plant growth as it related to recent botulism outbreaks in the bay. The study found macrophyte beds have more than tripled over the previous 10 years. In addition, although water quality was determined to generally be excellent, numerous sediment samples indicated phosphorus levels indicative of mesotrophic or eutrophic conditions. One surface water total phosphorus concentration in the bay (at Traverse City) was also indicative of mesotrophic to eutrophic conditions (TWC 2010).

U.S. Army Corps of Engineers Sediment Monitoring (2010)

In the Boardman River watershed, sediment has been transported and deposited in the river channel, primarily in the impoundments behind the four Boardman River dams. The U.S. Army Corps of Engineers (USACE), in partnership with W.F. Baird & Associates, conducted a sediment impact assessment model for the Boardman River in 2010 to characterize the sediment budget in light of planned dam removals and modifications. This analysis indicated that streambank erosion was not frequent along the Boardman River, and that riverbanks were largely stable along the entire project length. USACE did note a few localized sites of active bank erosion and over-steepening in places "where the river meandered against terraces" (USACE 2010).

Environmental Consulting & Technology Sediment Monitoring (2003)

In addition to benthic surveys, Environmental Consulting & Technology conducted sediment sampling in the Sabin, Brown Bridge, and Boardman ponds as part of its Boardman River Feasibility Study Reports. Their analysis found that in all three ponds, arsenic, selenium, and/or barium were present at concentrations that exceeded either ecological screening levels or apparent effect threshold levels. Brown Bridge Pond also showed exceedances of lead and zinc in some of the sampling locations (ECT 2009).

Michigan Department of Environmental Quality Sediment Monitoring (2002)

The MDEQ, in partnership with the USEPA, began sediment sampling in Boardman Lake in 1997. The sampling has focused on potential contamination from numerous commercial, industrial, and municipal sites along the lakeshore. These facilities have discharged directly to surface waters feeding the lake, as well as to waste disposal sites and lagoons. The MDEQ and the USEPA collected sediment samples from 17 locations along Boardman Lake using the USEPA Great Lakes National Program Office research vessel and a sediment coring unit. The sampling found the most significant chemical results at five stations within the lake, including locations that exceeded severe effect levels (SELs) and lowest effect levels (LELs) for certain types of inorganic chemicals such as copper, pyrene (and other polycyclic aromatic hydrocarbons), arsenic, iron, manganese, mercury, lead, cadmium, chromium, zinc, and cyanide, as well as solvent/metal degreasing type compounds (MDEQ 2002).

Pathogen (E. coli) Monitoring

The Watershed Center monitored both the Boardman River and Kids Creek from 2002-2004 (TWC 2004). *E. coli* levels at the mouth of the Boardman were relatively low; out of 44 samples over three years, only one registered above state Water Quality Standards for full body contact (300 col/100mL), and the average reading was 88 col/100mL. However, Kids Creek did have elevated *E. coli* levels; out of 41 samples collected over three years, 17 samples were above 300 col/100mL, and the average of all results was 327 col/100mL.

The Boardman River and Boardman Lake were also monitored for *E. coli* during The Boardman Lake Watershed Study (TWC and GLEC 2003).

2.5 GROUNDWATER

The Boardman River, like many northern lower Michigan rivers, is groundwater driven. Consistent groundwater discharge, particularly during low precipitation periods, has made the Boardman River one of the highest quality coldwater trout streams in the world. A 2005 study of Great Lakes basin groundwater recharge rates indicates that the Grand Traverse Bay Watershed, including the Boardman River, has an estimated recharge rate between 8.0 and 11.9 inches per year (Neff et al. 2005). Boardman River headwaters and forested uplands are important groundwater recharge areas.

Like surface water resources, groundwater is also protected under Michigan laws and promulgated rules. Under state regulations, groundwater discharges must meet a nondegradation standard to protect existing or potential uses such as domestic water supplies, irrigation, and stock watering. At this time, there is little data available on the quality of groundwater for the Boardman River watershed.

One threat to groundwater in the watershed is related to the unlawful release of hazardous materials (i.e., from storage and handling facilities or historical disposal sites) and accidental release of contaminants from spills and discharges that either gain direct access to groundwater or which enter otherwise protected groundwater aquifers through improperly plugged and/or abandoned hydrocarbon and mineral wells or domestic water wells.

There are also numerous sites in Kalkaska and Grand Traverse counties with active Leaking Underground Storage Tanks (LUSTs) and Underground Storage Tanks (USTs). The MDEQ website has a searchable feature to find both active and closed locations of both LUSTs and USTs by county. According to the MDEQ website, Grand Traverse County has 85 active LUST sites and Kalkaska has 14 (http://www.deq.state.mi.us/sid-web/Download_Search.aspx?id=Cadillac+District). More information on LUSTs in the watershed is found in Chapter 5.3 Toxins.

Additionally, elevated levels of nitrate are sometimes found in areas where agricultural activities are conducted on sandy soil. The MDEQ publishes water quality maps for Michigan by county, which includes nitrate levels (http://www.michigan.gov/deq/0,4561,7-135-3313_3675_3690-76500--,00.html). The MDEQ adopted the USEPA's maximum contaminant level (MCL) for nitrate at 10mg/L. It is estimated that most of the wells sampled in the Boardman River watershed have nitrate levels between 5-10mg/L, with a handful in the 10-20mg/L range. There may also be two locations where nitrate levels were measured above 20 mg/L in Grand Traverse County.

To protect the state's high-quality groundwater resources, Michigan has adopted water withdrawal regulations under a series of new state laws, Public Acts 179-190 of 2008 (Michigan Legislature 2008). One of the new laws requiring permits is specifically focused on groundwater withdrawals that occur near designated trout streams such as the Boardman River and its tributaries.

2.6 IMPACTS TO GRAND TRAVERSE BAY

The Boardman River watershed provides approximately 30 percent of the tributary water flow to Grand Traverse Bay. Thus, the protection and improvement of water quality in the Boardman River watershed plays a critical role in protecting the bay, particularly the nearshore zone in west Grand Traverse Bay.

In 2005, The Watershed Center Grand Traverse Bay (TWC) developed a comprehensive watershed management plan for the Grand Traverse Bay watershed (www.gtbay.org/resources/watershed-protection-pla/). The plan looked at the nine subwatersheds in the Grand Traverse Bay watershed, including the Boardman River. It characterized baseline conditions, described designated and desired uses, evaluated sources and causes of pollution in the watershed, and identified goals and strategies for addressing threats to water quality. The plan states that focusing on reducing and/or eliminating pollution stemming from stormwater runoff, streambank erosion, road stream crossings, fertilizer use, lack of riparian buffers, and the reduction of wetlands will address the bulk of pollution entering Grand Traverse Bay and its surrounding watershed. Additionally, implementing a widespread and effective Information and Education Strategy was one of the most critical and important long-term tasks to accomplish (TWC 2005). Since the Grand Traverse Bay Watershed Protection Plan was revised and approved to meet USEPA requirements in December 2005, TWC has steadily worked with partner organizations to implement key recommendations from the plan. Stormwater is a major concern throughout the watershed, and TWC has focused on decreasing harmful effects from stormwater runoff entering waterways through educational campaigns, ordinances, source tracking analyses on *E. coli*, stormwater assessments for small communities, inventorying and restoring riparian buffers and eroding stream banks, and discussing the possibility of a stormwater utility in Traverse City.

Since the plan was completed, numerous recommended actions have been implemented resulting in significant improvements in water quality and watershed protection over the last decade. TWC alone has been awarded more than $10 million in funding to implement key portions of the plan, annually preventing 1,612 tons of sediment, 1,115 lbs of phosphorus, and 3,241 lbs of nitrogen from entering Grand Traverse Bay and its watershed. Numerous other organizations have received funding to implement portions of the plan as well.

Examples of successful pollutant reductions and resource protections in the Boardman River subwatershed are discussed in detail in Chapter 10.1. A few of the major accomplishments over the past 10 years include:

- restoration of over 150 streambank erosion sites
- restoration of over 50 public access sites
- restoration of over 50 transportation crossings, including road and railroad

- restoration efforts on Kids Creek (mainly on Tributary A and AA), through a partnership with Munson Medical Center, including restoration of eroded stream banks, removing underground culverts to "daylight" the creek, reducing impervious surface cover, expanding the floodplain, and creating a buffer between the hospital and surrounding neighborhoods (Kids Creek is the only impaired waterbody in the Boardman River watershed, so restoration and reduction of pollutant sources to the creek is a key implementation action from this plan)
- evaluation and initiation of the Boardman dams removal/ modification project, the largest dam removal project in Michigan's history and the biggest wetland restoration project in the Great Lakes basin
- tracking of stormwater pollutant sources and installing seven oil and grit separator systems that help reduce the amount of oil, grease, and other pollutants entering the river and Grand Traverse Bay
- development of water quality action plans in nine local townships, villages, and/or counties that made recommendations for changes to zoning ordinances and local policies that would better protect the river from pollutants (See Chapter 3.2 for more information).

Of special note is that nearly 300 streambank erosion sites have been stabilized/restored throughout the Boardman River watershed since the early 1990s. This effort was led by the Grand Traverse Conservation District (GTCD) and TWC, with support from other partner organizations.

The Boardman River watershed was also identified as a priority area in the Grand Traverse Bay Watershed Protection Plan for conservation practices. As part of the analysis to complete the plan, the Grand Traverse Regional Land Conservancy (GTRLC) prioritized areas of "high ecological importance with significant water quality impact" on a parcel-by-parcel basis. The GTRLC has also protected 1,601 acres of land in the Boardman since 2005. Additionally, as described in Chapter 2.2, there has also been work on the Boardman River dams removal/ modification project, the largest dam removal project in Michigan's history and the biggest wetland restoration project in the Great Lakes basin.

The effect of the Boardman River on the nearshore zone of west Grand Traverse Bay can be seen in a 2009 study TWC conducted on macrophyte bed growth in the bay (TWC 2010). TWC conducted aquatic plant surveys in Grand Traverse Bay in 1991, 1998, and 2009, and completed a variety of water and sediment testing for nitrogen and phosphorus at locations with and without macrophyte beds and the mouths of several tributaries to the bay. These surveys showed a six-fold increase in the number of plant beds identified between 1991 and 2009 (1991: 64 beds; 1998: 124 beds; 2009: 402 beds). Most of the macrophyte beds were concentrated in embayments, such as Northport and Omena bays, as well as the southern end of west Grand Traverse Bay, where the Boardman River drains. This growth is attributed to rapid development and nutrient flushing from stormwater inputs, particularly the amount of phosphorus entering the bay.

Water quality monitoring conducted as part of the study found that phosphorus levels at all Grand Traverse Bay monitoring sites except near the Great Lakes Maritime Academy in Traverse City near the mouth of the Boardman River, were within the oligotrophic range. At the Maritime Academy location, total phosphorus concentration was measured at 0.014mg/L, almost mid-way between mesotrophic and eutrophic.[5] Sediment testing from this study also showed elevated phosphorus levels in the southwestern portion of the bay (Traverse City/Boardman River outlet) as well. Both of these elevated levels could be caused by outflow from the Boardman River.

[5] Oligotrophic water bodies are those with low biological productivity (little algae and other plant growth); mesotrophic waterbodies are defined as those with moderate biological productivity (fairly clear with some submerged plants); eutrophic waterbodies are those with high biological productivity (dominated by aquatic plants and algae). See: http://www.secchidipin.org/trophic_state.htm.

Additionally, to control eutrophication, the USEPA recommends that total phosphorus not exceed 0.05mg/L in a stream at a point where it enters a lake or reservoir.[6] Results of water sampling for total phosphorus for major tributaries to Grand Traverse Bay did not indicate any exceedances of this standard. However, total phosphorus concentrations in water samples collected at the mouth of the Boardman River, Mitchell Creek, and Yuba Creek, indicated elevated levels of total phosphorus (more than twice as high) as compared to samples taken from Elk River, and Acme Creek, Cedar Creek, and Leo Creek. Phosphorus levels should be monitored at the mouth of the Boardman River to ensure levels do not exceed the USEPA recommendations.

To adequately restore and protect the health of the greater Grand Traverse Bay, nutrient sources from the Boardman River will have to be controlled and maintained, if not decreased.

2.7 ECONOMIC CONDITIONS

Like the greater Grand Traverse Bay watershed region in which they are located, the communities of the Boardman River watershed have economies based largely on recreation, tourism, forestry, agriculture, services, light manufacturing, and oil and gas production. Because the Boardman River is considered one of the top 10 destinations for quality trout fishing in Michigan, the river has a profound impact on the region's economy and quality of life, providing opportunities for fishing, kayaking, canoeing, nature observation, and other forms of recreation that make this region one of the best destinations for tourism in the United States (Veritas 2008).

There is significant disparity in economic prosperity among the watershed communities. The watershed supports 2,410 businesses clustered primarily in the northwestern portion of the watershed (Table11; Figure 9). The City of Traverse City and Garfield Township are home to 68 percent of the 2,410 business establishments identified in the inventory.

The taxable value of commercial property in the watershed exceeds $590,000,000. Commercial activity is clustered in six activity areas: downtown Traverse City, the Garfield-Blair Township developments along US-31, Ranch Rudolf area, Kingsley, South Boardman on US-131, and the Village of Kalkaska (see Figure 9).

Chapter 7, Economic Uses and Issues, provides a detailed discussion about the opportunities for advancing economic prosperity.

[6] http://pubs.usgs.gov/circ/circ1136/circ1136.html#CONCERNS.

TABLE 11. Commercial Property in the Boardman River Watershed

	Count	Acreage	Taxable value
Kalkaska County			
Boardman Township	64	229.4	$2,255,126
Coldsprings Township	7	60.1	$126,886
Excelsior Township	6	434.6	$1,097,981
Garfield Township	1	62.2	$58,300
Kalkaska Township	45	559.1	$2,663,568
Orange Township	3	4.1	$96,323
Village of Kalkaska	198	320.9	$16,286,160
Kalkaska County Total	**324**	**1,670.4**	**$22,584,344**
Grand Traverse County			
Blair Township	273	1,057.3	$47,453,351
East Bay Township	22	144.0	$4,074,383
Fife Lake Township	7	38.9	$1,404,660
Garfield Township	752	2,742.5	$298,009,846
Green Lake Township	39	30.2	$1,348,550
Long Lake Township	3	99.5	$435,740
Mayfield Township	2	14.8	$28,970
Paradise Township	20	440.2	$2,366,534
Union Township	3	188.3	$246,190
Village of Kingsley	64	212.8	$4,600,361
City of Traverse City	901	655.3	$208,111,162
Grand Traverse County total	**2,086**	**5,623.8**	**$568,079,747**
Boardman River Watershed	**2,410**	**7,294.3**	**$590,664,091**

SOURCE: Beckett & Raeder Inc., 2012, using parcel data from Kalkaska and Grand Traverse counties

THE BOARDMAN RIVER WATERSHED

Commercial Real Estate Locations

Data Sources: Michigan Geographic Data Library, Michigan DNR, Grand Traverse and Kalkaska Equalization

- Commercial Area
- Boardman River Watershed
- City or Village
- County Boundary
- Township Boundary
- Major Road
- Minor Road
- Boardman River

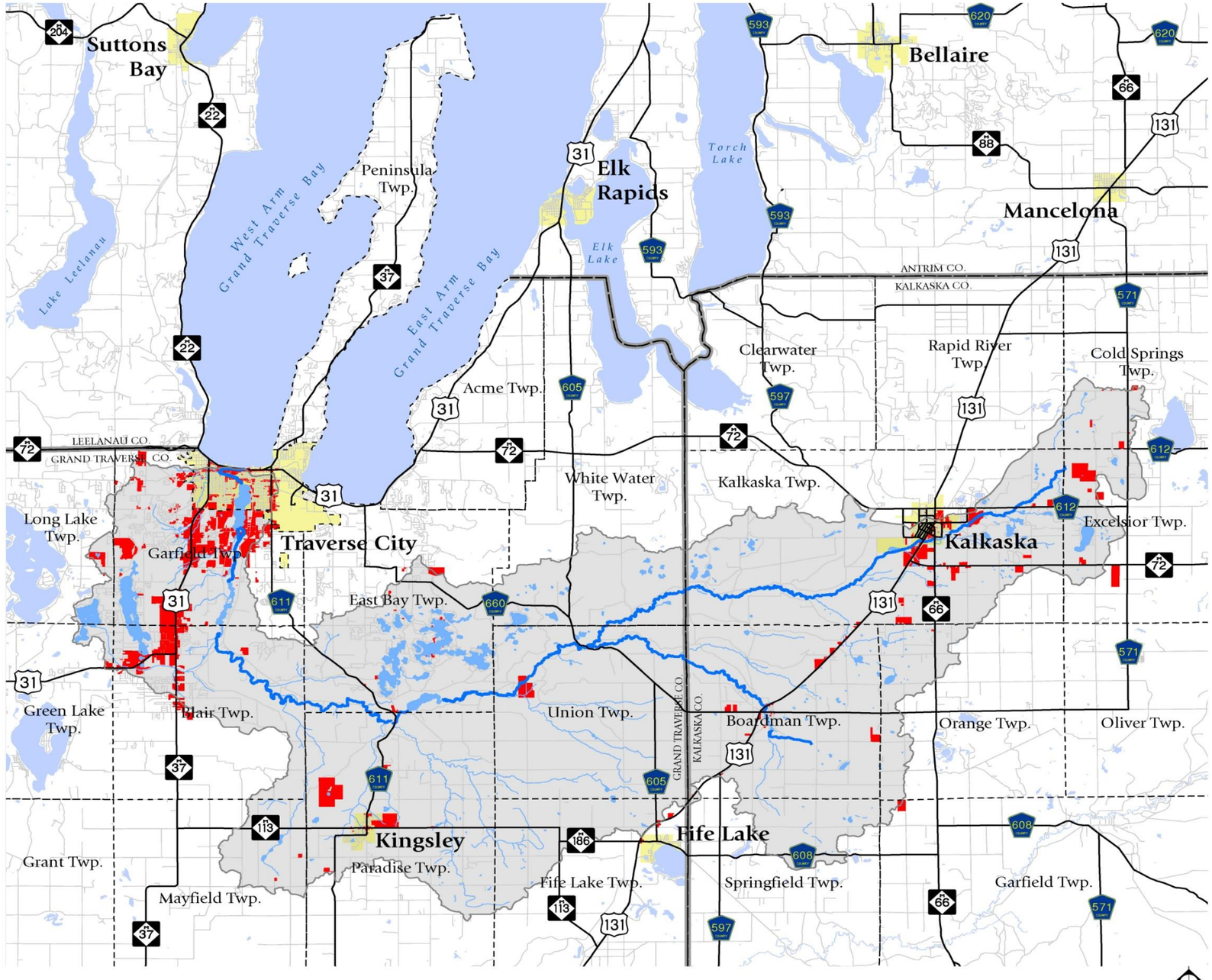


FIGURE 9. Commercial Activity in the Boardman River Watershed

SOURCE: Beckett & Raeder Inc., 2012, using parcel data from Kalkaska and Grand Traverse counties

Oil and gas extraction has also played a significant role in the watershed and its local economies, particularly in the central and northeastern portions of the watershed as shown in Figure 10. There has been significant investment in related oil and gas exploration infrastructure, including access roads. However, the extraction of oil and gas has also caused significant natural resource impacts within the watershed. This includes groundwater contamination, terrestrial habitat fragmentation related to the placement of access roads and utility lines, and surface water quality impacts related to undersized culverts at road crossings resulting in sediment deposition and blocked aquatic organism passage.

2.8 COMMUNITY AND QUALITY OF LIFE

Population Overview

The Boardman River watershed has seen significant population changes over the last 30 years. The most dense population areas in the watershed are clearly in Traverse City, its surrounding townships, and the Village of Kalkaska, with densities reaching up to 1,730 people per square mile in some of these areas (TWC 2005). As Table 12 shows, population in the greater Boardman River watershed region (Grand Traverse and Kalkaska counties) started increasing rapidly in the 1970s, with Kalkaska County's population increasing by 156 percent between 1970 and 1990. Since 1990, the populations of both Grand Traverse and Kalkaska counties have continued to grow, although the most recent decade saw a slowing of previous growth. Both counties saw a greater rate of growth than the state of Michigan during the periods 1991-2000 and 2001-2010, and even in the most recent census, Grand Traverse County had greater population growth than the United States as a whole (U.S. Census Bureau 2010).

TABLE 12. Population Change for Grand Traverse and Kalkaska Counties

	Population change (%)				Population
County	**1951–1970**	**1971–1990**	**1991–2000**	**2001–2010**	**2010**
Grand Traverse	37.0	64.1	20.8	12.0	86,986
Kalkaska	14.7	156.0	22.8	3.5	17,153

SOURCE: U.S. Census Bureau, 2010

The population in both counties is predominantly white (95 percent in Grand Traverse County and 97 percent in Kalkaska County). Grand Traverse has a highly educated population, with over 90 percent high school graduates and almost 30 percent of the population having a bachelor's or higher degree. Kalkaska's population has slightly lower education levels, with 85 percent of the population having graduated from high school and only 12 percent having attained a bachelor's or higher degree.

Median income in Grand Traverse County is $50,629 and the percentage of the population in poverty is almost 10 percent. In Kalkaska County, median income is $39,350 and the percentage of the population in poverty is 17 percent (U.S. Census Bureau 2010).

THE BOARDMAN RIVER WATERSHED

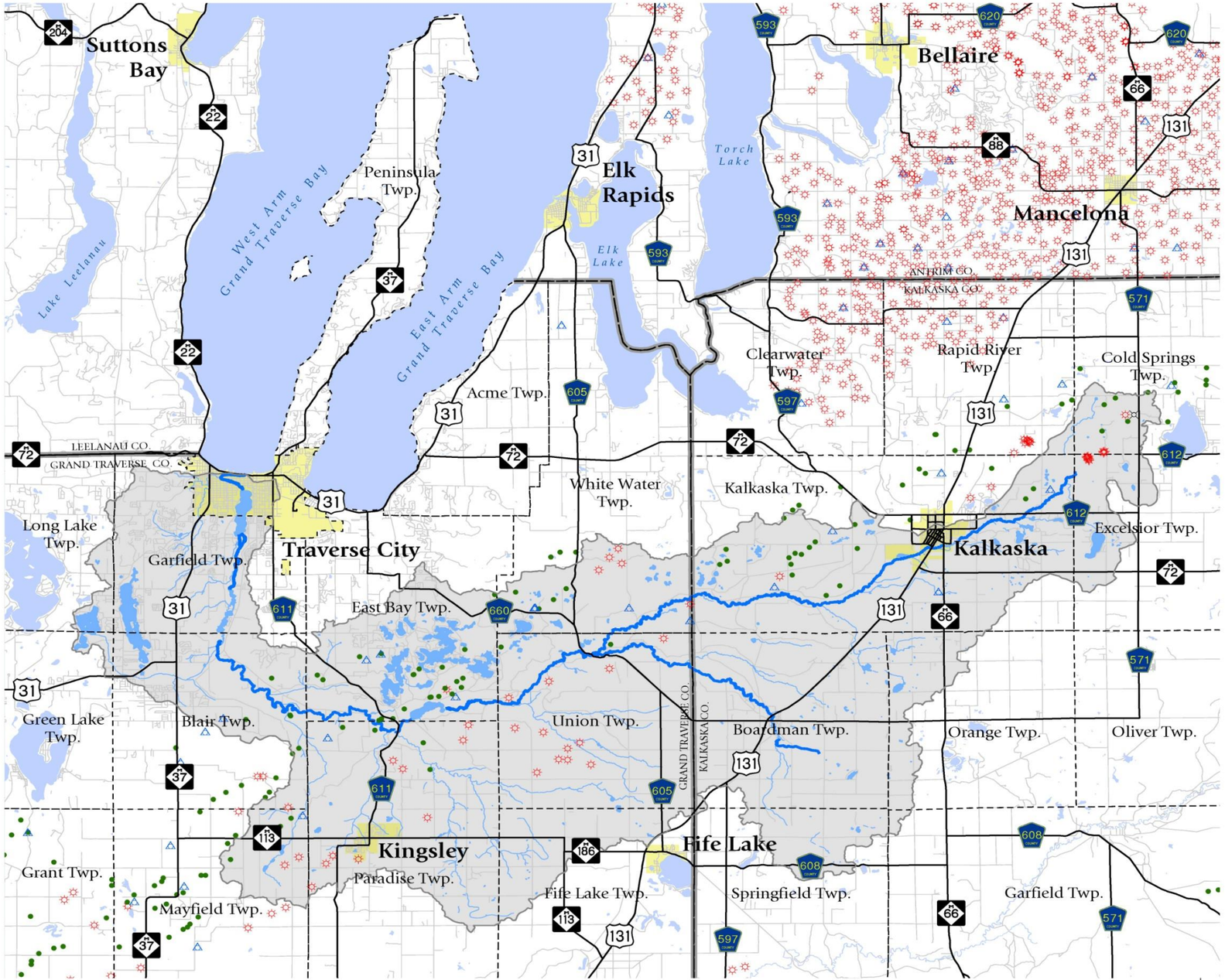
Active Oil and Gas Wells

Data Sources: Michigan Geographic Data Library, Michigan DNR

- Boardman River Watershed
- City or Village
- County Boundary
- Township Boundary
- Major Road
- Minor Road
- Boardman River

Well Type:

- Gas Well
- Oil Well
- Brine Disposal Well



SOURCE: Beckett & Raeder Inc., 2012

FIGURE 10. Active Oil and Gas Wells in the Boardman River Watershed

Governance

The Boardman River watershed falls within two counties (Kalkaska and Grand Traverse), 17 townships, and three municipalities (Table 13). This overlap of governance – with multiple systems of community and resource planning, zoning, and economic development – necessitates close coordination among jurisdictions for the management, protection, and leveraging of the watershed's abundant natural, cultural, and economic resources.

TABLE 13. Boardman River Watershed Municipal Jurisdictions

Township or Municipality	County	% of Municipality in Watershed	Total Population in Each Jurisdiction*
Union Township	Grand Traverse	100.00	349
Village of Kingsley	Grand Traverse	100.00	1,568
Boardman Township	Kalkaska	97.62	1,500
Garfield Township	Grand Traverse	75.02	16,123
Village of Kalkaska	Kalkaska	70.79	2,010
Paradise Township	Grand Traverse	66.26	4,723
Kalkaska Township	Kalkaska	62.39	4,546
East Bay Township	Grand Traverse	56.66	10,933
Blair Township	Grand Traverse	51.46	8,297
City of Traverse City	Grand Traverse	43.59	13,893
Fife Lake Township	Grand Traverse	30.08	1,399
Whitewater Township	Grand Traverse	28.45	2,673
Orange Township	Kalkaska	23.24	1,340
Excelsior Township	Kalkaska	21.83	933
Springfield Township	Kalkaska	20.86	1,407
Mayfield Township	Grand Traverse	19.57	1,518
Coldsprings Township	Kalkaska	13.63	1,510
Long Lake Township	Grand Traverse	6.84	8,885
Green Lake Township	Grand Traverse	2.64	5,541
Rapid River Township	Kalkaska	1.84	1,151

*U.S. Census Bureau 2010-2014 American Community Survey 5-year Estimates

SOURCE: Compiled using data from Networks Northwest (http://www.networksnorthwest.org/main-site/), formerly called the Northwest Michigan Council of Governments

Land Ownership

The Boardman River watershed includes large tracts of public and quasi-public lands, including the Pere Marquette State Forest and lands owned by Grand Traverse and Kalkaska counties, the City of Traverse City, individual townships, nonprofit organizations like Rotary Camps and Services, and land conservation groups. Figure 11 shows the public land holdings within the watershed. Over 59,000 acres of public land are located in the watershed. This large amount of publicly owned land provides significant recreational opportunities within the watershed, attracting thousands of visitors every year, and adds significantly to the highly cherished quality of life that makes this area such a desirable place to live.

THE BOARDMAN RIVER WATERSHED

Publicly Owned Property

Data Sources: Michigan Geographic Data Library, Michigan DNR, Grand Traverse and Kalkaska Equalization, Grand Traverse Conservation District, Grand Traverse Regional Land Conservancy

- Boardman River Watershed
- County Boundary
- Township Boundary
- Major Road
- Minor Road
- Boardman River

Public Land Owned By:

- State
- County
- Local Municipality
- Rotary Camp
- Local Conservancy

Only public land located within 1000ft from the watershed are represented

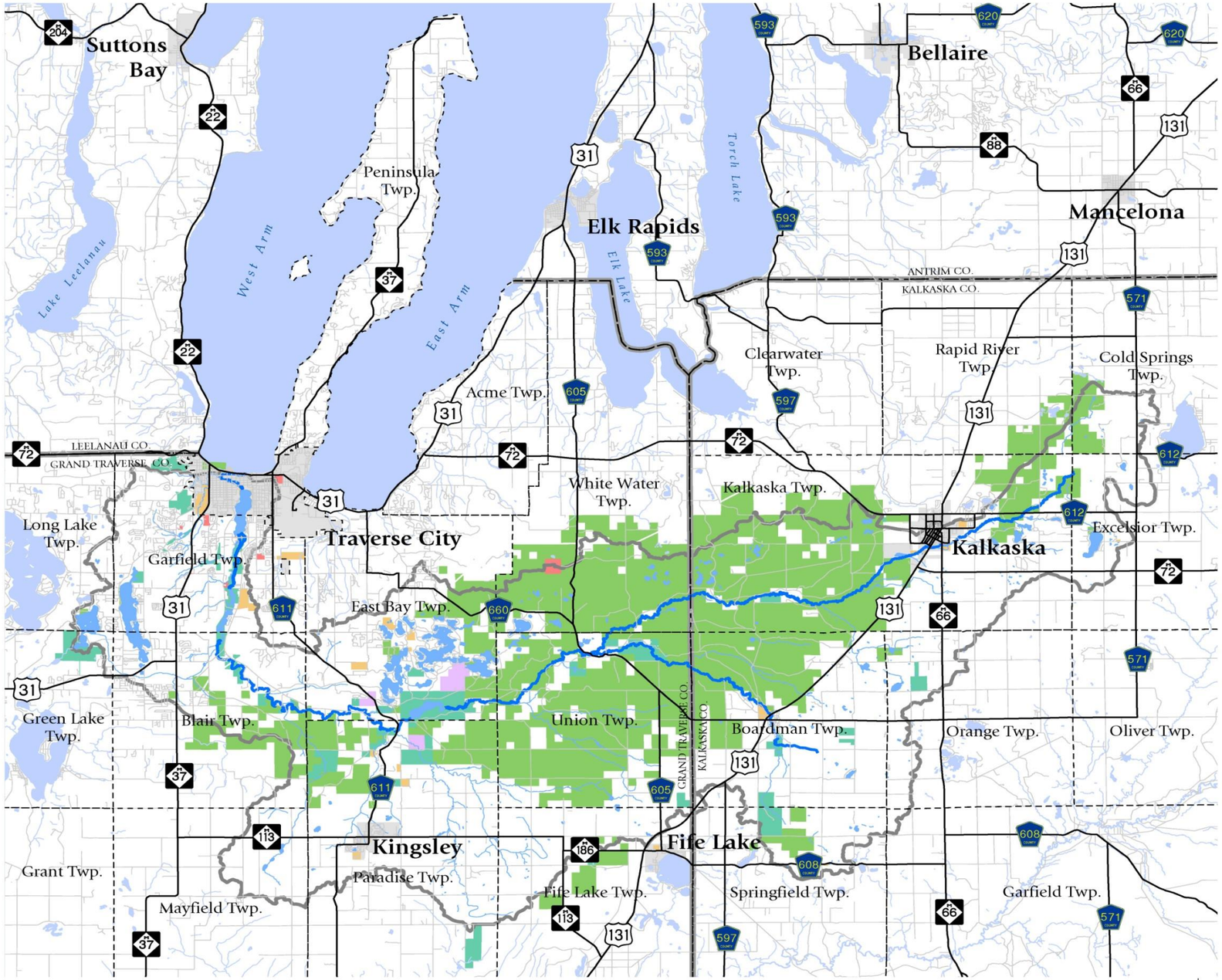


FIGURE 11. Public Land Holdings in the Boardman River Watershed

SOURCE: Beckett & Raeder Inc., 2012, using parcel data from Kalkaska and Grand Traverse counties

Recreation Activities

The Boardman River watershed is rich in recreation resources and offers opportunities for numerous water- and land-based recreational activities including canoeing, kayaking, fishing, hiking, biking, snowmobiling, snow shoeing, cross country skiing, camping, horseback riding, hunting, wildlife viewing, and photography, to name a few.

As stated previously in this chapter, fishing is one of the more popular recreational activities in the watershed. The watershed offers a variety of fishing experiences, including outstanding brook and brown trout fishing throughout the Boardman River system, and great warmwater species fishing in the many inland lakes. Rainbow trout (steelhead), Chinook and Coho Salmon are found lower in the watershed where it adjoins Lake Michigan. Farther upstream, the Boardman River is rated among the top 10 trout streams in Michigan, and contains 36 lineal miles of Blue Ribbon trout stream. According to a socioeconomic study completed by Veritas Economic Consulting, the annual number of angler days on the Boardman River ranges from 21,000 to 33,000 (Veritas 2008).

On-water recreational activities such as kayaking and canoeing have been growing in popularity over the years. According to Trails.com, the Boardman is a

> spirited, attractive stream that flows past conifer forests and north-country cottages before emptying into Grand Traverse Bay. The Boardman ranks as one of the Lower Peninsula's finest rivers for paddling. Possessed of a moderate current and a winding river corridor that passes through a broad valley of cedar, pine, and assorted hardwoods, it also features one of Lower Michigan's rare bursts of light whitewater (Trails.com 2007).

Additionally, an extensive trail network crisscrosses many parts of the watershed, particularly the north and central part around Ranch Rudolf and extending east (Figure 12). The watershed is a juncture for a major multistate trail system (The North Country Trail) and a cross-state horse riding/hiking trail system (Shore-to-Shore Trail). Other significant trail systems include the Grand Traverse (motor) Cycle Trail, Muncie Lakes Pathway, Sand Lakes Quiet Area, and Boardman Valley Snowmobile Trail (Johnson Hill/Greenway 2001). Most recently, TART is working on the third phase of the Boardman River Trail that, when finished, will follow the river valley 24 miles from Traverse City to the North Country Trail.

Photo courtesy of TART Trails

In addition, the Grand Traverse Conservation District manages 3,000 acres of public land contained in 10 different parklands, many of which straddle or are located adjacent to the Boardman River.

A more detailed analysis of recreation activities is provided in Chapter 7, Community Quality of Life Uses and Issues, including a description of existing resources and potential recreation opportunities under post-dam removal scenarios.

THE BOARDMAN RIVER WATERSHED

Recreation Trails

Data Sources: Michigan Geographic Data Library, Michigan DNR, Grand Traverse Conservation District, Traverse Trails, Michigan Trail Riders Association, North Country Trail Association

- Boardman River Watershed
- City or Village
- County Boundary
- Township Boundary
- Major Road
- Boardman River

Trail Type:

- Non-Motorized
- Equestrian
- Off Road Vehicle
- All Terrain Vehicle
- Motorcycle
- Snowmobile
- Michigan Cross Country Cycle

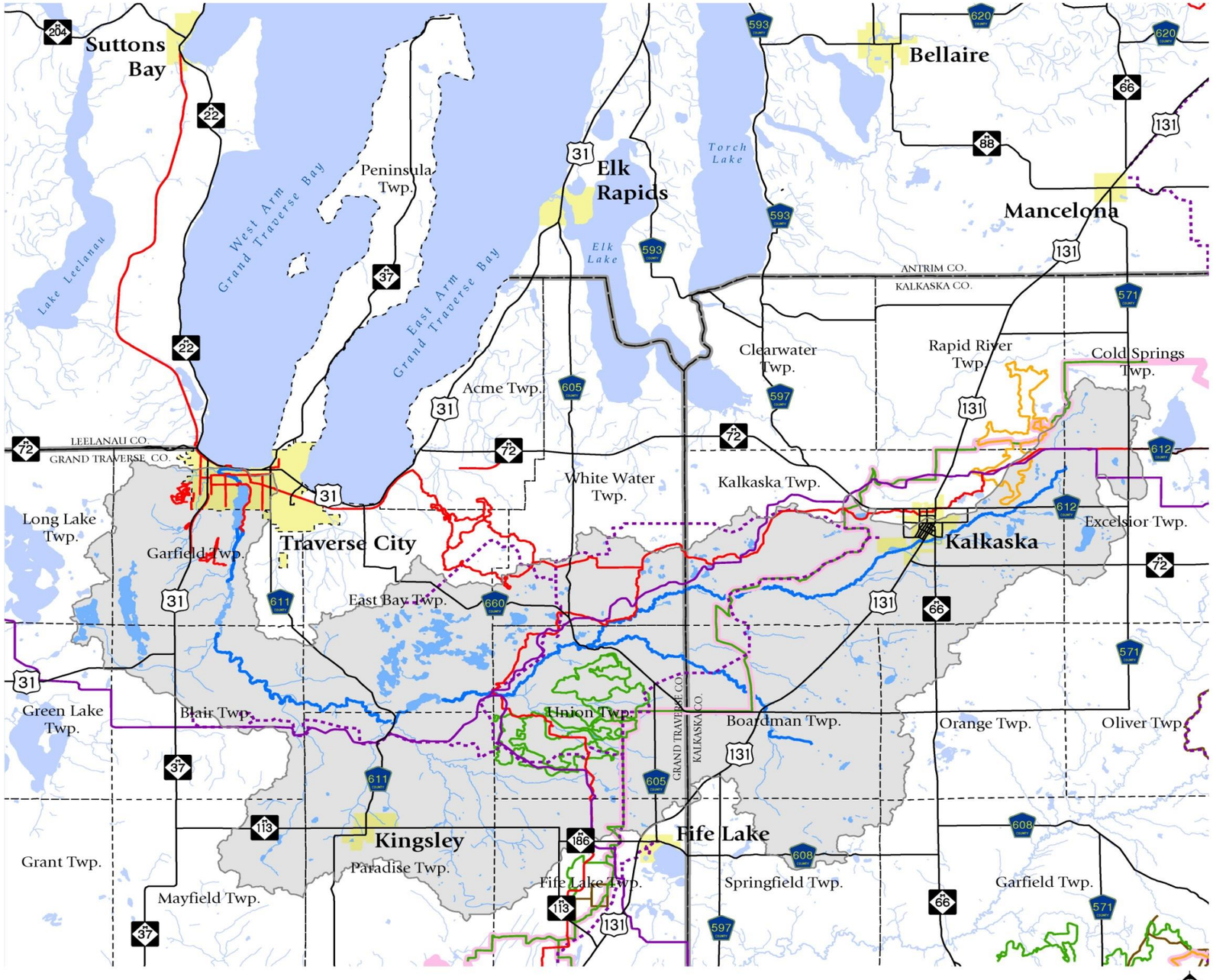


FIGURE 12. Major Boardman River Watershed Recreation Trail Systems

SOURCE: Beckett & Raeder Inc., 2012, using data from TART Trails, Grand Traverse Conservation District, Michigan Trail Riders Association, North Country Trail Association, and local government parcel data. There are additional smaller and informal trails throughout the watershed, particularly hiking trails in and around the Brown Bridge area and Boardman River Nature Center.

Chapter 3. Local Ordinances Impacting Water Quality

In addition to state and federal laws and regulations that impact water quality, local governmental entities may adopt ordinances that directly or indirectly impact water quality. Along the Boardman River, there are two counties, 16 townships, one city, and two villages. Each of these governmental entities has the authority to regulate, a variety of activities that may improve or degrade water quality within their respective jurisdictions. In particular, local governments regulate land use, construction activities, runoff, and wastewater discharges through a combination of planning, zoning, soil erosion, stormwater, and septic ordinances. This chapter first provides a description of the types of local ordinances that contribute to water quality protection within the Boardman River watershed, then considers the contents of those ordinances for the municipalities within the watershed.

3.1 ORDINANCES IMPACTING WATER QUALITY PROTECTION

Municipal Planning & Zoning

Land use activities and decisions have great potential to affect local water quality. Local land use is regulated through master plans and zoning ordinances. Overall, master plans and zoning ordinances are enacted to protect the use of a property and ensure the public's safety, health, and welfare.

A master plan is a comprehensive set of a community's long-term goals and policies that are intended to guide development decisions. The master plan guides zoning decisions (including special land use and site plan reviews); capital improvement programs; special programs such as economic development, parks, trails, and gateway improvements; and leveraging financial support for community efforts.

Zoning is a tool for making master plans a reality. Zoning is regulatory and provides specific enforceable standards. Zoning ordinances regulate the permitted uses of the land, including, for example, maximum impervious surface coverage, lot size, and setbacks from neighbors, roads, and water bodies. How communities make and implement these land use provisions has a direct impact on the community's water resources.

Since protecting water quality requires consideration at what happens on land, master plans and zoning ordinances are important watershed management tools.

Master Plans

Michigan law requires local planning commissions to adopt a master plan to guide development and public capital improvements within the jurisdiction. In addition, the planning commission is obligated to update the master plan every five years. The master plan may be developed at a county level and followed by individual townships in the county (as several townships in Kalkaska County have done), or may be developed on a township-by-township basis.

A master plan is intended to help ensure that development is coordinated, harmonious, efficient, and economical, considering the character of the community and the suitability of particular uses. In addition, the master plan is intended to ensure that future development will be in accordance with the community's present and future needs and will promote public health, safety, morals, order, convenience, prosperity, and general welfare. It is through the municipality's master plan that the community's goals and vision are established.

The master plan in turn guides zoning decisions as well as community capital improvement projects. Municipalities with a master plan must adopt an annual capital improvement program for all agencies and departments within the municipality, which guides public structures and improvements. The capital improvement project identifies the structures and improvements, along with their relative priority, that will be needed or desired in the ensuing six-year period. In addition, public entities may not undertake a new street, park, playground, open space, public building, or other structure in a community with a master plan without first obtaining planning commission approval.

Through the master plan and capital improvement plan process, a community may identify and prioritize water quality improvement and protection goals. For example, a master plan may identify protecting water quality as a community goal, and then identify specific ordinance and infrastructure projects to achieve that goal. A master plan is adopted and amended through a public process that includes coordination with other municipalities, open meetings, and public input. The capital improvement program is also adopted in a public forum. As a result, the process of adopting and amending a community's master plan and capital improvement program offer an opportunity for stakeholders to identify, prioritize, and plan for water quality protection measures in the community in a way that is consistent with watershed management goals.

Table 14 identifies the municipalities in the Boardman River watershed that have adopted a master plan, including when it was last updated.

TABLE 14. Boardman River Watershed Jurisdictions with Master Plans

Township or Municipality	Master Plan	Last Updated
Grand Traverse County	**yes**	**2013**
Blair Township	yes	2009
East Bay Township	yes	2009
Fife Lake Township	yes	2011
Garfield Township	yes	2007
Green Lake Township	yes	2011
Long Lake Township	yes	2005
Mayfield Township	yes	unknown
Paradise Township	yes	2014
Union Township	yes	unknown
Whitewater Township	yes	2000
Village of Kingsley	yes	2007
City of Traverse City	yes	2009
Kalkaska County		
Village of Kalkaska	yes	2011
Townships: Boardman, Coldsprings, Excelsior, Garfield Kalkaska, Orange, Rapid River, Springfield	yes	2010

SOURCE: Municipalities' Master Plans, online (2016)

Zoning Ordinances

A zoning ordinance is adopted to establish the permissible uses of property within the municipality. As it relates to water quality, a zoning ordinance may impose vegetative buffer zones along bodies of water, require greenbelt areas, protect the integrity of soil by having filtered views along stream corridors (protect banks from erosion), protect wetlands, limit impervious areas, and even address stormwater

management. In other words, zoning can be used effectively for managing land uses in a way that is compatible with watershed management goals.

Zoning may be implemented at the township, city, or village level of local government, or it may be done at the county level. Both approaches are used within the Boardman River watershed. In Grand Traverse County, each township, the Village of Fife Lake, and the City of Traverse City administer their own zoning ordinances. In Kalkaska County, several townships rely on the County to administer their zoning, including Coldsprings, Excelsior, Kalkaska, Orange, and Springfield townships. The Village of Kalkaska and Boardman Township administer their own zoning codes.

No two zoning ordinances are the same; each is inherently unique because each community determines the exact combination of land uses (*e.g*., commercial, residential, open space), density, setbacks, and other tools to implement their desired developmental goals. In addition, zoning ordinances may be amended regularly. As a result, it would be inappropriate to catalogue every relevant provision in each zoning ordinance of each municipality in the watershed.

Several of the townships and villages within Grand Traverse County have specific zoning classifications or special overlay districts for the protection of environmentally sensitive areas, particularly lakes, streams, and rivers. For example, East Bay Township has Mitchell Creek, Baker Creek, and Forest Lakes overlay districts, as well as a Boardman River zone. In the Mitchell and Baker Creek Overlay, projects have more stringent setback requirements from waterbodies (100 feet versus 50 feet), and require wider vegetative buffer areas. In the Forest Lakes Overlay, properties within 500 feet of Arbutus, Spider, Rennie, High, Chandler, Vandervoight, Indian, Perch, Spring, George, Tibbets, and Bass lakes must limit impervious surfaces to only 20 percent of the site, cannot develop on steep slopes, and are required to maintain 80 percent natural vegetative cover from the high water mark to a 30-foot setback and 50 percent vegetative cover between 30 and 50 feet from the water's edge.

Traverse City and Blair Township have provisions regarding bicycle parking and pedestrian orientation and connectivity. Fife Lake requires greater parcel size and a lower maximum development percentage for properties in the Forest Recreational and Agriculture Districts. The Village of Kingsley has a Forest/Parks/Recreation District, which is an area exclusive of residential, commercial, or industrial growth to preserve the natural features of the village and to provide for the recreational needs of the community. Union Township has adopted an open space ordinance that encourages the protection of natural vegetation and other natural resources on-site.

Table 15 provides a summary of the current zoning provisions that relate to the protection of aquatic and other natural resources in each municipality in the Boardman River watershed.

TABLE 15. Boardman River Watershed Jurisdictions with Water Quality-Related Zoning Ordinance Provisions

Township or Municipality	Setback from Water/Vegetated Strips	Other Water Quality Provisions
Kalkaska County		
Boardman Township	• Natural River Overlay (incorporates Natural Rivers restrictions discussed below) • Water setback ranges from 30 to 60 feet depending on high water	• No salvage yards or waste disposal sites allowed within 200 feet of waterbodies
Garfield Township	• All buildings and structures on waterfront lots within the Natural Rivers District must have a minimum setback of 100 feet • Setbacks not within the Natural Rivers District shall have a minimum of 50 feet • Exceptions to this would be in the case of high banks that would exceed 10 feet vertical height from the high water mark to the brink of the bank	• For Special Use Permits, projects must retain natural features of the landscape, particularly where they help control erosion or the discharge of stormwater • For Special Use Permits, project must address the relationship to shore and stream preservation principles where appropriate • Any accessory building proposed to have a height over 10 feet at the side wall, or a maximum height of more than 16 feet, to be built on a lot or parcel of land bordering on any stream, river, or other body of water shall have a concrete slab floor and shall be subject to obtaining a Special Land Use Permit as provided in Article 13
Rapid River Township	• 60 feet for all waterfront lots, except the waterfront setback may be decreased 1 foot for every 1 foot of rise in bank height above the water's edge up to a distance of 30 feet • On waterfront lots, a strip of land extending a minimum of 50 horizontal feet from the water's edge will be maintained and forested with trees and shrubs, or in no less than its natural and undeveloped state • No terrain shall be altered or vegetative cover be removed from any land abutting swamps, lakes, rivers, streams, or other natural water bodies, for a distance of 25 feet from the edge of the highest known water level without a Special Use Permit	• No junk yards, salvage yards, or refuse dumps shall be located less than 200 feet from any swamp, lake, river, stream, reservoir, or pond
Townships: Coldsprings, Excelsior, Kalkaska, Orange, Springfield	• Waterfront lots outside of Natural Rivers areas must have waterfront setback of 60 feet, which may be decreased 1 foot for every 1 foot of rise in bank height above the water's edge up to a distance of 30 feet • Minimum waterfront setback on the designated portions of Natural Rivers is 100 feet • Must maintain 50-foot vegetative buffer around water bodies for Natural Rivers areas; that setback is encouraged outside of Natural Rivers areas • Special use permits are required for any land alteration within 25 feet of water's edge • Incorporates Natural Rivers provisions (see discussion below)	• Lakefront residential District for waterfront lots on lakes includes provision (*e.g.* lot sizes) to protect water quality

Township or Municipality	Setback from Water/Vegetated Strips	Other Water Quality Provisions
Village of Kalkaska	• None in zoning ordinance (see Natural Rivers discussion below)	• As part of Site Plan Review, provisions must be made for a feasible storm drainage system, the construction of stormwater facilities, and the prevention of erosion and dust • Maximum percentage of a lot that can be developed is 30% for residential, 100% for commercial, and 60% for industrial
Grand Traverse County		
Blair Township	• 100-foot setback from ordinary high water mark and 50 feet from the crest of a bluff in the Boardman Valley District (comprised of the Boardman River, Beitner Creek, Jaxon Creek, and the designated tributaries) • 50-foot vegetation buffer strip in Boardman Valley District	• Recreation Conservation District limits impervious surface to 10% • No stream alteration or mineral extraction in Boardman Valley District • Minimum lot size in Recreation Conservation District is 5 acres • Lot coverage maximums are 66% of property
City of Traverse City	• Setback from water varies by district; generally 50-foot setback on Boardman Lake, 25-foot setback or 10 feet from waterline or established dockline along parts of Boardman River • Some areas (D-2, south of 8th Street) have no apparent water setback	• Lot coverage (impervious surface) limitations vary widely by district; 45% in residential areas, up to 100% in commercial areas • Site Plan Review allows the Planning Commission to impose conditions to protect the natural environment • Landscaping provisions require preservation of existing trees and shrubs within setbacks, up to critical root zone of trees; this provision does not apply in residential areas
East Bay Township	• Minimum setback of 50 feet from waterline • In Boardman River District, setback downstream of former Brown Bridge Dam is 100 feet and upstream is 150 feet • In Boardman River District, 75-foot buffer strip upstream of former Brown Bridge Dam and 50-foot required downstream • In Mitchell and Baker Creeks Overlay District100-foot setbacks required from the streams and their tributaries • 100-foot buffer strips maintained along Mitchell and Baker creeks and their tributaries; chemical control of vegetation not allowed in buffer area • In the Forest Lakes Overlay District, 50-foot buffer strip required	• Open Space Preservation Subdivisions require at least 50% of the parcel remain perpetually in an undeveloped state by means of a recorded legal instrument • Minimum lot size from 5,500 square feet to 5 acres; any property without central water/sewer requires 40,000 square feet • Lot coverage maximums are 15% in professional office district and 50% in industrial district • Deck may project up to 10 feet into water setback if stated criteria are met • Landscaping provisions restrict vegetation removal in all but single-family detached developments • Forest Lakes Overlay District includes restrictions on impervious surfaces, development

Township or Municipality	Setback from Water/Vegetated Strips	Other Water Quality Provisions
		on slopes, buffer strip, artificial beaches, landscaping, shoreline structures, and waterside decks
Fife Lake Township	• 50 feet for properties on Fife Lake	• Open Space Preservation Development options available that require at least 50% of the parcel remain perpetually in an undeveloped state by means of a recorded legal instrument • Lake Residential District requires 20% maximum lot coverage • As part of Site Plan Review, the use must be served by necessary storm drainage
Garfield Township	• 50 feet from the watermark for roads, single-family residences, and structures on Silver and Boardman lakes • 75 feet from the watermark or normal stream bank for commercial, industrial, or multifamily housing • Stormwater retention/detention ponds set back 50 feet from lake or stream bank • 25-foot setback from wetlands • 35-foot vegetated buffer strip is required along the water of lake or stream shorelines	• Lot coverage maximums are 35% except in the commercial districts • By special permit in the Agricultural District, stormwater containment on split-zoned properties to support non-agricultural uses, provided Low Impact Development standards are used • Site plans should preserve existing trees greater than three inches in caliper whenever feasible • Requires 10-foot no-build buffer strip for landscaping, screening, or drainage on perimeter of parking areas, drives, and alleys • No grading or removal of vegetation on slopes greater than 20% • Restrictions on filling and grading within 200 feet of water mark or stream bank along any lake, river, stream, or water body
Green Lake Township	• 60-foot setback from water's edge	• Decks may extend into waterfront setback if development restrictions are met • Lake Residential District imposes density (1 unit/acre) and other restrictions • Site Plan Review requires adequate drainage structures and limited impervious surfaces • No storm water runoff from site development, design, or other alterations may collect or stand on the surface, except in a natural wetland or properly managed and maintained stormwater retention system or sediment pond • Amount of runoff leaving a parcel after use or development cannot exceed that of the parcel in its original natural state

Township or Municipality	Setback from Water/Vegetated Strips	Other Water Quality Provisions
Long Lake Township	• Natural Lakefront District requires 100-foot setback from water • In the Natural Lakefront District, there are restrictions on vegetation removal, grading, and filling within 50 feet of the water • In the Natural Lakefront District, there is a 50-foot buffer strip requirement with additional limitations on the types of vegetation within the strip • Low Density Residential and Lake Residential districts require 50-foot setback from water	• Waterside decks permitted within 50 feet of water when development standards are met, including requirement for 30-foot native vegetation strip • Natural lakefront district requires two-acre minimum lots, 200-foot minimum lot width, and 100-foot setback from the waterbody • Natural features inventory completed for the township; site plans must demonstrate as many natural features as possible have been retained or protected in accordance with designated natural features priority levels • Low density and lake residential districts are 10,000 square feet (with community wastewater) and one acre (without community wastewater) • Moderate density residential district is 10,000 square feet (with community wastewater) and 20,000 square feet (without community wastewater) • Soil erosion and stormwater runoff plan required for extension of nonconforming building in the lakeside setback
Mayfield Township	• Agriculture District requires 60-foot setback of any building from the ordinary high water mark	• Landscape requirements for light industrial, commercial, and planned unit developments, including greenbelt buffers; does not require native vegetation • No gravel/soil removal or mining extraction operations within 100 feet of water • Roads must have sufficient stormwater control measures • Site Plan Review requires retaining natural features, particularly when they help control erosion and stormwater runoff
Paradise Township	• In the Natural River District (includes Boardman River and Jaxon Creek), setback of 100 feet from water and 50 feet from crest of a bluff • In the Natural River District, 50-foot vegetative strip with native vegetation	• Minimum lot size is 2.5 acres • Lot coverage maximums are 50%; in the Natural River District, lot coverage limited to 15% • Prohibition of composting facilities on wetlands • Site plans required to review impacts of storm water discharge • Site Plan Review requires retaining natural features, particularly when they help control erosion and storm water runoff

Township or Municipality	Setback from Water/Vegetated Strips	Other Water Quality Provisions
		• Private roads require drainage collection/storage
Union Township	• Natural Rivers zoning provisions	• Site Plan Review requires a showing that the use will provide adequate storm drainage
Whitewater Township	• Natural Rivers zoning requires 100-foot setback along Boardman River and tributaries and 50-foot vegetation buffer	• Site Plan Review requires on-site water management
Village of Kingsley	• 25-foot vegetated buffer along streams • Setback of 50 feet from the water line or 25 feet from the high water mark of any water body for waterfront lots • Requires 25-foot vegetative strip of native vegetation along the shore of all water bodies	• No docks along rivers and streams • Site Plan Review requires buildings and structures to preserve environmentally sensitive areas • Site Plan Review requires minimizing the discharge of stormwater • Site Plan Review requires retaining natural features, particularly when they help control erosion and stormwater runoff • Site Plan Review requires stormwater management system and facilities to preserve natural drainage and to protect against pollution and flooding on and off site

SOURCE: Municipalities' Zoning Ordinances, online (2016)

Natural Rivers Restrictions

The Boardman River is a designated Michigan Natural River, one of 16 in the State (Chapter 2.3, Figure 7). This designation brings special protections to preserve and enhance water quality, recreation opportunities, and fisheries and wildlife habitat. For property along Natural Rivers segments of the Boardman River and its tributaries, there are additional setbacks and development restrictions. The Michigan Natural River program is administered by the Michigan Department of Natural Resources (MDNR) under Part 305 of the Natural Resources and Environmental Protection Act, known as the Natural Rivers Act (MCL 324.30501 *et seq*). MDNR has designated numerous sections of the Boardman River and tributaries under the Natural Rivers Program.

Along the designated Natural Rivers segments of the Boardman River and its tributaries, 400 feet on either side of each stream segment are in the Natural River Zoning District. Within this 400-foot district, new industrial and most commercial uses (except forest plantations and agricultural crop farms) are prohibited; only single-family dwellings are permitted. New subdivisions within the Natural River District must have a minimum lot size of 200 feet in width by 200 feet in depth. Table 16 describes setback requirements within the Natural Rivers District.

TABLE 16. Boardman River Natural River District Setback Requirements

River Segment	Building Setback	Minimum Lot Width	Natural Vegetated Buffer	Septic System Setback
Mainstem	150 feet	200 feet	75 feet	100 feet
Tributary	100 feet	200 feet	50 feet	100 feet

**setback distances are measured from the ordinary high water mark on each side of the river*

SOURCE: MDNR Boardman River Natural River Plan, Adopted Feb. 1976, amended rev. March 12, 2012

In addition, alteration of the stream channel and building in floodplains and wetlands within the Natural River District is prohibited. Utilities (including pipelines and transmission lines) are also generally prohibited within the Natural River District or to cross the designed river and tributaries. Signage within the district is restricted. MDNR standards also address timber harvest, oil and gas activity, public access, riverbank stabilization and fisheries habitat projects, and management of public lands along the designated tributaries and mainstream.

Where the Natural Rivers District is located in a municipality with local zoning, the Natural River setbacks and standards are incorporated into and administered as part of the zoning ordinance (discussed above). MDNR staff review local ordinance language amendments, comment on variance requests, and assist in compliance activities when needed. Locally zoned areas are routinely monitored to ensure uniformed administration within each river system.

Soil Erosion Program

Earth change activities such as digging, land clearing, and construction-related activities have a significant potential to cause soil erosion that may pollute water bodies. Earth change activities along the Boardman River are regulated by both state and county regulations.

The MDEQ administers Part 91 of the Natural Resources and Environmental Protection Act, known as the Soil Erosion and Sedimentation Control Act (MCL 324.9101 *et seq*). The primary intent of Part 91 is to protect waters of the state and adjacent properties by minimizing soil erosion and controlling off-site sedimentation. The MDEQ maintains an oversight role of the soil erosion programs in Grand Traverse and Kalkaska counties to ensure their compliance with the requirements in Part 91.

In Grand Traverse County, soil erosion regulations are administered by the Soil Erosion and Sedimentation Control Department. Grand Traverse County adopted a Soil Erosion and Sedimentation Control Ordinance (Grand Traverse County 2012). Under this ordinance, a permit is required for earth changes that disturb one or more acres; are within 500 feet of a lake, stream, wetland, and certain drains; are on steep slopes (>20%); or are on clay-type soils. The ordinance also includes waivers and exemptions from the permit requirement and provisions addressing the contents of permit applications, inspections, appeals, and other requirements.

In Kalkaska County, soil erosion regulations are administered by the Soil Erosion Officer in the Planning and Zoning Department. Kalkaska County administers its soil erosion program through state regulations, MDEQ Administrative Rules Part 17 (MDEQ R 323.1701 *et seq*). Under MDEQ Rules, a permit is required for earth change that disturbs one or more acres or is within 500 feet of a lake or stream. In addition, the rules provide for waivers and exemptions, application contents, inspections, appeals, and other requirements.

Even for earth changes that do not require a permit, state law requires a landowner who makes earth changes that may result in soil erosion or sedimentation to waters of the state must install and maintain soil erosion and sedimentation control measures. In other words, all earth changes that may result in discharges to the Boardman River or its tributaries must install erosion control measures.

Stormwater Ordinances

Stormwater runoff from developed sites is a significant source of pollutants in the Boardman River watershed. Stormwater runoff is regulated by both state and local government. From a regulatory perspective, stormwater regulations or ordinances may be distinguishable from soil erosion programs addressed in the section above. Soil erosion regulatory programs generally address soil erosion only during earth changes (activities that involve changing the topography of land; typically construction-related activities). Stormwater regulatory programs generally address runoff from a site after construction and earth change activities are completed. From a practical perspective, there is obviously overlap between these regimes, which results in some complexity and confusion.

Unless a community is designated as a Phase II MS4 community under the Clean Water Act, the MDEQ has a limited role overseeing stormwater programs. To the extent stormwater runoff – whether during construction, from a developed site, from a municipal stormwater system, or otherwise – results in a point-source discharge to a stream, river, lake or wetland, the MDEQ regulates the discharge under the federal Clean Water Act and Part 31 of the Natural Resources and Environmental Protection Act (MCL 324.3101 *et seq*). Point-source discharges are generally required to obtain a National Pollutant Discharge Elimination System (NPDES) permit from MDEQ; depending on the nature of the discharge, the discharger may require an individual permit or a general permit, or it may qualify for a permit by rule.

In addition to the NPDES regulations, several municipalities within the Boardman River watershed have adopted ordinances to address stormwater runoff from property within their jurisdiction. These ordinances generally restrict the quantity of stormwater that may leave a site during a particularly-sized storm event. These ordinances typically apply to new developments and to existing developments that undertake site changes.

As with zoning ordinances, stormwater ordinances are generally unique. In Grand Traverse County, however, there was an historic effort to consolidate the regulation of both stormwater and soil erosion through a single ordinance administered by the county. Through that effort, most townships in Grand Traverse County adopted an identical stormwater ordinance, which was administered by the county together with the soil erosion program. However, since 2012, Grand Traverse County no longer

administers township stormwater ordinances with its soil erosion ordinance, resulting in amendments to township stormwater ordinances.

Well & Septic System Regulations

Many residents within the Boardman River watershed rely on private wells to supply their water and private onsite wastewater systems (septic systems) to manage their wastewater. Statewide, about 30 percent of homes and businesses manage their wastewater through private septic systems, and more than half of the new single-family homes are built with septic systems. When wells are improperly sited or inadequately constructed or maintained, they create risk for groundwater contamination (*e.g.*, broken well caps, abandoned wells, nearby contamination sources). Further, improper sites or inadequate construction or maintenance of septic systems may result in untreated wastewater discharges that may adversely affect local water quality. See Chapter 5.3 – Pollutants of Concern: Nutrients for further discussion about water quality impacts of septic systems. The placement and construction of wells and septic systems are regulated primarily by the county health department, with oversight and guidance from MDEQ. State law does not require post-construction inspections of private wells or septic systems.

Grand Traverse County

A large portion of the Grand Traverse County population is served by municipal water and wastewater treatment rather than on-site disposal. Blair, East Bay, and Garfield townships are part of a master sewer agreement with the City of Traverse City. Garfield and Paradise Townships also have setback requirements for septic systems of 75 and 100 feet, respectively. In Grand Traverse County, the Environmental Health division of the Health Department regulates wells and septic systems through the Environmental Health Regulations (Grand Traverse County Health Department 1990). The regulations provide the minimum standards for the placement, sizing, and installation of wells, septic tanks, and drain fields. As relevant to water quality, the regulations require both a septic tank and its drain field to be at least 50 feet from any potable water supply, well, spring, lake, pond, creek, or other surface water. In addition, the drain field must be at least 4 feet above the maximum high water table. The regulations do not include a post-construction inspection requirement for septic systems. However, in 2008, Long Lake Township adopted a Time-of-Transfer Ordinance (Long Lake Township 2008).

The Long Lake Time-of-Transfer Ordinance requires that the owner of a private septic system must have an inspection report for the system filed with the township and provided to the buyer. The inspection report must provide information about the operational and functional status of the system and whether the system is failing or if failure is imminent. In addition, the inspection report must provide information on available repairs and whether the system is in compliance with the Grand Traverse County Health Regulations. Further, if the inspection report concludes that the system is not in substantial conformance with the Health Regulations the report is forwarded to the Grand Traverse County Health Department.

Kalkaska County

In Kalkaska County, Public Health Department District #10 regulates private well and septic systems through the public health code (District Health Department #10 2008). In addition to regulations for the siting and installation of wells and septic systems, the Health Code includes a Point-of-Sale Evaluation of On-Site Water and Sewage Disposal Systems Ordinance at Chapter 11.

The Kalkaska County point-of-sale code requires private well and septic systems to be inspected and in compliance with the Health Code at the time a property is transferred. If the seller/transferor does not have proof that the septic system has been pumped in the preceding two years, the tank must be pumped prior to the closing of the sale. This program results in significant improvements and upgrades to wells and septic systems and provides the Health Department with information about how the systems are

functioning. While the Kalkaska code has resulted in significant improvements, it does not address failing septic systems outside of the sale of property.

For over a decade there has been dialogue calling for a state-wide inspection standard for private well and septic systems, but that has not yet come to fruition. Coldsprings Township considered developing a Septic Ordinance to address properties in the township with failing septic systems. Other communities in Michigan have developed a code requiring periodic septic system inspections.

3.2 REGIONAL PLANNING EFFORTS

In an effort to coordinate development and address regional inconsistencies, there have been several regional planning efforts that bear mention because of their potential to further watershed management goals.

New Designs for Growth

In 1992, the Northwest Michigan Council of Governments, now known as Networks Northwest, with support from the Traverse City Area Chamber of Commerce, developed an initiative called New Designs for Growth (NDFG). This was a collaboration among community volunteers, planning and design professionals, developers, and governmental representatives. NDFG promotes planning and development best practices that accommodate growth while maintaining quality of life and protecting the high-quality resources in northwest lower Michigan, including the Boardman River watershed communities. As part of this program, NDFG created a Guidebook that includes examples of smart growth development practices that protect valuable natural resources while promoting economic growth and prosperity (NDFG 2008). The guidebooks are used by citizens, developers, and community leaders to better understand local land use and regulations and to more effectively incorporate smart growth principles into local policies and development projects.

Boardman Valley Master Plan

In 2001, East Bay, Paradise, and Union townships worked with the Greenways Alliance and Johnson Hill Associates to develop a master plan for the Boardman River Valley between Garfield Road and Supply Road/Fife Lake Road. The purpose of the plan was to provide a framework for guiding future development in the valley to help protect and retain its rural, wild, and recreational character. The plan emphasized the scenic, unique, and highly desirable nature of the Boardman River Valley and recognized that there could be significant development pressures if the resources were not managed appropriately. The plan made over a dozen recommendations in four interrelated areas: management, conservation and land management, transportation, and recreation. Many of the plan's recommendations, particularly related to recreation, have been incorporated into this Prosperity Plan (Johnson Hill and Associates and The Greenway Collaborative 2001).

The Grand Vision

In 2008, a diverse group of stakeholders came together to complete a regional land use and transportation study for the six-county region of Antrim, Benzie, Grand Traverse, Kalkaska, Leelanau, and Wexford counties. The scope expanded and became the broader Grand Vision, a citizen-led vision for the future of land use, transportation, economic development, and environmental stewardship. Based on three years of community engagement, in which over 15,000 citizens participated, the Grand Vision is built upon and sets out a framework for regional collaboration centered on six guiding principles (Grand Vision Coordinating Committee 2009):

- **Transportation**. A regional multimodal transportation system that supports energy conservation

- **Energy**. Sustainable energy uses in construction, transportation, and economic development
- **Natural Resources**. Protected and preserved water, forests, natural and scenic areas
- **Growth and Investment**. Unique and vibrant communities that strengthen the local economy
- **Food and Farming**. Local farms and regional food systems as a viable part of local communities
- **Housing**. A diverse mix of regional housing choices with affordable option

Participating communities have formed issue networks and have been leveraging resources to implement programs and projects identified through the Grand Vision process. The Boardman River Watershed Prosperity Plan embraces the principles of the Grand Vision, and is one of the regional cooperative efforts to advance the goals of that collaboration.

Boardman River Townships Project

In 2009, as an outgrowth of recommendations in the Grand Traverse Bay Watershed Protection Plan, local communities within the Boardman River watershed developed individual action plans in partnership with The Watershed Center, the Great Lakes Water Studies Institute, and the Grand Traverse Conservation District. Projects were funded by a grant through the MDEQ. Participating communities included:

- Blair Township
- Boardman Township
- East Bay Township
- Garfield Township
- Kalkaska County
- Union Township
- Village of Kalkaska
- Village of Kingsley
- Whitewater Township

These communities and partners utilized a code and ordinance worksheet provided by the Center for Watershed Protection that assists communities throughout the country in assessing impacts on water quality. The worksheet focused on three impact areas: (1) roads and parking lots, (2) lot design and development, and (3) conservation of natural areas. All of the participating communities had some gaps in their ordinances or policies in terms of how well they protected water quality. As a result of the analyses, an action plan was developed for each community that included recommended changes to ordinances and other actions to address Boardman River water quality impacts in these three areas (TWC N.d.). The Watershed Center continues to work with townships, villages, and counties to implement recommended changes as they have updated zoning ordinances and/or approved proposed projects. Suggested actions include:

- **Roads and parking lots**. Roads and parking lot design and development are significantly influenced by the county road commissions and the local fire departments. Suggested actions to protect water quality from these sources focused on reducing parking space numbers and sizes and limiting road width.
- **Lot design and development**. Lot design and development are subject to several zoning ordinances at the local level. These include cluster and open space limitations and limitations to the amount of impervious surface allowed. Shared driveways and subdivision controls were included in some local ordinances. Some required stormwater management plans and requirements for the preservation of natural areas during development. Actions included increasing restrictions on developed space and impervious surface coverage and reducing the use of pavement for driveways. Other actions included the development of stormwater plans where current plans did not exist. Public awareness of proper septic management was also included.

- **Conservation of natural areas**. Where the Boardman River is designated as a state Natural River, a 75-foot riparian buffer along the river is required for any development. Where there is no Natural River designation, those communities added buffer ordinances (between 25 and 50 feet) to provide protection to those sections of the river. In addition, communities included setbacks from wetlands, floodplain protections, and landscaping restrictions in their ordinances. Where it was lacking in existing ordinances, action plans also recommended the addition of floodplain management and protection provisions to local zoning ordinances.

Chapter 4. Designated Uses: Water Quality Problems

4.1 DESIGNATED USES AND WATER QUALITY STANDARDS

Watershed plans approved under Section 319 of the federal Clean Water Act must determine whether or not surface waterbodies within the watershed meet the designated, protected uses specifically identified in the state water pollution control statutes and promulgated rules established consistent with the authority delegated under federal law. That determination includes an assessment of compliance with Michigan Water Quality Standards established to protect those uses. Under Michigan's water pollution control statute (324.3109 Natural Resources and Environmental Protection Act, Act 451 of 1994), discharges to surface waters are unlawful that are or may become injurious to:

- Public health, safety, or welfare
- Domestic, commercial, industrial, agricultural, recreational, or other uses that are being made or may be made of such waters
- Value or utility of riparian lands
- Livestock, wild animals, birds, fish, aquatic life, or plants or to their growth or propagation or the value of fish and game

Michigan water quality rules based on this state law and the federal Clean Water Act establish as a minimum that all waters of the state are designated and protected for the following uses:

- Agriculture
- Navigation
- Industrial water supply
- Warmwater or coldwater fishery
- Other indigenous aquatic life and wildlife
- Partial body contact
- Fish consumption
- Total body contact from May 1 to October 31

In addition, protected uses include the following if identified by the state of Michigan:

- Migratory routes for anadromous salmonids
- Public water supply intakes

Under state rules, both numerical and narrative water quality standards are established for designated and protected uses. In all cases where waters are designated for more than one of these protected uses, the most restrictive water quality standards apply. In the case of the Boardman River watershed, migratory routes for anadromous salmonids (trout and salmon) and coldwater lakes and trout streams would apply as additional protected uses in the Boardman River and its tributaries. There are no public surface water supply intakes in the watershed (MDEQ 2009).

Where water is to be protected for more than one use under these standards, the most restrictive individual standard of designated water use applies. Also, if existing water quality is superior to the designated use requirements, it must be maintained at that level until it has been adequately demonstrated to the state that the change in quality does not or will not become injurious to the public health, safety, or welfare, or become injurious to any other uses being made of such waters.

4.2 IMPACTED DESIGNATED USES IN THE BOARDMAN RIVER WATERSHED

The MDEQ is required to monitor each water body every five years, biannually assess and report on the status of its waterbodies, and publish a list of waterbodies that are not attaining water quality standards (MDEQ 2014). If a body of water or stream reach is not meeting the water quality standards set for a specific designated use, then it is said to be in "nonattainment" and listed on the State Impaired Waters List, also known as the Section 303(d) list.

The Boardman River watershed was last monitored by MDEQ in 2013 and is included in the MDEQ's monitoring and reporting for the Boardman-Charlevoix hydrologic unit code (HUC) 04060105 (Figure 13). The MDEQ monitors both water chemistry and biological health at several sampling locations within the Boardman River and its subwatersheds. Biological health is determined using a method known as Procedure 51, which evaluates the fish community, the benthic macroinvertebrate community (small animals that live among the sediments and stones on the bottom of streams, rivers, and lakes), and habitat quality. Monitoring results can be found in Section 2.4.

FIGURE 13. Boardman-Charlevoix Hydrologic Unit Code Map

SOURCE: MDEQ 2014

Attainment of Designated Uses

Overall, water quality in the Boardman River watershed is very good. None of the designated uses for the watershed are impaired on a watershed-wide scale. The MDEQ's 2014 Integrated Report indicates that the quality of the waters monitored within the Boardman River basin meets or exceeds all standards established for the river, with the exception of the "Other Aquatic Life and Wildlife" designated use for Kids Creek, a major tributary to the Boardman River (MDEQ 2014). Currently an approximate 4-mile section of Kids Creek near its confluence with the Boardman is not supporting this designated use due to flow regime alterations, sedimentation/siltation, and other human caused substrate alterations, all caused by stormwater (Figure 14). Although a Total Maximum Daily Load (TMDL) plan for Kids Creek is not currently scheduled to be drafted as part of the MDEQ's 2016-2022 "Prioritization Framework for the Long-Term Vision for Assessment, Restoration, and Protection under the Clean Water Act Section 303(d) Program," it remains on the 303(d) non-attainment list as needing a TMDL (MDEQ July 2015). Chapter 4.2 discusses these water quality conditions and issues in greater detail.

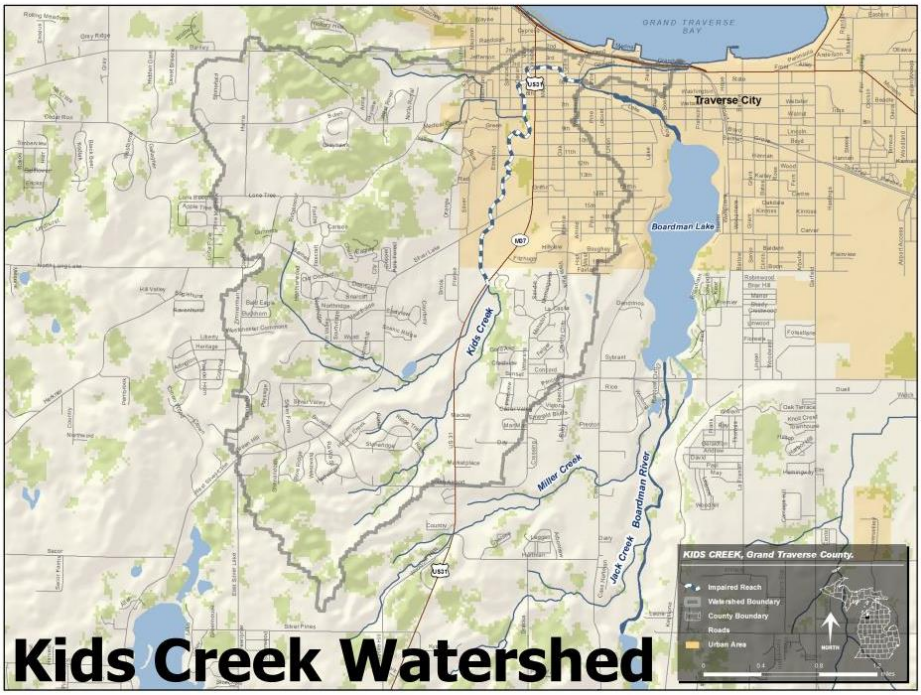


Figure 14. State-Designated Impaired Reach of Kids Creek

SOURCE: Lipsey 2010

The Integrated Report also states that

> Overall, many of Michigan's surface waters are impacted by polychlorinated biphenyls[7] (PCB) and mercury and consequently do not support the other indigenous aquatic life and wildlife designated use and/or the fish consumption designated use. Atmospheric deposition is considered to be the major source of these persistent bioaccumulative chemicals (MDEQ 2014).

[7] Polychlorinated biphenyls are an organic industrial chemical used in various applications such as plasticizers, adhesives, and fire retardants

In fact, a statewide mercury-based fish consumption advisory applies to all of Michigan's inland lakes, reservoirs, and impoundments. Additionally,

> Water column PCB monitoring using highly sophisticated and sensitive sampling/analytical techniques indicates that 100% of the assessed river miles [in the state] are not attaining PCB water quality standards; therefore, a significant number of river miles are listed as not supporting the fish consumption designated use (MDEQ 2014).

A handful of locations in the Boardman River watershed (Beitner Creek, Miller Creek, Jacks Creek, and the Boardman River downstream of Sabin Dam) are not meeting the "other indigenous aquatic life and wildlife" standard due to PCBs in the water column. A statewide TMDL for PCB was submitted for the USEPA's approval in 2013 and a statewide TMDL for mercury is under development. Since the MDEQ has taken the lead to develop pollution prevention and abatement strategies throughout the state for mercury and PCB contamination, these problem will not be addressed in this plan.

While none of the designated uses for the Boardman River watershed are impaired on a watershed-wide scale, in some cases activities and resulting pollutants in the watershed may prove to be a threat to water quality and designated uses. 'At risk' waterbodies are defined as those that currently meet water quality standards, but may not in the future and are at risk of becoming degraded. The Boardman River Watershed Prosperity Plan will focus on the following two at risk designated uses to protect in order to maintain water quality throughout the Boardman River and its watershed:

- Coldwater fishery
- Other indigenous aquatic life and wildlife

The at risk designated uses were identified through review of related monitoring studies and input from the Leadership Team. Table 17 summarizes the designated uses in the Boardman River watershed, as well as water quality standards used to determine attainment and any related existing activities associated with the designated use.

Temperature is a special concern in the Boardman River due to its high quality coldwater fishery. Rules 72, 73 and 75 of the State's Water Quality Standards refer to heat loads to inland lakes as well as coldwater and warmwater fisheries (MDEQ 2006). These are meant for point source discharges where a 'heat load' from the end of the pipe is added to the existing waterbody. Among other things, the standards state that the temperature of the receiving waters cannot be warmed more than the monthly maximum temperatures listed in Table 18. Although these standards do not directly apply to surface waterbodies, the temperatures listed in Table 18 do provide general guidelines for water quality protection for coldwater and warmwater fisheries in the Boardman River watershed.

TABLE 17. Comparison of Designated Uses Versus Existing Conditions

Designated, Protected Uses	Michigan Water Quality Standard	Existing Activities and Uses	Existing Condition Compared to Standard
Agriculture	• Surface water must be of the quality that it can be used for livestock watering, irrigation, and spraying crops	• Agriculture surface water withdrawal	• Attainment
Coldwater fisheries (Boardman River and tributaries)	• Dissolved oxygen not less than 7.0 mg/l (ppm) • Temperature guidelines in Table 18	• Trout, salmon for recreational fishing, and related coldwater organisms	• Attainment, but considered at risk
Fish consumption advisories	• Triggers established by Michigan Department of Community Health for mercury and various organic compounds (MDCH 2011)	• Recreational fishing in Boardman River, Boardman Lake, and tributaries	• Nonattainment. • Fish consumption advisories apply to certain species from contaminant sources outside of watershed (mercury and PCBs)
Industrial water supply	• Surface waters must be clean enough to be used for commercial or industrial applications or non-contact food processing	• Industrial or commercial supply	• Attainment
Migratory routes for anadromous salmonids	• Rivers and lakes serving as migratory routes shall not receive a heat load, which may adversely affect salmonid migration	• Anadromous fish populations for recreational fishing and ecosystem health	• Attainment
Navigation	• No interference or increased cost to navigation	• Boating, paddling, fishing access on the river	• Attainment
Other indigenous aquatic life and wildlife	• Surface waters must support fish, other aquatic life, and wildlife that use the water for any stage of their life cycle	• Fish, wildlife, ecosystem health	• Attainment in most places, but considered at risk • Nonattainment in Kids Creek due to sedimentation/siltation, other flow regime alterations, other anthropogenic substrate alterations.
Partial body recreational contact (all waterbodies)	• Counts of 1,000 or less *E. coli* per 100mL	• Canoeing, kayaking, cruising, and fishing	• Attainment
Total body recreational contact (all waterbodies)	• Counts of 130 or less *E. coli* per 100mL monthly average and 300 or less for *E. coli* per 100mL at any time	• Swimming, tubing, fly fishing, and related full body contact activities	• Attainment

Designated, Protected Uses	Michigan Water Quality Standard	Existing Activities and Uses	Existing Condition Compared to Standard
Warmwater fisheries (Boardman River, tributaries, and inland lakes)	• Dissolved oxygen not less than 5.0 mg/L (ppm) at any time in epilimnion (uppermost layer of the lake) during summer stratification and 5.0 mg/L rest of year • Temperature standards in Table 18	• Warmwater fish populations for recreational fishing and related aquatic food organisms	• Attainment • Current warmwater fisheries in the ponds behind the Boardman, and Sabin dams will revert to swift-flowing, coldwater fish habitat as dams are removed.

SOURCE: Compiled using data from MDEQ 2006

TABLE 18. Boardman River Watershed Monthly Maximum Water Temperature for Streams and Lakes

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Inland lakes	45	45	50	60	70	75	80	85	80	70	60	50
Coldwater streams	38	38	43	54	65	68	68	68	63	56	48	40
Warmwater streams	38	38	41	56	70	80	83	81	74	64	49	39

SOURCE: Compiled using data from MDEQ 2006

Since most designated uses are being met in the watershed, this watershed prosperity plan is more focused on protecting the watershed from future degradation rather than reducing pollutant loads to meet water quality standards. Efforts to address the impairment in Kids Creek are found in Chapter 4.3.

4.3 IMPAIRED REACH - KIDS CREEK

A 4-mile portion of Kids Creek, a major tributary to the Boardman River, is on the State's 303(d) Impaired Waters List due to the "other indigenous aquatic life" designated use not being met because of a poor aquatic macroinvertebrate community. The section is located just north of where Kids Creek crosses US-31/M-37 to the confluence with the Boardman River and includes Tributary A as well (Figure 14). Previous MDEQ studies on the macroinvertebrates in this section of Kids Creek indicate poor scores at locations by 11th Street and Oak Street, as well as Tributary A of Kids Creek by Elmwood Avenue (Chapter 2.4, Table 10). The impairment is mainly due to sedimentation, flow regime alteration, and other human-caused sources – all of which relate to stormwater.

Kids Creek drains almost 11 square miles and enters the Boardman River near its mouth at Grand Traverse Bay in Traverse City. The Kids Creek subwatershed is 58% urban land use, 38% natural/upland areas, 3% agriculture, and 1% water. It is spring fed by three major tributaries originating in Garfield Township on the southern and western watershed boundaries. The majority of the upper watershed is in Garfield Township, with the downstream portion in Traverse City. The downstream portion is the section that has been determined impaired and is almost wholly located within City of Traverse City limits, starting where the main stem crosses M-37/US-31.

Kids Creek experiences severe changes in flow due to stormwater inputs during storm events. The creek exhibits signs of flashiness and causes regular flooding within the city limits. This flashiness has led to scoured stream bottoms and increased sedimentation (from eroding stream banks) within the stream. This is one of the main reasons that Kids Creek is on the state Impaired Waters List and is said to be in "nonattainment."

In 2009, The Watershed Center (TWC) was awarded an MDEQ grant to work on developing a Kids Creek Action Plan to address stormwater inputs and other water quality issues. Complete in 2013, the Action Plan provides a prioritized list of Best Management Practices (BMPs) – both stormwater and habitat related – that will decrease both the input and effects of stormwater to the creek as well as improve in-stream habitat for macroinvertebrates and fish communities (TWC 2013). Concurrent to the development of the action plan, MDEQ was working with TWC and the Grand Traverse Conservation District (GTCD) on writing the Total Maximum Daily Load (TMDL) for Kids Creek, which is required under the Clean Water Act for waterbodies not meeting water quality standards. The Kids Creek TMDL will identify the allowable levels of pollutants (in this case, sediment) in the water body that will result in attainment of the designated uses. A TMDL identifies the sources of pollution and provides potential solutions.

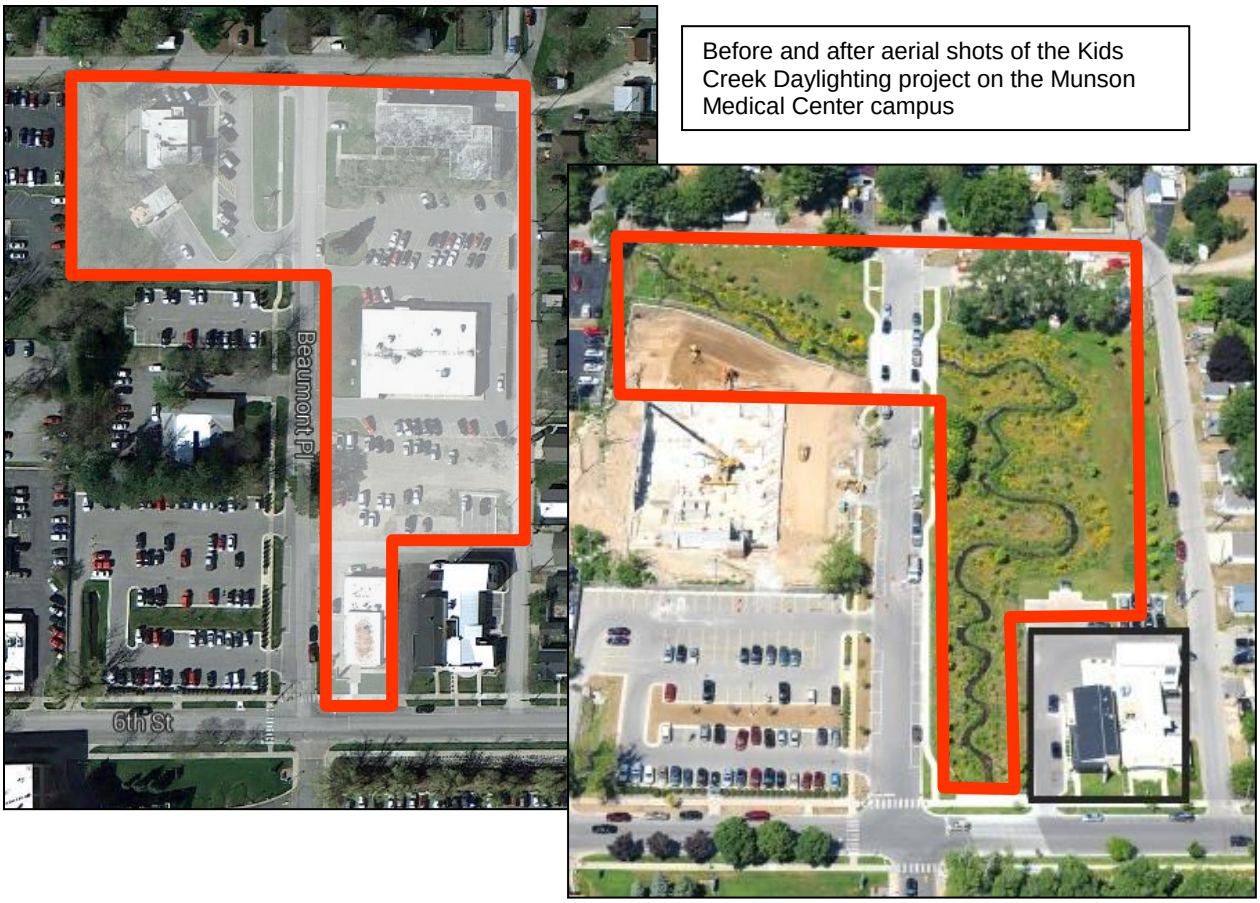
A goal for the Kids Creek TMDL is to work closely with local stakeholders to make the final TMDL more implementable by providing some guidance. Implementation guidance has not been included in previous Michigan TMDLs that address biotic impairments. As such, TWC and GTCD have been an integral part of the data gathering, fieldwork, and discussions that the MDEQ has been conducting as part of the TMDL development.

Since the TMDL is not complete and the MDEQ is still analyzing collected data, only preliminary results were used to write the Kids Creek Action Plan. One of the general concepts in the preliminary report from the MDEQ's TMDL development is the need to reduce stormwater input to Kids Creek wherever possible and that there is no widespread channel instability throughout the watershed; meaning, a particular source of sediment to the creek cannot be determined (TWC 2013). A hydrologic assessment performed on the creek by the MDEQ Hydrologic Studies Unit showed increases in erosive potential measured from 1978 to 2005 and 2009. It also determined that protecting Kids Creek and its tributaries from both higher flows and longer durations of channel-forming flows is important to prevent further destabilizing the stream channels (Fongers 2010). MDEQ's analysis of the full dataset may provide additional insight into sediment sources and the ability of the stream to move the sediment generated throughout the watershed. Until the TMDL is complete, the Kids Creek Action Plan will remain a draft so as to include final information outlined in the TMDL.

Even though the Kids Creek Action Plan is still in draft form, TWC has been implementing key portions. The current draft of the action plan focuses on reducing stormwater inputs to the creek by listing priority recommendations for locations and types of BMPs. It also notes the severe and moderately ranked streambank erosion sites that should be stabilized. Recommendations follow general guidelines and recommendations from the Grand Traverse Bay Watershed Protection Plan. As of June 2016, TWC has received $4.2 million of funding to implement recommendations in the action plan from state and federal grants and matching sources. Activities focused on daylighting a portion of Kids Creek, installing Low Impact Development (LID) stormwater BMPs, and stabilizing eroding streambanks, including:

- Installation of a set of LID practices at Building 29 on Munson Medical Center's campus, including a rain garden retrofit, pervious pavement, and downspout planter boxes
- Installation of a number of LID practices at Munson Medical Center's Cowell Family Cancer Center, including a green roof, pervious pavement, rain garden, and two sets of underground infiltration trenches; infiltration trenches filter stormwater runoff from the cancer center roof and parking lot, preventing its diversion into storm drains
- Daylighting and naturalizing a 900 foot section of Kids Creek running through the Munson Medical Center campus; this daylighting project created almost 1/4 mile of natural meandering stream, eliminated 72,000 square-feet (1.25 football fields) of impervious pavement, created a new 15- to 30-foot wide buffer that was planted with native flowers and shrubs, and established a 27,000 square-foot (.62 acre) floodplain (Figure 15)

Current grant-funded activities include additional LID installations on Munson's campus, a stormwater master plan and LID installations for the Grand Traverse Pavilions and Grand Traverse Commons properties (just south of Munson), and the stabilization of 30 severe and moderately ranked erosion sites on Kids Creek and its tributaries.



Before and after aerial shots of the Kids Creek Daylighting project on the Munson Medical Center campus

FIGURE 15. Daylighting and Naturalizing Kids Creek on Munson Medical Center's Campus

SOURCE: Aerial photo left: Google Map data pre-2013, Aerial photo right: Anderson Aerial Photography 2015

Chapter 5. Designated Uses: Pollutants, Sources, and Causes

5.1 WATERSHED POLLUTANTS

For each of the water quality designated uses, there are a number of pollutants or stressors that are either currently affecting water quality or pose future threats if they are not addressed. The Glen Lake Watershed Plan utilized the term "stressor" to mean a broader range of factors that might negatively affect the ecosystem – not just traditional water quality pollutants such as chemicals or nutrients (U'Ren et al. 2009). This term is adopted in this prosperity plan. Examples of environmental stressors include changes to hydrologic flow and loss of habitat.

Pollutants and environmental stressors were ranked by the Leadership Team (Table 19). However, it should be noted that it is difficult to rank all the pollutants and environmental stressors in the watershed because all are important and should be priorities for maintaining the health of the Boardman River. The pollutant ranking depends on which area of the watershed is analyzed. In some places, sediment may be the biggest threat, while in others it could be pathogens. Almost always, the pollutants and stressors are interconnected with each other, and changes in one causes changes to the others. For instance, increasing the hydrologic flow in a stream could increase the amount of sedimentation and erosion, which may then increase thermal pollution and the amount of nutrients entering the system. Additionally, losing valuable habitat in a stream could itself be the result of excessive sedimentation and subsequently affect the amount of nutrients and toxins entering the stream, as well as pave the way for invasive species to populate the area.

Given the generally good water quality in the Boardman River watershed, this plan is more focused on maintaining water quality and protecting against future threats.

TABLE 19. Ranked Environmental Stressors Affecting Designated Uses in the Boardman River Watershed

Environmental Stressor	Designated Uses Affected	
Sedimentation	• Coldwater and warmwater fishery • Other indigenous aquatic life	• Navigation
Nutrients	• Coldwater and warmwater fishery • Other indigenous aquatic life	• Total body contact
Thermal pollution	• Coldwater fishery • Other indigenous aquatic life	
Habitat loss	• Coldwater and warmwater fishery • Other indigenous aquatic life	
Hydrologic flow alteration	• Coldwater and warmwater fishery • Other indigenous aquatic life	• Navigation
Invasive Species	• Coldwater and warmwater fishery • Other indigenous aquatic life • Navigation	• Total body contact
Pathogens	• Total body contact	
Oils, grease, metals, toxins	• Coldwater and warmwater fishery • Other indigenous aquatic life	

5.2 SOURCES AND CAUSES OF WATER QUALITY DEGRADATION

Through review of literature and previous studies, and input from the Leadership Team, numerous sources and causes of water quality degradation in the Boardman River watershed have been identified. In addition to the historic hydrologic flow modifications associated with the four major dams, other sources and causes of water quality degradation in the watershed include loss of habitat; introduction of invasive species by recreationalists and other sources; lack of protective development zoning/planning; poor urban stormwater, agriculture, and forestry management practices; and failing or undersized septic systems.

Table 20 identifies the potential causes and sources of pollutants or stressors related to each of the Boardman River's designated uses. This table summarizes key information necessary to begin water quality protection, provides specific targets to act upon for watershed management, and forms the basis for all future implementation projects to protect the quality of the watershed. Based on the assumption that the Sabin, and Boardman dams will be removed, the exhibit breaks down potential causes of stress or water quality threats into two categories: lower watershed (Boardman Lake and downstream) and upper watershed (upstream of Boardman Lake). This approach reflects potential short- and long-term water quality threats and stressors once the river has reverted to free-flowing conditions.

Boardman River watershed communities are also increasingly evaluating and planning for the potential impacts on water quality associated with climate change, including warming water temperatures, more frequent and severe storm events, increased stormwater runoff, drought conditions, and flooding. In this way, climate change could be considered a cause for the sources of pollutants/stressors in the watershed (Table 20). For example, increased storm events would increase stormwater volumes and outputs, resulting in more pollutants entering the watershed. Communities in the Great Lakes must prepare for these impacts and develop adaptation measures. The Watershed Center (TWC) was a partner in a recently-completed Michigan Sea Grant Climate Change Integrated Assessment grant awarded to Michigan State University. That project conducted an integrated assessment to help communities in the Grand Traverse region understand how climate knowledge can inform planning in a realistic way by evaluating the vulnerabilities and assessing strategies to increase resilience against anticipated climate change impacts. The assessment was able to quantify changes in temperature, precipitation, ice cover, lake levels, streamflow, and water quality, as well as project future conditions and assess the impacts of those changes. It also developed and assessed adaptive management strategies, such as the mitigation benefits of stormwater projects such as the ones TWC is currently conducting. The results of this study will help Boardman River watershed communities understand management options for adapting to climate change over time (Michigan Sea Grant N.d).

TABLE 20. Boardman River Watershed Water Quality Stressors, Sources, and Causes

Stressor	Impacted Designated Use	Likely Source	Potential Causes	
			Lower Watershed	Upper Watershed
Sedimentation	• Coldwater and warmwater fishery • Other indigenous aquatic life and wildlife • Navigation	• Transportation crossings • Urban/suburban stormwater • Construction • Bank/shoreline erosion • Forestry practices • Livestock in stream • Oil and gas well development	• Poor urban stormwater management practices • Poor soil erosion practices; lack of enforcement • Historically unrestricted access of buffalo in Kids Creek streams • Inadequate recreation access facilities to the river • Climate change-related storm frequency and precipitation amounts • Higher water levels related to climate change and other human-related activities	• Poorly designed, undersized, and failing transportation crossings • Short-term sediment loading when dams are removed • Poor urban stormwater management practices • Inadequate recreation access facilities to the river • Poor timber practices • Climate change-related storm frequency and precipitation amounts • Livestock grazing impacts near headwaters of Jacks and Miller creeks
Nutrients	• Coldwater and warmwater fishery • Other indigenous aquatic life and wildlife • Total and partial body contact	• Septic systems • Residential fertilizer • Agriculture (manure storage, livestock in/near waterbodies, fertilizer use, crop tillage practices) • Lack of riparian buffer • Stormwater	• Improper application of fertilizers • Clearing of riparian vegetation • Lack of zoning setback requirements • Poor stormwater management practices • Climate change-related loss of tree species (ecological changes or pests/disease) and storm frequency and precipitation amounts • Failing, undersized, and poorly maintained septic systems	• Failing, undersized, and poorly maintained septic systems • Clearing of riparian vegetation • Lack of zoning setback requirements • Climate change-related loss of tree species (ecological changes or pests/disease) and storm frequency and precipitation amounts
Thermal pollution	• Coldwater fishery • Other indigenous aquatic life and wildlife	• Impervious surfaces • Lack of streamside shoreline canopy and riparian buffer • Impoundments	• Increased development expanding number impervious surfaces • Clearing of riparian vegetation	• Occasional low-flow conditions and ponding • Small dams on tributaries • Climate change-related temperature increases and

Stressor	Impacted Designated Use	Likely Source	Potential Causes	
			Lower Watershed	Upper Watershed
		• Stormwater • Warmwater discharge	• Dams (Union Street, Boardman, Sabin) • Climate change-related temperature increases and precipitation amounts	precipitation amounts
Habitat loss	• Coldwater and warmwater fishery • Other indigenous aquatic life and wildlife	• Development sprawl • Shoreline hardening • Vegetation removal • Invasive species • Removal of woody debris • Intensive recreational activity	• Lack of adequate zoning and planning controls • Lack of efforts to educate property owners • Damage by visitors and recreationalists • Removal of habitat wood for aesthetic reasons or navigation • Climate change-related loss of tree species (ecological changes or pests/disease) • Inadequately sized transportation crossings	• River-related aquatic habitat altered and historically lost with impoundments • Damage by visitors and recreationalists • Climate change-related loss of tree species (ecological changes or pests/disease) • Removal of habitat wood for aesthetic reasons or navigation
Hydrologic flow alteration	• Coldwater and warmwater fishery • Other indigenous aquatic life and wildlife • Navigation	• Dams • Urban/suburban stormwater • Loss of wetlands • Riparian zone activities • Transportation crossings • Groundwater withdrawals	• “Flashy” streams/runoff from weather events and snowmelt in tributaries • Hardened shorelines • Climate change-related storm frequency and precipitation amounts • Inadequately sized transportation crossings	• Restricted water flow due to impoundments • Hardened shorelines • Climate change-related storm frequency and precipitation amounts • Inadequately sized transportation crossings • Commercial withdrawal of groundwater
Invasive species	• Coldwater and warmwater fishery • Other indigenous aquatic life and wildlife • Navigation • Total and partial body contact	• Connected waterways • Watercraft • Other animals/organisms	• Potential movement upstream of Union Street Dam • Lack of public knowledge on how to avoid transporting invasive species • Carried by other species • Climate change-related expanded species range	• Lack of public knowledge on how to avoid transporting invasive species • Carried by other species • Climate change-related expanded species range

Stressor	Impacted Designated Use	Likely Source	Potential Causes	
			Lower Watershed	Upper Watershed
Pathogens	• Total and partial body contact	• Septic systems • Livestock in streams • Urban/suburban stormwater	• Poor urban stormwater management practices • Historically unrestricted access of buffalo in Kids Creek • Failing, undersized, and poorly maintained septic systems	• Poorly designed, undersized, and failing transportation crossings
Oils, grease, metals, toxins	• Coldwater and warmwater fishery • Other indigenous aquatic life and wildlife	• Urban/suburban stormwater • Lack of riparian buffer • Contaminated sediments • Leaking underground storage tanks • Road salt and de-icing	• Poor stormwater management practices • Clearing of riparian vegetation • Lack of zoning setback requirements • Historic chemical dumping in Boardman Lake • Leaking underground storage tanks • Runoff of salt and chemicals from roadways • Poor handling procedures	• Poor stormwater management practices • Clearing of riparian vegetation • Lack of zoning setback requirements • Runoff of salt and chemicals from roadways • Poor handling procedures • Leaking underground storage tanks

5.3 POLLUTANTS OF CONCERN

A Note About Stormwater

One of the major pathways many types of pollutants get to lakes and streams is through stormwater runoff. Stormwater runoff results when drops of rain fall to the ground, or snow melts, and the resulting water that does not infiltrate into the ground flows over the surface of the land. This stormwater flow often dislodges and carries soil or sediment particles (causing streambank erosion in some places) to which many pollutants are attached. The stormwater flow may also directly move the pollutant itself (i.e., garbage, oils, grease, gas, pesticides, etc.). The amount of stormwater runoff that occurs depends on a variety of conditions including storm intensity and duration, topography, time of year, soil moisture levels, soil permeability, vegetative cover types, the extent of vegetated cover, and the amount of impervious surfaces.

Urban locations in the watershed, like Traverse City, often produce greater amounts of stormwater flow due to the increased amount of impervious surfaces relative to more rural settings within the watershed. Impervious surfaces are those areas on land that cannot effectively absorb or infiltrate rainfall or snowmelt. Areas such as these may include roads, streets, sidewalks, parking lots, and rooftops. Research suggests there is a threshold to the amount of impervious cover that can occur within a watershed at which the degradation of aquatic systems occurs. Findings reveal that stream degradation consistently occurs when impervious surface levels in a watershed reach between 10-20 percent (CWP 1998).

Stormwater entering the Boardman River and its tributaries from storm drain outlets contributes a significant amount of pollution to the river. When added up, inputs from all these small, single inputs of stormwater can result in a massive amount of pollution entering the river and, ultimately, Grand Traverse Bay. Most often the pollution coming from these storm drains is at its worst during heavy rain and snowmelt events. Table 21 lists phosphorus, nitrate, suspended sediment, and *E. coli* measurements taken during a single storm event at various storm drains in the watershed (taken from Table 30 of the Grand Traverse Bay Watershed Plan, TWC 2005).

TABLE 21. Pollutants Measured at Selected Storm Drains from a Single Storm Event (11/09/2000)

Storm Drain	Measured Flow (cfs)	Total Phosphorous (mg/L)	Nitrate (mg/L)	Suspended Sediment (mg/L)	Average *E. coli* (CFU/100mL)
Northport	0.13	*	0.32	210.33	713**
Suttons Bay	0.12	*	0.38	13.75	162
City of Traverse City					
Bryant Park	2.31	0.37	.030	43.60	487**
East 8th Street	0.36	0.57	0.15	15.33	51,330**
East Bay Park	3.20	0.44	0.13	6.63	80,000**
Hope Street	1.33	0.07	0.09	7.03	15,300**
Maple Street	0.51	0.12	0.14	13.23	2,700**

**Not measured*
***Above USEPA and Michigan Water Quality Standard for a single sample event (see Pathogens section below)*

SOURCE:TWC 2005

Due to a high amount of impervious surfaces, the City of Traverse City generates the largest amount of stormwater input to the Boardman River and Grand Traverse Bay during rain and snowmelt events, and city officials consider stormwater to be a high priority issue. Kids Creek, a tributary to the Boardman River located in Traverse City, experiences severe changes in flow due to stormwater inputs during storm events. The creek exhibits signs of flashiness and causes regular flooding within the city limits primarily

due to undersized culverts. This flashiness has led to scoured stream bottoms and increased sedimentation (from eroding stream banks) within the stream. This is one of the main reasons that Kids Creek is on the state impaired waters list and is said to be in "nonattainment" (see Chapter 4.3).

Stormwater also contributes directly to thermal pollution. As stormwater runs over the land, especially paved surfaces during the hot summer months, it can be warmed, causing significant increases in water temperatures when it is deposited into a stream or other waterbody. Spikes of warm temperatures in streams can be fatal to fish and other aquatic life due to the lack of dissolved oxygen.

Reductions to stormwater flow, as well as better management of stormwater, will decrease the amount of sediment, nutrients, thermal pollution, toxins, and pathogens that enter area waterbodies.

Nonpoint Sources of Nutrients and Sediment

Nonpoint sources of nutrients and sediment are among the highest priority threats to water quality in the Boardman River watershed.

Sediment

Sediment is fine inorganic soil or sand particles, and sedimentation is the process whereby sediment is deposited in a stream or lake bottom. Sedimentation occurs naturally in all stream and lake environments due to land erosion by wind and water. However, excessive sedimentation can severely degrade an entire riparian system (Waters 1995) and can be a major cause of degradation to aquatic life in many Michigan streams and rivers. Excessive sediment deposition in many of Michigan's streams also severely impacts the amount of suitable habitat needed to support healthy and diverse communities of fish and other aquatic organisms. When sediment enters a stream, it covers gravel, rocky, and woody habitat areas, thereby leading to decreases in habitat diversity and aquatic plant production. Sedimentation caused by streambank erosion may increase channel widening and cause changes in stream water temperatures.

Significant sources of sediment to streams include streambank erosion such as road/stream or other transportation crossings, increased flow levels (rapidly changing stream levels), and other land use activities including removing streamside vegetation, users entering and exiting the river, recreational trails that cross streams, and historic logging practices. Another source is clearing land for agriculture, development, or other purposes. Land clearing also creates a host of other erosion-related problems including flooding, polluted runoff, loss of topsoil from surface runoff, and a reduction in fisheries and channel depth from deposition of sediments in the stream. Any kind of excavation, earth moving, draining, bridging, tunneling, or other activity in which soil is disturbed can result in sediment transport to nearby streams. Alexander and Hansen (1988) report that increases in sediment erosion are detrimental to aquatic communities. Increased sediment loads from development activities may also continue past the construction phase due to the resulting increase in stormwater runoff from newly created impervious surfaces. Roads, rooftops, and parking lots are examples of impervious surfaces that replace rural and forested land during development. Development may result in decreased water-retention capacities, increased flood frequencies, and rapid filling of stormwater detention systems.

Agricultural grazing on or near streambanks are known to cause a significant increase of sediment in streams. Most effects of grazing in riparian areas include bank degradation, loss of vegetation, and compaction of soils that leads to overland flow and severe erosion. This in turn causes increased deposition on the streambed, channel widening, and mass bank failures, especially during storm events.

Sediment is identified as a major pollutant present in the Boardman River watershed based on field inspections and inventories conducted throughout the watershed, as well as through existing research and historic evidence. Significant known sources of sediment include streambank erosion, road/stream crossings, surface runoff, recreational access, and construction activities.

The Boardman River Watershed Report, completed by the Grand Traverse Conservation District (GTCD) in 1991 and updated in 2005, identified more than 600 eroded sites along streambanks and at road crossings in the watershed (GTCD 2005). An estimated 85 percent are caused by human activity. As noted in the report, sediment entering the river from these 600 erosion sites negatively impacts the river's aquatic ecosystem and threatens the high quality of this Blue Ribbon trout stream. It should be noted that, since 1993, more than 300 of the 600 identified streambank erosion and road crossing sites identified in this report have been restored through grant funding and various local resources, but there are still many sites remaining that need repair.

Due to time constraints, in-depth surveys for road stream crossings and streambank erosion sites have not been updated for this report, therefore data from GTCD's Boardman River Watershed Report are visually shown in Figures 16, 17, 17a, 17b. However, the GTCD has anecdotally estimated that there are 25 severe and 17 moderate ranked road crossing sites remaining in the watershed. Estimated pollutant load for the 2005 streambank erosion sites and 2015 estimated road stream crossing sites are included in Table 22. This table shows that remaining severe and moderate streambank sites have a combined soil loss of more than 1,700 tons/year and the severe and moderate road crossing sites have a combined soil loss of 1,100 tons/year (Table 22).

TABLE 22. Boardman River Watershed Streambank Erosion and Road Stream Crossing Site Analysis Rankings and Loadings

Average Erosion for Severity Type	# of Each Type	Soil Loss/Year (tons)	Phosphorous Load (lb/yr)	Nitrogen Load (lb/yr)
Streambank Erosion Sites (2005 Survey)				
Severe=8+ tons/yr	134	1,072	911	1,822
Moderate=4-8 tons/yr	111	666	566	1,132
Minor=0-4 tons/yr	71	142	121	241
None/Restored=none	23/75	0/0	0/0	0/0
Estimated Road Stream Crossing Sites (2016)				
Severe=30+ tons/yr	25	750	638	1,275
Moderate=15-30 tons/yr	17	383	326	651
Minor=0-15 tons/yr	32	240	204	408
None/Restored=none	22/11	0/0	0/0	0/0

SOURCE: GTCD 2005, GTCD communications

Calculations used to determine phosphorus and nitrogen load for were taken from the MDEQ Pollutants Controlled Manual (MDEQ 1999), the soil correction factor for 'sand' (0.85) was used. More discussion regarding calculating streambank and shoreline erosion, as well as phosphorus and nitrogen loads is in Chapter 10.2.

Dam Removal & Sedimentation

The Boardman River is in the midst of the largest dam removal in the Michigan's history with the 2012 removal of Brown Bridge dam and the pending removal of Boardman Dam in 2017 followed by Sabin dam in 2018. Union Street Dam will be modified to allow the passage of desired fish species while blocking sea lamprey and other non-native aquatic organisms.

It is widely understood that dams impact rivers in a variety of ways, interrupting natural stream functions that include aquatic organism passage; movement of sediment, wood, and nutrients; and disrupting natural thermal regimes, among others. Dam removal restores these functions over time

One function restored immediately after dam removal is sediment delivery. This, combined with sediment introduced through the dam removal process, including from post removal eroding banks, is known to

cause downstream impacts. Sediment traps and other management practices help reduce the amount of sediment that moves downstream beyond the project area, but the immediate change in stream bottom composition is noticeable.

A majority of the newly exposed streambanks will heal as vegetative cover is reestablished. Other banks, including where the floodplain/streambank increased in height due to sediment deposition while the dam was in place, may require more aggressive restoration measures. This is evident by the streambank restoration/floodplain reconnection project above the former Brown Bridge pond that took place in summer 2016. This section of river is detached from its floodplain and actively eroding due to steep banks and sand deposits. These sand deposits are loose, non-cohesive, infertile, and highly erodible. This project reestablished the river's connection with its floodplain and stabilized the banks.

Another section of the Boardman River where floodplain disconnection and streambank erosion is evident is at Grand Traverse County's Lone Pine Landing in the Natural Education Reserve above Boardman Pond. In 2007, the river cut through floodplain deposits after an initial drawdown of the pond. Restoration of this area will be addressed in conjunction with the removal of Boardman Dam in 2017. After each dam is removed, long-term monitoring and subsequent restoration efforts are needed within and upstream of the former impoundments.

Biological monitoring over a period of years prior to the removal of Brown Bridge dam, and each year after its removal, suggests aquatic insect populations have rebounded to near pre-dam conditions just three years post dam removal (Au Sable Institute 2014). Fish surveys conducted by the Michigan Department of Natural Resources and Trout Unlimited also show an increase in trout populations after Brown Bridge Dam was removed. Surveys also show that trout moved into the new channel within six months after dam removal. Furthermore, the ratio of brook trout to brown trout increased due to the colder water since the removal of Brown Bridge Dam.

For further discussion on sediment, including sediment loading in the watershed, see Chapter 5.3 Pollutants of Concern: Nutrient and Sediment Loading to the Watershed.

Typical Impacts from Sedimentation

- Sand and sediment harm aquatic life by covering natural stream and lake substrate, which fish and prey species rely on for spawning and feeding.
- Sediment increases turbidity, decreasing visibility and clogging fish and insect gills. Turbid stream flow also dislodges fish eggs and aquatic insects making them more susceptible to demise.
- When more sand and sediment is deposited than can be moved by stream flow, stream morphological features such as pools, riffles, and runs are smothered, and water levels rise, causing streambank erosion and potential flooding. Excessive sedimentation may also fill lakes, ponds, and wetlands.
- Nutrients, heavy metals, and other pollutants can attach to finer sediment particles and enter the water when suspended.
- Excess sedimentation can potentially impair navigation by making the water too shallow for boats and boat access.

THE BOARDMAN RIVER WATERSHED

Road / Stream Crossings

Data Sources: Michigan Geographic Data Library, Michigan DNR, LIAA

- Boardman River Watershed
- City or Village
- County Boundary
- Township Boundary
- Major Road
- Major Road
- Boardman River
- Watershed Inland Lakes
- Minor Stream Crossings
- Moderate Stream Crossings
- Severe Stream Crossings

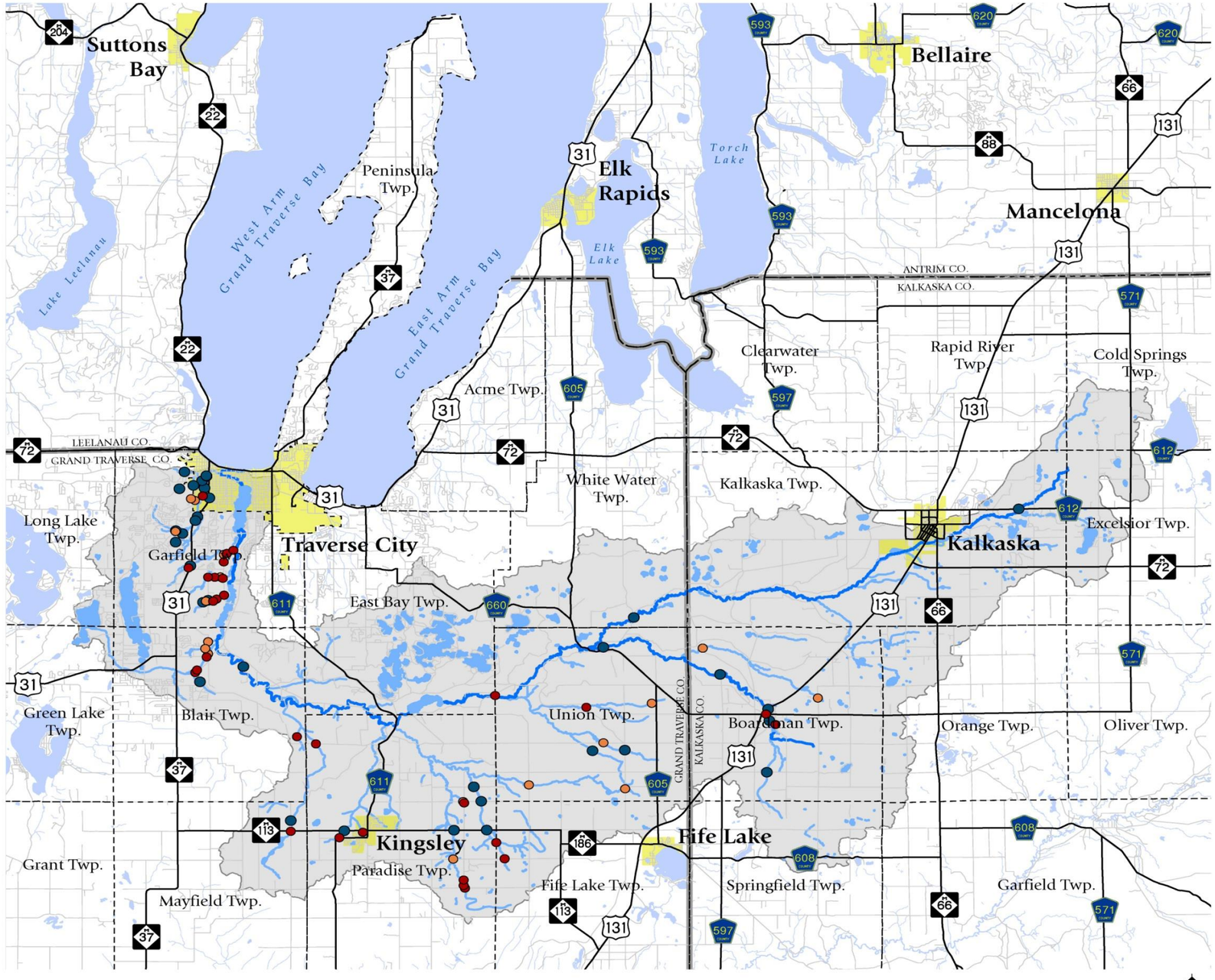


FIGURE 16. Boardman River Watershed Road Stream Crossing Erosion Sites

SOURCE: Beckett & Raeder Inc., 2016

THE BOARDMAN RIVER WATERSHED

Streambank Erosion Sites

Data Sources: Michigan Geographic Data Library, Michigan DNR, LIAA

- Boardman River Watershed
- City or Village
- County Boundary
- Township Boundary
- Major Road
- Major Road
- Boardman River
- Watershed Inland Lakes
- Minor Streambank Erosion Sites
- Moderate Streambank Erosion Sites
- Severe Streambank Erosion Sites

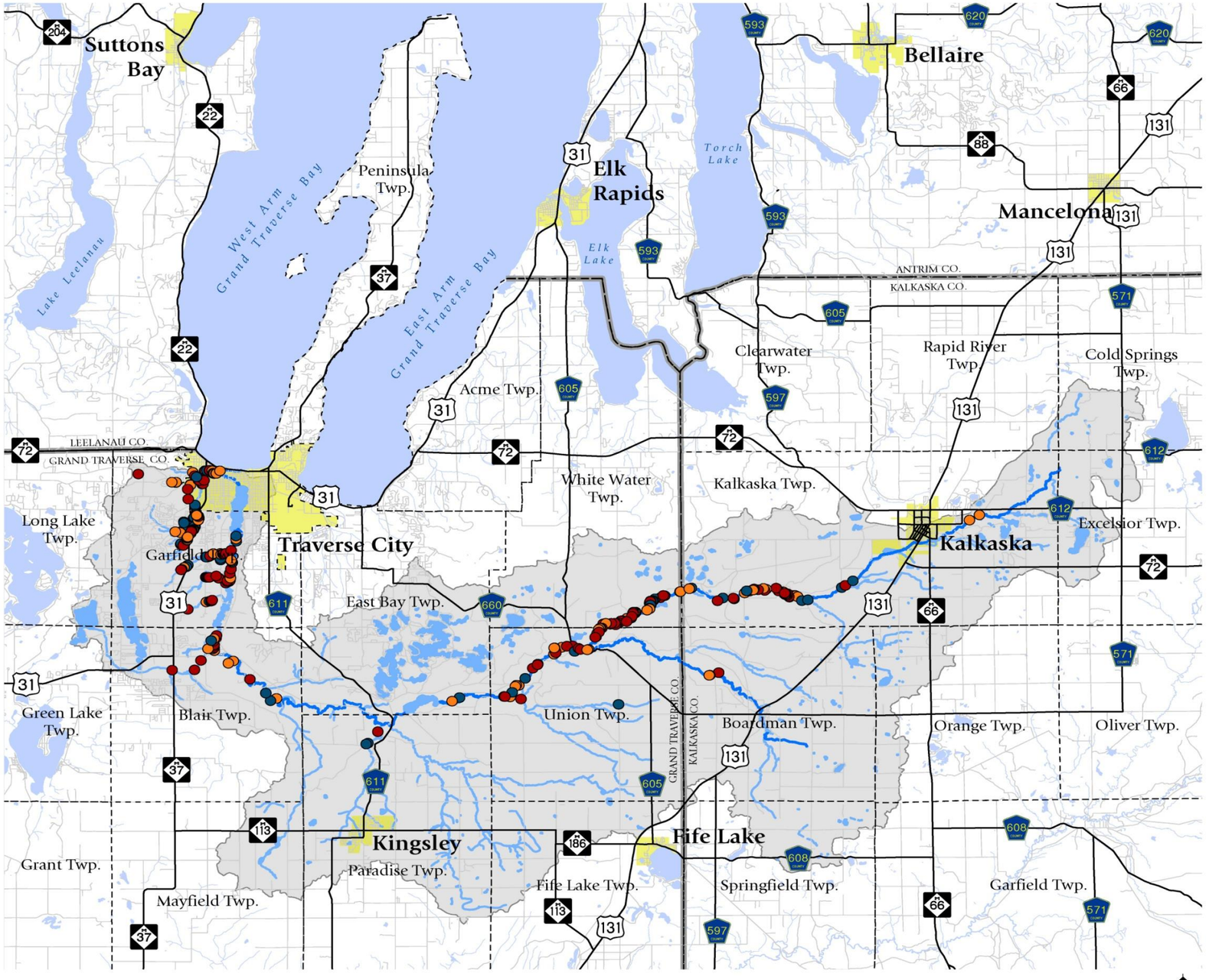


FIGURE 17. Boardman River Watershed Streambank Erosion Sites

SOURCE: Beckett & Raeder Inc., 2016

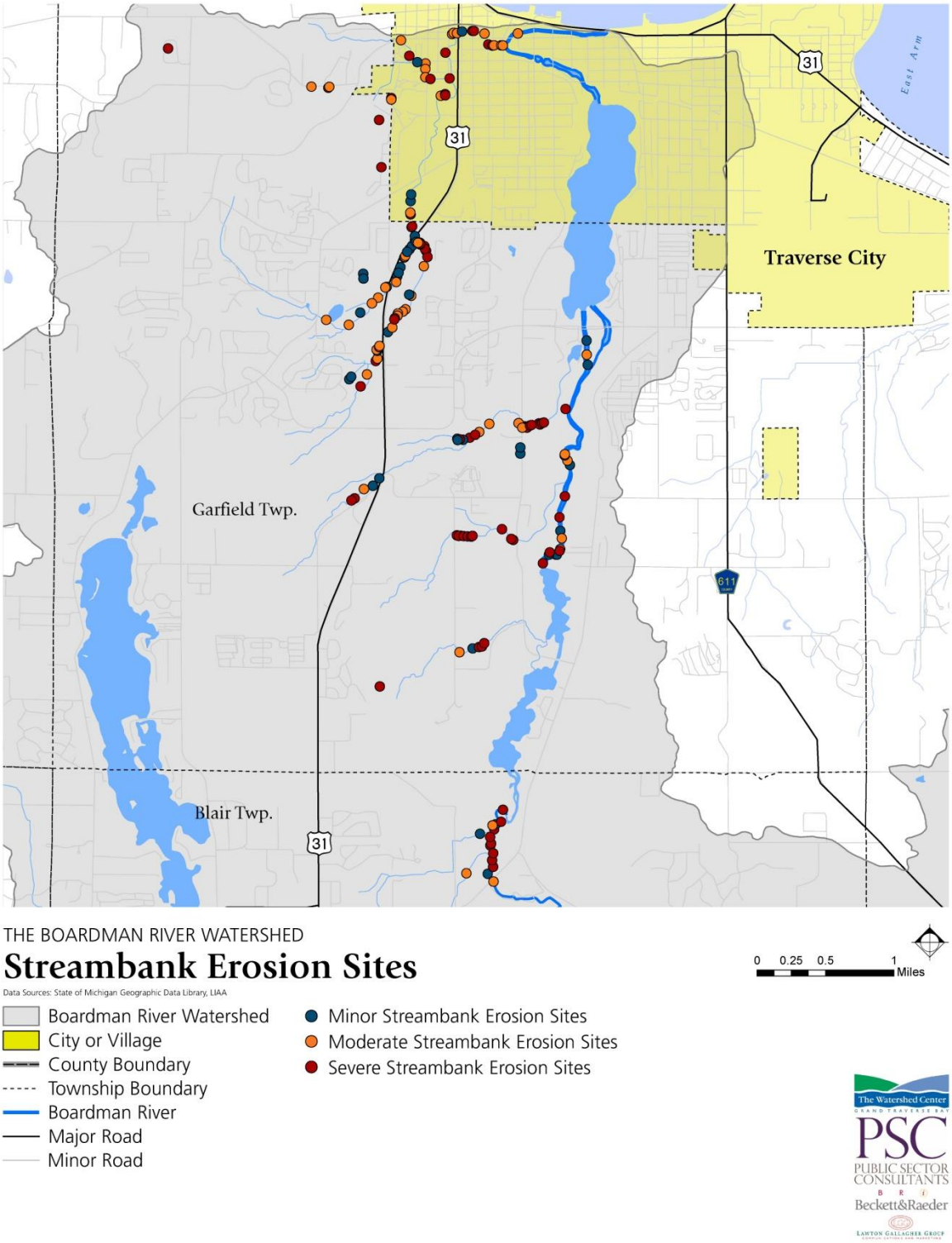


FIGURE 17a. Road Stream Crossing Erosion Sites in Traverse City, Garfield Township, and Blair Township

SOURCE: Beckett & Raeder Inc., 2016

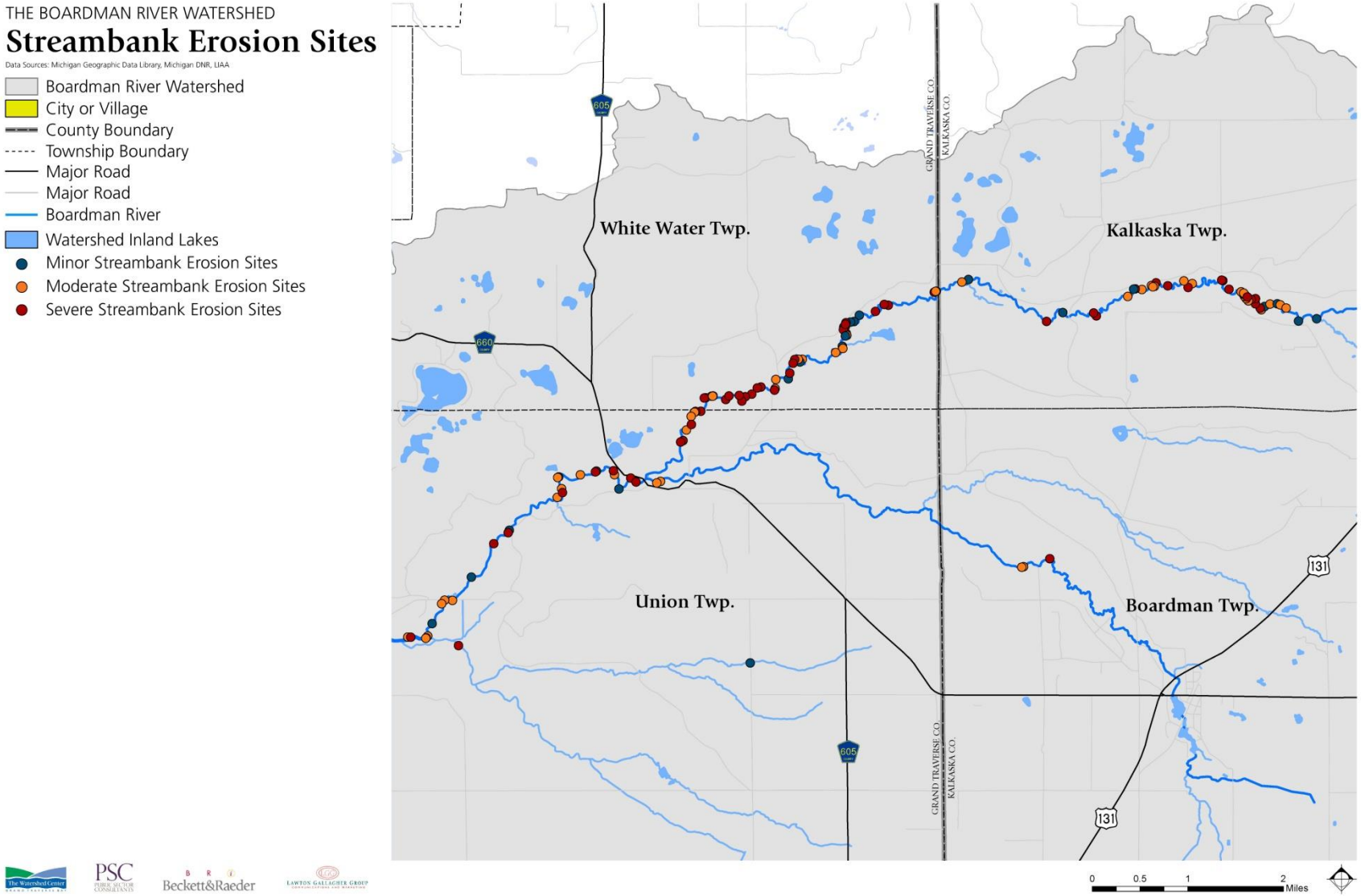


FIGURE 17b. Road Stream Crossing Erosion Sites in Whitewater, Kalkaska, Union, and Boardman Townships

SOURCE: Beckett & Raeder Inc., 2016

Nutrients

Nutrients are elements such as nitrogen, phosphorus, carbon, sulfur, calcium, potassium, iron, manganese, boron, and cobalt that are essential to the growth of living things. In particular, nitrogen and phosphorus are critical nutrients for all types of plants, including aquatic species. The nitrogen requirements of these species are typically about 10 times that of phosphorous. Because nitrogen/phosphorous ratios exceed 10:1 in most freshwater systems, nitrogen is not usually the limiting nutrient. In Michigan, rooted aquatic vegetation and algal growth are most commonly limited by the amount of phosphorous in the water column. Ordinarily, as the amount of phosphorous in the water column increases, rooted plant and algal growth increase as well. Generally speaking, total phosphorous concentrations greater than 10ug/L in lakes and ponds may contribute to increased aquatic plant growth and are indicative of impaired water quality (TWC 2005). Recently measured phosphorous concentrations in the Boardman River have been around 0.024 mg/L, or 20ug/L (Table 4, Chapter 2.4).This causes concern for the potential impact to Grand Traverse Bay from the nutrient output of the Boardman River. As detailed in Chapter 2.6, there have been notable increases in the number of aquatic plant beds from 1991 to 2009. One of the factors of the four-fold increase was attributed to elevated nutrient output from Boardman River (TWC 2010).

When elevated levels of phosphorous occur in the water column, rooted plant and algae growth can be quite excessive, resulting in nuisance conditions. Blooms of algae resulting from nutrient enrichment eventually die and decompose, removing oxygen from the water and potentially leading to levels of dissolved oxygen that are insufficient to sustain aquatic life (Allan 1995). In terms of water quality, nutrients have a negative impact on the system when their concentrations exceed natural background levels. This condition can effectively reduce the recreational value of the waters by making the water unpleasant and undesirable for swimming, fishing, or boating due to increased algae and aquatic plant growth.

Nutrients also speed up the natural aging process of lakes and ponds; this process is called eutrophication. The signs of an aging water body are deeper bottom sediments and heavy plant growth. This aging process would normally be measured in hundreds of thousands of years if not for the added sediments, fertilizers, and other organic wastes supplied by runoff from a developed watershed.

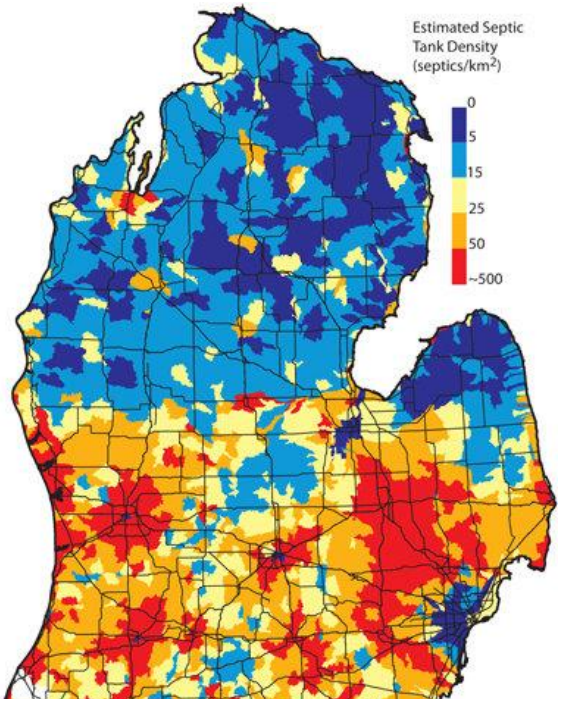
Sources of nutrients to the Boardman River watershed resulting from human activities include stormwater runoff from agricultural, residential, and urban areas; septic systems; residential fertilizer use; agriculture (manure storage, livestock in and near water, crop tillage practices); and runoff from animal waste (both residential and agriculture sources). In addition, nutrients also attach themselves to soil particles, so an increase of sediment in the watershed will also increase nutrient loading to the river and Grand Traverse Bay.

Fertilizers and other pollutants used on agricultural lands in the watershed may also be of concern. As stated in Chapter 2.2, agricultural land use makes up about 11.5 percent of the Boardman River watershed (33 square miles/21,022 acres). Agricultural activities consist mainly of row crops, including potatoes, hay, corn, and small grains, but also include a very limited amount of pasture and orchards/vineyards. These agriculture lands are mainly found in the headwater areas of the tributaries in the southern part of the watershed, as well as the downstream portions closer to Garfield Township. These croplands may potentially have high soil erosion and nutrient runoff rates. The eastern portion of the watershed in Kalkaska County where the north and south branches of the Boardman River begin have very little agriculture.

Another potential source of nutrient enrichment in the Boardman River watershed is from septic systems. Septic systems are used to treat and discharge wastewater from toilets, wash basins, bathtubs, washing machines, and other water-consumptive items, many of which can be a source of high pollutant loads.

They are particularly common in rural or large lot settings, where centralized wastewater treatment systems are not available or economical, as is the case for much of the Boardman River watershed.

Nationally, one out of every four homes uses some form of septic system, with a combined discharge of over one trillion gallons of wastewater each year to subsurface and surface waters (NSFC 1995). The graphic to the right from a MSU study shows the density of septic tanks across Michigan. Much of the Boardman River watershed has a density between 0-15 systems/ km^2. While Traverse City is served by a wastewater treatment plant, the outlying areas often are not, and, as the graphic shows, densities of septic systems can reach up between 25-500 systems/km^2.



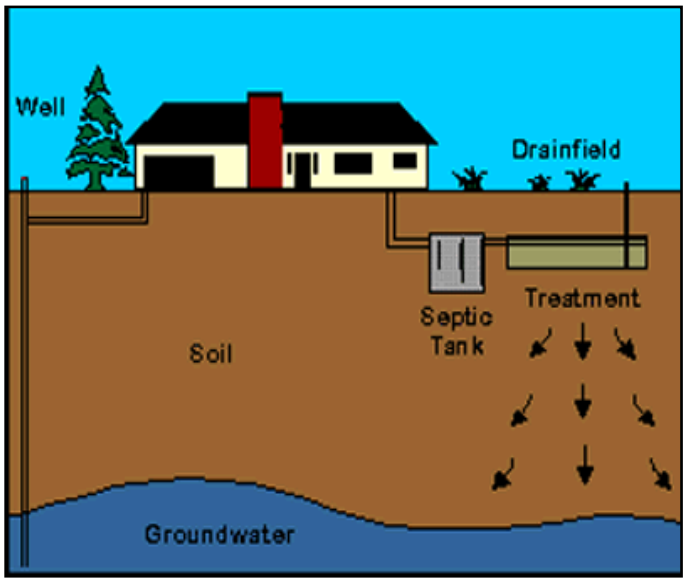
SOURCE: Alexander 2013, courtesy of Hydrogeology Group, Geological Sciences Department, Michigan State University

A failing septic system is considered to be one that discharges effluent with pollutant concentrations exceeding established water quality standards. According to an online news report from MLive,

"...there are about 1.3 million on-site wastewater treatment systems in Michigan, most of which are septic systems for single-family homes. State officials estimate that 10 percent of those (130,000) have failed and are polluting the environment," (Alexander 2013).

Failed septic systems are a concern because human sewage is loaded with pathogens that can threaten the health of people who swim in polluted waters or drink contaminated well water. Several experts interviewed for the report mentioned above said water pollution from failed septic systems is a serious, but under-appreciated, problem across Michigan.

The best way to prevent septic system failure is to ensure that a new system is sited and sized properly and to employ appropriate treatment technology and maintenance. Design requirements will vary



A septic system consists of two basic parts: a septic tank and a soil absorption field or drainfield. Wastes flow from the house into the septic tank where most solids are separated to the bottom and are partially decomposed by bacteria to form sludge. Some solids float and form a scum mat on top of the water. The liquid effluent from the septic tank, carrying disease-causing organisms and liquid waste products, is discharged into the soil absorption field. In the absorption field, the water is further purified by filtration and decomposition by microorganisms in the soil. The semi-purified wastewater then percolates to the groundwater system.

Image and information courtesy of MSU Institute for Water Research
www.iwr.msu.edu/edmodule/water/septic

according to local site factors such as soil percolation rate, grain size, and depth to water table.

The effectiveness of septic systems at removing pollutants from wastewater varies depending on the type of system used and the conditions at the site. The fact is, even a properly operating septic system can release more than 10 pounds of nitrogen per year to the groundwater for each person using it (Septic System Fact Sheet- Matuszeski 1997). The average pollutant removal effectiveness for a conventional septic system is as follows: total suspended solids: 72 percent, biological oxygen demand: 45 percent, total nitrogen: 28 percent, and total phosphorus: 57 percent (USEPA 1993). This shows that even properly operating conventional septic systems have relatively low nutrient removal capability, and can be a cause of eutrophication in lakes and coastal areas.

Although not identified as a known pollutant in the watershed, failing and improperly maintained septic systems are a concern in rural places of the watershed with no sewer service and increasing development such as the Boardman River watershed. More in-depth research is required to better understand the specific amount of pollution coming from failing septic systems in the watershed.

Holding tanks are often required where the water table is within two feet of the ground. These areas are located along rivers, streams, lakes, and wetlands. Holding tanks are expensive to have pumped and maintained leading some landowners to seek alternative treatment or disposal methods that may or may not adequately filter nutrients and waste. Some landowners have been known to dispose of their "gray water" by other means, including direct discharge into the river.

Typical Impacts from Excessive Nutrients

- Increased weed and algae growth impact water recreation and navigation.
- Decomposition of algae and weeds removes oxygen from lakes, harming aquatic life and reducing the recreational and commercial fishery.
- Exotic plant species like Eurasian watermilfoil and purple loosestrife can better compete with native plants when nutrients are abundant.
- Some algae (i.e., blue-green algae) are toxic to animals and humans and may cause taste and odor problems in drinking water.
- High nitrogen levels in drinking water are a known human health risk.
- Rate of eutrophication increases significantly in inland lakes, ponds, and wetlands.

Nutrient and Sediment Loading to the Watershed

Table 23 shows the nitrogen, phosphorus, and sediment load for the Boardman River watershed using the Spreadsheet Tool for Estimating Pollutant Load (STEPL). The STEPL model was designed by Tetra Tech, a private consulting company, for the USEPA. The model is the most recently developed watershed pollutant model supported by the USEPA that is specific to USEPA Region 5, which includes Michigan and the Boardman River watershed (USEPA N.d). The model takes into consideration annual precipitation, land use, agricultural practices, household septic tank use, and soil conditions. Common sources of nutrient loading include riparian septic systems, fertilizer use, livestock waste, and stormwater runoff.

Expected nonpoint source pollution loadings to waterbodies in the Boardman River watershed were estimated using the STEPL model. The model estimates annual loading of phosphorus as 45,499 lbs/year and nitrogen loads as 210,327 lbs/year. As Table 23 shows, the highest areas of nutrient loading are the highly urbanized lower part of the watershed from Boardman Lake to the mouth (Boardman Lake-Boardman River) and the North Branch of the Boardman River in Kalkaska County, which is highly forested with some tributary agriculture inputs from headwater streams.

The STEPL model indicates that the average annual sediment load in the Boardman River watershed is 0.09 tons/acre/year (0.036 tons/hectare/year), which is about average for mixed land use forested

watersheds in the eastern United States. A study that included 226 watersheds in the eastern United States with mixed land use showed a range of sediment load of 0.02-4.42 tons/hectare/year; with a mean sediment load of 0.35 tons/hectare/year (Brooks 2003).

As Table 23 shows, sediment loads measured in tons/acre/year are highest in the lower portions of the watershed (Boardman Lake-Boardman River). This is likely due to the significant urbanization in Traverse City. Two other reaches had relatively high sediment loads as well: North Branch and Crofton Creek in Kalkaska County. These areas are heavily forested, and potential sources of sediment loading might be showing up in the STEPL models from the agricultural lands in the headwater areas of these streams (Figure 5, Chapter 2.2).

As stated above, as the dams along the Boardman River are removed, it will be essential to manage sediment loads delivered downstream and into Boardman Lake, including potential impacts to the culverts under South Airport Road at the inlet to Boardman Lake. There is a need for an action plan to address increased sediment loads in this area several years after dam removal.

While the STEPL model has the capacity to calculate potential load reductions associated with the implementation of specific best management practices (BMPs), it allows for only a limited selection of BMPs. Throughout most watersheds, conservationists frequently utilize multiple BMPs that are the most applicable to site-specific conditions in ways that are not captured by the model.

TABLE 23. Boardman River Watershed Pollutant Loading

Subwatershed* (12-digit HUC)	Acres	Hectares	Phosphorous Load (lb/yr)	Phosphorous Load (lb/acre/yr)	Nitrogen Load (lb/yr)	Nitrogen Load (lb/acre/yr)	Sediment Load (tons/yr)	Sediment Load (tons/acre/yr)
Grand Traverse County								
Brown Bridge Pond-Boardman River	27,069	10,954	2,579	0.24	10,732	0.40	519	0.02
Boardman Lake-Boardman River	5,206	2,106	12,260	5.82	63,791	12.25	1,780	0.34
East Creek	26,415	10,690	5,731	0.54	24,797	0.94	871	0.03
Jaxon Creek-Boardman River	19,564	7,917	10,522	1.33	47,320	2.42	1,598	0.08
North Branch Boardman River	29,936	12,11	642	0.05	2,768	0.09	125	0.00
South Branch Boardman River	1,743	705	354	0.50	1,533	0.88	66	0.04
Kalkaska County								
Brown Bridge Pond-Boardman River	20,379	8,247	184	0.02	778	0.04	38	0.00
Crofton Creek-North Branch	12,007	4,859	6,594	1.36	29,604	2.47	1,374	0.11
North Branch Boardman River	1,467	593	1,421	2.39	6,230	4.25	288	0.20
South Branch Boardman River	37,842	15,314	5,209	0.34	22,770	0.60	1,012	0.03
Total	**181,632.90**	**73,504.30**	**45,499.00**		**210,326.80**		**7,675.60**	

SOURCE: Calculations generated using the STEPL model. Available: http://it.tetratech-ffx.com/steplweb/ (accessed 10/26/12).
**Three subwatersheds are shown twice because the STEPL model is county-based. Figures for those subwatersheds are specific to the portion of the subwatershed within the indicated county.*
NOTE: Different sources that estimate the total acreage of the Boardman River watershed vary slightly (less than 1 percent difference among estimates used in this report) based on different underlying data sets used to estimate watershed boundaries. Additional differences can occur due to rounding of figures.

Thermal Pollution

Not normally thought of as a pollutant, heated stormwater runoff and elevated stream temperatures are a concern in developing areas like the Boardman River watershed. The river is especially at risk due to its classification as a coldwater trout stream. As water temperature increases, its ability to hold dissolved oxygen decreases, resulting in a reduced amount of oxygen available for fish and other aquatic life. Temperature also influences the rate of physical and physiological reactions such as enzyme activity, mobility of gases, diffusion, and osmosis in aquatic organisms. For most fish, body temperature will be almost precisely the temperature of the water. Therefore, as water temperature increases, a fish's body temperature increases, changing their metabolic rate and other physical or chemical processes. When thermal stress occurs, fish cannot efficiently meet these energetic demands (Diana 1995).

Dams, including small earthen dams, lake-level control structures, and hydro-electric dams, are a known cause of thermal pollution to their downstream waterbodies. Three of the four major dams on the Boardman River have been removed or are slated for removal before 2020. However, a 2015 study completed by The Watershed Center (TWC) and the Grand Traverse Conservation District (GTCD) indicates a number of small dams throughout the Boardman River watershed, including man-made earthen dams and beaver dams (Figure 18). Survey results show at least 10 man-made small dams in the Boardman River and its tributaries, and 22 beaver dams (about half of which are on state-owned land). Each of these man-made and beaver dams has the potential to contribute to thermal pollution of downstream waters.

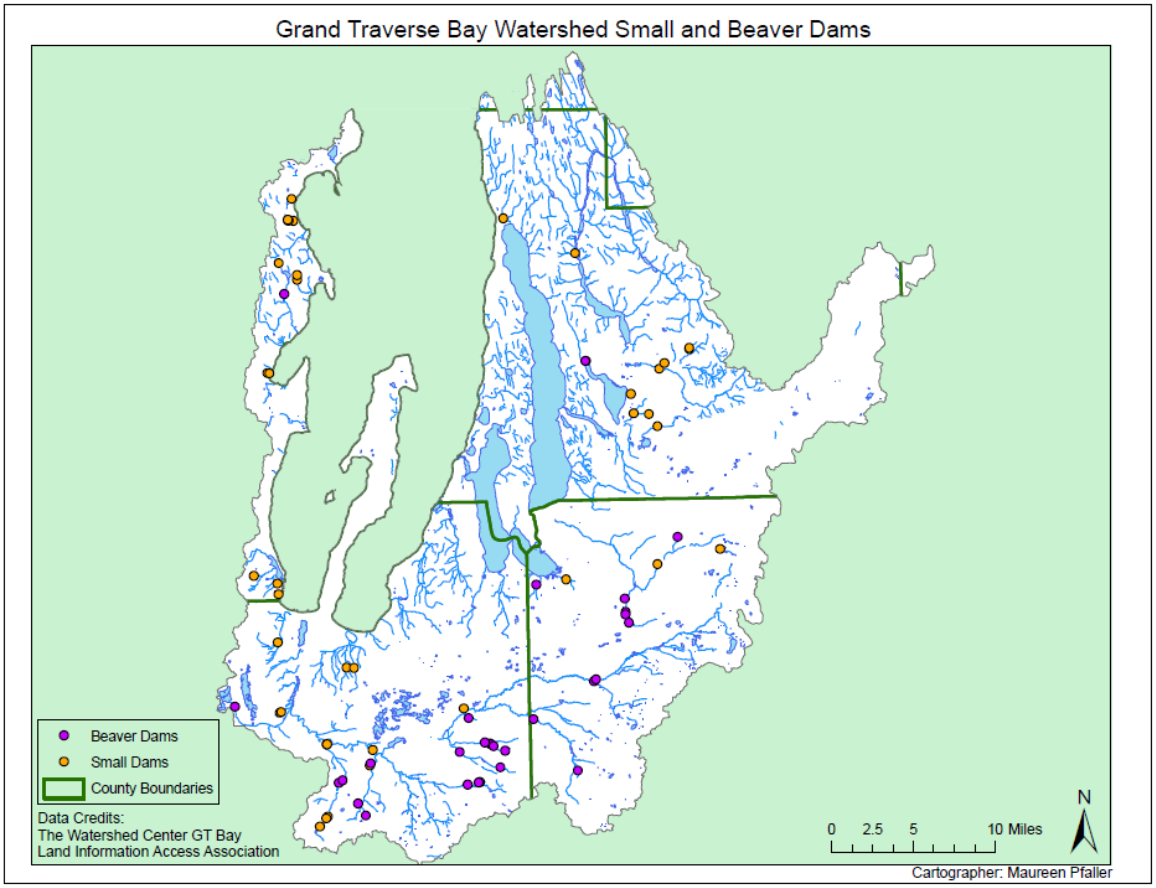


FIGURE 18. Small Dam Inventory of the Grand Traverse Bay Watershed

SOURCE: The Watershed Center 2015, using data from the Land Information Access Association

The GTCD completed a temperature study at the former Brown Bridge Dam location and results show a 9.2 degree Fahrenheit drop in the average July water temperature below the former Brown Bridge Dam when compared to the average water temperature data for the same month prior to dam removal (GTCD 2013). The study also revealed other temperature related changes downstream of the former impoundment including warmer winter temperatures. This is likely due to increased groundwater influx as the weight of the water in the former impoundment suppressed groundwater inputs. I n the winter, groundwater is often warmer than surface (river) water temperatures, thereby slightly increasing the average monthly temperatures during the coldest winter months.

Other than dams on the river, the greatest amount of thermal pollution in the Boardman River watershed is the result of heated runoff from paved surfaces and the removal of shade vegetation along streams and lake shorelines. Excessive inputs of sediment into streams and lakes may also contribute to thermal pollution. Sediment inputs can fill stream pools and lakes, making them shallower and wider and, consequently, more susceptible to warming from solar radiation.

Changes in climate due to global activities also may enhance the degree of thermal pollution in a watershed. Average global surface temperatures are projected to increase by 1.5-5.8 degrees Celsius by the year 2100 (Houghton et al. 2001). Increases in surface temperatures may increase stream water temperatures as well, although impacts will vary by region. Overall, increases in stream water temperature will negatively affect coldwater aquatic species. For example, coldwater fish, such as trout and salmon, are projected to disappear from large portions of their current geographic range in the continental United States due to an increased warming of surface waters (Poff et al. 2002). See Chapter 5.4 for more discussion on climate change impacts.

Typical Impacts from Thermal Pollution

- Surges of heated water during rainstorms can shock and stress aquatic life, which have adapted to coldwater environments. Aquatic diversity is ultimately reduced. Constant heating of rivers and lakes ultimately changes the biological character and thus the fishery value.
- Thermal pollution decreases the amount of oxygen available to organisms in the water, potentially suffocating them.
- Warm water increases the metabolism of toxins in aquatic animals.
- Algae and weeds thrive in warmer waters.

Loss of Habitat

The Boardman River watershed is blessed with a significant amount of public land that provides high-quality habitat (aquatic and upland) in much of the watershed. Rapid development and suburban sprawl in the northwestern lower portion of the watershed, however, have resulted in habitat loss and fragmentation. Habitat loss and fragmentation affect wildlife populations and water quality (loss of natural pollutant filtration). As the region continues to grow, the need to balance economic development with habitat protection will be very important to preserving the region's water quality and wildlife.

Habitat can also be degraded or lost due to overuse of the watershed's recreational resources. For example, increased use of the river for fishing, paddling, and inner-tubing could lead to even greater use of informal access sites, which causes trampling and destruction of habitat. Habitat can also be threatened by riparian property owners installing shoreline hardening devices (such as seawalls or rock walls), removing vegetation along the river, and/or removing important in-stream woody debris along the banks of their properties.

The recaptured sections of river and bottomlands where the impoundments were once located also lack habitat. The area where the 191-acre Brown Bridge pond existed before dam removal in 2012 is now occupied by 2.5 miles of river flowing through its original channel and 175 acres of bottomlands. The

bottomlands that were undisturbed are, for the most part, progressing well with only invasive species control and riparian zone seeding and native tree and shrub plantings required. The spoil areas where over 250,000 cubic yards of sand and organic material that was dredged to locate the original river channel are permanently stored are slower to recover. These spoil areas, primarily located in the upper one third of the basin/bottomlands, require more intense management in the form of native seeding and tree and shrub plantings, as well as invasive species management. The same effort, if not greater, will be needed for Boardman and Sabin bottomlands as well.

Instream habitat fragmentation is a critical issue. Removal of the dams will help immensely, but as stated above, there are a number of small dams located on tributaries throughout the watershed that block aquatic organism passage. In addition, perched or improperly designed transportation crossings add significantly to the fragmentation issue. Perched culverts, where the water flow drops from the outlet of the culvert, are an obvious barrier to fish and insects. Other crossings, where the culvert is improperly designed or placed, may accelerate the water flow, making it difficult for younger age class fish to swim upstream. A brook trout cannot swim against flows greater than 3 feet per second without what is called darting cover. Darting cover includes rocks, logs, and other instream features that provide areas of refuge or rest out of the main flow. Culverts or crossings with a bottom do not provide a natural stream bottom or areas of refuge, therefore fragmenting the upper sections of the stream system. Open bottom culverts, bridges, or culverts that are oversized and buried, allowing for a natural stream bottom, are a much better option.

Changes to Hydrologic Flow

Excessive hydrologic flow in a watershed system often causes problems. The term hydrologic flow encompasses all the factors affecting the stream flow and discharge in a watershed. By far, the most notable and significant alteration in stream flow is caused by urban and stormwater runoff. Stream channel shape, meander pattern, base flow, and storm flow characteristics are largely determined by watershed runoff characteristics. Hydroelectric facilities, lake-level control structures, excessive sedimentation, and channelization by culverts are additional sources of fluctuations in hydrologic flow. Surges of water from dams and lake-level control structures may cause peak stream flows to increase, leading to unstable bottom substrates, flooding, and sedimentation, which destroys aquatic habitats and causes property damage (while also changing stream hydrology further).

Changes in hydrologic flow may also be affected by the amount of groundwater recharge in the watershed. As more and more development paves over forests and fills wetlands, valuable recharge areas are cut off, and stream base flows may eventually be affected. The Boardman River is a groundwater-driven stream and has specific requirements in terms of the quantity, quality, and seasonality of its water supplies. For the system to be sustainable, it must fluctuate within a range of natural variation. If the quantity of the water flow through a system is disrupted, long-term sustainability within the system will be lost.

Typical Impacts from Changes to Hydrologic Flow

- Deviations in storm flow caused by increased runoff from paved surfaces or channeled flow through culverts often causes erosion of the stream channel, which leads to sedimentation problems.
- In some stream reaches, storm surges can spill over banks causing localized flooding, endangering humans and causing widespread economic damage.
- Severe fluctuations in stream flow may disrupt aquatic habitat and strand aquatic organisms, while also interfering with recreational uses of the river.

Invasive Species

Invasive species, particularly aquatic species, pose significant ecological threats to the Boardman River watershed. There are aquatic invasive species within Grand Traverse Bay including the sea lamprey, fishhook water flea, rusty crayfish, spiny water flea, Eurasian ruffe, alewife, and Eurasian water milfoil. The Union Street Dam controls most of these invasive species, but sea lamprey have been discovered upstream of the dam. Zebra mussels have also been found in benthic surveys of both Boardman Lake and Brown Bridge Pond (MACTEC 2011). More recently the New Zealand Mud Snail, a new and potentially harmful invasive species, was found in sections of the Boardman River.

Terrestrial invasive species also pose threats to the Boardman River watershed. The Northwest Michigan Invasive Species Network (ISN) has identified 20 high-priority invasive plant species known to occur across a four-county region that includes much of the Boardman River watershed. Invasive species were considered "high" priority if their characteristics (such as high seed production) rendered them particularly problematic to control (MACTEC 2011). Early Detection Rapid Response species, which have not yet become established in the region, were also identified. Updated lists can be found at www.HabitatMatters.org/challenges.

While the Boardman River Dams Removal Project will result in significant restoration of aquatic and terrestrial ecosystems, it could also present an opportunity for establishment of invasive species if there is no plan to manage and reduce this threat. The Boardman Dams Implementation Team has developed an invasive species management plan that focuses on newly exposed bottomlands and surrounding riparian and wetland areas. The goal of that plan is to prevent new infestations of invasive species and restore native wetland and floodplain plant communities. The plan emphasizes prevention rather than treatment and has targeted the control of sea lamprey and zebra mussels as well as the 20 high-priority terrestrial species identified by ISN (MACTEC 2011).

Pathogens

Water quality and human health are also threatened in the Boardman River watershed due to pathogens in the river, its tributaries, and its outflow to Grand Traverse Bay. Pathogens are organisms that cause disease and include a variety of bacteria, viruses, protozoa, and small worms. These pathogens can be present in water and may pose a hazard to human health. The US Environmental Protection Agency (USEPA) recommends that freshwater recreational water quality be measured by the abundance of *Escherichia coli* (*E. coli*) or by a group of bacteria called *Enterococci*. Michigan has adopted the USEPA's *E. coli* water quality standards. *E. coli* is a common intestinal organism, so the presence of *E. coli* in water indicates that fecal pollution has occurred. However, the kinds of *E. coli* measured in recreational waters do not generally cause disease; rather, they are an indicator for the potential presence of other disease-causing pathogens. USEPA studies indicate that when the numbers of *E. coli* in freshwater exceed water quality standards,

MDEQ Water Quality Standards for Microorganisms

R 323.1062 Microorganisms. Rule 62.

(1) All waters of the state protected for total body contact recreation shall not contain more than 130 Escherichia coli (E. coli) per 100 milliliters, as a 30-day geometric mean. Compliance shall be based on the geometric mean of all individual samples taken during 5 or more sampling events representatively spread over a 30-day period. Each sampling event shall consist of 3 or more samples taken at representative locations within a defined sampling area. At no time shall the waters of the state protected for total body contact recreation contain more than a maximum of 300 E. coli per 100 milliliters. Compliance shall be based on the geometric mean of 3 or more samples taken during the same sampling event at representative locations within a defined sampling area.

(2) All waters of the state protected for partial body contact recreation shall not contain more than a maximum of 1,000 E. coli per 100 milliliters. Compliance shall be based on the geometric mean of 3 or more samples, taken during the same sampling event, at representative locations within a defined sampling area.

swimmers are at increased risk of developing gastroenteritis (stomach upsets) from pathogens carried in fecal pollutions. If more than 130 *E. coli* are present in 100mL of water in five samples over 30 days, or if more than 300 *E. coli* per 100mL of water are present in a single sample, the water is considered unsafe for swimming.

Bacteria monitoring on the Boardman River at its mouth conducted from 2002-2004 by The Watershed Center (TWC) indicates that *E. coli* levels are relatively low. Out of 44 samples analyzed over three years, only one registered above 300 col/100mL; the average reading was 88 col/100mL. However, the Boardman River tributary of Kids Creek does frequently experience elevated *E. coli* levels. Out of 41 samples collected over three years, 17 samples were above 300 col/100mL, and the average of all results was 327 col/100mL (TWC 2004).

Bacteria monitoring data for Great Lakes beaches can be found and accessed at anytime via the MDEQ's online BeachGuard database: http://www.deq.state.mi.us/beach/. Great Lakes beach monitoring results do not indicate that bacteria from the Boardman River is impacting nearby beaches. Clinch Park Beach is located directly west of the Boardman River outlet, separated by a long sheetpile pier. This beach has not had any posted *E. coli* advisories since 2007, with the exception of a one-day closing due to a suspected sewage leak at the wastewater treatment plant. The City of Traverse City's wastewater treatment plant is located at the mouth of Boardman Lake, where it outlets to Boardman River. The plant uses membrane filtration and typically water effluent from the plant is of higher quality than the river.

Fecal pollution entering the Boardman River watershed may come from urban stormwater runoff, failing and under-maintained septic systems, agricultural runoff, or from animals on the land or in the water. Different sources of fecal pollution may carry different pathogens. Peak *E. coli* concentrations often occur during high flow periods when floodwater is washing away possible contaminants along the streambank such as waste from ducks and geese. Additionally, stormwater runoff in the urban areas of the Boardman River watershed that are serviced by storm drains can be a significant source of pathogen contamination. TWC routinely tests storm drain outlets in the Traverse City area during rain events and regularly finds very high levels of *E. coli* bacteria, often in the range of tens of thousands. Storm drains are a source of bacteria because fecal material from dogs, deer, geese, etc. gets washed into them during rain events. Then, in between rain events, the storm drains act as an incubator for the bacteria to grow in large numbers, until the next rain event, when it all gets flushed out. Additionally, TWC has noted the presence of raccoons living in storm drains in Traverse City.

Failing, undersized, or poorly maintained septic systems contribute bacteria to waterbodies throughout the watershed. In Kalkaska County, for example, residents outside the Village of Kalkaska rely on individual water wells and septic systems. While this provides lower costs and greater flexibility for locating new housing, private systems must adhere to certain quality conditions in order to avoid negatively impacting the surrounding physical and aquatic environment. There have been problems in the past with septic systems that are not adequately maintained throughout the watershed and in much of Michigan's northern Lower Peninsula (Kalkaska County 2010). High-density development around lakes and streams utilizing old septic systems can contribute to water quality degradation. A particular problem in the watershed has been the conversion of small, older cottages to year-round residences, which has increased usage of the septic systems. Septic systems are discussed in-depth in Chapter 5.3 Pollutants of Concern: Nutrients.

Historically, there were issues within the Boardman River watershed where livestock (buffalo and cattle) had unobstructed access to tributaries. Many of these sites were rectified using exclusion fencing and alternative watering sources, though there are areas where livestock are suspected of still having uncontrolled access and may be contributing to the problem. In addition, agricultural operations that spread manure on crops also have the potential to contribute large amounts of bacteria to headwater areas, especially during rain/snowmelt events.

Typical Impacts from Pathogens

- High levels of potential pathogens in the water pose a threat to human health and can reduce the recreational value of lakes and the bay.

Oils, Greases, Metals, and Toxins

Manufacturing, light industrial activity, and a former City of Traverse City dump site along the Boardman River has contributed toxics and metals to the river over the years, impacting water quality. Just upstream of Boardman Lake along the east side of the river, the city operated a dump for several decades that is now abandoned, but historic trash remains buried along the banks of the river (TWC and GLEC 2003). There are several known contaminated sites along the shores of Boardman Lake as well, where manufacturing plants contributed large amounts contamination to the lake and river. Another well-known historical contaminated site is the Traverse City Iron Works, which was located downstream of Boardman Lake along the south bank of Boardman River between Union and Cass streets in Traverse City. This site is now home to a successful Brownfield redevelopment site that boasts a mixture of residential condominiums, townhouses, restaurants, and commercial activity, including Hagerty Insurance. Appendix G of the Boardman Lake Watershed Study summarized all of the contamination sites listed under Michigan's Natural Resources and Environmental Protection Act (TWC and GLEC 2003).

It is unknown how many of the numerous past and present oil and gas production well sites might be contributing contaminates to the groundwater as well, which may require more comprehensive investigation and monitoring.

In other parts of the watershed, food production facilities have contributed pollutants to the watershed, as have other industrial activities, many of which remain un-remediated and contain leaking underground storage tanks (TWC 2003). Part 201 Environmental Remediation and Part 213 Leaking Underground Storage Tanks of Michigan's Natural Resources Environmental Protection Act are the primary tools the state uses for addressing remediation of contaminated sites. MDEQ tracks enforcement and compliance with Parts 201 and 213 to ensure they are remediated and cleaned up. Figures 19 and 19a show current Part 201 remediation sites and leaking underground storage tank sites in the Boardman River watershed.

Water quality in the Boardman River watershed is also impacted by stormwater runoff, particularly in urbanized areas, which carries toxics substances such as pesticides, herbicides, oils, gas, grease, and metals. These types of toxins are perhaps the most threatening of all the watershed pollutants because of their potential to affect human and aquatic health. It is highly probably that at any given moment, somewhere in the watershed there is a leaking automobile radiator, a landowner applying herbicides or pesticides to their lawns, or someone spilling gasoline while filling up their car. Every time it rains, these toxic pollutants are washed from the roads, parking lots, driveways, and lawns into the nearest storm drain or road ditch, eventually reaching nearby lakes and streams. Each winter, hundreds of tons of road salt and sand are spread over area roadways. When spring arrives, the remaining sand and salt are washed into the nearest waterway. Additionally, farms, businesses, and homes throughout the watershed are potential sites of groundwater contamination from improperly disposed and stored pesticides, solvents, oils, and chemicals.

Local partners, including the City of Traverse City and The Watershed Center Grand Traverse Bay, have installed seven oil and grit separators in locations downstream of Boardman Lake to separate and capture oils, greases, sediment, litter, or other solids before they enter the Boardman River, and there are plans for additional separators at other stormwater outfalls in the lower watershed.

Typical Impacts from Toxins

- Toxic chemicals entering waterbodies harm stream life, potentially causing entire reaches of a stream to be killed off if the concentrations of contaminants are high enough.

- Persistent toxic pollution in a stream may put human health and recreation at risk.
- Contaminated groundwater may pose a problem for homes and businesses throughout the watershed that rely upon groundwater wells for drinking water; this poses a risk to human health and often requires difficult and costly cleanup measures.

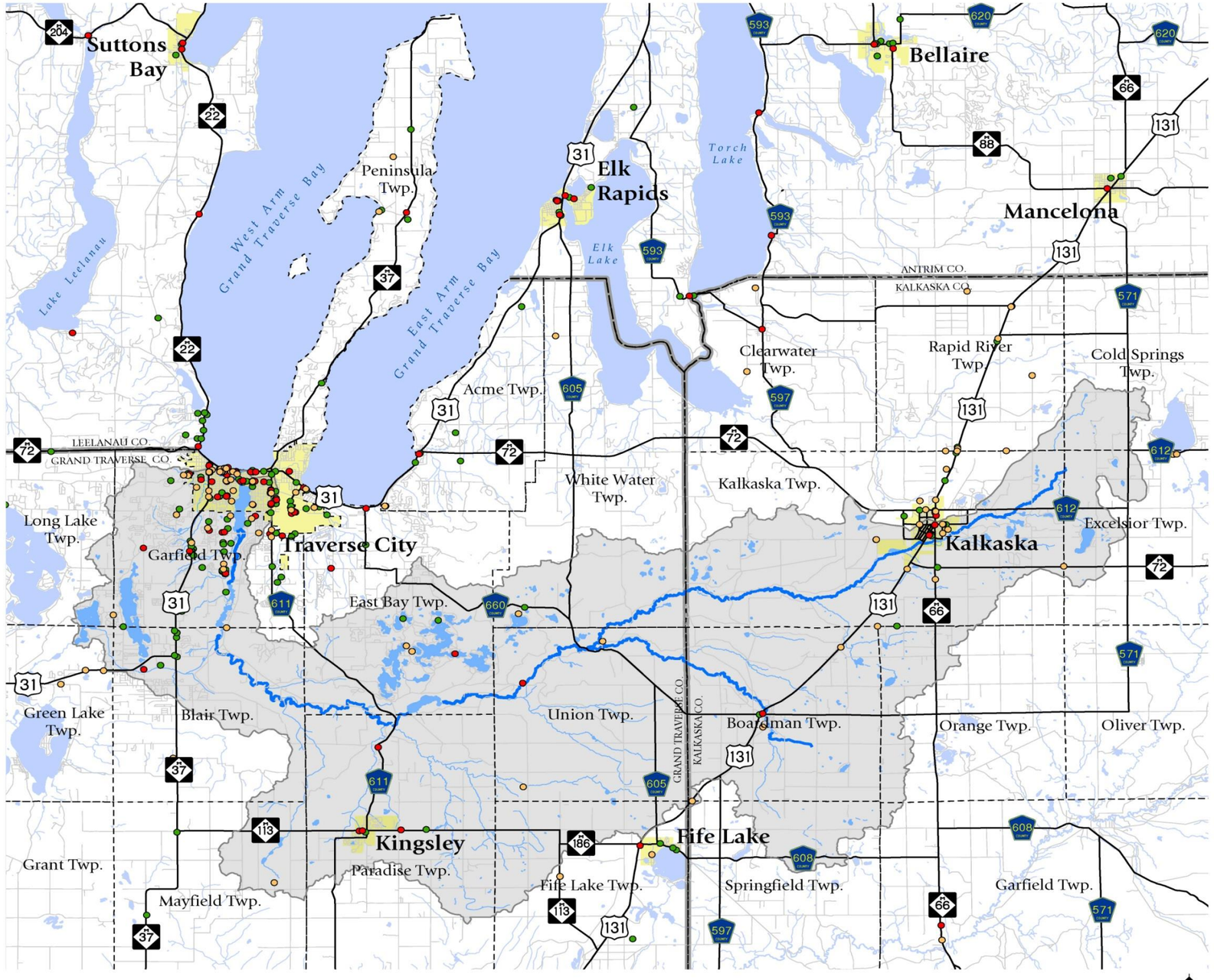
THE BOARDMAN RIVER WATERSHED

LUST and Part 201 Sites

Data Sources: Michigan Geographic Data Library, Michigan DNR

- Boardman River Watershed
- City or Village
- County Boundary
- Township Boundary
- Major Road
- Major Road
- Boardman River

- Part 201 Site
- Open Leaking Underground Storage Tank
- Closed Leaking Underground Storage Tank



SOURCE: Beckett & Raeder Inc., 2012, using data provided by MDEQ

FIGURE 19. Part 201 and Part 213 Environmental Remediation Sites

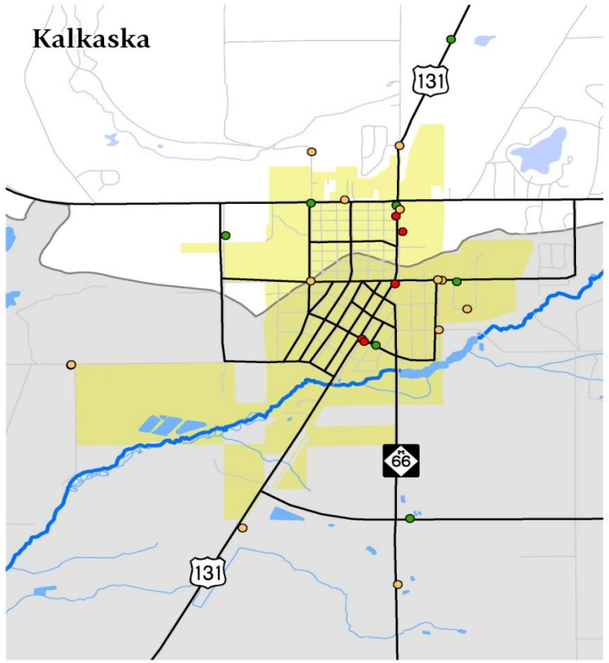
THE BOARDMAN RIVER WATERSHED

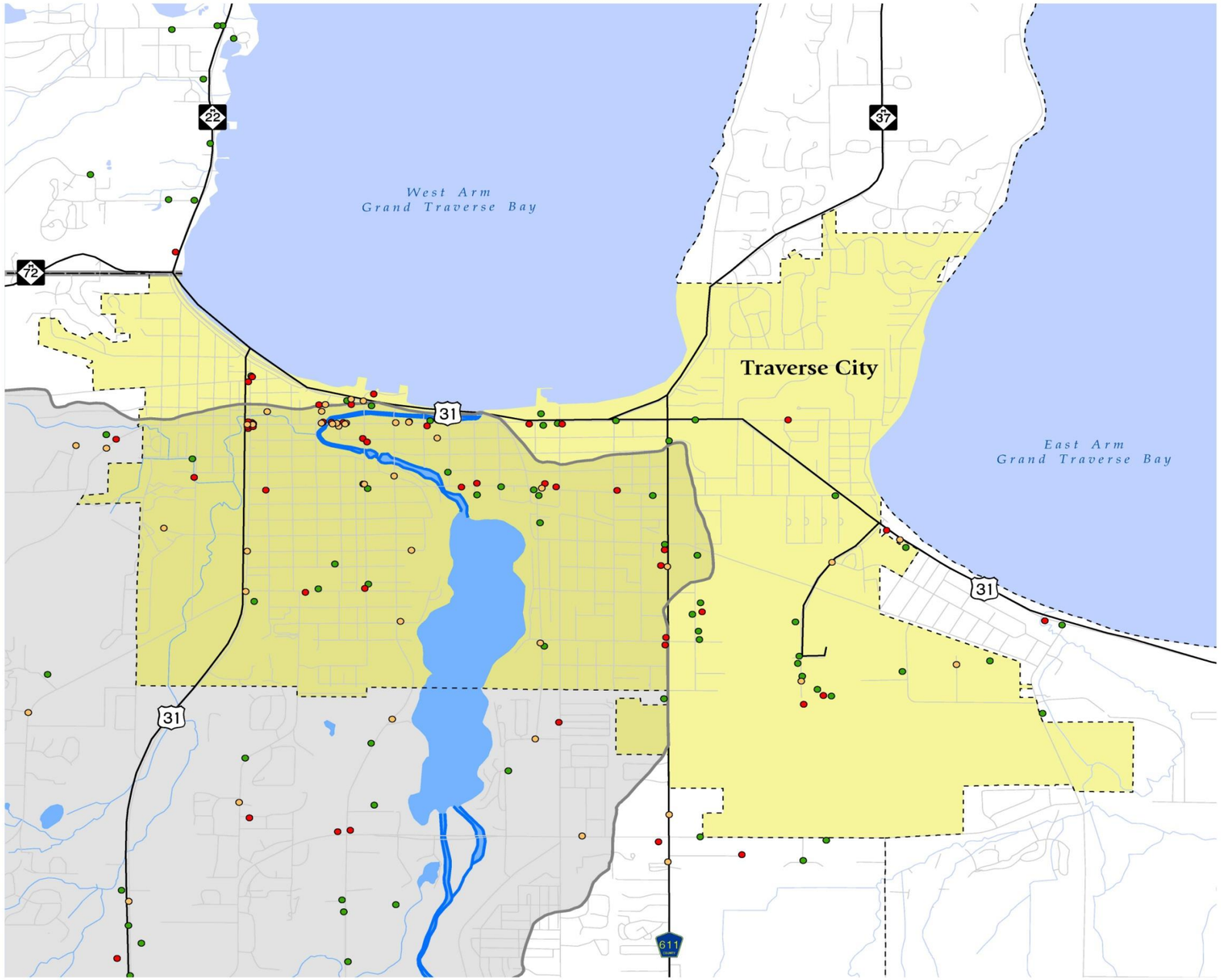
LUST and Part 201 Sites

Data Sources: Michigan Geographic Data Library, Michigan DNR

- Boardman River Watershed
- City or Village
- County Boundary
- Township Boundary
- Major Road
- Major Road
- Boardman River

- Part 201 Site
- Open Leaking Underground Storage Tank
- Closed Leaking Underground Storage Tank





0 0.25 0.5 1 Miles

SOURCE: Beckett & Raeder Inc., 2012, using data provided by MDEQ

FIGURE 19a. Part 201 and Part 213 Environmental Remediation Sites for Traverse City and the Village of Kalkaska

5.4 SPECIAL CAUSE OF CONCERN: CLIMATE CHANGE

Communities in the Boardman River watershed should increasingly be evaluating and planning for the potential impacts on water quality associated with climate change, including warming water temperatures, more frequent and severe storm events, increased stormwater runoff, drought conditions, and flooding. In this way climate change could be considered a cause for the sources of pollutants/stressors in the watershed as noted in Chapter 5.3 Pollutants of Concern. For example, increased storm events would increase stormwater volumes and outputs, resulting in more pollutants like sediments and nutrients entering the watershed, as well as altering the hydrologic flow. Table 24 discusses potential watershed changes due to climate change and the resulting pollutants that could be increased.

TABLE 24. Pollutants/Stressors Affected by Climate Change

Climate Change Result	Pollutant/Stressor Increased
Decreases in wetlands and 1st and 2nd order streams levels due to less summer precipitation	• Thermal pollution • Changes to hydrologic flow
Increased intense storms and greater occurrence of precipitation during late winter and early spring on frozen/bare ground	• Sediments and nutrients • Changes to hydrologic flow
Loss of tree species to ecological changes or pests/disease	• Nutrients • Loss of habitat
Warmer temperatures	• Invasive species • Thermal pollution

The Watershed Center recently partnered with Michigan State University to complete a Climate Change Integrated Assessment through Michigan Sea Grant funding. That project conducted an Integrated Assessment to help communities in the Grand Traverse region understand how climate knowledge can inform planning in a realistic way by evaluating the vulnerabilities and assessing strategies to increase resilience against anticipated climate change impacts. The assessment was able to quantify changes in temperature, precipitation, ice cover, lake levels, streamflow, and water quality, as well as project future conditions and assess the impacts of those changes. It also developed and assessed adaptive management strategies, such as the mitigation benefits of stormwater projects such as the ones TWC is currently conducting. The results of this study will help Boardman River watershed communities understand management options for adapting to climate change over time (Michigan Sea Grant N.d).

A new USEPA report, *Climate Change in the United States: Benefits of Global Action*, estimates the physical and monetary benefits to the U.S. of reducing global greenhouse gas emissions. This report summarizes results from the Climate Change Impacts and Risks Analysis (CIRA) project, a peer-reviewed study comparing impacts in a future with significant global action on climate change to a future in which current greenhouse gas emissions continue to rise (USEPA 2015). The report states that, among a host of other things,

> "...climate change will result in increased intensity of precipitation events, leading to heavier downpours. Therefore, as climate change progresses, many areas are likely to see increased precipitation and flooding, while others will experience less precipitation and increased risk of drought. Some areas may experience both increased flooding and drought. Many of these meteorological changes, along with their associated impacts, are already being observed across the U.S." (USEPA 2015).

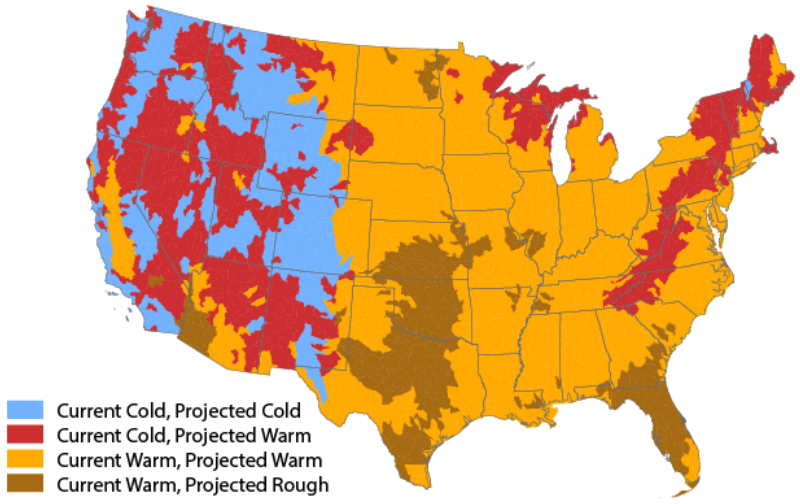
Climate change is also likely to have numerous effects on water quality due to increases in river and lake temperatures and changes in the magnitude and seasonality of river flows, both of which will affect the

concentration of water pollutants. These physical impacts on water quality will potentially have substantial economic impacts, since water quality is valued for drinking water and recreational and commercial activities such as boating, swimming, and fishing. Additionally, these changes, combined with demographic, socioeconomic, land use, and other changes, affect the availability, quality, and management of water resources in the U.S.

For example, freshwater fishing is an important recreational activity that contributes significantly to local economies in the Boardman River watershed. In the freshwater fish category, the USEPA report states that most fish species thrive only in certain ranges of water temperature and stream flow conditions. Climate change threatens to disrupt these habitats and affect certain fish populations through higher temperatures and changes in river flow. In fact, increasing stream temperatures and changes in stream flow could make coldwater habitats more suitable to warmwater fish species, and coldwater species are projected to be replaced in many areas by less economically valuable fisheries over the course of the 21st century. The graphic to the right shows a map from this report that has Northwest Lower MI projected to change from coldwater fish habitat to a mostly warmwater fish habitat. If kept on the current track, without any reduction in greenhouse gases that potentially cause changes in climate, coldwater fish habitat could decline by as much as 62 percent in the next 80 years.

Figure 1. Projected Impact of Unmitigated Climate Change on Potential Freshwater Fish Habitat in 2100

Change in distribution of areas where stream temperature supports different fisheries under the Reference scenario using the IGSM-CAM climate model. Results are presented for the 8-digit hydrologic unit codes (HUCs) of the contiguous U.S.



For more information, visit EPA's "Climate Change in the United States: Benefits of Global Action" at www.epa.gov/cira.

SOURCE: EPA 2015, accessed online at www.epa.gov/cira

5.5 PRIORITY PROTECTION AND CRITICAL AREAS

Since water quality in the existing Boardman River watershed is already of high quality, the Boardman River Watershed Prosperity team identified several areas in the watershed as critical areas or those needing priority protections. Recommendations will be aimed at protecting land from future development or protecting water quality from future potential impairment. High priority locations for these actions are placed into either "Priority Areas" (for protective actions) or "Critical Areas" (for restoration actions). Priority areas are those that are particularly vulnerable to degradation or development pressure and should be protected from future harm. Critical areas are those in need of restoration that are contributing a significant amount of pollutants to the watershed (currently or in the future).

Priority Areas for Protection

Specific priority protection areas in the Boardman River watershed are (Figure 20):

- **Natural lands of high conservation value/priorities for protection.** The top priority areas for natural land protection are the Brown Bridge Quiet Area and the bottomlands for Brown Bridge, Boardman and Sabin dams. Additionally, groups like the Grand Traverse Regional Land Conservancy have developed specific criteria for conservation easements and nature preserves to ensure that lands acquired or put into easements are leveraging other protection areas and meeting broader watershed conservation goals.
- **Wild and Scenic designated areas along Boardman River.** These areas are a priority for maintaining and protecting designation status and high quality (see Figure 7 for a map of Natural River segments.
- **Boardman River channel from "The Forks" down to Brown Bridge Quiet Area.** Wildlife and aquatic habitat in this area need protection because of potential overuse from recreation.

General priority areas (not shown on map):

- **Ridgelines and other areas with expansive viewsheds of the Boardman River** (privately owned) that provide wildlife habitat, contribute to the region's rural character and quality of life, and help recharge groundwater.
- **Headwaters of tributaries.** These areas are a priority for extending the Natural Rivers designation and its protective zoning to protect their wild and scenic properties. The top priorities for headwater protection are the north and south branches of the Boardman River.

Brown Bridge Quiet Area
Photo courtesy of: Grand Traverse Conservation District

THE BOARDMAN RIVER WATERSHED

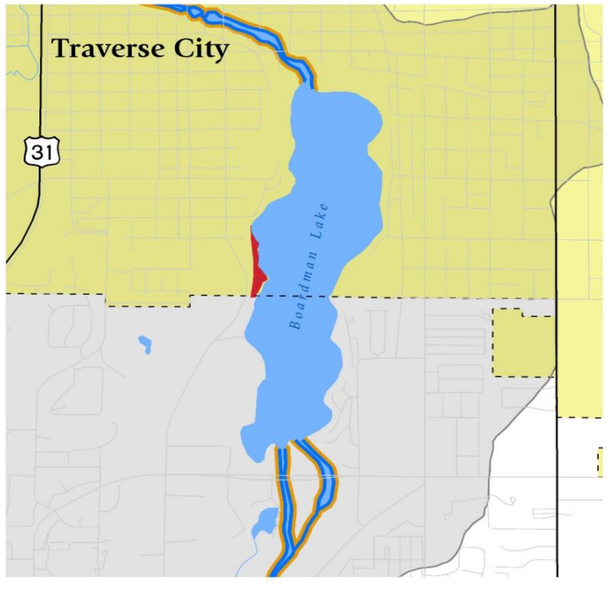
Priority Areas

Data Sources: Michigan Geographic Data Library, Michigan DNR, GTRLC

- Boardman River Watershed
- City or Village
- County Boundary
- Township Boundary
- Major Road
- Major Road
- Boardman River
- Country Scenic Designated Natural Rivers
- Wild Scenic Designated Natural Rivers
- 1 Boardman River Channel, "The Forks"
- 2 Boardman Dam Bottomlands
- 3 Brown Bridge Quiet Area

Natural Lands Designated for Future Conservation Easements

- GTRLC Priority Area - Tier 1
- GTRLC Priority Area - Tier 2



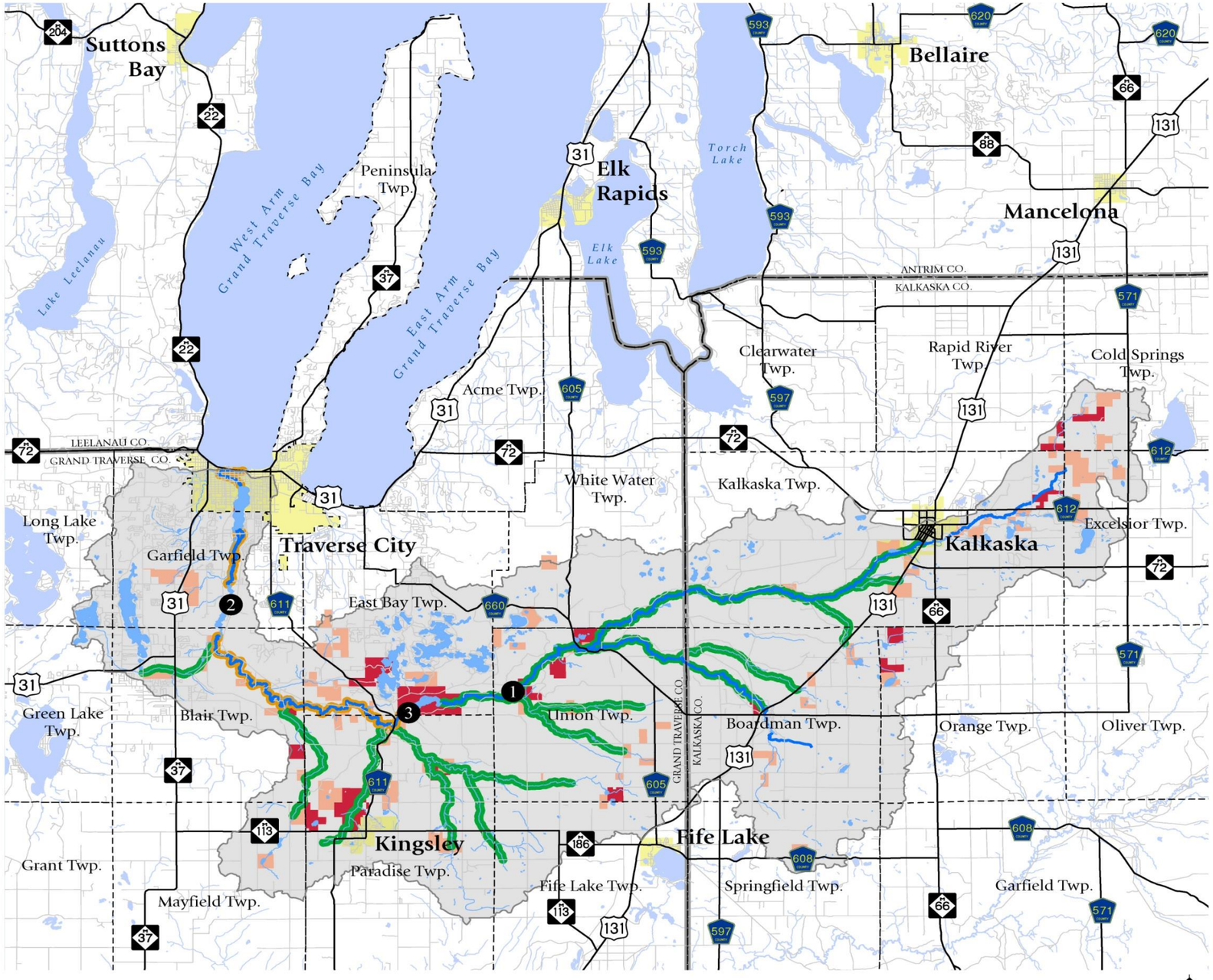


FIGURE 20. Major Priority Protection Areas in the Boardman River Watershed

SOURCE: Grand Traverse Regional Land Conservancy, 2013 based on input from the Boardman River Watershed Steering Committee

Critical Areas

Critical areas for the Boardman River watershed are the areas in which management measures need to be implemented to achieve load reductions identified in the plan. They also refer to locations where actions are needed to address ongoing sources of nonpoint source pollutants. The process of identifying critical areas relies on a combination of methods, including resource inventories, GIS, and reports from resource managers and others familiar with a particular aspect of the watershed.

The critical areas identified (Figure 21) reflect the primary sources of nonpoint source pollution, including urban stormwater, dam removal activities, development and shoreline management, agriculture, transportation crossings, and malfunctioning septic systems. Critical areas are shown at two levels: general critical areas and acute critical areas. General critical areas represent broader areas where attention is needed, in general. Acute critical areas are the priority locations where attention is needed first and foremost. Circled areas on Figure 21 and the corresponding legend help to identify the acute critical areas.

General Critical Areas:

- **Riparian corridors**. Areas within approximately 1,000 feet of Boardman River or tributaries that drain to the river.
- **Wetlands**. All wetlands and areas within 1,000 feet of wetlands identified in the National Wetlands Inventory for the Boardman River watershed.
- **City and village centers**. Urban areas that contribute significant stormwater runoff to the Boardman River and its tributaries. Although each urban area's individual contributions vary according to many factors, including total impervious surface, implementation of stormwater best management practices, and pollutant loadings, it is reasonable to assume they are all contributing nonpoint source pollutants to some extent, and therefore, should be continually managed to reduce their loadings.
- **Transportation Crossings**. The degree of severity of road-stream and other transportation crossings on the Boardman River and its tributaries varies; consequently, the impacts to the resources vary as well. Severe and moderate crossing sites are included as critical areas because of their potential to contribute large amounts of sediments and other nonpoint source pollutants.
- **Agricultural Lands.** Agricultural areas are included because water quality monitoring in other watersheds has shown higher levels of nitrates in areas where agricultural practices are hydrologically connected via groundwater or runoff. The application of nitrogen-rich fertilizers, particularly in sandy, well-draining soils, is suspected as one of the sources of these nitrates.

Acute Critical Areas:

1. **Bottomlands and impacted upstream areas from Brown Bridge, Boardman, and Sabin dam removals.** As dam removal projects are completed, concurrent restoration of the bottomlands and associated upstream impacted areas is critical to prevent soil erosion and sediment contribution, protect and enhance in-stream habitat, and control invasive species (see Figure 1 for location of dams).
2. **North Branch of the Boardman River from Kettle Lake Road downstream to the confluence of Failing Creek.** Water quality and ecological function in this stretch of the river is severely impacted for several reasons, including temperature and sediment.
3. **Inland lakes with hydrologic connection to the Boardman River and/or increased residential development, including Silver, Arbutus, and Spider lakes.** Development (historic and new) along these lakes may be causing increased pollutant contributions from greater amounts of impervious surface, bank erosion, and aging or undersized septic systems.

4. **Traverse City and surrounding urban area, roughly defined by the land area encompassed by South Airport Road, Garfield Avenue, US31 North to Grand Traverse Bay (includes Traverse City and Garfield Township).** This highly urbanized portion of the watershed in Traverse City contributes pollutants to the river and Grand Traverse Bay via stormwater runoff. While a number of stormwater reduction and filtration projects have been implemented, there is still a significant need to reduce the amount of oils, greases, litter, and other pollutants to the river in this portion of the watershed.

5. **Kids Creek subwatershed.** As discussed in Chapter 4.3, Kids Creek is the only impaired waterbody on MDEQ's 303(d) list. Water quality in the creek is severely impacted by stormwater and sedimentation. TWC launched a large-scale Kids Creek Restoration Project a number of years ago that included stormwater reduction BMPs on tributaries A and AA of the creek, streambank stabilizations, and "daylighting"[7] a portion of Tributary A (See Chapter 4.3 and Figure 14 for more detail). Restoration efforts must continue on Kids Creek to further aid in efforts for its removal from the impaired waters list.

[7] Daylighting means redirecting the stream to an above-ground channel instead of an underground culvert

6. **Boardman Lake shoreline.** The lake has had significant historic sediment contamination from previous industrial activities around the lake and is vulnerable to increasing sediment load as upstream dams are removed (see Figure 2 for Boardman Lake location).
7. **Severe streambank erosion sites and transportation crossings.** As previously described, the Grand Traverse Conservation District identified more than 600 eroded sites along the Boardman River and its tributaries in the Boardman River Watershed Report. Since 1993, more than 300 of the 600 identified sites have been restored, but there are still many severe road crossing and streambank erosion sites that need to be restored to protect and improve the Boardman River watershed ecosystem (Figures 16, 17, 17a, 17b). Particular attention should be around streambank erosion sites around the dams as they are removed.
8. **Village of Kalkaska.** As the second largest urbanized area in the watershed, the Village of Kalkaska contributes stormwater runoff from urban areas to the headwaters of the Boardman River. Monitoring in the area has indicated negative impacts on benthic macroinvertebrate communities.
9. **Agricultural lands – Fife Lake/Kingsley/Garfield Township areas.** Agriculture in the watershed is centered on these headwater areas and makes the potential nutrient and sediment inputs to these small streams a high priority.
10. **Small dam removal.** As stated earlier, dams are a known cause for thermal pollution to their downstream waterbodies. Survey results show at least 10 man-made small dams in the Boardman River and its tributaries, each with the potential to contribute to thermal pollution of downstream water (Figure 18). When feasible and with owner approval, these dams should be removed.

THE BOARDMAN RIVER WATERSHED

Critical Areas

Data Sources: Michigan Geographic Data Library, Michigan DNR, LIAA

- Boardman River Watershed
- City or Village
- County Boundary
- Township Boundary
- Major Road
- Major Road
- Boardman River
- Wetlands and areas within 1,000 feet of wetlands
- Riparian Corridors - areas within 1,000 feet of the Boardman River or it's tributaries
- Agricultural Lands
- Watershed Inland Lakes
- Moderate Stream Crossings
- Severe Stream Crossings
- Identified Small Dams

Location	Critical Concerns
1. Bottom land areas from Brown Bridge, Boardman, and Sabin dam removals	Restoration of the bottomlands to prevent soil erosion and sediment contribution, protect and enhance in-stream habitat, and control invasive species
2. North Branch of the Boardman River from Kettle Lake Road downstream to the confluence of Failing Creek	Temperature and sediment
3. Inland lakes with hydrologic connection to the Boardman River and/or increased residential development, including Silver Lake, Arbutus Lake, and Spider Lake	Development may be causing increased pollutant contributions from stormwater, bank erosion, and septic systems
4. Traverse City and surrounding urban area	Urban stormwater
5. Kids Creek Subwatershed	Urban stormwater and sedimentation
6. Boardman Lake shoreline	Sediment contamination
7. Severe Streambank Erosion Sites and Transportation Crossings (See legend above for locations)	Erosion and sedimentation
8. Village of Kalkaska	Urban stormwater
9. Agricultural Lands - Fife Lake/Kingsley/Garfield Township Areas	Nutrient/Sediment inputs
10. Small Dam Removal (See legend above for locations)	Sediment, hydrologic flow, thermal pollution

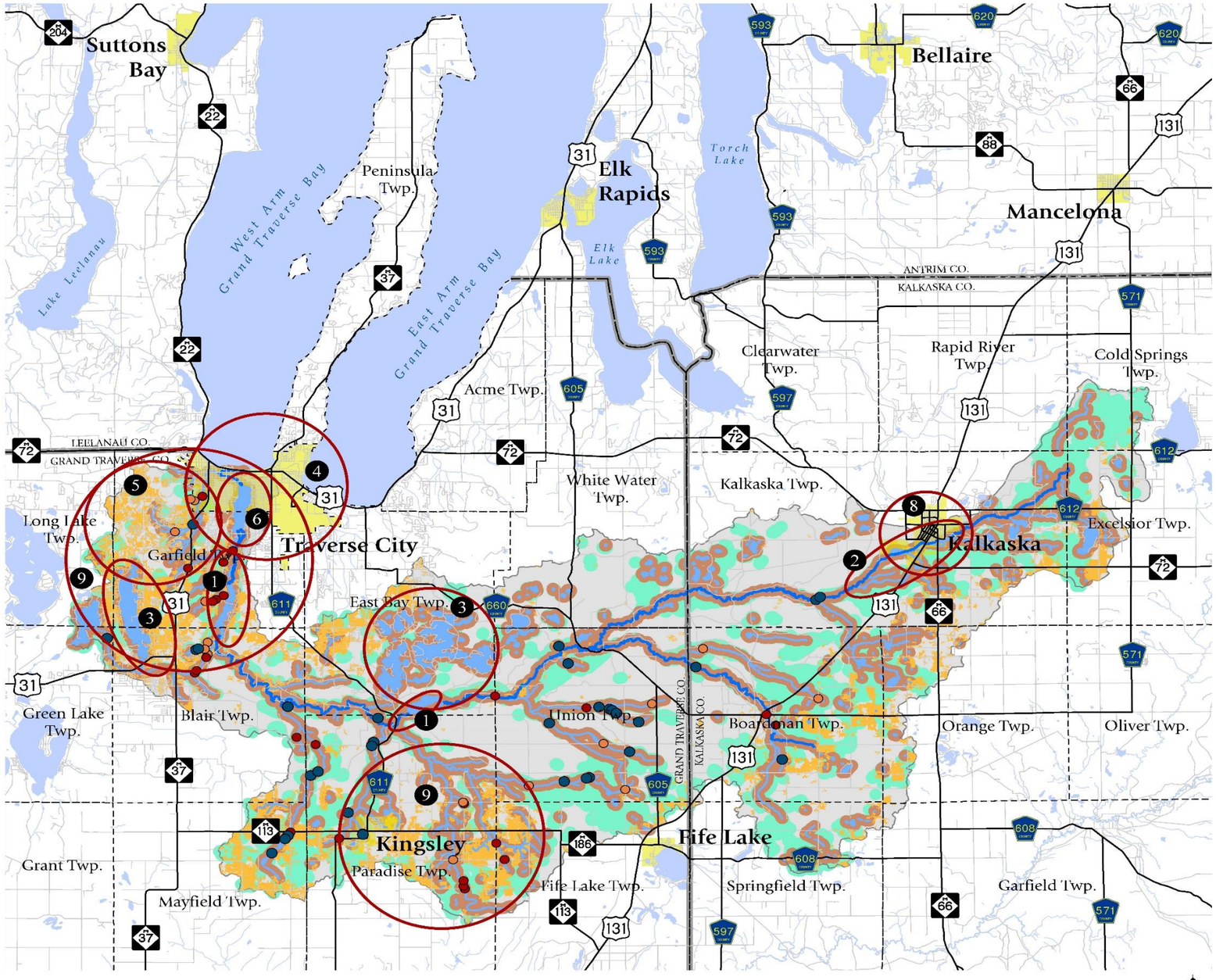


FIGURE 21. Critical Areas in the Boardman River Watershed

SOURCE: Beckett & Raeder 2016

Chapter 6. Other Natural Resource Uses and Issues

6.1 NATURAL RESOURCE DESIRED USES

In addition to the water quality designated uses discussed in Chapter 4, there are many other natural resource desired uses that help advance prosperity in the Boardman River watershed. These have been identified through several previous planning efforts such as the Grand Vision, Grand Traverse Bay Watershed Protection Plan, Boardman Valley Master Plan, and Boardman Dams Feasibility Study, as well as public input received through the watershed prosperity planning process and discussions with the Leadership Team. The three primary natural resource (non-water quality) desired uses that have been identified in the planning process are:

- **Abundant, healthy wetlands and aquatic habitat.** In addition to the substantial water quality benefits that wetlands provide, they also support the region's world-class fishery by providing critical nursery grounds and refuge, provide opportunities for nature enthusiasts to watch and photograph birds and wildlife that are supported by these critical areas, and are important areas of open space that contribute to the undeveloped natural resource character of the watershed.
- **Abundant, healthy upland wildlife habitat.** As described in Chapter 2, the Boardman River watershed is home to many varieties of upland wildlife habitat. These areas support game and nongame animals and threatened and endangered species. They also contribute to the open space, undeveloped character of the region.
- **Natural resource education and interpretation.** Providing education and interpretation of the watershed's valuable natural resources through programs, projects, and hands-on learning opportunities is one of the best ways to engender a stewardship ethic in people and create lifelong champions and protectors of natural resources.

6.2 NATURAL RESOURCE PROSPERITY ISSUES

Wetlands

The Boardman River watershed currently has over 2,000 acres of wetlands, including many that are pre-settlement complexes. The watershed's existing wetland communities are diverse and have a range of plant species that are characteristic of lowland, scrub, and wooded wetlands.

Through the dam removal project, more than 250 acres of additional wetlands will be restored along the river corridor. It will also result in increased species and ecosystem structural diversity as the open water aquatic habitats convert to emergent and then forested and scrub-shrub systems. While there will be some short-term impacts to wetlands and other aquatic habitat during and in the immediate aftermath of the dam removal, over the longer term this increased acreage and diversity will improve and protect water quality in the watershed and support increasing amounts of wildlife along the river (ECT 2009).

In the western portion of the watershed, primarily in Garfield Township, there are remaining wetland systems along the river and tributaries. If regional growth results in continued development south of Traverse City, wetlands – particularly those that are not on public lands – could be impacted through alteration, increased runoff, and sedimentation.

Upland Wildlife Habitat

The upland habitat communities in the Boardman River watershed support a diversity of wildlife including bird species such as songbirds and woodpeckers, neotropical migratory birds (warblers), raptors (hawks, bald eagle), upland game birds (wild turkey, ruffed grouse), and numerous species of mammals including bats, rodents (groundhog, squirrels, chipmunks, white-footed mouse, etc.), whitetail deer, cottontail rabbit, bear, coyote, red and gray fox, raccoons, and striped skunks. The Michigan Natural Features Inventory (MNFI) has identified 14 threatened and endangered species element occurrences[8] in the watershed, as well as eight species of special concern occurrences (ECT 2009).

Photo courtesy of: Wikipedia Commons

The watershed includes a substantial amount of public and private forest cover, as well as areas of herbaceous grassland habitat. The MNFI has identified five exemplary natural communities (dry mesic [moderately moist] northern forest, mesic northern forest, northern fen, oak pine barrens, rich conifer swamp) and one special breeding/rearing habitat (Great Blue Heron rookery) in the watershed as well (ECT 2009). The dam removal projects will result in restoration of an additional 57 acres of upland habitat (Boardman River Dams Project N.d).

Given the abundant and high-quality wildlife habitat available in large parts of the watershed, one of the focuses of the Prosperity Plan is to maintain, protect, and connect these important resources in the future. Potential threats or issues could arise if there are substantial increases in recreation use in the mid and upper watershed that might damage or destroy habitat areas. If not accommodated in managed areas (public and private), biking, off-road vehicles, and equestrian uses could have impacts on upland wildlife habitat, including sensitive habitat areas. While not currently an issue, terrestrial invasive species could also have negative impacts on existing upland communities in the future if they are not monitored and addressed.

Natural Resource Education and Interpretation

There is an increased understanding that educating people about natural resources and their surrounding natural environments helps engender a stewardship ethic among people and plays an important role in protecting and managing natural resources. There are several opportunities for natural resource education and interpretation in the watershed, including the Boardman River Nature Center (run by the Grand Traverse Conservation District), school programs, community events, and trail-side interpretation. Emerging technologies including online trail maps, social media, and other opportunities also play a critical role. Nevertheless, there are significant, untapped opportunities to connect people – physically and emotionally – to the Boardman River through education, hands-on experiences, volunteer opportunities, and new technologies. These education and interpretation opportunities can be larger and more formal, such as nature centers and organized school/education programs, or they can be deployed in smaller, less formal ways through interactive exhibits or information centers at key locations (such as along trails, at popular fishing sites, in lodging or other tourist destinations), and through online resources and media (social and traditional).

[8] Known and verified sightings of threatened, endangered, and special concern species.

Chapter 7. Economic Uses and Issues

7.1 DESIRED ECONOMIC USES

In addition to identifying water quality and other natural resource uses, the Leadership Team, informed by public input and previous planning efforts, also identified several important economic uses for the watershed:

- **Strong "knowledge-based" economy.** A knowledge-based economy is one that is largely based on technology and human capital sectors, driven by innovation and globalization. Industries and job sectors such as engineering, science, process and system design, logistics, biotechnology, and health care management are a handful of examples of knowledge economy sectors that are helping grow local economies and add jobs. The Boardman River watershed region has existing clusters in education, health, recreation, and retail areas, and continuing to provide job opportunities and quality of life that attract knowledge economy businesses and workers is an important part of the watershed's future economic prosperity.
- **Viable local agriculture.** The watershed has historically supported agriculture clusters in Paradise, Blair, Boardman, East Bay, Garfield, and Kalkaska townships, as well as around the Village of Kingsley. This strong local agriculture sector not only provides an important element of the regional economy, it also helps maintain rural character and open space in much of the watershed, which has been identified as an important objective in other planning efforts such as the Grand Vision.
- **Diverse business/jobs base.** The community has recognized that maintaining a diverse business and jobs base in the region is an important aspect of advancing economic growth and providing varied employment opportunities for workers with various skill levels.
- **Tourism-serving industry.** The Boardman River watershed, particularly the northwestern portion of Traverse City along Grand Traverse Bay, is a popular tourist destination for Michigan travelers as well as out of state and international visitors. While Traverse City hosts the bulk of the tourism activity, the entire watershed is an important recreational tourist destination, attracting people for its fisheries, motorized and non-motorized trails, paddling, and hunting activities, among others. The restoration of the Boardman River to a free-flowing river will offer substantial opportunities for growing the region's tourism-serving industries such as recreation guides, gear shops, lodging, and restaurants.

Photo courtesy of: Greg Smith

7.2 ECONOMIC PROSPERITY ISSUES

There are approximately 41,636 households in Grand Traverse and Kalkaska counties and 17,796 households within the physical boundaries of the Boardman River watershed. County residents have a median age of 41.3 and 43 years, respectively, and over 95 percent of them are white (U.S. Census Bureau 2010). The U.S. Department of Agriculture (USDA) classifies both Grand Traverse and Kalkaska counties as "nonmetro recreation and retirement destination counties." The agency further classifies the Grand Traverse County economy as "service dependent," and the Kalkaska County economy as "mining dependent" (USDA Economic Research Service 2013).

Although the two counties can be grouped together for some demographic purposes, there are fairly significant differences between them in terms of income, education, poverty, and employment. At a meeting with regional service agencies convened by Rotary Charities, one participant summarized the general character of the two counties within the watershed by noting that the watershed is "Grand Traverse County's playground," while in Kalkaska County it is viewed as a "source of added subsistence." While this is a broad generalization, it does frame the discussion of how the natural assets of the Boardman River watershed can be leveraged to improve overall regional prosperity. It also raises the question of whether the success of the dam removal projects and Boardman River restoration should be measured against how many residents are lifted from poverty and are achieving increased economic prosperity, particularly in Kalkaska County.

Measuring Economic Prosperity

Although the term prosperity can have many meanings, the following measures were used to assess *economic* prosperity in the Boardman River watershed:

- **Job sector diversity:** the ratio of private-sector jobs to public-sector jobs. This serves as a barometer of job market stability because local employment is not dependent on government-funded jobs.
- **Diversity of the job base**: the ratio of manufacturing jobs to retail jobs, which reflects a more even employment market that is less affected by specific employment sector job fluctuations.
- **Average commute time:** the number of minutes it takes a worker to drive to work. A longer commute time can reflect lack of local jobs for resident skill sets or the lack of affordable housing in the location of employment.
- **Residents over the age of 25 not completing high school**: this condition has long-term economic consequences affecting employment opportunities, household income, and potential dependency on safety net government programs for welfare and health care.
- **Percentage of persons uninsured**: this may result from lack of full-time work and access to health care benefits, long-term unemployment, and presence of employers that promote the utilization of part-time employment.
- **Percentage of households receiving food stamps**: an indication of high unemployment, poverty, single-parent households, and low-wage job employment.

Other measures of economic prosperity include the percentage of the knowledge-based workforce, the percentage of workers in the creative class, and median household income. While there are many ways to measure prosperity, the six measures listed above reflect the fact that if residents within the Boardman River watershed do not have the means to put food on the table, lack a sustainable family income sufficient to provide for health care, or lack the educational skills to work in today's job market, they cannot be defined as prosperous.

Table 25 compares prosperity indicators in the five main Boardman River watershed communities and the state of Michigan as a whole.[9] There are many notable differences. For example, the diversity of the job base as a relationship between manufacturing jobs and retail-based employment is 1.52 for the State of Michigan, or 1.52 manufacturing jobs for every one retail job. In Traverse City, this number is 0.45, reflecting an economy dependent on retail jobs. In the Village of Kalkaska, this ratio is 1.85 manufacturing to retail jobs, which is higher than the state average and reflects that area's strong employment base in manufacturing-related work in gas and oil exploration and production.

[9] The data in Table 25 is for individual communities within Grand Traverse and Kalkaska counties. County-wide median incomes for Grand Traverse County ($50,629) and Kalkaska County ($39,350) were provided in Chapter 2.

TABLE 25. Prosperity Indicators by Community

	Michigan	Traverse City	Village of Kingsley	Fife Lake	South Boardman	Village of Kalkaska
Job sector diversity (private vs. public)	87.1%	85.5%	85.1%	96.3%	85.5%	80.3%
Diversity of job base (manufacturing to retail)	1.52	0.45	1.25	1.37	1.58	1.85
Diversity of job base (nonretail to retail, lodging, food)	2.7	1.14	2.4	2.08	1.94	2.29
Creative class as % of worker 16+ years	18.3%	24.1%	24.1%	24.1%	15.4%	15.4%
Knowledge occupations as % of workers 16+ years	7.6%	8.3%	8.0%	7.1%	7.9%	9.3%
Number of jobs per 1,000 residents	439.1	532.1	481.1	481.8	504.3	406.8
Number of nonservice jobs per 1,000 residents	360.2	416.9	372.6	381.0	371.3	284.1
% of population 25−34 years of age (U.S. average)	13.3%	14.4%	12.1%	18.2%	7.4%	18.5%
% of population 25−34 years of age with bachelor's or higher degree	28.6%	43.9%	23.0%	24.6%	18.8%	8.1%
Average commute time to work (minutes)	23.7	14.6	29.7	30.3	30.0	22.0
More highly educated residents (bachelor's or higher degree)	25.2%	39.7%	19.3%	14.7%	7.5%	8.0%
More educated residents (associate's or higher degree)	47.0%	61.7%	47.5%	47.1%	58.2%	34.7%
Residents not completing high school	8.4%	4.0%	7.9%	4.6%	3.2%	12.7%
% of population uninsured	11.0%	14.0%	14.0%	14.0%	16.0%	16.0%
% of households receiving food stamps	12.6%	9.5%	23.1%	20.4%	17.2%	30.5%
Walkability (highest=100)	70	92	77	48	6	51
Median household income	$48,432	$41,961	$41,010	$42,981	$40,104	$37,524

SOURCES: U.S. Census Bureau *American Community Survey 2011*; U.S. Census Bureau, *U.S. Census: State and County Quick Facts, 2010*; MiDashboard; U.S. Bureau of Labor Statistics 2012; and Walk Score N.d.

Other indicators worth noting are the percentage of residents not completing high school, the percentage of the population uninsured, and the percentage of households receiving food stamps. The food stamps indicator is particularly troubling. The percentage of households receiving food stamps in Michigan statewide is almost 13 percent and in Traverse City it is about 10 percent. In the Village of Kalkaska, nearly one-third of residents (31 percent) are receiving food stamps – more than twice the state average and three times the rate in neighboring Traverse City.

Another indicator of prosperity is the number of "creative class" workers (people in design, education, arts, music, and entertainment, whose economic function is to create new ideas, new technology, and/or creative content) as a percentage of workers 16 years of age and older (Florida 2002). Statewide, about 18

percent of workers are aggregated in the "creative class" designation. For Traverse City this percentage is 24 percent, and in Kalkaska it is about 15 percent. The long-term implication of this disparity is that Traverse City, with its combination of natural assets and highly educated workforce, will likely continue to draw the higher paying and family-wage–sustainable jobs within the watershed. As a result, Traverse City will likely remain the hub of employment, retail, and accommodations for the foreseeable future.

Employment Clusters

Employment clusters are defined by aggregating like businesses into categories. For example, retail trade includes motor vehicle sales, furniture and home furnishings, appliances, clothing and accessory shops, sporting goods, and general merchandise. Because the economy is different in each part of the watershed, the watershed was divided into 11 subareas to reach a finer level of detail. Table 26 groups employment clusters in each of these 11 different watershed subareas.

As the table reflects, almost 75 percent of all businesses within the watershed boundaries are located in the Grand Traverse market. Broken down by market sector in the watershed, the Grand Traverse market area captures:

- 87 percent of recreational businesses
- 85 percent of educational and health care businesses
- 82 percent of retail trade businesses
- 81 percent of sporting goods businesses
- 78 percent of manufacturing businesses

Why is this important? First, concentrated economic activity creates corporate and personal wealth, which fuels other components of the economy such as housing, arts and culture, dining, and entertainment. The demand to live near one's place of employment coupled with access to recreational, cultural, and entertainment venues pushes the cost of housing (owner-occupied and rental) higher. This in turn requires lower wage employees to live outside their area of employment to find more affordable housing. As a result, commute times and transportation related expenses increase. These factors are evident in the watershed, where the average commute time in the City of Traverse City is about 15 minutes compared to about 30 minutes for workers living and commuting from the Village of Kingsley, Fife Lake, and South Boardman.

TABLE 26. Business Clusters by Subareas of the Boardman River Watershed

Name	All Business		Educational / Health Care		Manufacturing		Recreational		Retail Trade		Sporting Goods	
	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Garfield Zone	677	14.4%	65	11.3%	70	18.7%	4	7.7%	91	24.7%	52	23.9%
Silver Lake	421	9.0	76	13.2	27	7.2	1	1.9	16	4.3	15	6.9
Traverse City	2,401	51.2	348	60.5	194	51.7	40	76.9	196	53.3	110	50.5
Grand Traverse Market	**3,499**	**74.7**	**489**	**85.0**	**291**	**77.6**	**45**	**86.5**	**303**	**82.3**	**177**	**81.2**
Brown Bridge	15	0.3	–	0.0	2	0.5	–	0.0	–	0.0	1	0.5
Fife Lake	110	2.3	5	0.9	7	1.9	–	0.0	9	2.4	5	2.3
Forest Lakes	277	5.9	15	2.6	11	2.9	–	0.0	10	2.7	12	5.5
Forks East	21	0.4	1	0.2	–	0.0	1	1.9	2	0.5	1	0.5
Kalkaska	280	6.0	32	5.6	24	6.4	3	5.8	22	6.0	10	4.6
Kingsley	205	4.4	19	3.3	20	5.3	2	3.8	8	2.2	4	1.8
River Road Corridor	136	2.9	5	0.9	7	1.9	–	0.0	8	2.2	3	1.4
South Boardman	143	3.1	9	1.6	13	3.5	1	1.9	6	1.6	5	2.3
Total	**4,686**	**100.0%**	**575**	**100.0%**	**375**	**100.0%**	**52**	**100.0%**	**368**	**100.0%**	**218**	**100.0%**

SOURCE: NAICS Association (N.d.); third-party data derived from U.S. Census data, purchased by Beckett & Raeder, Inc. for Boardman River watershed project.

Marketplace Potential

Using the average commute times for the five main watershed communities (Table 27), an approximate worker-/labor-shed market area was constructed by prosperity plan consultants resulting in a 1,652-square-mile catchment area from which these five employment centers draw their commuting workforce. Table 27 compares the Boardman River watershed with the Boardman worker-/labor-shed. The preponderance of business activity in the Grand Traverse market overshadows the ability of the outlying communities to effectively compete and provide similar services locally, especially in the areas of retail and health care.

In addition, a drive-time-based retail marketplace profile for a 10-, 20-, and 30-minute drive time from the intersection of E. Front Street and Cass Street in downtown Traverse City indicated no apparent "leakage" in retail sales until 30 minutes outside the market. Retail leakage means residents are spending more than local businesses can supply and suggests there is unmet demand in a market area. Low retail leakage rates generally indicate less opportunity for new retail. At the 30-minute drive time from Traverse City, the only leakage by industry group was noted for appliance stores, lawn and garden supplies, gasoline stations, general merchandise, mail-order, and direct selling establishments. Similar assessments indicated that Kingsley, Fife Lake, and South Boardman have little if any retail sales leakage due to the accessibility and dominance of the Grand Traverse market. In Kalkaska, however, 10 out of 13 retail industry groups indicated a leakage in retail sales. The total retail trade and food and drink sales leakage was in excess of $30 million in sales in Kalkaska, indicating a potentially significant opportunity for new business in these sectors.

TABLE 27. Expenditures by Geographic Area

	Boardman River Watershed			Boardman Work-/Labor-shed		
Population (Residents)	42,978			148,267		
Employees	41,782			92,153		
Employees per Resident Ratio	0.97			0.62		
2010 Expenditures	**Average per Capita**	**Total**	**Percentage**	**Average per Capita**	**Total**	**Percentage**
Total Expenditures	**$46,435.61**	**$826,348,000**	**100.0%**	**$50,126.36**	**$3,004,126,005**	**100.0%**
Housing	13,952.14	248,286,302	30.0	14,747.94	883,860,049	29.4
Shelter*	10,676.85	190,000,559	23.0	11,137.66	667,491,755	22.2
Transportation	7,212.99	128,359,325	15.5	7,933.26	475,448,489	15.8
Food	5,422.96	96,504,586	11.7	5,865.11	351,502,508	11.7
Pensions and Social Security	4,587.03	81,628,751	9.9	4,971.59	297,952,894	9.9
Utilities, Fuel and Public Services	3,275.30	58,285,743	7.1	3,610.29	216,368,294	7.2
Food at Home	3,164.47	56,313,472	6.8	3,443.46	206,370,209	6.9
Health Care	2,764.71	49,199,519	6.0	3,096.05	185,549,756	6.2
Entertainment and Recreation	2,311.42	41,133,065	5.0	2,528.91	151,559,979	5.0
Food Away from Home	2,258.49	40,191,113	4.9	2,421.65	145,132,299	4.8
Support Payments/Cash Contributions/Gifts in Kind	1,746.62	31,082,083	3.8	1,890.42	113,294,953	3.8
Travel	1,285.31	22,872,828	2.8	1,375.13	82,412,804	2.7
Household Furnishings and Equipment	1,261.01	22,440,449	2.7	1,367.21	81,938,392	2.7
Apparel and Services	1,153.00	20,518,227	2.5	1,227.60	73,571,310	2.4
Household Operations	1,078.94	19,200,313	2.3	1,164.16	69,769,195	2.3
Education	830.60	14,781,073	1.8	872.70	52,301,709	1.7
Miscellaneous	812.02	14,450,419	1.7	888.26	53,234,092	1.8
Housekeeping Supplies	506.03	9,005,087	1.1	555.92	33,316,677	1.1
Personal Care Products & Services	494.37	8,797,637	1.1	529.07	31,707,792	1.1
Alcoholic Beverages	394.56	7,021,462	0.9	411.06	24,635,491	0.8
Smoking Products	318.97	5,676,238	0.7	359.87	21,567,360	0.7
Life/Other Insurance	302.92	5,390,633	0.7	342.10	20,502,556	0.7

SOURCE: Esri Business Analyst Online 2002–2012; third-party data purchased by Beckett & Raeder Inc. for Boardman River Watershed project.
* Shelter refers to temporary housing.

Housing and Transportation Costs

The Center for Neighborhood Technology's (CNT) Housing and Transportation Affordability Index (H+T®) is a tool that helps communities think about the cost of housing and its true level of affordability. It challenges traditional affordability measures that recommend housing should be less than 30 percent of income. The CNT states that using the traditional measure:

> …three out of four (76 percent) U.S. neighborhoods are considered "affordable" to the typical household. However, that benchmark ignores transportation costs, which are typically a household's second largest expenditure. The H+T Index offers an expanded view of affordability, one that combines housing and transportation costs and sets the benchmark at no more than 45 percent of household income. Under this view, the number of affordable neighborhoods drops to 28 percent, resulting in a net loss of 86,000 neighborhoods that Americans can truly afford (Center for Neighborhood Technology n.d.).

In the Boardman River watershed, data from the CNT was used to assess four factors for each of the five watershed communities (Table 28):

- Employment access
- Housing and transportation costs as a percentage of household income
- Vehicle miles traveled per year
- Transit connectivity index[10]

TABLE 28. Employment, Housing, and Transportation Factors

	Employment access (jobs/square mile)	Housing + transportation as a % of income	Vehicle miles traveled (VMT) annually	Transit connectivity index
Traverse City	15,885	52.8%	21,700	0
Kingsley	1,691	64.0%	26,495	0
Fife Lake	347	52.2%	26,574	0
South Boardman	319	52.0%	26,527	0
Kalkaska	551	53.0%	26,984	0

SOURCE: Calculated and summarized by Beckett & Raeder Inc., 2013, using U.S. Census Bureau 2010 data and Center for Neighborhood Technology model.

The data reinforces the dominance of the Traverse City market as a regional labor market. The H+T Index reflects the higher cost of housing in Traverse City, and the added cost associated with commuting based on vehicle miles traveled per household for workers residing outside of Traverse City.

Regional Development Patterns

Development within the Boardman River watershed is located primarily in the western portion in Traverse City, Garfield Township, Blair Township, and East Bay Township. There are small pockets of development around Kingsley, Fife Lake, South Boardman, and Kalkaska. The major employers for Grand Traverse County are shown in Table 29.

[10] Transit Connectivity Index is a modeled measure of the extent and frequency of transit service in a given census block. Access is determined using a quarter-mile buffer around each bus route, and intensity is based on the number of lines that serve the Census block group (Center for Neighborhood Technology N.d.). Boardman River Watershed communities have a Transit Connectivity Index of zero because the amount and frequency of available transit is so low.

TABLE 29. Grand Traverse County Major Employers

Employer	Number of employees	Industry
Munson Medical Center	4,000	Health care
Traverse City Public Schools	2,069	School/education
Interlochen Center for the Arts	*1,100/325	Arts education
Grand Traverse Resort	*900/650	Hotel/tourism
Meijer Inc.	650	Department stores
Northwestern Michigan College	630	Education
Sara Lee	620	Baked goods
Grand Personality Inc.	500	Hotels and motels
Traverse Community Hospital	407	Health care
Tower Automotive	400	Metal stamping
Traverse Bay Intermediate School District	350	Education
County of Grand Traverse	260	Executive offices
Grand Traverse Medical Care Facility	225	Health care
Aramark Services Inc.	200	Dining
Traverse City Area Schools Trans.	200	Bus service facility
Ameritech	190	Telephone

SOURCE: Michigan Economic Development Corporation (MEDC) 2012, available at http://ref.michigan.org/medc/miinfo/places/GrandTraverseCounty/?section=all (accessed 10-26-12).
* Seasonal Employment

The Traverse City Downtown Development Authority (DDA) has been extremely successful utilizing public and private investment through Tax Increment Financing (TIF) 2 and TIF 97 to create a mixed-use district along Front, Union, Cass, State, Park, and Boardman streets. The Traverse City DDA is the largest of the three DDAs within the watershed with an annual revenue of $2,859,000. The Kingsley DDA has an annual revenue around $50,000 and the Kalkaska DDA has an annual revenue of approximately $264,000. Other commercial development extends along the US-31/M-37 corridor from the west arm of Grand Traverse Bay to Beitner Road, where US-31 turns west to Green Lake Township.

Development in the Village of Kingsley is very localized within the village limits along the M-113 corridor. Efforts by the Kingsley DDA to revitalize the community through improvements along M-113 (Main Street) and County Road 611 (Brownson Avenue) have influenced the vitality of the business district and enhanced the image of the community. In November 2015, the Village sponsored a community engagement session focused on the redevelopment potential of vacant and underutilized properties for new commercial and residential development.

Fife Lake has a compact downtown area along State and Merritt streets with several stores, including the Fife Lake Inn, art galleries, and the Fife Lake Area Historical Museum. Similarly, South Boardman has a handful of small businesses located primarily at the intersection of US-131 and Supply Road. Both communities are included in the US-131 corridor study being coordinated by Networks Northwest.

The Village of Kalkaska has a linear business district along S. Cedar Street (US-131) commencing just north of the US-131 intersection with M-66 and M-72 to Beebe Road NE. The traditional downtown portion of the business district is along S. Cedar Street from 1st to 4th streets, although the DDA district covers most of the larger US-131 and M-72 corridor. In the last two years, the historic portion of downtown Kalkaska has seen new ownership of eight buildings, each in various stages of restoration. This rejuvenation has created the opportunity of several new businesses opening directly downtown, with additional businesses in the process of opening in the summer of 2016. The Kalkaska DDA has begun

development of Railroad Square, an open-space event area, creating a focal public space in the center of the village. Although these efforts are great steps in the right direction for economic development, additional efforts for revitalization are still needed. The commercial area along the West Mile Road (M-72) corridor between US-131 and Old 72 appears to be most active, with the Northland Foods Center, Cherry Street Market, and the Kalkaska County administrative complex. Table 30 shows the top employers in Kalkaska County.

TABLE 30. Kalkaska County Major Employers

Employer	Number of employees	Industry
Kalkaska Memorial Health Center	250	Health care
County of Kalkaska	185	Executive offices
American Waste	180	Waste management
Wayne Wire Cloth Products	106	Manufacturing
Team Services LLC	100	Oil and gas
Coding Products	76	Manufacturing
Arrow Energy Services LLC	55	Oil and gas
Flannery Machine and Tool, Inc.	35	Manufacturing
Mike's Steamer Service, Inc.	30	Oil and gas
Kalkaska Screw Products, Inc.	23	Manufacturing

SOURCE: Traverse City Area Chamber of Commerce, N.d.

The middle portion of the watershed comprising Union, the north part of Paradise, Whitewater, Kalkaska, and Boardman townships can be characterized as extremely rural with very low densities. Master plans for these townships promote very large lot acreages to maintain the rural character. Much of the publicly owned land in the Boardman River watershed is in these townships. The Boardman River Valley Master Plan focuses on this part of the watershed in Grand Traverse County offering measures to protect the rural, recreational, and scenic values.

Regional Initiatives

The 2012 Comprehensive Economic Development Strategy (CEDS) for the 10-county region, prepared by Networks Northwest (formerly known as the Northwest Michigan Council of Governments - NWMCOG), used the Michigan Prosperity Initiative (MPI) as the regional template to shape economic development policy (NWMCOG 2012). The MPI focuses on three major components: people, place, and policy. The assessment in the CEDS led to five strategic economic development goals and strategies:

- Creating an entrepreneurial culture
- Educating our future workforce
- Strengthening quality of place
- Seizing green opportunities
- Optimizing infrastructure investments

For each of these goals, the CEDS identified several specific strategies. These goals and strategies align very well with the designated and desired uses articulated by the Boardman River watershed community, and were used to help identify goals, objectives, and strategies for this Prosperity Plan (see Chapter 9, Watershed Guiding Principles, Goals, and Objectives, for further detail on how the CEDS strategies align with the Boardman River watershed strategies).

As discussed in Chapter 3, the regional collaboration effort called the Grand Vision identified six guiding principles for the prosperity of this region. These focus areas were determined through extensive public engagement and stakeholder involvement. The Grand Vision Coordinating Committee is helping to direct efforts by subcommittees in each of these areas to implement programs and policies to achieve the vision.

Each Grand Vision element has economic implications for the Boardman River watershed. The designated and desired uses for the watershed were shaped by and align with the principles of the Grand Vision, and the guiding principles, goals, and objectives included in Chapter 9 all contribute toward advancing the Grand Vision.

Chapter 8. Community Quality-of-Life Uses and Issues

8.1 COMMUNITY QUALITY-OF-LIFE DESIRED USES

Prosperity is more than healthy ecosystems and economic growth. A prosperous Boardman River watershed will be dependent on maintaining and growing the following community quality-of-life assets:

- **Abundant, diverse, and high-quality outdoor recreation amenities**. The Boardman River watershed offers a substantial number of recreation activities for its residents and visitors in every season. Access to recreational amenities contributes to residents' quality of life, health, and overall well-being, and is a key part of attracting visitors and potential residents to the region.
- **Available entertainment and cultural opportunities, clustered in downtown areas.** Entertainment and cultural offerings are a key part of attracting and retaining residents and visitors to the Boardman River watershed area. Maintaining existing areas in the northwestern part of the watershed, and identifying and investing in augmented opportunities in other communities, particularly in the Kalkaska area, are important uses of land and resources identified for the watershed.
- **Available multimodal transportation options.** Multimodal transportation options are an increasingly important part of maintaining a diverse job sector, providing access between jobs and affordable housing, and reducing environmental and health impacts associated with personal vehicle use. The community desires greater multimodal transportation options to address these increasingly pressing issues.
- **Charming, walkable, compact downtowns.** From the small villages to the larger downtown of Traverse City, the watershed community has consistently indicated its desire to maintain quaint and charming downtowns that are reflective of the northern character, coastal location, and both urbanized and rural settings. Providing charming and walkable downtown areas has been identified as a priority use in many of the related planning efforts for the region over the last several years, including the Grand Vision, and local community master plans.
- **High-quality education facilities.** The Boardman River watershed community recognizes the important role that education plays in attracting businesses, maintaining social strength, and protecting natural resources. Providing high-quality education facilities throughout the watershed will help grow the local economy, attract talented residents, and reduce social issues such as crime.

8.2 QUALITY-OF-LIFE ISSUES

While each of the community quality-of-life elements described above can be found in the Boardman River watershed, they are not all distributed equally throughout the watershed. Some of the key issues are described below.

Recreation

While the Boardman River watershed is blessed with abundant outdoor recreation opportunities, there are numerous ways these assets could be improved or augmented to further improve quality of life and prosperity in the watershed. One of the key issues is that there are gaps in connecting the region's outdoor recreation resources – both physical gaps and missed opportunities for cross marketing or promotion of activities. Existing and planned Traverse Area Recreation and Transportation (TART) trails are making significant headway in physically connecting trails, parks, downtown areas, and entertainment amenities. But there are segments that are not completed, and there are additional connections of other types of

trails, including off-road vehicle, snowmobile, and equestrian, that could create even greater recreation and tourism opportunities.

Photo courtesy of: Grand Traverse Conservation District

Better marketing and cross-promoting of existing outdoor recreation facilities/amenities could increase the number of recreation visitors to the region and help better distribute visitors across the watershed so that all of the recreation-serving businesses are not clustered in Traverse City. Finding ways to cross-promote recreational amenities would not only increase the number of visitors, but could broaden the scope of activities in which current users participate and increase visitors' length of stay in the region (for example, people who come to fish may also stay and do some bike riding on the connected trails). Improved wayfinding and signage along trails and at key recreation facilities and community entry portals help educate people about the broad range of recreation opportunities available in the watershed and direct visitors to local community businesses (such as restaurants, gear shops, and stores).

Another recreation issue in the watershed is that existing activities are often informal and do not occur in designated places. For example, people access the river to fish and paddle in many different locations on both public and private land. While this type of access and freedom is welcomed by many, it can have environmental consequences (such as habitat damage and erosion) and can be a barrier for many potential users. For some, the barrier may be due to physical ability, and for others, lack of structure or direction may impede their willingness to try a new activity. Relying almost entirely on informal recreation access to the river also limits the ability of communities to manage use in a way that recognizes resource capacity (for example, too many inner tubes or paddlers on the water at one time) or user conflicts (such as shoreline fishing versus canoeing). Dam removal and modification will substantially change the flow and course of the river at those locations and may open the door to many new recreation opportunities that could improve quality of life in the region. But it will also require some level of management to control the negative impacts described above.

Entertainment/Cultural Amenities

Entertainment and cultural amenities are clustered primarily in Traverse City, where a strong and vibrant downtown has developed over the last several decades. The bulk of theaters, restaurants, museums, shops, and music venues are found in this part of the watershed. The Village of Kingsley has focused significantly on its downtown in recent years, and has nurtured a small commercial district. Kalkaska's downtown is struggling economically, including in the provision of entertainment and cultural offerings. The lack of entertainment options in the downtown Kalkaska area limits the number of people who might want to stay in the area when they come to the watershed for recreation or vacation purposes, or wish to live near downtown amenities.

Multimodal Transportation Options

The Bay Area Transportation Authority (BATA) provides public transit access within Grand Traverse and Leelanau counties. The City Loops system offers five routes in and around the greater Traverse City area (see Figure 22).

It also offers five Village Loops that provides service between the downtown BATA Transit Center and nearby communities, including Kingsley and Williamsburg. The loops run almost hourly on weekdays.

For people who live in these adjacent communities and work in Traverse City, this offers some options for public transit.

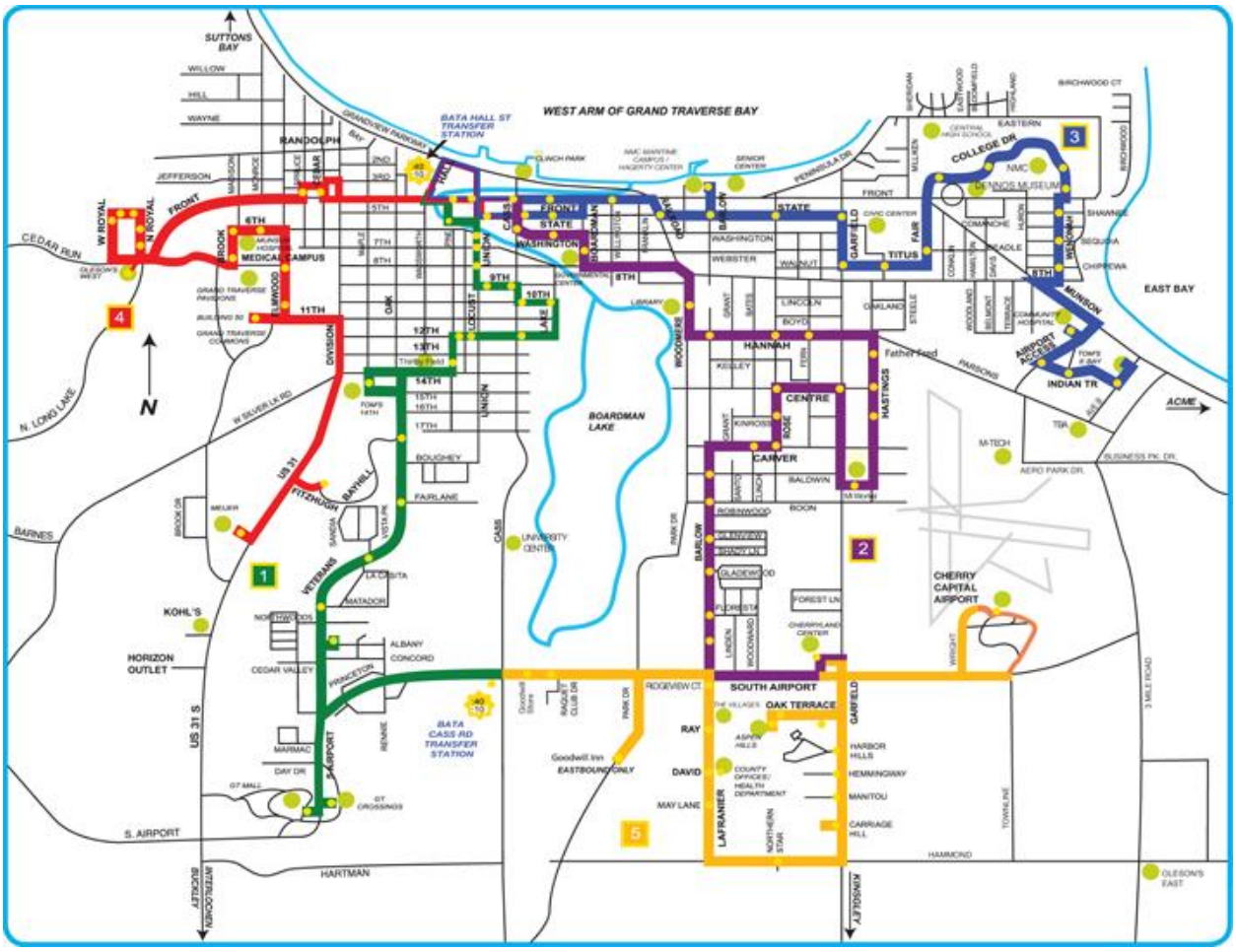


FIGURE 22. BATA City Loops Transit Route Offerings

SOURCE: Bay Area Transportation Authority, available at http://www.bata.net/maps-schedules/.

At this time, no regular public transportation options connect Kalkaska and Traverse City. As described in Section 7.2, Kalkaska, Kingsley, Fife Lake, and South Boardman areas provide affordable housing options and rural living accommodations, which many people in the watershed choose. However, for the whole region to prosper, transportation options within the work-shed must be sufficient to allow affordable, easy commuting between communities.

Other multimodal transportation options, such as bike/walk trails and marked bike routes, provide additional transportation options, particularly in and around Traverse City and through portions of the mid-watershed. TART trails, which currently provide more than 60 miles of paved, non-motorized trails in Grand Traverse and Leelanau counties, has future planned connections between Traverse City and both Kingsley and Kalkaska that will provide a strong non-motorized transportation connection between these communities.

Charming, Compact Downtowns

Three primary and inter-related issues are associated with protecting the watershed's charming, compact downtown communities: abandonment of downtown areas, sprawling commercial and residential development outside of downtown areas, and lack of sufficient policy controls to protect local character

and charm. All of the watershed's major communities have historic downtown districts that provide housing, commercial opportunities, and public spaces. Some of the downtown areas have been a source of significant investment and protection over the years, such as in Traverse City, Kingsley, and Fife Lake. In others, such as Kalkaska, economic conditions have resulted in significantly vacant downtown areas (as described in Section 7.2), with a shift of commercial enterprises to adjacent corridors.

Photo courtesy of: Village of Kingsley

In other areas, primarily in and around Traverse City, sprawling commercial and residential development has accompanied growth in the region. In other words, while the downtown has been able to remain the center of cultural and economic activity, there has also been significant expansion of industry and housing in the outlying areas, particularly along the US-31/M-37 corridor and South Airport Road. This expansion has had environmental implications related to stormwater contributions to the Boardman River, more vehicles and vehicle miles traveled in the watershed (and associated air pollution), and loss of wetlands and upland habitat. It also has had health implications by decreasing the use of bikes, feet, or other self-powered transportation options, thereby reducing daily activity levels of residents and visitors. Finally, the sprawl creates greater competition with downtown commercial offerings and has the potential to drive smaller, owner-operated enterprises out of business.

All of the major communities in the watershed have zoning ordinances in place to help protect downtown character through building requirements, sign limitations, and infrastructure requirements. But in addition to zoning controls, local communities must have other proactive policies and programs that protect local character, such as strong downtown development authorities and investment in public goods and infrastructure (such as parks, public gathering spaces, squares, roads, and public buildings). Both Traverse City and Kingsley have fairly strong programs to protect their downtown areas and have prioritized investments that attract people to live and work in their downtown areas.

Education Facilities

The Boardman River watershed is home to four public primary school districts, all part of the Traverse Bay Area Intermediate School District:

- Forest Area Community Schools
- Kalkaska Public Schools
- Kingsley Area Schools
- Traverse City Public Schools

There are also two public school academies in Traverse City. As discussed in Section 7.2, Fife Lake, South Boardman, Kingsley, and Kalkaska all have relatively lower education attainment than the surrounding communities of Traverse City. Some of this is related to access to educational institutions, and some is related to quality. Table 31 shows how the four public school districts rank in Michigan's most recent "Top to Bottom" school rankings (MDE 2012).

TABLE 31. Michigan Top to Bottom Rankings for Schools in the Boardman River Watershed

School	Statewide percentile ranking
Kalkaska Public Schools	
Cherry Street Intermediate School	25%
Kalkaska High School	40%
Rapid City Elementary School	30%
Kalkaska Middle School	23%
Birch Street Elementary School	21%
Forest Area Community Schools	
Fife Lake Elementary School	43%
Forest Area High School	26%
Forest Area Middle School	44%
Kingsley Area Schools	
Kingsley Area High School	87%
Kingsley Area Elementary School	91%
Kingsley Area Middle School	67%
Traverse City Area Public Schools	
Central Grade School	22%
Cherry Knoll Elementary School	62%
Eastern Elementary School	73%
Interlochen Elementary School (now closed)	13%
Long Lake Elementary School	20%
Old Mission Peninsula School	71%
West Middle School	40%
Central High School	50%
Traverse Heights Elementary School	10%
Willow Hill Elementary School	70%
Silver Lake Elementary School	72%
Blair Elementary School	21%
Westwoods Elementary School	53%
Courtade Elementary School	82%
East Middle School	60%
West Senior High	48%
TCAPS Montessori School	80

SOURCE: Michigan Department of Education, 2012.

The rankings are based on achievement (test scores), improvement in achievement over time, and the achievement gaps between the top- and bottom-performing students. Three schools (Rapid City Elementary, Central High School, and West Senior High) are on the state's list of Focus schools, the 10 percent of schools on the Top-to-Bottom list with the largest achievement gaps between their top 30 percent of students and bottom 30 percent. Two schools in the watershed, Kingsley Area Elementary and Kingsley Area High School, are on the list of Reward schools. Schools are designated Reward Schools if they are (MDE 2012):

- In the top 5 percent of schools on the Top-to-Bottom list
- In the top 5 percent of schools making the greatest gains in achievement
- "Beating the Odds"

The watershed is also home to Northwestern Michigan College (community college) and programs from nine other colleges[11] housed in a collaborative at the Northwestern Michigan College University Center and are available to residents. These nine partner organizations awarded more than 400 degrees between 2011 and 2012.

Given the importance of education in advancing the region's prosperity, there are clearly some opportunities for improving the availability of high-quality educational facilities in the watershed.

[11] Michigan State University, Ferris State University, Central Michigan University, Davenport University, Eastern Michigan University, Grand Valley State University, Lawrence Technological University, Western Michigan University, and Spring Arbor University. See: *https://www.nmc.edu/uc/* (accessed 10/26/12).

Chapter 9. Watershed Guiding Principles, Goals, and Objectives

9.1 GUIDING PRINCIPLES

In considering the future of the Boardman River watershed, the Leadership Team identified seven guiding principles that shaped the team's definition of prosperity. These guiding principles helped the team articulate a broad vision of prosperity for the watershed and served as the foundation for identifying and prioritizing specific goals, objectives, and strategies for achieving that vision.

- ***Preserving Prosperity Attributes.*** In recent years, the value of healthy and abundant natural resources has been recognized as a key underpinning of economic prosperity and outstanding quality of life in the watershed. Therefore, preserving these important natural resource attributes should be a priority.
- ***Broad, Diverse Economy.*** In addition to maintaining the strong connections between the watershed's unique natural assets and economy, the watershed prosperity plan should encourage a diverse range of emerging and new business sectors; support public, private, and nonprofit sector cooperation; and inspire an entrepreneurial culture for future growth.
- ***Diversity of Uses.*** The watershed can support a diversity of uses as well as a range of use intensity. Areas with high-quality natural resources, particularly those on publicly owned lands, should be managed for low-intensity use with limited development so that they continue to support exceptional recreational experiences. Some areas of the watershed, on both public and private land, can sustain more intense recreational, business, and residential uses that will require public and private investment in infrastructure and maintenance.
- ***Public Involvement and Education.*** A highly engaged, well-informed, and civic-minded community is one of the strongest mechanisms for protecting and enhancing the prosperity of the watershed community. The development and implementation of the watershed management plan, along with timely updates, must provide opportunities for area residents and visitors to be involved. Opportunities to inform the public and activities to engage the community in projects are essential to the success of the plan.
- ***Integration with Regional Initiatives.*** The residents of the greater Grand Traverse region and its local units of government have completed a number of initiatives to advance continued prosperity. The Grand Vision, and the outcome and recommendations of similar community planning efforts, were considered in the development of the Boardman River Watershed Prosperity Plan. To the extent possible, implementation of the Prosperity Plan should align with other community plans such as zoning, master plans, and recreational plans to protect the region's natural resources and advance identified social and economic goals.
- ***Balancing Increased Tourism and Quality-of-Life of Area Residents.*** Visitors to the area provide a major component of the economic vitality of the region. The restoration of a free-flowing, reborn Boardman River has the potential to significantly increase tourism. The watershed management plan should address ways to capture and reinvest increased tourism-related revenue to support and maintain infrastructure and quality-of-life amenities for residents.
- ***Sustainability of the Prosperity Plan.*** To effectively restore and protect natural resources and capitalize on social and economic opportunities, a sustainable watershed management plan is essential. The management plan must consider carrying capacity of the natural resources, especially the river as it relates to the balance between paddlers and fisherman. It must also address long-term governance and funding mechanisms required to sustain the desired uses for present and future generations.

The vision for the Boardman River Watershed Prosperity Plan is to build a consensus for community actions that will protect the Boardman River as a critical performing asset in the watershed communities and contribute to the overall quality of life for present and future generations of residents, businesses, and visitors. The Prosperity Plan process was designed to integrate and build upon work that is already in progress, reflect community values and be embraced by the community, generate new community leaders, include voices from the entire watershed, and implement the principles established in the Grand Vision.

9.2 GOALS AND OBJECTIVES

To achieve the vision of the Boardman River Watershed Prosperity Plan as described above, the Leadership Team has identified five broad prosperity goals for the watershed. The goals are interrelated and together would make the Boardman River watershed a world-class place to live, operate a business, or visit.

- Protect, restore, and enhance the high-quality water and other natural resources that are the backbone of social and economic prosperity in the watershed.
- Support a sustainable economy that benefits and strengthens all of the watershed communities.
- Improve the quality-of-life and advance greater social equity throughout the watershed to retain and attract businesses, a talented workforce, and student and retiree residents.
- Provide managed expansion and improvement of recreation opportunities in the watershed to attract a talented workforce, student and retiree residents, and visitors from around the world.
- Through education and engagement efforts, create community ownership of the Prosperity Plan and community capacity that will assure implementation of recommended actions and achievement of the goals and objectives.

Individually and collectively, these goals help protect and restore the designated and desired uses for the watershed identified in this plan. The goals are closely linked to broader planning efforts in the region, and where applicable, overlap with other related natural resource, community, and economic development plans. For each goal, the Leadership Team has identified specific objectives. Table 32 outlines the goals and their respective objectives.

TABLE 32. Boardman River Watershed Goals and Objectives

GOAL 1: Protect, restore, and enhance the high-quality water and other natural resources that are the backbone of social and economic prosperity in the watershed.
Objective 1.1 Reduce threats to water quality in the Boardman River and tributaries from stormwater and wastewater inputs.
Objective 1.2 Restore and enhance wetlands and other aquatic habitat and improve fish passage.
Objective 1.3 Reduce erosion and minimize barriers to fish passage associated with transportation crossings along the Boardman River and its tributaries.
Objective 1.4 Control the spread and introduction of invasive species that threaten designated uses of the Boardman River and its tributaries.
Objective 1.5 Maintain and improve forests and other key wildlife habitat corridors throughout the watershed.
GOAL 2: Grow a sustainable economy that benefits and strengthens all of the watershed communities.
Objective 2.1 Focus and support economic growth in the watershed's existing downtown hubs.
Objective 2.2 Encourage the growth of a diverse range of emerging and new business sectors and entrepreneurs.
Objective 2.3 Expand the tourism economy throughout the watershed.
Objective 2.4 Preserve and expand agricultural economic activity in the watershed.
GOAL 3: Improve the quality-of-life and advance greater social equity throughout the watershed to retain and attract businesses, a talented workforce, and student and retiree residents.
Objective 3.1 Advance educational opportunities for watershed residents to expand potential economic and social opportunities.
Objective 3.2 Provide affordable and regular transportation options within and between watershed communities in order to better accommodate workforce participants throughout the watershed.
Objective 3.3 Expand affordable housing opportunities throughout the watershed to accommodate the needs of the Traverse City worker market.
Objective 3.4 Protect scenic vistas, rural character, and key cultural and historic sites.
GOAL 4: Provide managed expansion and improvement of recreation opportunities in the watershed to attract a talented workforce, student and retiree residents, and visitors from around the world.
Objective 4.1 Manage and capture opportunities for diverse water-based recreation in the watershed.
Objective 4.2 Manage and capture opportunities for diverse land-based recreation in the watershed.
Objective 4.3 Promote recreation opportunities to residents and visitors.
GOAL 5: Through education and engagement efforts, create community ownership of the Boardman River Watershed Prosperity Plan and community capacity that will assure implementation of recommended actions and achievement of the goals and objectives.
Objective 5.1 Cultivate the development of local public and private watershed champions (both individual and organizational) through training, organizational capacity building, and opportunities for leading implementation efforts.
Objective 5.2 Foster an ongoing culture of prosperity stewardship among watershed residents by integrating stewardship learning into education at all levels, providing regular information to the public on the overall economic, ecological, and social health of the watershed, and providing organized opportunities for residents and businesses to participate in the implementation of the Boardman River Watershed Prosperity Plan.
Objective 5.3 Create a watershed prosperity stewardship ethic among visitors to the region so that they might help protect and promote natural resource protection and the region as a high-quality destination.

Chapter 10. Implementation Strategies

This section identifies the specific actions and recommendations that residents, businesses, and communities in the Boardman River watershed will need to undertake to achieve the Prosperity Plan's goals and objectives. In an effort to successfully accomplish the first goal listed in Chapter 9.2 (Protect, restore, and enhance the high-quality water and other natural resources that are the backbone of social and economic prosperity in the watershed), specific and tangible recommendations were developed based on the prioritization of watershed pollutants, sources, and causes, while also looking at the priority areas in the watershed (Table 20, Figures 20 and 21). These implementation tasks (also known as Best Management Practices or BMPs) are listed in Chapter 10.2 and represent an integrative approach, combining watershed goals and objectives and covering more than one pollutant at times, to reduce existing sources of priority pollutants and prevent future contributions. It is intended that these BMPs be implemented in critical and priority areas in the watershed (Figures 20 and 21).

Effective watershed management must rely upon an integrative approach that includes:

- BMPs
- Partnerships, community consensus building, and local governments participation
- Information and education components

Some of the proposed actions are short-term, and others will be implemented over many years. The actions will require collaboration among communities, relying on both public and private partners, and will be most effectively achieved by building the capacity of watershed stakeholders of all ages to understand the interrelationship between healthy natural resources, quality-of-life, economic strength, and social equity.

10.1 SUMMARY OF IMPLEMENTATION EFFORTS TO DATE

Since the Boardman River watershed was included in the Grand Traverse Bay Watershed Protection Plan in 2005, much work has been completed to date. Numerous recommended actions have been implemented, and there have been significant improvements in water quality and watershed protection over the last decade. TWC (which drafted and facilitated the Grand Traverse Bay Watershed Protection Plan) has received more than $10 million in funding to implement key portions of the plan, annually preventing 1,612 tons of sediment, 1,115 pounds of phosphorus, and 3,241 pounds of nitrogen from entering the Grand Traverse Bay and its watershed each year. Table 33 outlines the pollutant savings for BMPs implemented only in the Boardman River watershed by projects led by TWC.

As previously mentioned in Chapter 5.3, the GTCD completed a comprehensive erosion inventory in 1991 that documented more than 600 erosion sites and other areas of concern in the watershed. Since then, more than 300 of these sites have been restored. These include severe to moderate streambank erosion sites and transportation crossings. Approximately one third of the restored sites are associated with the Kids Creek subwatershed.

Other partners working to restore and protect the Boardman River watershed include: Grand Traverse Regional Land Conservancy, Michigan Department of Natural Resources, Grand Traverse Band of Ottawa and Chippewa Indians, U.S. Fish and Wildlife Service, Natural Resource Conservation Service, Great Lakes Commission, Grand Traverse County Road Commission, Kalkaska County Road Commission, Rotary Camps and Services, Adams Chapter of Trout Unlimited, Michigan Fly Fishing Club, Grand Traverse Snowmobile Club, Michigan Trail (horse) Riders Association, Traverse Area

Paddle Club, Boardman River Clean Sweep; Traverse Area Recreation and Transportation (TART) Trails, local units of government, businesses, and landowners.

While there are many examples of successful pollutant reductions and resource protections in the Boardman River subwatershed since the Grand Traverse Bay Watershed Protection Plan was completed, a few of the major accomplishments include:

- Restoration of more than 150 streambank erosion sites.
- Restoration of more than 50 public access sites.
- Restoration of more than 50 transportation crossings including road and railroad.
- Restoration efforts on Kids Creek (mainly on tributaries A and AA) through a partnership with Munson Medical Center, including restoration of eroded streambanks, removing underground culverts to "daylight" the creek, reducing impervious surface cover, expanding the floodplain, and creating a buffer between the hospital and surrounding neighborhoods. Kids Creek is the only impaired waterbody in the Boardman River watershed, so restoration and reduction of pollutant sources to the creek is a key implementation action from this plan.
- Creation of 0.615 acres of demonstration wetlands at the Boardman River Nature Center and 4,420 cubic feet of rain garden/biodetention basins for stormwater treatment, installation of 5,870 square feet of pervious pavement, and planting of 18,730 square feet of a riparian filter strip, all of which have reduced runoff of sediment, phosphorous, and nitrogen to the river.
- Evaluation and initiation of Boardman dams removal/modification project, the largest dam removal project in Michigan's history and the biggest wetland restoration project in the Great Lakes basin.
- Tracking of stormwater pollutant sources and implementation of seven oil and grit separator systems that help reduce the amount of oils, grease, and other pollutants entering the river and Grand Traverse Bay.
- Development of water quality action plans in nine local townships, villages, and/or counties that made recommendations for changes to zoning ordinances and local policies that would better protect the river from pollutants (See Chapter 3.2).
- Creation of the Boardman River Valley Master Plan aimed to protect the heart of the Boardman River watershed, where the bulk of an estimated 2 million recreational user days take place.

Photo courtesy of: The Watershed Center Grand Traverse Bay

- Worked with the North Branch Landowners Association and the Michigan Department of Transportation (MDOT) to provide alternatives routes for the proposed extension of the US-131 expressway rather than through the heart of the "Wild & Scenic" portion of the watershed. MDOT implemented the option that utilized the existing US-131 corridor.
- Worked with various recreational user groups to improve trail linkages, public access, and stream crossing improvements.
- Development of numerous outreach and education materials, including the award-winning Low Impact Development Guidebook and informational signs and other materials. Hosted frequent water quality and natural resource protection educational events, such as the Grand Traverse Baykeeper® Boat Tour and annual Freshwater Summits.
- Annually assisted Boardman River Clean Sweep volunteers in the trash clean-up of the Boardman River.

TABLE 33. Summary of Pollutant Savings through BMPs in the Boardman River Watershed

Site	Sediment (ton)	Phosphorous (lb)	Nitrogen (lb)	Area Restored
Streambank Stabilization Sites				
Kids Creek Buffalo Pasture	115	109.25	218.5	843 feet
NB Boardman S356	17	14.5	28.9	8 feet
NB Boardman S790	1.6	1.8	3.7	20 feet
NB Boardman S791	45.4	52.2	104.4	32 feet
NB Boardman S930 (Twin Birch)	6.2	7.2	14.4	132 feet
Boardman River				1300 feet
Kids Creek S323	1.2	1.4	2.8	30 feet
Kids Creek S318	3.2	3.7	7.5	80 feet
Kids Creek S318-A	2.2	2.53	5.1	40 feet
Kids Creek S322	1	1.2	2.4	10 feet
NB Boardman S374	10.56	12.14	24.28	90 feet
NB Boardman S482	4.13	4.74	9.48	15 feet
NB Boardman S740	3	3.45	6.9	8 feet
NB Boardman S780	7.92	9.11	18.22	12 feet
Kids Creek S011	2.05	2.28	4.56	12 feet
Kids Creek S012	2.75	3.16	6.32	20 feet
Kids Creek S014	3.3	3.8	7.6	24 feet
Kids Creek S018	3.52	4.05	8.1	32 feet
Kids Creek S022	5.28	6.07	12.14	32 feet
Kids Creek S023	3.3	2.8	5.61	25 feet
Kids Creek S027	9.9	8.42	16.83	32 feet
Kids Creek S281	1.32	1.12	2.24	10 feet
Kids Creek S801	2.05	2.28	4.56	14 feet
Kids Creek Tributary A	10.56	0	0	96 feet
Farmers Market - Boardman River	176.4	149.9	299.9	700 feet
Kids Creek S296	28	26.5	53	40 feet
Kids Creek S298	18	16	31.6	30 feet
Riparian Buffers				
Twin Birch #1	0	1.3	4.3	0.046 acres
Twin Birch #2	0	2.1	7.1	0.076 acres
Hannah Park				0.12 acres
Munson	0.08	0	2	0.017 acres
Mayfield Pond	0.003	0	0	0.077 acres
Arbutus Lake	0.003	0	0	0.074 acres
Munson Medical Center – Kids Creek	0	12.14	24.28	0.09 acres
Rain Gardens				
Residential Rain Garden	0.005	0	0	100 ft^2
Boardman Nature Center NE	0.017	0	0	412.5 ft^3 store
Boardman Nature Center NW	0.017	0	0	412.5 ft^3 store
Boardman Nature Center SW	0.017	0	0	412.5 ft^3 store
Boardman Nature Center SE	0.017	0	0	412.5 ft^3 store
Boardman Nature Center #5	0.057	0	0	1100 ft^3 store

Site	Sediment (ton)	Phosphorous (lb)	Nitrogen (lb)	Area Restored
Munson – Building 29	0.086	0.558	2.577	
Wetlands				
Boardman Nature Center	0.176	0	1	0.115 acres
Pervious Pavement				
Lot K	0.097	0	1	4582 ft^2
Site #1	0.00045	0	0	112 ft^2
Site #2	0.00136	0	0	456 ft^2
Munson – Infiltration Trenches		0.7	3.9	1033 feet
Munson – Building 29	0.010	0.062	0.487	
Oil Grit Separators				
Hannah Park (2)	15.173	18.6	42.2	60.22 ac. drain
Cass Street Outfall	2.28	4	33	108.84 ac. drain
Union Street Outfall	1.14	1	15	14.15 ac. drain
Road Stream Crossings				
Hanson Road	434	0	0	
Kellogg Road	347	0	0	
Kids Creek Perched Culvert				1crossing
Reduction of Stormwater				
Smith Street Drain – Northport	3	7		1 outlet
Kids Creek Daylighting	6.3	4.5	17.3	900 feet
Building 29 Downspout Planters (4)	0.003	0.021		4 boxes
Sediment Management				
Brown Bridge Dame Removal	390,000	331,500	663,000	2.5 miles
Hannah Park Access Stairs				6 sets

SOURCE: The Watershed Center Grand Traverse Bay

10.2 IMPLEMENTATION ZONES AND STRATEGIES

Zones

Proposed actions are organized into five areas, or "zones," of the watershed to help focus on specific geographies and consider the unique but integrated environmental, economic, and social needs in each part of the watershed (see Figures 23-30). Each of these zones has a unique character and will have specific prosperity opportunities that build on the character of that area:

- **Zone 1: Headwaters and Eastern Watershed.** Includes the Village of Kalkaska, South Boardman, and Forks East areas. Mainly forested public land and sandy soils. Includes the headwaters of North and South branches, recreational trails, hunting, fishing, camping, and Sand Lakes Quiet Area. Has the Wild & Scenic Natural Rivers designation. *Critical Areas #2 and #8*
- **Zone 2: Southern Communities.** Includes Kingsley and Fife Lake areas. Mostly agriculture areas, little public land, and large acre lots. Headwaters to several tributaries. M-113 and US-131 travel corridors. *Critical Areas #9 and #10*
- **Zone 3 Mid-Watershed.** Includes River Road, Forest Lakes, and Brown Bridge Quiet Area. Contains the navigable portion of the Boardman River, Brown Bridge Quiet Area, and Rotary's East Creek Reserve. Abundant forested public land and hub for recreational trail system. Most of the inland lakes in the watershed are located in this zone (i.e., Arbutus, Spider, Rennie, and Island lakes). Has Fork's and Scheck's state campgrounds and river access sites, hunting, fishing, and motorized and non-motorized recreational trails. This section is the heart of what makes the Boardman River watershed special. *Critical Areas #1, #3, and #10*
- **Zone 4: Lower River.** Includes Silver Lake and Garfield Township areas. Also contains Boardman and Sabin Dams, Grand Traverse Conservation District's Natural Education Reserve, Silver Lake, and Boardman River Trail. This area is less forested and contains more agriculture than other areas. *Critical Areas #1, #7, #9, and #10*
- **Zone 5: Boardman Lake to River Mouth.** Includes Traverse City and surrounding urban area. This is the most urban area of all the zones and has abundant impervious surfaces. *Critical Areas #4, #5, and #6*

THE BOARDMAN RIVER WATERSHED

Character Zones

Data Sources: Michigan Geographic Data Library, Michigan DNR

- City or Village
- Watershed Boundary
- County Boundary
- Township Boundary
- Major Road
- Major Road
- Boardman River

Character Zones:

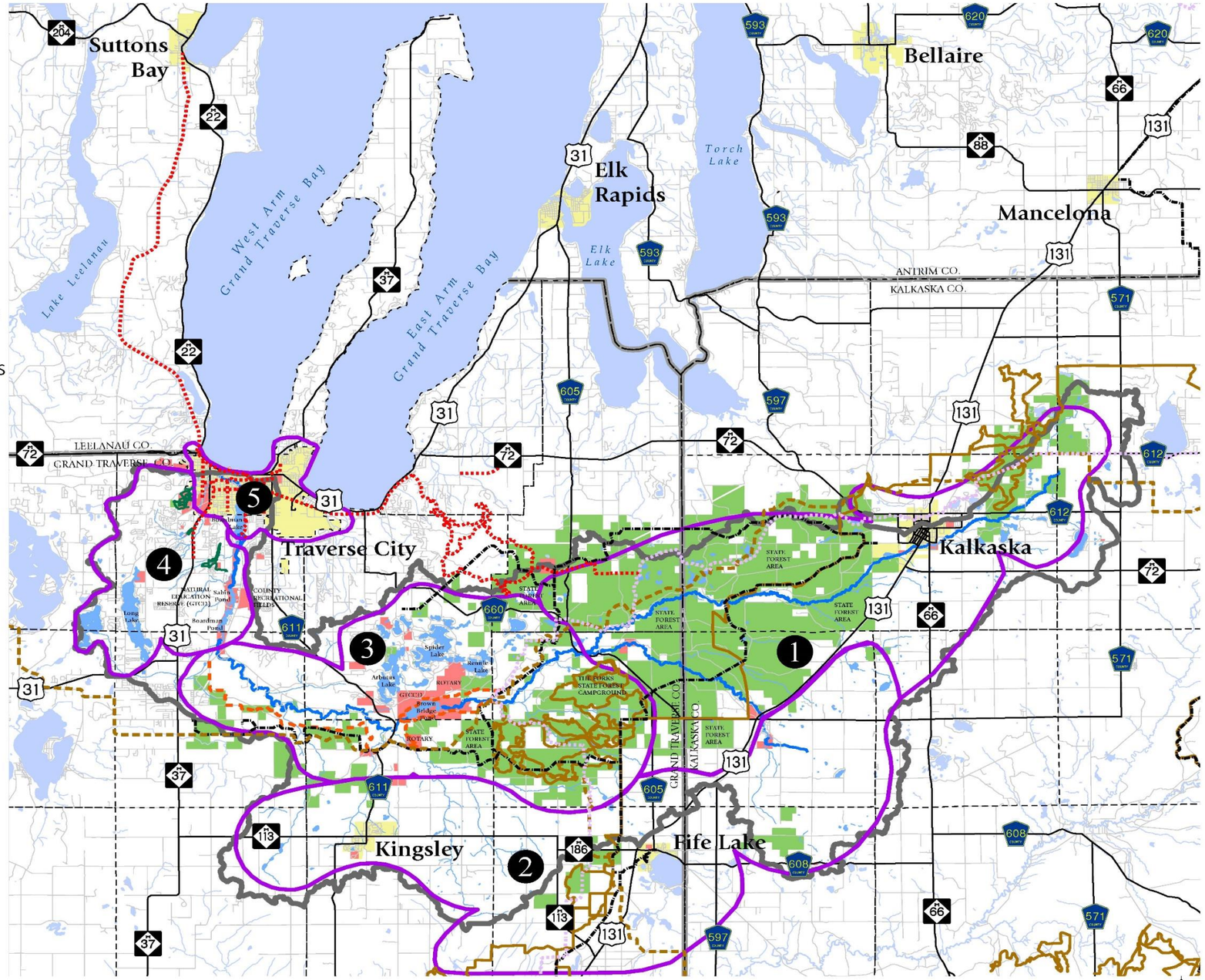
1. Kalkaska / Forks East / South Boardman Zones
2. Kingsley / Fife Lake Zones
3. River Road / Forest Lakes / Brown Bridge Zones
4. Silver Lake / Garfield Zones
5. Traverse City / Boardman Lake Zone

Public Land Owned By:

- State
- County / Local

Trails:

- Off Road Vehicle
- Non-Motorized
- North Country Trail
- Snowmobile
- Equestrian
- TART (Existing)
- TART (Proposed)



SOURCE: Beckett & Raeder Inc., 2012

FIGURE 23. Boardman River Watershed Character Zones

Best Management Practices (BMPs)

BMPs are techniques, measures, or structural controls designed to minimize or eliminate runoff and pollutants from entering surface and ground waters. Each site must be evaluated, and specific BMPs can be selected to perform under the site conditions. For BMPs to be effective, the correct method, installation, and maintenance need to be considered for each site. Addressing each of these factors will result in a conservation practice that can prevent or reduce non-point source pollution.

Structural BMPs are physical systems that are constructed for pollutant removal and/or reduction. This can include rip-rap along a streambank, rock check dams along a steep roadway or detention/retention basins, oil/grit separators, and porous asphalt for stormwater control.

Non-structural BMPs are preventative actions that involve management and source controls. These include policies and ordinances that provide requirements and standards to direct growth of identified areas, protection of sensitive areas such as wetlands and riparian areas, and maintaining and/or increasing open space. Other examples include providing buffers along sensitive water bodies, limiting impervious surfaces, and minimizing disturbance of soils and vegetation. Additional non-structural BMPs can be education programs for homeowners, students, businesses, developers, and local officials about everyday actions that protect water quality. Educational efforts are expounded upon in the Information and Education Strategy.

Although most of these non-structural BMPs are difficult to measure quantitatively in terms of overall pollutant reduction and other parameters, research demonstrates that these BMPs have a large impact on changing policy, enforcing protection standards, improving operating procedures and changing public awareness and behaviors to improve water quality and quantity in a watershed over the long term. Moreover, they target source control, which has been shown to be more cost effective than end-of-the-pipe solutions (i.e. “An ounce of prevention is worth a pound of cure”). Therefore, these BMPs should not be overlooked, and in some cases, should be the emphasis of a water quality management program.

It is important to note that installing a single BMP has the potential to reduce more than one type of pollutant (and source as well). For example, installing a riparian buffer will reduce a number of different pollutants (sediment, nutrients, toxins, etc.), as well as reduce impacts from fertilizer use and streambank erosion. Also, installing more than one BMP at a single site will increase the likelihood of pollutant reduction, but the effects will not be *cumulative*.

Types of BMPs

Some examples of possible BMPs for the most common sources of non-point source pollutants are listed in Table 34. Specific BMP recommendations for the Boardman River watershed are located in the Recommended Implementation Tasks (Tables 37-41).

TABLE 34. BMP Examples by Source

Source	Potential System of BMPs	
Road/Stream Crossings	• Extend or enlarge culverts • Install runoff diversions to direct runoff	• Install box culverts or elliptical culverts • Install clear-span bridges
Streambanks/Lakeshores	• Biotechnical erosion control • Vegetative buffer strips • Rock riprap	• Tree revetments • Land conservation easements
Stormwater	• Rain gardens (bioretention) • Runoff diversions • Infiltration basins or trenches	• Sand filters • Oil/grit separators • Pervious pavers
Recreation	• Runoff diversions • Walkways/stairways • Parking lot barriers • Biotechnical erosion control	• Rock riprap • Tree revetments • Canoe landings
Lawn/Shoreline Care	• Zero-phosphorus fertilizers • Vegetative buffer strips (greenbelts)	• Soil testing
Agriculture – Livestock	• Fencing • Alternative watering devices	• Vegetative buffer strips • Land conservation easements
Agriculture – Manure	• Nutrient management • Animal waste storage	• Manure application plan
Agriculture – Cropland	• Grade stabilization structures • Conservation crop rotation and tillage • NRCS Cost Share programs	• Cover crops • Grassed waterways
Septic	• Regular maintenance (includes education on how to maintain)	
Development	• Implement proper soil erosion measures • Low impact development techniques to reduce stormwater runoff	• Various construction BMPS (barriers, staging/scheduling, grading, etc.)

SOURCE: Grand Traverse Bay Watershed Protection Plan and Lake Charlevoix Watershed Management Plan

Location of BMPs

The location of structural BMPs depends on the site and site conditions. Table 35 lists general guidelines for the placement of structural BMPs that have been adapted from the rapid assessment protocol of the Center for Watershed Protection (Huron River Watershed Council 2003). The last row on the table suggests different areas within the Boardman River watershed to apply types of BMPs.

TABLE 35. General Guidelines for Locating BMPs

	Undeveloped	**Developing**	**Developed**
Philosophy	Preserve	Protect	Retrofit
Amount of impervious surface	<10%	11-26%	>26%
Water quality	Good	Fair	Fair-Poor
Stream biodiversity	Good-Excellent	Fair-Good	Poor
Channel stability	Stable	Unstable	Highly unstable
Stream protection objectives	Preserve biodiversity and channel stability	Maintain key elements of stream quality	Minimize pollutant loads delivered to downstream waters
Water quality objectives	• Sediment • Nutrients • Thermal Pollution • Loss of Habitat	• Sediment • Nutrients • Thermal Pollution • Hydrologic Flow • Loss of Habitat • Toxics	• Sediment • Nutrients • Hydrologic Flow • Toxics • Pathogens
BMP selection and design criteria	• Maintain pre-development hydrology • Emphasize filtering systems • Minimize stream warming and sediment	• Maintain pre-development hydrology • Emphasize filtering systems • Maximize pollutant removal, remove nutrients	• Focus on stormwater management • Maximize pollutant (sediment, nutrients, toxics) removal and quantity control • Implement systems that reduce hydrologic instability • Emphasize filtering systems
Example Locations in Watershed	All Priority Areas	• Acute Critical Area #1: Dam Removal Bottomlands • Acute Critical Area #2: N. Branch Boardman • Acute Critical Area #3: developing inland lakes	• Acute Critical Area #4: Traverse City and surrounding urban area • Acute Critical Area #5: Kids Creek subwatershed

BMP Effectiveness

BMP effectiveness, or efficiency, is determined by the size of the BMP implemented (e.g., feet of vegetated buffer or acres of stormwater detention ponds) and how much pollution was initially coming from the source.

The Center for Watershed Protection has compiled a considerable amount of information regarding the effectiveness of selected stormwater BMPs. Most are listed by percentages of effectiveness, because, as stated above, the actual amount of pollutants reduced depends on the size of the BMP installed. For more specific information on these stormwater BMPs, see the Center for Watershed Protection's Stormwater Center website at www.stormwatercenter.net.

The amount of nutrients and sediments reduced from streambank and shoreline stabilization projects can vary widely. In general, one can calculate the sediment and nutrients saved from entering a stream by eliminating the source of erosion using the MDEQ Pollutants Controlled Manual and the Channel Erosion Equation (MDEQ 1999):

Sediment Reduced (T/yr) =
Length (ft.) x Height (ft.) x LRR (ft./yr.) x Soil weight (ton/ft^3)

LRR: Lateral Recession Rate
Soil weight: Values available in MDEQ Pollutants Controlled Manual, Exhibit 1 (MDEQ 1999)

In turn, phosphorus and nitrogen attached to soil particles will be saved from entering the stream. The following calculations may be used to estimate the amount of phosphorus and nitrogen reduced by repairing an erosion source.

Phosphorus Reduced (lb/yr) =
Sediment reduced (T/yr) x 2000 lb/T x 0.0005 lb P/lb of soil x correction factor

Nitrogen Reduced (lb/yr) =
Sediment reduced (T/yr) x 2000 lb/T x 0.001 lb N/lb of soil x correction factor

Correction factor: Soil texture correction factors available in MDEQ Pollutants Controlled Manual, Exhibit 2 (MDEQ 1999)

Not every BMP may be the best selection for every site. Some places are better suited for specific kinds of BMPs. There are other factors to consider besides pollutant removal efficiency when deciding which BMP to use at a site. Other factors include the size of site, money available for implementation, maintenance commitments, and the purpose of the land (i.e., what the site will be used for).

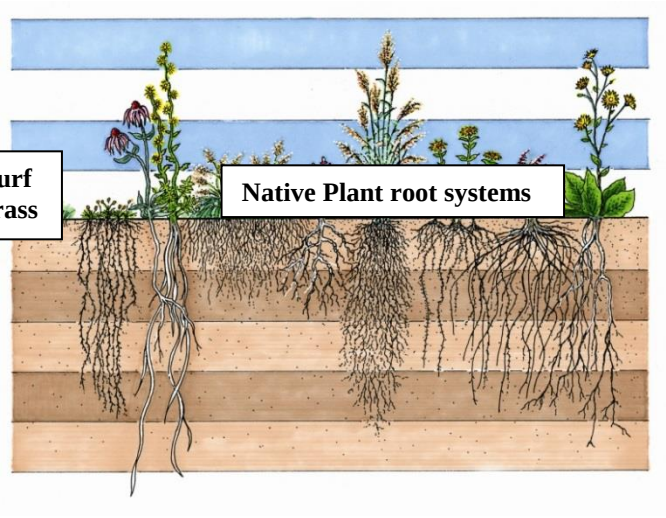
A Note on Low Impact Development for Stormwater BMPs

Of particular importance are the more innovative stormwater BMPs known collectively as low impact development (LID) techniques. LID is a set of small-scale stormwater management practices that mimic and work with nature to reduce stormwater runoff. This strategy uses things such as green space, native landscaping, and other techniques to encourage water to infiltrate into the ground rather than conveying it through costly infrastructure to an "end-of-pipe" facility or waterbody. Since most pollutants are carried to waterbodies by stormwater, LID can significantly reduce the amount of pollution entering a watershed because it reduces or eliminates runoff from a site. Additionally, since LID reduces stormwater leaving a site, it can help reduce flooding, channel erosion, and scouring downstream.

LID is applicable to new and existing development and can be integrated into virtually any site, from the residential scale to larger sites such as commercial areas. The range of techniques continues to expand and new advances in design provide greater water quality benefits. According to the U.S. Environmental Protection Agency, LID practices save substantial money for property owners, communities, and

developers while also improving water quality. LID methods decrease the amount of expensive below ground drainage infrastructure required and reduce or eliminate the need for other stormwater-related facilities such as curbs, erosion control measures, catch basins, and outlet control structures.

Because LID encourages the use of vegetation to help infiltrate water into the ground, it also provides ecosystem services (insect habitat, food for birds, nesting areas) that conventional stormwater controls d not. LID also stresses the use of nativ plants, which typically have much deepe roots systems than turf grass. This dramatically increases infiltration at a site, as well as uptake of nutrients (see photo at right).



TWC has already installed numerous LID techniques as part of the Kids Creek Restoration Project and other projects throughout the Grand Traverse Bay watershed. Future plans for Kids Creek involve additional installations of LID techniques to reduce stormwater inputs to the creek. Additionally, TWC plans to install LID BMPs throughout Traverse City and other urban areas in the watershed.

Green roof at Munson Cowell Family Cancer Center
Photo courtesy of:
The Watershed Center Grand Traverse Bay

Underground infiltration trench at Bryant Park, Traverse City
Photo courtesy of:
The Watershed Center Grand Traverse Bay

Planter box at Munson Medical Center Building 29
Photo courtesy of:
The Watershed Center Grand Traverse Bay

Rain Gardens in Suttons Bay
Photo courtesy of:
The Watershed Center Grand Traverse Bay

10.3 LIST OF IMPLEMENTATION TASKS

The following tables (Tables 36-41) include a comprehensive list of proposed tasks and actions that, if implemented, will result in water quality protection or improvements and work toward achieving the Prosperity Plan's goals and objectives. The first set of tasks are ones that need to be implemented on a watershed-wide basis (Table 36). After watershed-wide tasks are listed, tasks and actions were then organized into zones (Tables 37-41). Within each zone, strategies are grouped under three broad types: water quality and environmental, sustainable economic development, and recreation-related. Water quality and environmental tasks were also divided into the following categories:

- Shoreline Stabilization and Protection
- Stormwater
- Transportation/Stream Crossings (i.e. roads, railroads, etc.)
- Planning, Zoning, and Land Use
- Land Protection and Management
- Habitat, Fish, and Wildlife
- Human Health Strategies
- Hydrology and Groundwater
- Water Quality Monitoring
- Wetland
- Invasive Species
- Agriculture
- Wastewater and Septics

If conditions change or opportunities to pursue tasks emerge, the Boardman River Watershed Prosperity Plan Implementation Team should re-evaluate the relative priorities and distribution of resources.

Each task and action identifies the following:

Priority Level. Each task and action has been assigned a priority level based on one or more of the following factors: urgency to correct or reduce an existing problem; need to enact a specific task or action before a problem develops; availability of funds, partner(s), or program(s) ready to implement; and the overall need to balance low, medium, and high priorities over the course of ten years.

Milestones. Project milestones for specific tasks were established where feasible. The milestones identify when the noted task should be completed. They are meant to guide implementation priorities and measure progress. Key milestones include completing dam removal projects, installing stormwater reduction BMPs in the Kids Creek subwatershed, completing streambank erosion restoration projects, repairing transportation crossings, and updating zoning ordinances.

Estimated Costs. Costs are estimated for each action, and generally include construction, materials, and staff costs. Where the primary cost of the activity is staff (or volunteer) time, costs are shown with an "S" and are calculated at $35 per hour. Tables 42 and 43 summarize the total estimated costs by zone and category. Tasks that will be done on a yearly or site-by-site basis are noted as such ($/yr or $/site). Appendix A lists average rates for costs associated with purchasing materials for and installing standard BMPs (taken from TWC 2005). Further details are noted where applicable.

Timeframe. The implementation time frame for the proposed actions in the plan is 10 years, beginning in 2017, although the Leadership Team envisions ongoing implementation of many of the proposed actions beyond this period as well. Many tasks will be implemented immediately and many will occur over the 10-year watershed plan implementation period. Some proposed strategies should be undertaken annually and are given a timeframe of "ongoing."

Potential Partners. The potential partners specified are those who have the interest or capacity to implement the task or action; they are not obligated to fulfill the task or action. It is expected that they will consider pursuing funds to implement the task or action, work with other identified potential partners, and communicate any progress with the Leadership Team.

Acronyms

BATA – Bay Area Transportation Authority
BDIT – Boardman Dams Implementation Team
CRA – Conservation Resource Alliance
MDEQ – MI Dept of Environmental Quality
MDNR – MI Dept of Natural Resources
EPA – Environmental Protection Agency
FERC – Federal Energy Regulatory Commission
GTB – Grand Traverse Band of Ottawa and Chippewa Indians
GTC – Grand Traverse County
GTCD – Grand Traverse Conservation District
GTRCF – Grand Traverse Regional Community Foundation
GTRLC – Grand Traverse Regional Land Conservancy
H Depts. – Local Health Departments
KalC – Kalkaska County
KCD – Kalkaska Conservation District
LA – Lake Associations
LGOV – Local Governments
M-DOT – Michigan Department of Transportation
MEDC – MI Economic Development Corporation
MSU-E – Michigan State University Extension
MSHDA – MI State Housing Development Authority
NMC – Northwestern MI College
NN – Networks Northwest
NRCS – USDA Natural Resources Conservation Service
ISN – Northwest MI Invasive Species Network
NWMW – Northwest MI Works
RCs – County Road Commissions
Rotary – Rotary Charities
TART – Traverse Area Recreational and Transportation Trails, Inc.
TCACC – Traverse City Area Chamber of Commerce
TACVB – Traverse Area Convention and Visitors Bureau
TBECD – Traverse Bay Economic Development Corporation
TC – City of Traverse City
TC-DDA – TC Downtown Development Authority
TCLP – Traverse City Light and Power
TWC – The Watershed Center Grand Traverse Bay
USGS – United States Geological Survey

Other Organizations:

Chambers of Commerce, Convention Visitors Bureau
Local Realtors, Businesses
MI Agricultural Stewardship Association
New Designs for Growth
Northern Lakes Economic Alliance
Schools, Universities

TABLE 36. Watershed-wide Actions and Related Goals/Objectives

	Watershed Wide Actions	Goals/ Objectives Addressed	Priority	Milestones	Estimated Costs	Potential Partners	Y1: 2017	Y2: 2018	Y3: 2019	Y4: 2020	Y5: 2021	Y6: 2022	Y7: 2023	Y8: 2024	Y9: 2025	Y10: 2026
Shoreline Stabilization and Protection Strategies																
WW.SS.1	Update GTCD's streambank erosion and road stream crossing inventory every five years to reflect newly identified road stream crossings and streambank erosion sites and restoration progress. Update the online River Restoration in Northern Michigan database accordingly (http://www.northernmichiganstreams.org/boardmansbe.asp). (CRA, N.d.)	1.1; 1.3	High	By 2018	$25,000	GTCD TWC GTB CRA										
WW.SS.2	Work with public and private landowners to stabilize and restore eroding streambank sites at priority sites with biotechnical and soft engineering techniques.	1.1; 1.3	High	Complete 200 linear feet (LF) of restoration/ stabilization by 2020; 500 LF by year 2025	$100/LF; Total $50,000	GTCD TWC CRA										
WW.SS.3	Post dam removal - Monitor and restore resulting eroding streambanks.	1.1; 1.3	High	Restore a minimum of 100 LF per year	$10,000/yr	GTCD GTB CRA										
WW.SS.4	Inventory riparian corridors on private property to identify a list of priority riparian buffer installation or restoration sites.	1.1; 1.3; 5.2	Low	--	Total = $30,600	TWC GTCD										
WW.SS.5	Post dam removal - re-establish riparian zone vegetation along new stream channel to provide bank stability, shading, and other riparian zone benefits as soon as possible.	1.1; 1.3	High	Plant a minimum of 5,000 native trees and shrubs per year	$16,000/yr	GTCD GTB TWC										
WW.SS.6	Install vegetated riparian buffers on private property in identified priority areas, with particular emphasis on tree preservation (where trees exist) or tree planting (where no or insufficient tree canopy exists).	1.1; 1.3; 5.2	Low	Install at least 1 riparian buffer on private land each year	Total costs TBD depending on sites. Average cost/acre ranges from $220 to $730	TWC GTCD										
WW.SS.7	Work with public landowners to install vegetated riparian buffers in priority areas, with particular emphasis on tree preservation (where trees exist) or tree planting (where no or insufficient tree canopy exists).	1.1; 1.3; 5.2	Medium	Install at least 1 riparian buffer each year	Total costs TBD depending on sites. Average cost/acre ranges from $220 to $730	TWC GTCD										
WW.SS.8	Install barriers, signage, or stairs where needed to manage human access to stream and lakeside banks at risk of erosion (steep slopes, sandy soils) from recreational foot traffic	1.3; 4.1; 4.2	Low	--	<$10,00 year; S/V = $1,400 year Total = $4,200	GTCD GTB MDNR										
Stormwater Strategies																
WW.St.1	Work with local governments, area businesses, and property owners to install the following stormwater BMPs in urban areas where appropriate. Vegetative Filter Strips: Filter Strips/Aquatic Buffers, Wet Swales, Dry Swales, Grass Channels Stormwater Filtering Systems: Bioretention and Surface, Perimeter, Organic, Underground, Pocket Sand Filters Infiltration Practices: Infiltration Trench or Basin, Porous Pavement Retention and Detention Ponds Other Low Impact Design Elements: Rain/Roof Gardens, Native Plantings, Riparian Buffers	1.1; 1.3	High	Complete one LID project each year	Implementation costs vary Estimate ~$200K/yr Total - $2million	TWC										
WW.St.2	Upgrade or update applicable ordinances for local governments to accommodate and encourage more innovative forms of stormwater management *See Planning, Zoning, and Land Use*	--	--	--	--	--										

	Watershed Wide Actions	Goals/ Objectives Addressed	Priority	Milestones	Estimated Costs	Potential Partners	Y1: 2017	Y2: 2018	Y3: 2019	Y4: 2020	Y5: 2021	Y6: 2022	Y7: 2023	Y8: 2024	Y9: 2025	Y10: 2026
Transportation/Stream Crossings Strategies																
WW.TSX.1	Update Grand Traverse Conservation District's (GTCD) Boardman River Watershed Report every five years to reflect newly identified road stream crossings and streambank erosion sites and restoration progress. Update the online River Restoration in Northern Michigan database accordingly (http://www.northernmichiganstreams.org/boardmansbe.asp). *See Shoreline Stabilization and Protection*	--	--	--	--	--										
WW.TSX.2	Where priority transportation stream crossings have been identified, improve, repair, or replace outdated, failing, or eroding crossings by implementing the appropriate BMPs from the following; Crossings: Remove obstructions that restrict flow through the culvert; Replace undersized (too small or too short) culverts; Remove and replace perched or misaligned culverts to avoid erosion and provide for fish passage; Install bottomless culverts and bridges where possible; Replace culverts with a culvert that is 2x the bankfull width and a length that allows for ≥ 3:1 slope on embankments; Revegetate all disturbed or bare soils on embankments Approaches: Create diversion outlets and spillways to direct road runoff and stormwater away streams; Pave steep, sandy approaches where feasible; Dig or maintain ditches where needed and construct check dams if required Maintenance: Encourage Road Commissions and railroad officials to look at the long-term savings of crossing improvements over cumulative maintenance costs Construction and Closure: Minimize the number of access roads needed for oil, timber and gas exploration; When constructing new roads, avoid streams if possible and maintain natural channels to greatest extent possible; Close private roads and trails that are no longer needed. Remove culvert and restore stream channel.	1.1, 1.3	High	Complete upgrade of at least one priority transportation crossings per year.	Depends on size of crossing. $75,000–$100,000 per crossing; Total over 10 years = $750,000 to $1M	GTCD TWC CRA										
Planning, Zoning, and Land Use Strategies																
WW.PZL.1	Assist townships with drafting and updating zoning and master plans to protect water quality and natural resources. Examples of topics include: sufficient building setbacks from bodies of water, minimizing development clearings by landowners, minimizing vegetation removal and mowing to the water's edge, stormwater management, reducing impervious surfaces near water bodies, establishing riparian buffers along waterways, eliminating the dumping of grass clippings and other yard/solid wastes into the water, prohibiting the feeding of waterfowl near water bodies, and protecting wetlands.	1.1, 1.2, 1.5	High	Ongoing	S = $5,000/yr	TWC LGOV										
WW.PZL.2	Encourage local governments to establish policies and undertake projects that prioritize the protection of water quality on public land, including streets, roads, parking lots, and park land. This includes implementing green infrastructure into the planning and design phases of capital projects related to publically-owned infrastructure, such as street maintenance, building renovations, parking lot surfacing, and landscaping.		High	Ongoing	S = $5,000/yr	TWC LGOV										
WW.PZL.3	Upgrade or update applicable ordinances for local governments in the watershed to accommodate and encourage more innovative forms of stormwater management, including LID.	1.1	High	TC - by 2019 Garf Twp - by 2021	S = $10,000/yr	TWC LGOV										
WW.PZL.4	Integrate LID standards and other innovative techniques into sedimentation control ordinances throughout the watershed.	1.1	High	Ongoing	S = $5,000/yr	TWC LGOV										
WW.PZL.5	Ensure that zoning ordinances in all watershed communities include provisions to identify and protect scenic vistas, agricultural lands, and historic or cultural sites.	2.3; 3.4; 5.1	Low	Ongoing	S = $2,800	LGOV GTCD GTRLC										
WW.PZL.6	Any future road capacity or upgrade analyses associated with new housing or economic development projects should be consistent with the approach in the Grand Vision, include an analysis of the Boardman River water quality and habitat implications, and support the Prosperity Plan's emphasis on clustering housing and jobs to limit the need for larger roads.	1.1; 1.2; 1.3; 3.2	Low	--	No cost	TWC GTCD LGOV										
WW.PZL.7	Develop a Boardman River Recreation Plan that addresses and guides all current and future recreational uses of the river, including points of access and establishes a "carrying capacity" for each use as to protect and enhance the important resource values.	1.1; 1.2	High	Complete Plan by 2017	$50,000	GTCD MDNR GTB										

	Watershed Wide Actions	Goals/ Objectives Addressed	Priority	Milestones	Estimated Costs	Potential Partners	Y1: 2017	Y2: 2018	Y3: 2019	Y4: 2020	Y5: 2021	Y6: 2022	Y7: 2023	Y8: 2024	Y9: 2025	Y10: 2026
Land Protection and Management Strategies																
WW.LPM.1	Work with local units of government to develop and promote local initiatives that preserve open space and sensitive/important natural areas.	1.2; 4.2; 5.1; 5.2	Medium	--	S = 2,500/yr	GTRLC TWC LGOV										
WW.LPM.2	Identify priority private lands for conservation and work to acquire conservation easements or other permanent protection of these priority parcels.	1.2; 4.2; 5.1; 5.2	High	Acquire five priority easements by 2023	S/V time = $1,750–$2,450/year; Total = $17,500 to $24,500. Acquisition costs TBD	GTRLC										
Habitat, Fish, and Wildlife Strategies																
WW.HFW.1	Collect information that exists, and conduct stream inventories where needed, to evaluate appropriate sites for in-stream habitat improvement projects. Criteria to be assessed includes: woody debris, bank stability, floodplain connectivity, riparian vegetation, in-stream cover, flow dynamics, and fish population structure	1.1, 1.2	High	Complete by 2021	$35,000	GTCD TWC CRA MDNR GTB										
WW.HFW.2	Install in-stream habitat improvements where appropriate, according to the inventory above.	1.1, 1.2	Medium	After inventory, one site/year	$50,000/year (after inventory) Total= $200K	GTCD TWC CRA MDNR GTB										
WW.HFW.3	Continue to implement the Conservation Resource Alliance's Wild-Link program to protect and enhance fish and wildlife habitat on private property within ecological corridors throughout the watershed.	1.2; 1.4; 1.5; 5,1; 5.2	Low	Work with at least four or five landowners each year	~$20,000 per year, plus S/V = $1,400/year, Total = $214,000	CRA										
Human Health Strategies																
WW.HH.1	Conduct post-rain-event *E. coli* monitoring on inland lakes and Boardman River every two years in areas identified as potentially threatened by storm–water inputs of pathogens.	1.1	Low	Sample sites/ 2 yrs	$10,000–$15,000 Total = $50,000–-$75,000	TWC										
Hydrology and Groundwater Strategies																
WW.HG.1	Work with owners and operators of dams and lake-control structures to ensure these structures are operated so that they mimic natural flow conditions of the river. Where possible, seek permission for removal.	1.1, 1.2, 1.3	Medium	Contact two property owners annually	S=$2,500/yr	GTCD TWC LGOV										
WW.HG.2	Remove inoperative, failing, or economically unfeasible dams as well as priority dams that are blocking fish passage. Utilize 2015 small dam inventory as resource.	1.1, 1.2, 1.3,	High	(See above) Contact two property owners annually	Cost vary depending on size of dam	GTCD TWC CRA GTB LGOV MDNR MDEQ BDIT										
WW.HG.3	Eliminate improperly or uncapped abandoned wells to prevent contaminants from moving into and among groundwater aquifers via this route. Tasks will be to 1) inventory existing abandoned wells through surveys, well logs, and landowner interviews and 2) properly plug the abandoned wells.	1.1	Low	Contact all property owners that have known improperly or uncapped abandoned wells	$25,000 (well inventory only) $250K/county/yr (plugging wells)	MSUE HDept, MDEQ										

	Watershed Wide Actions	Goals/ Objectives Addressed	Priority	Milestones	Estimated Costs	Potential Partners	Y1: 2017	Y2: 2018	Y3: 2019	Y4: 2020	Y5: 2021	Y6: 2022	Y7: 2023	Y8: 2024	Y9: 2025	Y10: 2026
Water Quality Monitoring Strategies																
WW.WQ.1	Develop and implement a Comprehensive Water Quality Monitoring (CWQM) program to regularly monitor standard water quality parameters every three years (e.g., phosphorus, nitrogen, temperature, suspended solids, fecal bacteria), as well as fish and benthic communities. At a minimum, monitoring must include sites in identified Priority and Critical Areas to ensure pollutant concentrations remain the same or decrease *Details in Chapter 11.2 Water Quality Monitoring Plan*	1.1	High	Ongoing	$50,000/year	MDEQ TWC BDIT GTCD										
WW.WQ.2	Continue TWC's Adopt A Stream program that monitors macroinvertebrates and covers the Boardman River Watershed and expand to include additional streams.	1.1, 1.2	High	Yearly	$10,000/year	TWC LA Schools										
WW.WQ.3	Continue MDEQ collection and identification of macroinvertebrates from randomly selected stations on a 5-year rotating schedule, consistent with present sampling program.	1.1, 1.2	High	2018 2023	No Cost	MDEQ										
WW.WQ.4	Support the MDNR and the GT Band in their efforts to determine fish population estimates and trends throughout the watershed	1.1, 1.2	Medium	Ongoing/Yearly	$5,000/year	MDNR GTB										
WW.WQ.5	Synthesize raw temperature data collected by GTCD since 2013	1.1	High	By 2018	Intern or College Grad: $5,000	GTCD										
WW.WQ.6	Update appropriate online databases as new water quality information becomes available (eg: TWC, MiCorps, northernmistreams.org, BeachGuard)	1.1	Low	Update as needed	S=$1,000/yr	TWC GTCD CRA GTB										
WW.WQ.7	Undertake further evaluation and monitoring of nutrient, bacterial and toxic pollution sites identified in the Boardman Lake Watershed Management Plan.	1.1	Medium	Study complete by 2025	$50,000	TWC TC GarfTwp GTB										
WW.WQ.8	Conduct clean-up event(s) on Boardman Lake and downstream in Boardman River to remove tires, drums, various scrap metal, wooden pallets, bricks, ceramics and other debris.	1.1, 1.2	Low	ongoing	$2,000/clean-up	GTCD TWC,										
WW.WQ.9	Seek grant funding for research on (1) the impacts of climate change on Boardman River water quality; (2) ecosystem recovery following Boardman Dams removal; and (3) the impact of oil and gas extraction on Boardman River watershed natural resources.	1.1; 1.2	Low		S/V = $2,100/year; Total = $21,000	TWC GTCD										
WW.WQ.10	***Invasive Species monitoring tasks are located in the Invasive Species Category*	1.4														
Wetland Strategies																
WW.W.1	Protect and restore existing wetlands through the use of setback buffers, enforcement of wetlands regulations, and removal/management of invasive species.	1.2; 1.4	Low	ongoing	S=$5,250 year; Total = $52,500	GTCD TWC LGOV										
Invasive Species Strategies																
WW.IS.1	Work with local governments and businesses to install boat washing stations at area marinas and public boat launches to avoid spread of invasive species	1.4	Low	2 Stations installed by 2025	~$10,000/station	LA LGOV										
WW.IS.2	Support efforts to control *Phragmites* on inland lake shorelines; work with local governments, resource agencies, and others to monitor and treat infestations.	1.4	High	--	See Zone Tasks for more info	TWC ISN										
WW.IS.3	Monitor the spread of specific types of invasive species in the watershed including both terrestrial and aquatic (i.e., Phragmites, Eurasian watermilfoil, quagga mussels)	1.4	High	Ongoing	$6,000/yr	TWC ISN GTCD										
WW.IS.4	Develop and implement measures to effectively control or remove specific, targeted invasive species in priority areas throughout watershed.	1.4	High	Ongoing	$50,000	TWC ISN GTCD										

	Watershed Wide Actions	Goals/ Objectives Addressed	Priority	Milestones	Estimated Costs	Potential Partners	Y1: 2017	Y2: 2018	Y3: 2019	Y4: 2020	Y5: 2021	Y6: 2022	Y7: 2023	Y8: 2024	Y9: 2025	Y10: 2026
Agriculture Strategies																
WW.AG.1	Continue to work with and support farmers through the Michigan Agriculture Environmental Assurance Program (MAEAP) to evaluate their entire operation and to help them make sustainable, science-based management decisions that balance environmental, economic, and societal factors.	1.1; 1.2; 1.3	High	Verify 10 new farms per year.	$15,000	GTCD MDA										
	See Zone 2 and Zone 4 Tasks															
Wastewater and Septics Strategies																
WW.WW.1	Complete shoreline cladophora survey to determine potential sites where there may be improperly working septic systems. Work with landowners to conduct dye testing to determine which septic systems are leaking, if any, in potential sited areas	1.1	Low	5 lakes by 2021 10 lakes by 2025	$10,000/lake	TWC GTCD LA LGOV										
WW.WW.2	Offer advice and assistance to riparian landowners to help identify malfunctioning septic systems.	1.1	Medium	--	S= $2,500	TWC H Dept LA LGOV										
WW.WW.3	Work with local governments and health departments to establish regular, mandatory septic system inspections through ordinances (i.e. time of sale) or by other means in all communities without centralized wastewater treatment systems (similar to Kalkaska County program).	1.1	Medium	Ordinances adopted by 5 communities by 2023	S=$10,000	TWC HDept LGOV										
Sustainable Economic Development Strategies																
WW.Econ.1	Develop a Boardman River watershed “brand” and marketing effort that can be used to promote the region’s high-quality and diverse natural, cultural, historic, economic, and recreational amenities.	2.3; 4.3; 5.3	High	Brand concept developed and approved by implementation team, marketing materials developed	$35,000–$50,000 for design and materials; S = $7,000 Total = $43,000–$57,000	TCACC TACVB										
WW.Econ.2	Ensure that adequate technology infrastructure (including high-speed Internet and cell phone) is available throughout the region to leverage social networking and increase access to new markets.	2.1; 2,2; 3.1	Low	Technology infrastructure needs identified by 2016 Plan for upgrading technology infrastructure by 2016	S = $1,400 upgrade costs TBD	TCACC										
WW.Econ.3	Promote existing resort-recreational business establishments through wayfinding improvements.	4.3; 5.3	Medium	Wayfinding signage and materials completed by 2017 Wayfinding installed by 2018	Study and Conceptual Design $50,000 Implementation $150,000–$200,000	TCACC local businesses MDNR										
Recreation-Related Strategies																
WW.Rec.1	Create or improve trail links between Leelanau/Traverse City on the west to the mid, southern, and eastern portions of the watershed (to Kalkaska), including completion and extension of future TART trails, and links within existing equestrian, snowmobile, North Country, and VASA trails.	2.3; 4.2; 4.3	High	Funds secured for trail links by 2018; trail links completed by 2020	TBD	TART MDNR LGOV GTLC GTCD										
WW.Rec.2	Develop Boardman River recreation carrying capacity analysis that evaluates and makes recommendations regarding the amount and type of water-based recreational offerings the river can support.	1.2; 4.1; 5.2; 5.3	High	Carrying capacity study completed by 2017	~$40,000	GTCD TWC MDNR										

	Watershed Wide Actions	Goals/ Objectives Addressed	Priority	Milestones	Estimated Costs	Potential Partners	Y1: 2017	Y2: 2018	Y3: 2019	Y4: 2020	Y5: 2021	Y6: 2022	Y7: 2023	Y8: 2024	Y9: 2025	Y10: 2026
WW.Rec.3	Identify and leverage links with Pure Michigan, Traverse City Convention and Visitors Bureau, Experience Up North, and other recreational organizations or initiatives to market an integrated outdoor recreational system in the watershed.	2.3; 4.3	Medium	Collaborative marketing plan developed and implemented by the end of 2017	S = $1,750	MEDC TCCVB										
WW.Rec.4	Improve wayfinding (signage, mobile applications) for trails and recreational assets (such as snowmobile, TART, VASA, North Country, and equestrian trails, paddling and fishing opportunities, nature reserves, local parks, etc.) throughout the watershed.	2.1; 2.3;4.3	Medium	Funds secured for wayfinding by 2018 Fully implemented by 2021	$30,000–$50,000	TART MDNR LGOV GTCD TCCVB										
WW.Rec.5	Link BATA routes to recreational assets throughout the watershed to offer a world class, integrated recreational/transportation system. Evaluate opportunities for positioning transportation hubs along recreational corridors.	2.3; 3.2; 4.3	Medium	New BATA routes established by 2018	TBD	BATA LGOV										

SOURCE: Public Sector Consultants Inc., 2013, based on input from the Leadership Team

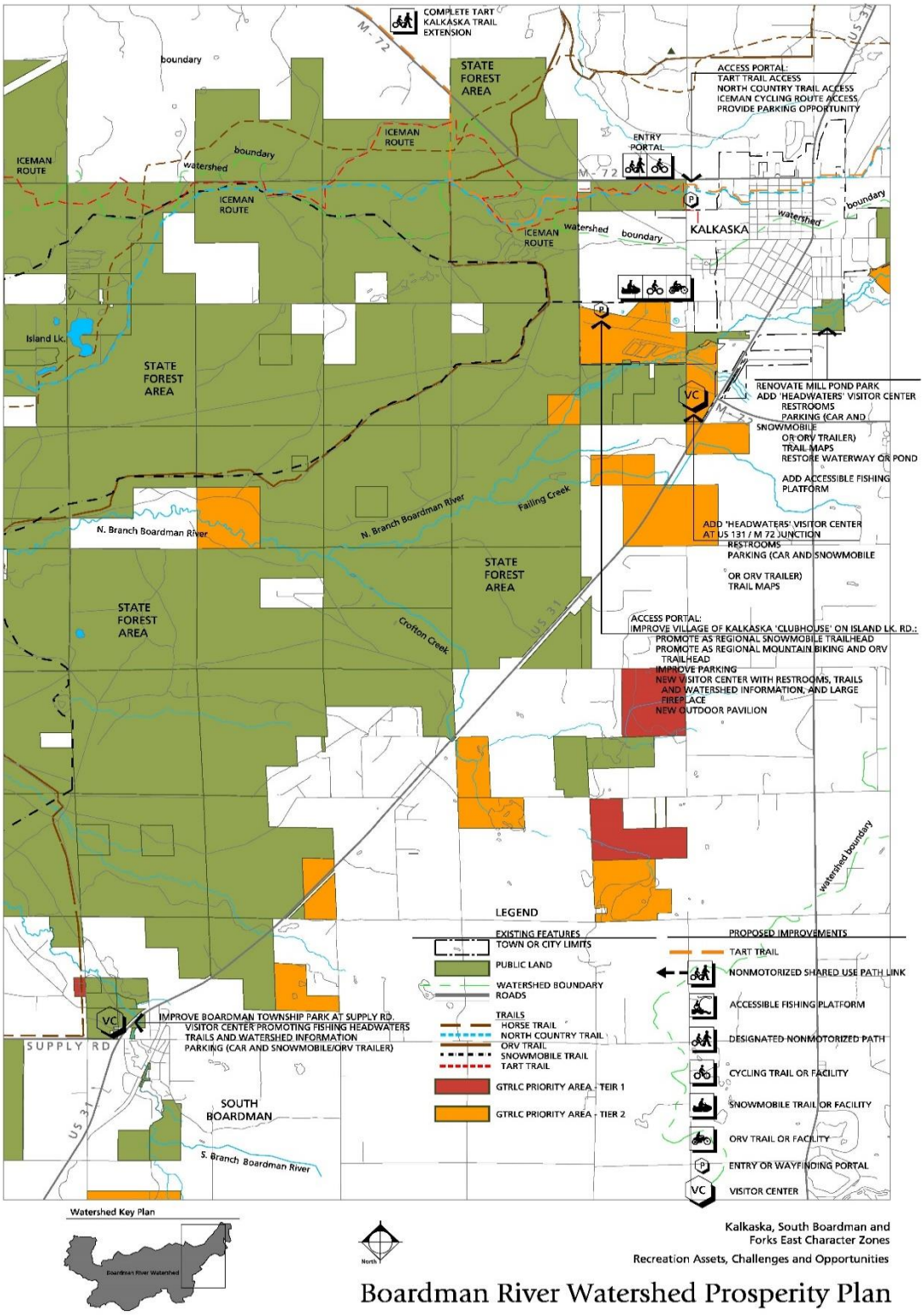


FIGURE 24. Map of Zone 1 – Headwaters and Eastern Watershed (Encompassing Kalkaska, South Boardman and Forks East areas)

SOURCE: Beckett & Raeder, 2012

TABLE 37. Zone 1 Actions and Related Goals/Objectives (Encompassing Critical Areas #2 and #8)

	Zone 1 Actions	Goals/ Objectives Addressed	Priority	Milestones	Estimated Costs	Potential Partners	Y1: 2017	Y2: 2018	Y3: 2019	Y4: 2020	Y5: 2021	Y6: 2022	Y7: 2023	Y8: 2024	Y9: 2025	Y10: 2026
Shoreline Stabilization and Protection Strategies																
Z1.SS.1	Determine MDNR Fisheries Division desire for sand trap maintenance. Either clean sand traps or abandon and stabilize accordingly.	1.1; 1.3	Medium	Clean or restore traps on both branches by Dec. 2018	$20,000	GTCD TWC GTB										
Stormwater Strategies																
Z1.St.1	Implement stormwater BMPs in the Village of Kalkaska (North Branch) and South Boardman (South Branch) to reduce runoff impacts to Boardman River headwaters.	1.1	Low	One BMP by 2025	$200,000	TWC LGOV										
Planning, Zoning, and Land Use Strategies																
Z1.PZL.1	Encourage adoption of a Soil Erosion Control Ordinance for Kalkaska County that addresses earth changes near wetlands, on slopes, in clay areas, close to drains, and other areas where there is increased potential for water quality impacts.	1.1	Low	Ordinance by 2025	S = $10,000	TWC										
Z1.PZL.2	Upgrade or update applicable ordinances for the Village of Kalkaska to accommodate and encourage more innovative forms of stormwater management, including LID, on private property.	1.1, 1.3	Medium	Ordinance by 2022	S = $5,000	TWC LGOV										
Z1.PZL.3	Encourage the Village of Kalkaska to prioritize the inclusion of green infrastructure in capital improvement projects, particularly street and parking lot projects.	1.1	Low	Ongoing	S = $1,500	TWC										
Z1.PZL.4	Establish low-density development requirements (such as larger lot sizes) to control nutrient loadings and habitat alterations in the Forks East area.	1.1; 1.3	Medium		S= $3,500	TWC LGOV										
Z1.PZL.5	Work with the MDNR, Kalkaska County, the Village of Kalkaska, Kalkaska Township, Boardman Township and others to extend Natural River Zoning above US-131 to the headwaters on both the North and South Branches of the Boardman..	1.1; 1.5; 3.4; 4.1	Medium	Evaluation of ecologic and economic impacts of expanded designation by 2017	S=$25,000	MDNR KCD GTCD										
Z1.PZL.6	To reduce fragmentation of critical wildlife habitats and recreational corridors, work with planning officials to encourage the use of existing transportation corridors, especially if planning efforts for the US131 freeway extension become active again. *Task also in Zone 2*	1.5	High	Action as needed	S=$10,000	MDNR KCD GTCD										
Z1.PZL.7	Work with Kalkaska County to draft and implement a county-wide soil erosion ordinance that includes stormwater runoff in urbanized areas as well	1.1	High	Ordinance adopted by 2021	S=$10,000	TWC LGOV KalC										
Habitat, Fish, and Wildlife Strategies																
Z1.HFW.1	To reduce fragmentation of critical wildlife habitats and recreational corridors, work with planning officials to encourage the use of existing transportation corridors, especially if planning efforts for the US131 freeway extension become active again. *See Planning, Zoning, and Land Use Task above*	--	--	--	--											
Z1.HFW.2	Preserve, enhance, and protect instream habitat including large woody debris material in this section of Boardman River. Conduct inventory to determine locations for woody debris placement. Choose priority sites from inventory and install woody debris as appropriate.	1.1, 1.2	Medium	Inventory by 2018 2 completed sites by 2022	Inventory: $10,000 Install: $20,000											
Hydrology and Groundwater Strategies																
Z1.HG.1	Kalkaska Mill Pond Dam removal: Discuss possibility of dam removal with village officials. If agreement is made, remove the Mill Pond Dam.	1.1, 1.2, 1.3	Low	Discussions by 2019	$450,000	KCD GTCD										
Water Quality Monitoring Strategies																
Z1.WQ.1	Conduct study to investigate sources of temperature increases and sediment loading in the North Branch of the Boardman River (one of the identified critical areas)	1.1; 1.3; 1.5;	High	Funding by 2018 Study complete 2021	$40,000	MDNR KCD GTCD TWC										

	Zone 1 Actions	Goals/ Objectives Addressed	Priority	Milestones	Estimated Costs	Potential Partners	Y1: 2017	Y2: 2018	Y3: 2019	Y4: 2020	Y5: 2021	Y6: 2022	Y7: 2023	Y8: 2024	Y9: 2025	Y10: 2026
Wastewater and Septics Strategies																
Z1.WW.1	Implement Kalkaska County water main and septic facility infrastructure projects in the Northwest Michigan Comprehensive Economic Development Strategy.	1.1	High	Infrastructure projects completed by 2025	~$5 million	NN KalC										
Sustainable Economic Development Strategies																
Z1.Econ.1	Encourage continued business growth through zoning and downtown development planning/incentives, particularly in retail, health care, tourist/lodging, financial service center, and ecosystem protection industries in Kalkaska and South Boardman.	2.1; 2.2	Medium	Incentive program/mechanism established by 2065	S = $3,500-$7,000 per year Total = $10,500–$21,000	LGOV										
Z1.Econ.2	Maintain a strong emphasis on compact mixed use development employing Complete Street and walkability strategies in Kalkaska and South Boardman.	1.1; 2.1; 3.2; 3.3	Medium	New development projects all incorporate complete streets strategies	N/C	LGOV										
Z1.Econ.3	Form and/or support business associations to promote small, downtown commercial districts in the smaller watershed gateway communities in Kalkaska and South Boardman.	2.1; 2.2	Low	Business associations established by 2076	S = $3,500	TCACC										
Z1.Econ.4	Pare back amount of commercial zoned property along US-131 corridor in order to concentrate retail zoned property in compact nodes.	1.1; 2.1	Low	Majority of new projects are located in existing commercial/retail nodes	N/C	LGOV										
Z1.Econ.4	Continue low-density development and limit commercial development in rural, less developed areas around Forks East.	1.1; 2.1; 3.4	Medium	Updates to zoning ordinances and master plans maintain low density development requirements	N/C	LGOV										
Z1.Econ.6	Continue to expand regional access to high-level technical and scientific degrees that support development of creative class employees and new watershed-sensitive, technology-based business in Kalkaska.	2.2; 3.1	Medium	Post-secondary technical and scientific courses and degree offerings at local colleges increased by 20 percent by 2021	S/V = $11,200 for planning Program costs TBD	NWMW NMC										
Z1.Econ.7	Provide economic and community development incentives to entrepreneurial business efforts that help protect and/or allow people to experience the region's high-quality natural resources, particularly in Kalkaska and Forks East.	1.1; 1.2; 1.3; 2.2	Low	Priority entrepreneurial projects identified by 2019 Funding for economic incentives secured by 2020	$500,000–$1 million	TBEDC MEDC										
Z1.Econ.8	Support development of outdoor guide businesses to serve upper parts of watershed in either Kalkaska or Forks East areas.	2.2; 4.1	Low	Evaluate types of guide businesses that are most applicable to the Boardman River by 2017 Technical/ business assistance provided to 2 to 3 providers by 2019	S = $5,600	TBEDC MEDC										
Z1.Econ.9	Support development or expansion of bed and breakfast or boutique hotel in Kalkaska to serve as smaller alternative to Traverse City.	2.1; 2.2; 2.3	Low	Market analysis of B&B/hotel completed by 2018 Identification of economic development incentives by 2019	S = $5,600	TBEDC MEDC										
Z1.Econ.10	Encourage the establishment of a Food Innovation District and Agricultural Renaissance Zone in the Village of Kalkaska.	2.2; 2.4	Low	Ad hoc committee formed by 2019 Feasibility study completed by 2020	Feasibility study = $100,000 Implementation TBD	NN										

	Zone 1 Actions	Goals/ Objectives Addressed	Priority	Milestones	Estimated Costs	Potential Partners	Y1: 2017	Y2: 2018	Y3: 2019	Y4: 2020	Y5: 2021	Y6: 2022	Y7: 2023	Y8: 2024	Y9: 2025	Y10: 2026
Z1.Econ.11	Continue agricultural uses in South Boardman. Limit development to very low-density residential and encourage preservation and production on remaining farm lands.	2.4; 3.4	Medium	Boardman Township zoning ordinances include requirements for low density residential and rural uses	N/C	LGOV										
Z1.Econ.12	Establish a “Kalkaska Promise” to promote college education for Kalkaska High School graduates, and encourage retention and attraction of residents.	3.1	Low	Funding secured by 2018; program design complete by 2019	>$1 million	Rotary, GTRCF										
Z1.Econ.13	Expand Bay Area Transportation Authority (BATA) routes to include Kalkaska County communities. Broaden the system to comprehensively manage public transit throughout the region and address the needs of people to travel from outlying communities to Traverse City for work and/or tourism.	2.1; 3.2	Low	Expanded service between Kalkaska and Traverse City by 2018	TBD	BATA										
Z1.Econ.14	Expand affordable housing opportunities to accommodate the needs of the Traverse City worker market.	3.3	High	Affordable housing in Kalkaska area increased 20% by 2020	>$10 million	MSHDA, Northwest Michigan Community Action Agency										
Recreation-Related Strategies																
Z1.Rec.1	Improve and expand existing fishing access in Kalkaska by providing new or updated platforms and developed access points, including infrastructure for anglers with physical limitations (example: At Mill Pond Park in Kalkaska).	4.1	High	Funding secured by 2019 New access installed by 2020	$10,000–$30,000 per site; total = $20,000–$60,000	GTRLC GTCD MDNR KalC										
Z1.Rec.2	Establish and designate snowmobile, mountain biking, and ORV trail heads (with signage) at logical locations near Kalkaska, Forks East, and South Boardman.	4.2; 4.3	Medium	Locations for priority trailheads identified by 2017 Signage installed for 5–7 sites by 2019	<$3,000 per site; $21,000 total	User groups Equipment manufacturers MDNR GTCD										
Z1.Rec.3	Encourage the use of existing transportation & utility corridors to reduce habitat fragmentation and other related impacts.															
Z1.Rec.4	Improve existing Kalkaska Township Snowmobile Lodge to accommodate snowmobilers and summer mountain bikers. *See IE Task IE.Rec.3 Zone 1 Map (Figure 24)*	2.3; 4.2; 4.3	Low	Planning completed by 2019 Funding secured by 2020 Improvements completed by 2021	$50,000–$150,000	User groups TBEDC										
Z1.Rec.5	Complete TART Kalkaska Trail Extension. *See Zone 1 Map (Figure 24)*	2.3; 4.2; 4.3				TART										
Z1.Rec.6	Add Access Portal near west side of Kalkaska: TART Trail, North Country Trail, and Iceman Cycling Route Access; provide parking opportunity. *See Zone 1 Map (Figure 24)*	2.3; 4.2; 4.3				TART										

SOURCE: Public Sector Consultants Inc., 2013, based on input from the Leadership Team.

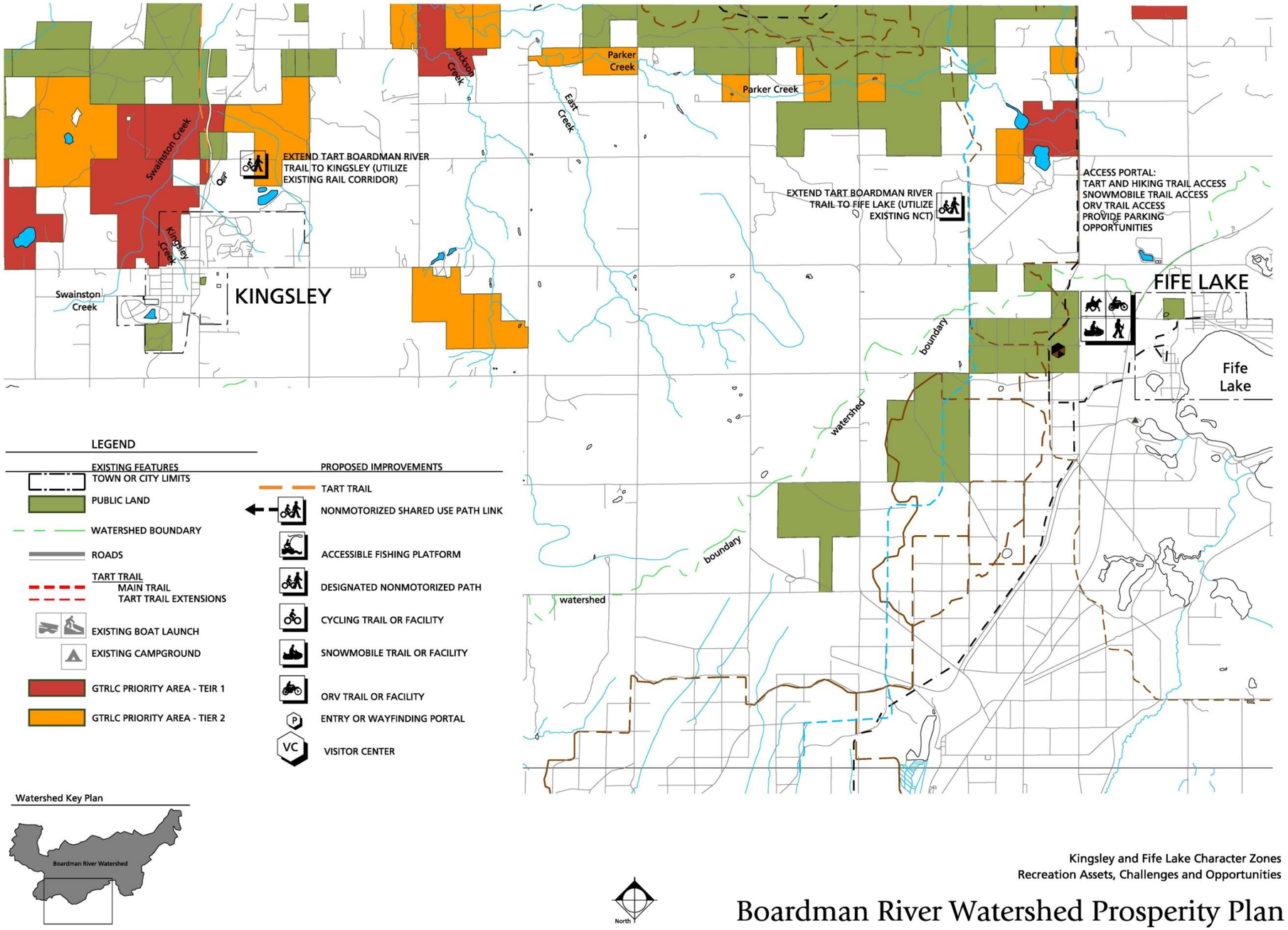


FIGURE 25. Map of Zone 2 – Southern Communities (Encompassing Kingsley and Fife Lake)

SOURCE: Beckett & Raeder Inc., 2012

TABLE 38. Zone 2 Actions and Related Goals/Objectives (Encompassing Critical Areas #9 and #10)

	Zone 2 Actions	Goals/ Objectives Addressed	Priority	Milestones	Estimated Costs	Potential Partners	Y1: 2017	Y2: 2018	Y3: 2019	Y4: 2020	Y5: 2021	Y6: 2022	Y7: 2023	Y8: 2024	Y9: 2025	Y10: 2026
Planning, Zoning, and Land Use Strategies																
Z2.PZL.1	Encourage adoption of a master plan in the Village of Kingsley.	1.1, 1.2, 1.3, 1.4, 1.5	Low Low	By 2021 Ongoing	S=$1,500 S=$1,500	LGOV TWC TWC LGOV										
Z2.PZL.2	Encourage the Villages of Kingsley and Fife Lake to prioritize the inclusion of green infrastructure in capital improvement projects, particularly street and parking lot projects.	1.1	Low	Ongoing	S=$1,500	TWC LGOV										
Z2.PZL.3	Upgrade or update applicable ordinances for the Villages of Kingsley and Fife Lake to accommodate and encourage more innovative forms of stormwater management, including LID, particularly in urban areas and near water courses and wetlands.	1.1, 1.3, 1.4	Medium		S=$5,000	MDNR KCD GTCD										
Z2.PZL.4	To reduce fragmentation of critical wildlife habitats and recreational corridors, work with planning officials to encourage the use of existing transportation corridors, especially if planning efforts for the US101 freeway extension become active again. *(Task also in Zone 1)*	1.5	High	Action as needed	S=$10,000	LGOV TWC										
Habitat, Fish, and Wildlife Strategies																
Z2.HFW.1	To reduce fragmentation of critical wildlife habitats and recreational corridors, work with planning officials to encourage the use of existing transportation corridors, especially if planning efforts for the US131 freeway extension become active again. *(See Planning, Zoning, and Land Use Task above)*	--	--	--	--											
Agriculture Strategies																
Z2.Ag.1	Develop Conservation Plans, Resource Management Plans, or Progressive Plans for all farms in the watershed that do not currently have one. As appropriate, information should be included on: crop nutrient management, weed and pest management, grassed waterways, sod centers in orchard rows, conservation buffers, proper manure management, conservation tillage, fencing off stream access to livestock, installing watercourse crossings, planting cover crops, and crop rotation. In addition, Conservation Plans that are more than 3 years old should be reviewed and updated to keep them eligible for USDA cost-share programs	1.1, 1.2, 1.5	High	Complete 5 plans/yr	$100,000/yr	NRCS GTCD KCD MSU-E										
Z2.Ag.2	Work with agricultural producers that have an approved Conservation Plan to implement USDA-NRCS cost-share programs that provide cost incentives and/or rental payments to farmers who implement eligible conservation practices on their land. Examples of these types of programs include: Environmental Quality Incentives Program (EQIP), Conservation Security Program (CSP), and the Conservation Reserve Program (CRP). More information on these and other cost-share programs are on the USDA-NRCS website at http://www.nrcs.usda.gov/.	1.1, 1.2, 1.5	High	Implement 5 plans/yr	$100,000/yr	NRCS GTCD KCD MSU-E										
Z2.Ag.3	Where appropriate, work with farmers to plant cover crops in fall on agricultural lands vulnerable to runoff (i.e., corn, potatoes, etc.).	1.1	High		$5,500 (salary costs only)	NRCS GTCD KCD MSU-E										
Z2.Ag.4	Minimize water contamination from farm vehicle fuel by installing and maintaining spill containment centers for above ground fueling stations where necessary and possible.	1.1	High		$5,500/station	NRCS GTCD KCD MSU-E										

	Zone 2 Actions	Goals/ Objectives Addressed	Priority	Milestones	Estimated Costs	Potential Partners	Y1: 2017	Y2: 2018	Y3: 2019	Y4: 2020	Y5: 2021	Y6: 2022	Y7: 2023	Y8: 2024	Y9: 2025	Y10: 2026
Sustainable Economic Development Strategies																
Z2.Econ.1	Encourage continued business growth through zoning and downtown development planning/incentives, particularly in retail, health care, tourist/ lodging, financial service center, and ecosystem protection industries in both Kingsley and Fife Lake.	2.1; 2.2	Medium	Updated zoning and master plans that encourage and support concentrated development in downtown areas	S=$3,500-$7,000 per year total = $10,500–$21,000	LGOV										
Z2.Econ.2	Maintain a strong emphasis on compact, mixed-use development employing Complete Street and walkability strategies.	2.1	Medium	Updated zoning and master plans encourage and support concentrated development in downtown areas	S=$3,500-$7,000 per year total = $35,000–$70,000	LGOV										
Z2.Econ.3	Form and/or support business associations to promote small, downtown commercial districts in the smaller watershed gateway communities of Kingsley and Fife Lake.	2.1	Medium	New development projects all incorporate complete streets strategies	S=$2,450 per year total = $4,900	LGOV										
Z2.Econ.4	Provide economic and community development incentives to entrepreneurial business efforts in Kingsley that help protect and/or allow people to experience the region's high-quality natural resources.	2.1; 2.2	High	Priority entrepreneurial projects identified by 2019 Funding for economic incentives secured by 2020	$200,000–$500,000	TBEDC MEDC										
Z2.Econ.5	Support development or expansion of bed and breakfast or boutique hotel lodging to serve as smaller, quaint alternative to Traverse City.	2.1; 2.3	Low	Market analysis of B&B/hotel completed and identification of economic development incentives by 2020 New hotel under development by 2023	S=$1,400 per year total = $5,600	TBEDC MEDC										
Z2.Econ.6	Expand the fly fishing history center/exhibit at the Kingsley branch of the Traverse Area District Library to celebrate fly fishing history (where L. Halladay created the Adams Fly) and attract visitors.	2.3; 4.1	Medium	Expanded or new exhibit space in place by 2019 New exhibit completed by 2020	$400,000–$700,000	Traverse Area District Library TBEDC MDNR										
Z2.Econ.7	Promote intergovernmental agreement between Traverse City and Kingsley to coordinate events, marketing, and commercial development.	2.2; 2.3	Low	Agreement developed and adopted by Traverse City and Kingsley	S=$2,800	LGOV TCACC										
Z2.Econ.8	Expand affordable housing opportunities to accommodate the needs of the Traverse City worker market.	3.3	High	Affordable housing plans completed by 2017 At least one affordable housing project completed by 2020	>$10 million	LGOV Michigan State Housing Development Authority (MSHDA)										
Recreation-Related Strategies																
Z2.Rec.1	Establish and designate snowmobile and ORV trail access points/trail heads with signage at logical locations in and around Fife Lake. *Zone 2 Map (Figure 25)*	4.2	Medium	Locations identified by 2019 Signage or trailhead infrastructure for at least 3 sites installed by 2020	<$3,000 per site total = $9,000	LGOV user groups MDNR										

	Zone 2 Actions	Goals/ Objectives Addressed	Priority	Milestones	Estimated Costs	Potential Partners	Y1: 2017	Y2: 2018	Y3: 2019	Y4: 2020	Y5: 2021	Y6: 2022	Y7: 2023	Y8: 2024	Y9: 2025	Y10: 2026
Z2.Rec.2	Create managed access points on public property in the Kingsley area using public/private joint ventures.	4.2	Medium	Priority access sites identified by 2017 Funding secured by 2018 At least two access points established by 2020	$1,000–$5,000 per sit total = $10,000	MDNR GTRLC user groups Village of Kingsley										
Z2.Rec.3	Relocate snowmobile trails that use the shoulder of major roads as a trail system to new or existing trails in order to reduce damage to and erosion of roads.	4.2	Low	Priority relocation segments identify by 2019 Funding for new or expanded trails secured by 2021	TBD	MDNR user groups LGOV										
Z2.Rec.4	Extend TART Boardman River Trail to Kingsley (utilize existing rail corridor). *See Zone 2 Map (Figure 25)*	2.3; 4.2; 4.3				TART										
Z2.Rec.5	Extend TART Boardman River Trail to Fife Lake. *See Zone 2 Map (Figure 25)*	2.3; 4.2; 4.3				TART										
Z2.Rec.6	Access portal: TART and hiking trail access, snowmobile trail access, ORV trail access (provide parking). *See Zone 2 Map (Figure 25)*	2.3; 4.2; 4.3				TART										

SOURCE: Public Sector Consultants Inc., 2013, based on input from the Leadership Team.

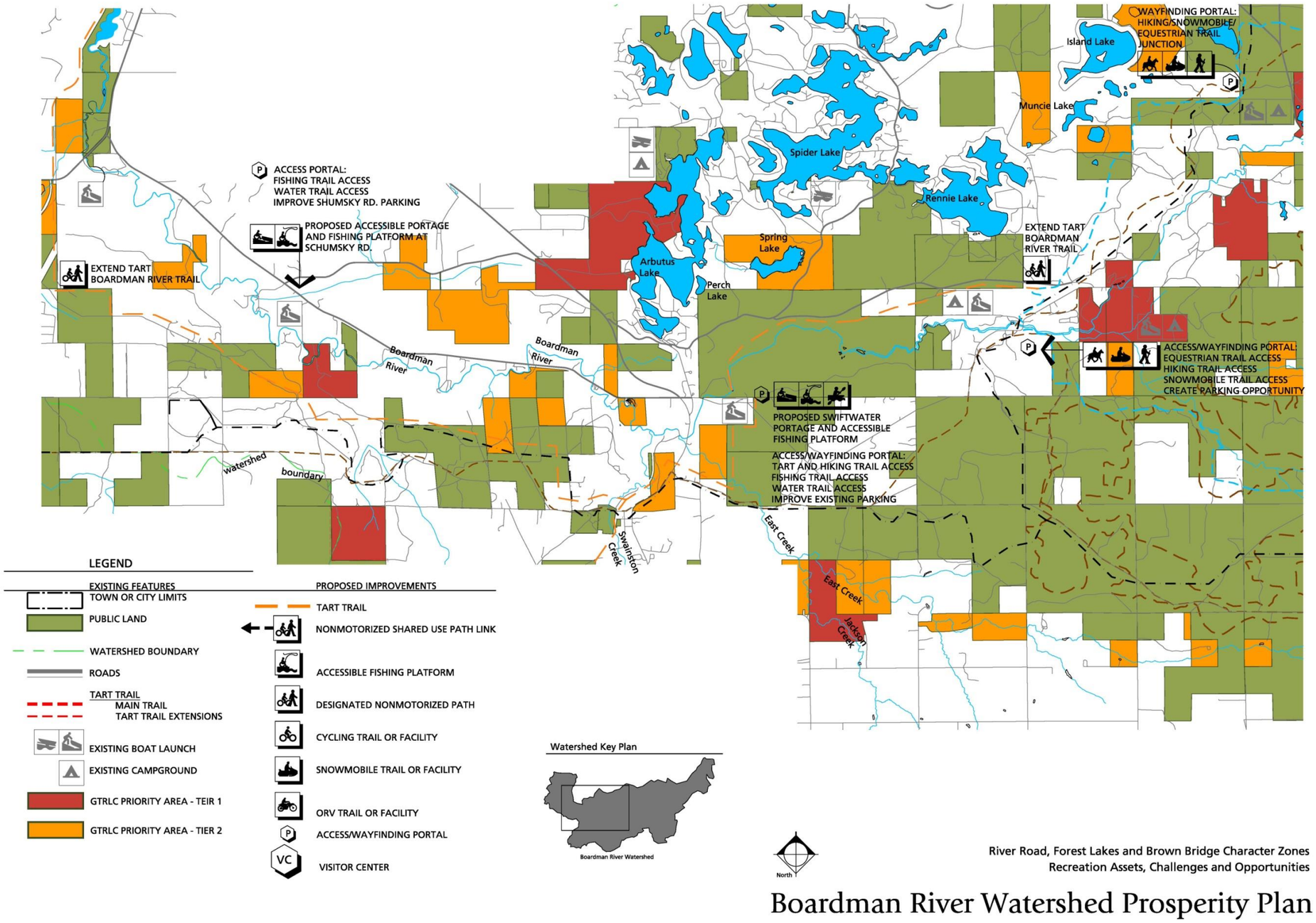


FIGURE 26. Map of Zone 3 – Mid-Watershed (Encompassing Brown Bridge Quiet Area, Forest Lakes, and River Road)

SOURCE: Beckett & Raeder Inc., 2012

TABLE 39: Zone 3 Actions and Related Goals/Objectives (Encompassing Critical Areas #1, #3, and #10)

	Zone 3 Actions	Goals/ Objectives Addressed	Priority	Milestones	Estimated Costs	Potential Partners	Y1: 2017	Y2: 2018	Y3: 2019	Y4: 2020	Y5: 2021	Y6: 2022	Y7: 2023	Y8: 2024	Y9: 2025	Y10: 2026
Shoreline Stabilization and Protection Strategies																
Z3.SS.1	Conduct shoreline surveys on inland lakes every 5 years and compile a list of priority areas for shoreline erosion, lack of riparian buffer, and lack of nearshore habitat. Follow-up with property owners.	1.1	Medium	5 lakes Year 2019 10 lakes Year 2021 15 lakes Year 2024	$5,000/lake	TWC GTCD LA										
Z3.SS.2	Restore priority shoreline erosion sites (moderate and severe, noted from surveys above) on inland lakes using bioengineering techniques.	1.1	Medium	300 LF/year	$22,500/yr ($75/LF) starting 2019 $157,500 total	TWC GTCD LA										
Z3.SS.3	Establish shoreline riparian buffer demonstration sites on public property to show riparian landowners how to create buffers that are both aesthetic and effective.	1.1	Medium	3 sites by Year 2022	~$10,000/site $30,000 total	TWC GTCD LA										
Z3.SS.4	Establish riparian buffers at priority sites noted from inland lake surveys.	1.1	Medium	100 LF/year	$7,500/yr ($75/LF) $75,000 total	TWC GTCD LA										
Z3.SS.5	Finish Phase-II (if not completed) and Phase-III of the effort to reconnect the river to its floodplain upstream of the former Brown Bridge impoundment.	1.1; 1.3	High	Finish all phases of the project by 2021	$150,000	GTCD TWC GTB NRCS										
Z3.SS.6	Finish riparian zone planting effort along the “new” river channel where the former Brown Bridge pond once occupied.	1.1, 1.2, 1.4, 1.5	High	Finish planting riparian zone using native trees and shrubs by 2021	$100,000	GTCD TWC GTB NRCS										
Stormwater Strategies																
Z3.St.1	Inventory conditions of road ends at inland lakes and work with Road Commission to implement better stormwater BMPs.	1.1, 1.3	High	Inventory by 2023 2 sites/yr after	$10,000 inventory $7,500 installation	GTCD LA TWC										
Transportation/Stream Crossings Strategies																
Z3.TSX.1	Restore/Repair Site S452 from inventory: this is a crossing of a forest two track/snowmobile trail/Shore-to-shore (horse) crossing of Jaxon Creek. Restoration includes the gravel refreshing at the horse crossing and stabilization of approaches. There currently exists about four inches of sand fill on top of the bridge; this should be removed.	1.1, 1.3	High	Funding by 2019 Complete by 2023	Depending on BMP selected, $25,000	GTCD TWC										
Planning, Zoning, and Lane Use Strategies																
Z3.PZL.1	Upgrade or update applicable ordinances for Blair and East Bay townships to accommodate and encourage more innovative forms of stormwater management, including LID.	1.1, 1.3, 1.4	Medium	Ordinances adopted by 2021	S=$3,000/yr $30,000 total	TWC LGOV										
Z3.PZL.2	Encourage Blair and East Bay Townships to prioritize the inclusion of green infrastructure in capital improvement projects, particularly street and parking lot projects.	1.1	Low	Ongoing	S=$1,500	TWC LGOV										
Z3.PZL.3	Work with East Bay Township to develop ordinances that protect water quality and natural resources in their inland lakes region. Examples of topics include: sufficient building setbacks from bodies of water, minimizing development clearings by landowners, minimizing vegetation removal and mowing to the water’s edge, stormwater management, reducing impervious surfaces near water bodies, establishing riparian buffers along waterways, eliminating the dumping of grass clippings and other yard/solid wastes into the water, prohibiting the feeding of waterfowl near water bodies, and protecting wetlands.	1.1, 1.3, 1.4	High	Ordinances adopted by 2021	S=$3,000/yr $30,000 total	TWC LGOV										

	Zone 3 Actions	Goals/ Objectives Addressed	Priority	Milestones	Estimated Costs	Potential Partners	Y1: 2017	Y2: 2018	Y3: 2019	Y4: 2020	Y5: 2021	Y6: 2022	Y7: 2023	Y8: 2024	Y9: 2025	Y10: 2026
Land Protection and Management Strategies																
Z3.LPM.1	Designate former Brown Bridge Dam bottomlands/area as a park or conservation land	1.1; 1.4; 4.2	High	Complete by 2017	S = $5,000	BDIT LGOV GTRLC										
Habitat, Fish, and Wildlife Strategies																
Z3.HFW.1	Introduce woody debris in areas formerly impounded by Brown Bridge dams to create in-stream aquatic habitat for fish.	1.2	Medium	Complete by 2021	$400,000–$500,000	BDIT										
Z3.HFW.2	Develop and implement a planting plan for Brown Bridge bottomlands	1.1; 1,2; 1.4	High	Plan by 2017 Planting by 2021	S= $2,800; implementation TBD	BDIT										
Z3.HFW.3	Develop and implement a plan to restore the habitat wood that was lost as a result of the 2012 breech of the dewatering structure downstream of former site of Brown Bridge dam site to Beitner Road.	1.1; 1.2; 1.4; 1.5; 3.4	High	Plan by 2017 Planting by 2021	S= $2,800 $30,000 implement	BDIT GTCD										
Z3.HFW.4	Develop and implement project plan for protecting wildlife and aquatic habitat in critical areas downstream of the Forks and along ridge line north of the river in the Brown Bridge Quiet Area	1.1; 1.2; 1.4; 1.5; 3.4	High	Plan completed 2019 Implementation - ongoing	S = $2,800	GTCD										
Water Quality Monitoring Strategies																
Z3.WQ.1	Monitor effectiveness of bank stabilization from Brown Bridge Dam removal project.	1.1	Medium		$40,000	BDIT										
Wetland Strategies																
Z3.W.1	Restore wetlands in and around former Brown Bridge Dam impoundment area.	1.2	High		>$500,000	BDIT										
Invasive Species Strategies																
Z3.IS.1	Maintain efforts to target removal of exotic invasive plant species in recently exposed areas of bottomlands associated with former Brown Bridge impoundment.	1.4	Medium		Monitoring = $50,000 Removal costs TBD	BDIT ISN										
Z3.IS.2	Continue Phragmites identification and removal efforts on inland lakes in East Bay Township.	1.4	High		S=$1,000 Removal costs TBD	ISN TWC										
Wastewater and Septics Strategies																
Z3.WW.1	Work with local governments and health departments to establish regular, mandatory septic system inspections through ordinances (e.g. time of sale) or by other means in all communities (similar to Kalkaska County program).	1.1	Medium		S=$10,000	TWC HDept LGOV										
Sustainable Economic Development Strategies																
Z3.Econ.1	Provide economic and community development incentives to entrepreneurial business efforts in the Brown Bridge area that help protect and/or allow people to experience the region's high-quality natural resources.	2.2; 4.1; 4.2	High	Priority entrepreneurial projects identified by 2019 Funding for economic incentives secured by 2019	$200,000–$500,000	TBEDC MEDC										
Z3.Econ.2	Evaluate the market and economic feasibility of establishing a small recreation resort in Forest Lakes to accommodate users of the many converging trail networks.	2.3; 4.2; 4.3	Low	Market analysis completed by 2019	Market analysis = $40,000; implementation TBD	TBEDC MEDC										

	Zone 3 Actions	Goals/ Objectives Addressed	Priority	Milestones	Estimated Costs	Potential Partners	Y1: 2017	Y2: 2018	Y3: 2019	Y4: 2020	Y5: 2021	Y6: 2022	Y7: 2023	Y8: 2024	Y9: 2025	Y10: 2026
Z3.Econ.3	Support development or expansion of bed and breakfast or boutique hotel lodging to serve as smaller, quaint alternative to Traverse City, perhaps in the Brown Bridge or Forest Lakes area.	2.2; 2.3;	Low	Market analysis of B&B/hotel completed and identification of economic development incentives by 2021 New hotel under development by 2022	S = $1,400	TBEDC MEDC										
Z3.Econ.4	Expand affordable housing opportunities in the River Road area to accommodate the needs of the Traverse City worker market.	3.3	Low	Affordable housing plans completed by 2017; at least one affordable housing project completed by 2020	>$10 million	Local governments MSHDA										
Recreated-Related Strategies																
Z3.Rec.1	Improve contiguity of canoe and kayak recreation by improving and designating boat access at logical locations in the Brown Bridge area.	4.1	High	Identify priority access points by 2017 Funding secured by 2018 At least 2 new access installed by 2019	$1,000–$5,000 per access site Total = $10,000	GTCD MDNR user groups GTC										
Z3.Rec.2	Create managed access points on public property in the Brown Bridge area using public/private joint ventures.	4.1; 4.2; 4.3	High	Priority access sites identified by 2017 Funding secured by 2018 At least 3 access points established by 2018	$1,000–$5,000 per access site Total = $15,000	GTCD MDNR GTLC GTC										
Z3.Rec.3	Improve and expand existing fishing access by providing new or updated piers, platforms, and developed access points, including infrastructure to create opportunities for anglers with physical limitations, in the River Road and Brown Bridge areas. Provide swiftwater portage opportunities. *See Zone 3 Map (Figure 26)*	4.1; 5.3	Medium	Priority access points identified by 2018 Project planning complete and funding secured by 2018	$25,000–$50,000	GTCD MDNR GTC										
Z3.Rec.4	Establish and designate snowmobile, ORV, equestrian trail access points/trail heads with signage at logical locations in the Brown Bridge, Forest Lakes, and River Road areas. Create parking opportunities if available. *See Zone 3 Map (Figure 26)*	4.2	Medium	Locations identified by 2020 Signage or trailhead infrastructure for at least 5 areas installed by 2021	$1,000–$5,000 per access site Total = $25,000	LGOV user groups MDNR										
Z3.Rec.5	Improve existing recreational facilities near the Brown Bridge dam site to serve as an entry portal to the watershed, due to the confluence of existing and proposed non-motorized recreational trails.	4.1; 4.2; 4.3	High	Evaluation of facility needs and identification of priority areas for information portals by 2018 Improvements implemented by 2019	$5,000–$25,000	GTCD MDNR GTC										

SOURCE: Public Sector Consultants Inc., 2013, based on input from the Leadership Team.

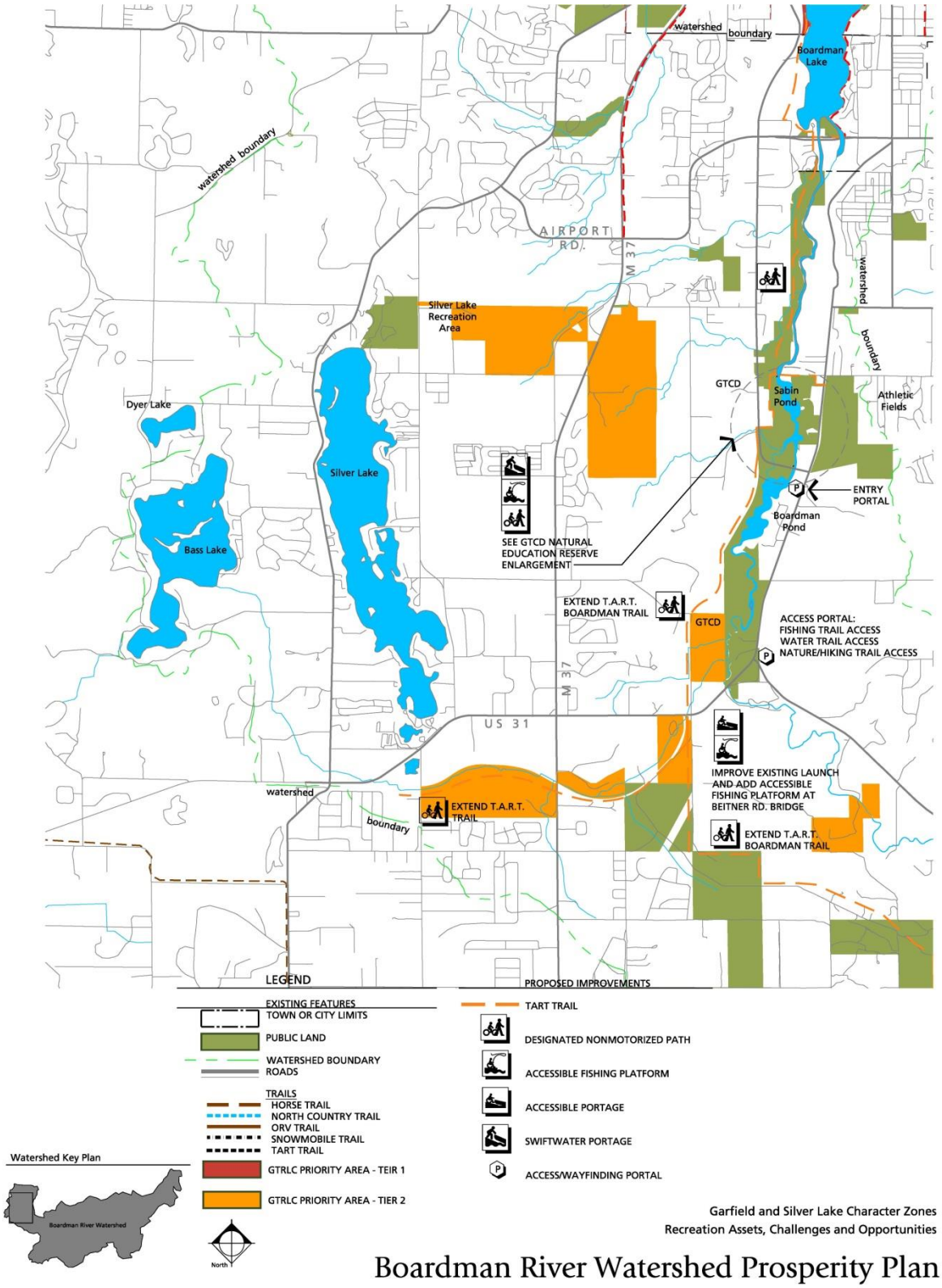


FIGURE 27. Map of Zone 4 – Lower River (Encompassing Silver Lake and Garfield Township)

SOURCE: Beckett & Raeder, 2012.

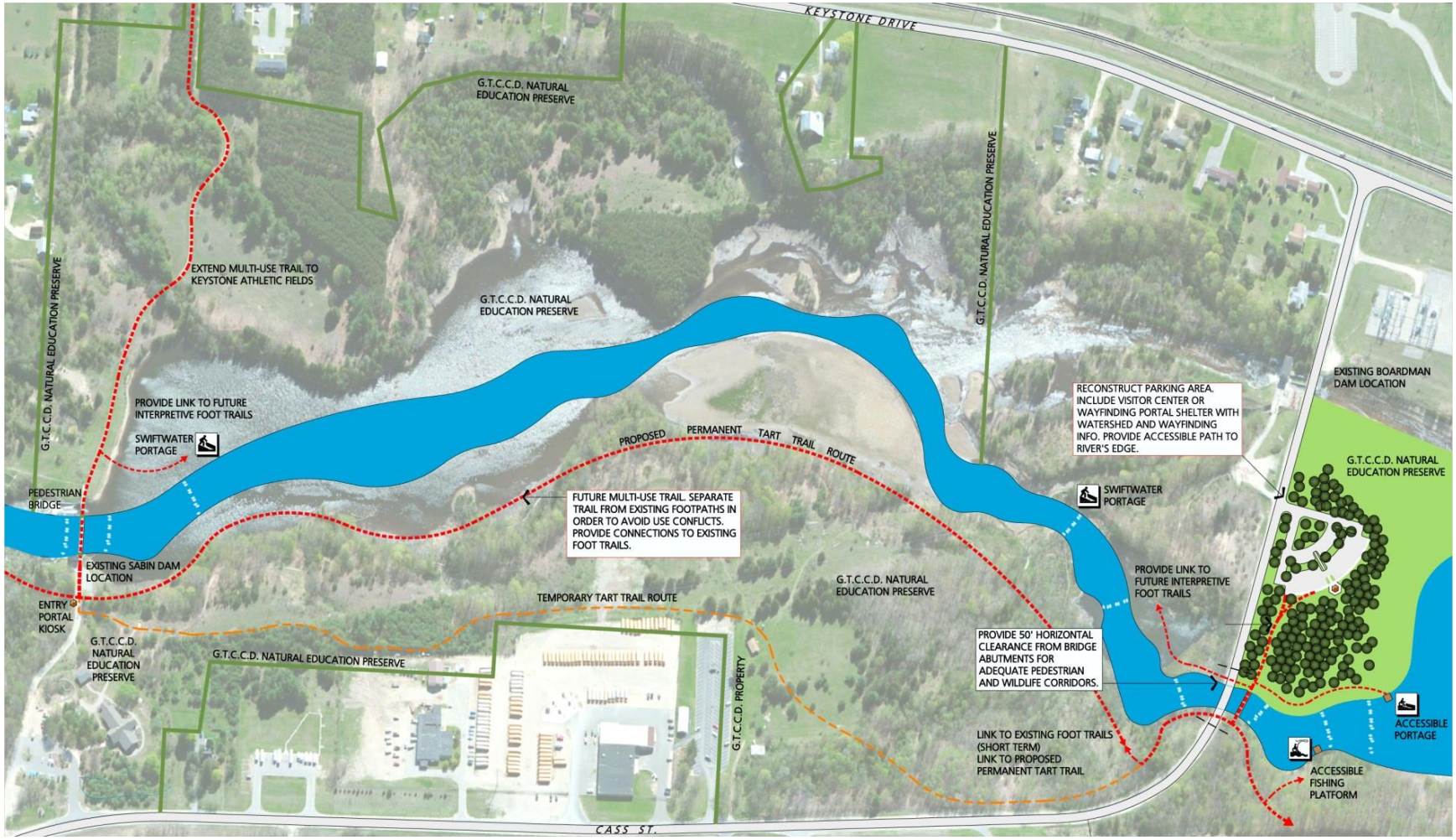


FIGURE 28. Map of Zone 4 - Sabin Dam Enlargement

SOURCE: Beckett & Raeder, 2012.

TABLE 40. Zone 4 Actions and Related Goals/Objectives (Encompassing Critical Area #1, #7, #9 and #10)

	Zone 4 Actions	Goals/ Objectives Addressed	Priority	Milestones	Estimated Costs	Potential Partners	Y1: 2017	Y2: 2018	Y3: 2019	Y4: 2020	Y5: 2021	Y6: 2022	Y7: 2023	Y8: 2024	Y9: 2025	Y10: 2026
Shoreline Stabilization and Protection Strategies																
Z4.SS.1	Restore streambanks as necessary as part of the Boardman Dams Removal Project and reconnect the Boardman River with its floodplain in the project area after the removal of Boardman & Sabin Dams.	1.1, 1.2, 1.3	High		~2000 LF @ $75/LF $150,000	BDIT										
Z4.SS.2	Stabilize severe and moderate streambanks along Kids Creek noted in the Kids Creek Action Plan. *See Zone 5 Tasks*	1.1, 1.2	High	30 sites by 2019	$50,000	TWC GTCD										
Z4.SS.3	Conduct shoreline surveys on inland lakes every 5 years and compile a list of priority areas for shoreline erosion, lack of riparian buffer, and lack of nearshore habitat. Follow-up with property owners.	1.1	Medium	5 lakes Year 2019 10 lakes Year 2021 15 lakes Year 2024	$5,000/lake	TWC GTCD LA										
Z4.SS.4	Restore priority shoreline erosion sites (moderate and severe, noted from surveys above) on inland lakes using bioengineering techniques.	1.1	Medium	300 LF/year	$22,500/yr ($75/LF) $225,000 total	TWC GTCD LA										
Z4.SS.5	Establish shoreline vegetated riparian buffer demonstration sites on public property to show riparian landowners how to create buffers that are both aesthetic and effective.	1.1	Medium	3 sites by Year 2023		TWC GTCD LA										
Z4.SS.6	Establish vegetated riparian buffers at priority sites noted from inland lake surveys.	1.1	Medium	100 LF/year	$7,500/yr ($75/LF) $75,000 total	TWC GTCD LA										
Stormwater Strategies																
Z4.St.1	Implement stormwater BMPs in the urban areas of Garfield Township (US31, S. Airport Rd, Silver Lake Rd) to reduce runoff impacts to Boardman River and Lake.	1.1	Medium	1st project by 2022 2nd project by 2026	$300,000/project $600,000 total	TWC TC Garf.Twp DEQ EPA										
Transportation/Stream Crossings Strategies																
Z4.TSX.1	Replace two crossings on Miller Creek including the railroad crossing (Site S339) and the Cass Road crossing (Site S913) as part of the Cass Road Drain project.	1.1	High	Complete by 2018	$450,000	GTCD TWC CRA GTB										
Z4.TSX.2	Replace two severely ranked road crossings of Robbin's Creek (Site S069) and Jack's Creek (S929) at Cass Road. Both are undersized crossings and restoration plans include replacing the current crossing with a wider, open bottom structure. (Timing will be AFTER dam removals)	1.1	High	Complete by 2023	$450,000	GTCD TWC CRA GTB										
Planning, Zoning, and Lane Use Strategies																
Z4.PZL.1	Evaluate whether storm water management in Garfield Twp may be aided by alternative funding systems (i.e., fee-based system) to improve water quality in priority areas and incentivize LID projects.	1.1	Medium		S = $5,600	TWC TC										
Z4.PZL.2	Encourage Garfield Township to prioritize the inclusion of green infrastructure in capital improvement projects, particularly street and parking lot projects.	1.1	High	Ongoing	S=$1,500	TWC LGOV										
Z4.PZL.3	Upgrade or update applicable ordinances for Blair, Garfield, and Long Lake townships to accommodate and encourage more innovative forms of stormwater management, including LID.	1.1, 1.3, 1.4	Medium	Ordinances adopted by 2021	S=$3,000/yr $30,000 total	TWC LGOV										

	Zone 4 Actions	Goals/ Objectives Addressed	Priority	Milestones	Estimated Costs	Potential Partners	Y1: 2017	Y2: 2018	Y3: 2019	Y4: 2020	Y5: 2021	Y6: 2022	Y7: 2023	Y8: 2024	Y9: 2025	Y10: 2026
Z4.PZL.4	Work with Blair, Garfield, and Long Lake townships to develop ordinances that protect water quality and natural resources along the inland lakes. Examples of topics include: sufficient building setbacks from bodies of water, minimizing development clearings by landowners, minimizing vegetation removal and mowing to the water's edge, stormwater management, reducing impervious surfaces near water bodies, establishing riparian buffers along waterways, eliminating the dumping of grass clippings and other yard/solid wastes into the water, prohibiting the feeding of waterfowl near water bodies, and protecting wetlands.	1.1, 1.3, 1.4	High	Ordinances adopted by 2021	S=$3,000/yr $30,000 total	TWC LA LGOV										
Land Protection and Management Strategies																
Z4.LPM.1	After dam removal, designate Boardman Dam bottomlands area as a park or conservation land	1.1; 1.4; 4.2	High	By 2020	S = 5,600	GTCD LGOV										
Habitat, Fish, and Wildlife Strategies																
Z4.HFW.1	Restore important habitat and wetland areas during the removal of Sabin and Boardman dams as recommended by the Boardman River Dams Committee. *See Related Task Under Hydrology and Groundwater*	1.1, 1.2, 1.3, 1.4	High	Boardman by 2018 Sabin Dam by 2020	Costs under dam removal task below	BDIT										
Z4.HFW.2	Fund the ongoing maintenance of existing sand traps in the Boardman River d/s of previously impounded areas to protect spawning habitat.	1.2	Medium		TBD	GTCD BDIT										
Hydrology and Groundwater Strategies																
Z4.HG.1	Implement dam removals/modifications for Sabin and Boardman dams as recommended by the Boardman River Dams Committee *See Related Task Under Habitat, Fish, and Wildlife*	1.2; 2.2; 2.3	High	Boardman by 2018 Sabin Dam by 2020	>$13,000,000	BDIT GTC MDOT LGOV GTB										
Water Quality Monitoring Strategies																
Z4.WQ.1	Monitor short-term sediment loading and effectiveness of bank stabilization that accompany dam removal projects.	1.1	Medium	By 2021	$50,000–$80,000	GTCD GTB BDIT										
Z4.WQ.2	Monitor sediment accumulation post Sabin Dam removal especially around culverts at South Airport Road to ensure their capacity is not impacted.	1.1, 1.3	High		S=$1,500	BDIT GTCD GTB										
Z4.WQ.3	Investigate potential nutrient inputs from two buffalo farms located in the headwaters of Jacks and Miller Creeks.	1.1	Medium	Complete by 2020	$10,000	TWC GTCD										
Invasive Species Strategies																
Z4.IS.1	Continue Phragmites identification and removal efforts on Long Lake and Bass Lake.	1.4	High	Ongoing	S=$1,000 Removal costs not included	ISN TWC										
Z4.IS.2	Target removal of exotic invasive plant species in recently exposed areas of bottomlands associated with former Sabin and Boardman impoundments.	1.4	Medium		Monitoring $50,000 Removal costs TBD	ISN GTCD GTB										
Agriculture Strategies																
Z4.Ag.1	Develop Conservation Plans, Resource Management Plans, or Progressive Plans for all farms in the watershed that do not currently have one. As appropriate, information should be included on: crop nutrient management, weed and pest management, grassed waterways, sod centers in orchard rows, conservation buffers, proper manure management, conservation tillage, fencing off stream access to livestock, installing watercourse crossings, planting cover crops, and crop rotation. In addition, Conservation Plans that are more than 3 years old should be reviewed and updated to keep them eligible for USDA cost-share programs.	1.1, 1.2, 1.5	High	Complete 5 plans/yr	$100,000/yr	NRCS GTCD KCD MSU-E										

	Zone 4 Actions	Goals/ Objectives Addressed	Priority	Milestones	Estimated Costs	Potential Partners	Y1: 2017	Y2: 2018	Y3: 2019	Y4: 2020	Y5: 2021	Y6: 2022	Y7: 2023	Y8: 2024	Y9: 2025	Y10: 2026
Z4.Ag.2	Work with agricultural producers that have an approved Conservation Plan to implement USDA-NRCS cost-share programs that provide cost incentives and/or rental payments to farmers who implement eligible conservation practices on their land. Examples of these types of programs include: Environmental Quality Incentives Program (EQIP), Conservation Security Program (CSP), and the Conservation Reserve Program (CRP). More information on these and other cost-share programs are on the USDA-NRCS website at http://www.nrcs.usda.gov/.	1.1, 1.2, 1.5	High	Implement 5 plans/yr	$100,000/yr	NRCS GTCD KCD MSU-E										
Z4.Ag.3	Where appropriate, work with farmers to plant cover crops in fall on agricultural lands vulnerable to runoff (i.e., corn, potatoes, etc.).	1.1	High		$5,500 (salary costs only)	NRCS GTCD KCD MSU-E										
Z4.Ag.4	Minimize water contamination from farm vehicle fuel by installing and maintaining spill containment centers for above ground fueling stations where necessary and possible.	1.1	High		$5,500/station	NRCS GTCD KCD MSU-E										
Z4.Ag.5	Investigate potential nutrient inputs from two buffalo farms located in the headwaters of Jacks and Miller Creeks. *See Water Quality Monitoring Task*															
Sustainable Economic Development Strategies																
Z4.Eon.1	Encourage continued business growth in Garfield Township through zoning and downtown development planning, particularly in the retail, healthcare, tourist/ lodging, financial service center, and ecosystem protection industries.	2.2; 2.3	Medium	Incentive program/ mechanism established by 2019	S = $3,500-$7,000 per year Total = $14,000–$28,000	LGOV										
Z4.Eon.2	Address existing US-31 and M-37 corridor sprawl by encouraging the development of internal properties and connecting residential areas to the main commercial corridor.	2.1	High	Majority of new projects in the corridor fill internal properties and connect residential neighborhoods	N/C	LGOV										
Z4.Eon.3	Continue low-density development and limit commercial development in the rural, less developed areas around Silver Lake.	2.1; 2.4; 3.4	Medium	Updates to zoning ordinances and master plans maintain low density development requirements	N/C	LGOV										
Z4.Eon.4	Provide economic and community development incentives to entrepreneurial business efforts in Garfield Township area that help protect and/or allow people to experience the region's high-quality natural resources.	2.2; 4.1; 4.2	Low	Priority entrepreneurial projects identified by 2019 Funding for economic incentives secured by 2020	$200,000–$500,000	TBEDC MEDC										
Z4.Eon.5	Expand affordable housing opportunities to accommodate the needs of the Traverse City worker market.	3.3	Medium	Affordable housing plans completed by 2017 At least one affordable housing project completed by 2020	>$10 million	LGOV, MSHDA										
Recreated-Related Strategies																
Z4.Rec.1	Improve and expand existing fishing access by providing new or updated piers, platforms, and developed access points, including infrastructure to create opportunities for anglers with physical limitations. (Example: Beitner Road Bridge and GTCD Natural Education Preserve, See Zone 4 Map Figures 26 and 27)	2.3; 4.1	Medium	Priority access points identified by 2017 Project planning complete and funding secured for at least two projects by 2018	$10,000–$30,000 each Ttotal = $20,000–$60,000	GTCD MDNR GTC										

Z4.Rec.2	Establish canoe and kayak access points at logical portage locations in Garfield Township to facilitate navigation or avoidance of whitewater and swiftwater. (Example: at Beitner and River Roads or on GTCD Natural Education Preserve *See Zone 4 Maps (Figures 27 and 28)*	2.3; 4.1	High	Identify priority access points by 2017 Funding secured by 2018 At least two new access installed by 2019	$5,000–$25,000 each Total = $10,000 - $50,000	GTCD MDNR user groups GTC GarfTwp											
Z4.Rec.3	Extend multiuse trail to Keystone Athletic Field and Boardman River Nature Center. *See Zone 4 Map (Figure 25)*	3.2; 4.2	High	Trail completed by 2021	TBD	TART LGOV GTCD											
Z4.Rec.4	Create outreach materials that educate residents and visitors about the existing amenities and programs available at Garfield Township Parks and the Boardman River Nature Center.	4.3; 5.2	Medium	Materials developed and distributed to partners	S = $1,750 per year Materials <$10,000	GTCD Garf Twp											
Z4.Rec.5	Extend TART Boardman River Trail. *See Zone 4 Map (Figure 27)*	2.2; 4.1; 4.2	High			TART											
Z4.Rec.6	New TART trail route on new Boardman River route after dam removals. Multi-use trail separate from existing footpaths in order to avoid use conflicts. Provide connections to existing foot trails.	2.2; 4.1; 4.2	High			GTCD TART											

SOURCE: Public Sector Consultants Inc., 2013, based on input from the Leadership Team.

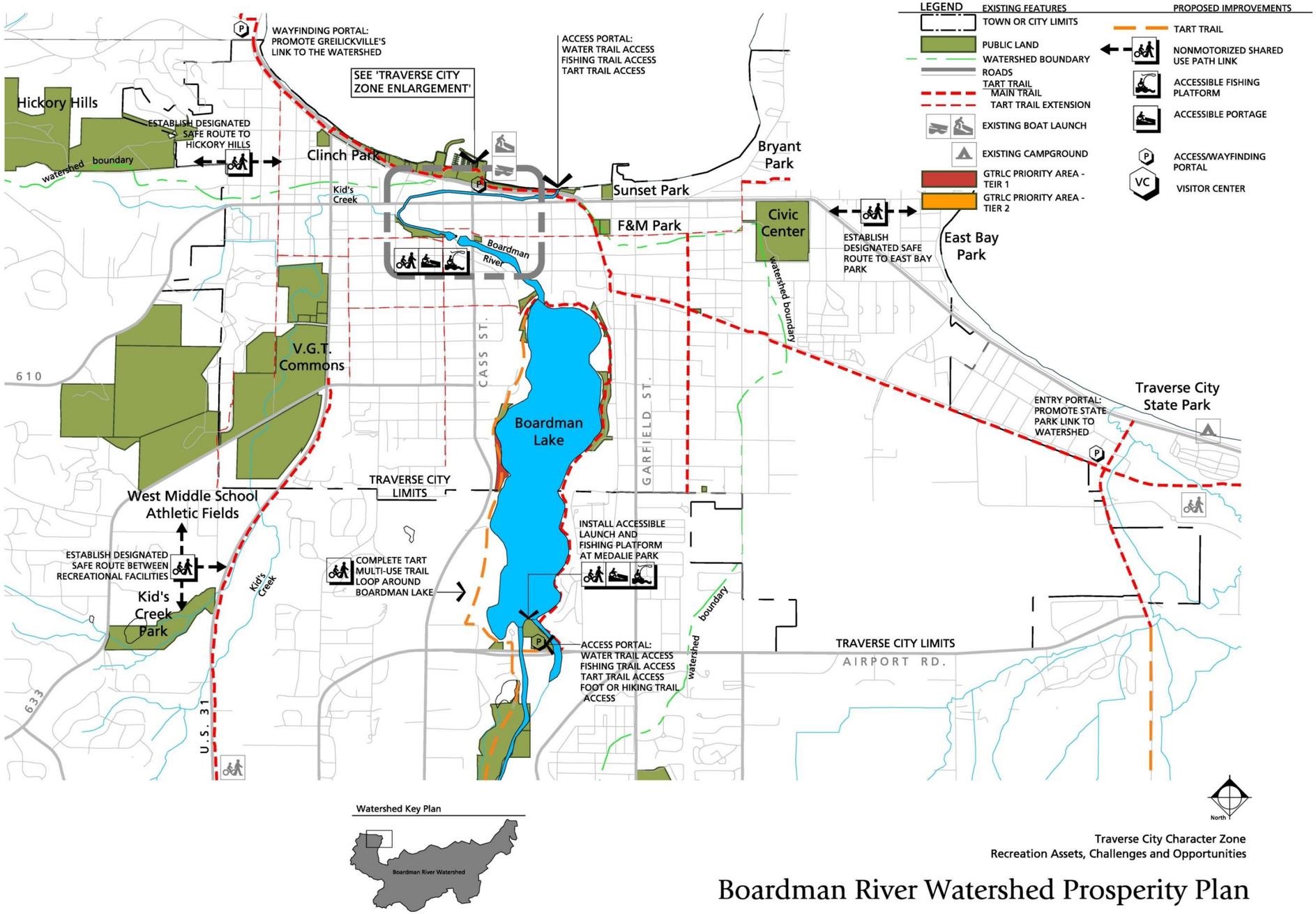


FIGURE 29. Map of Zone 5 – Boardman Lake to River Mouth (Encompassing Traverse City Area)

SOURCE: Beckett & Raeder Inc., 2012

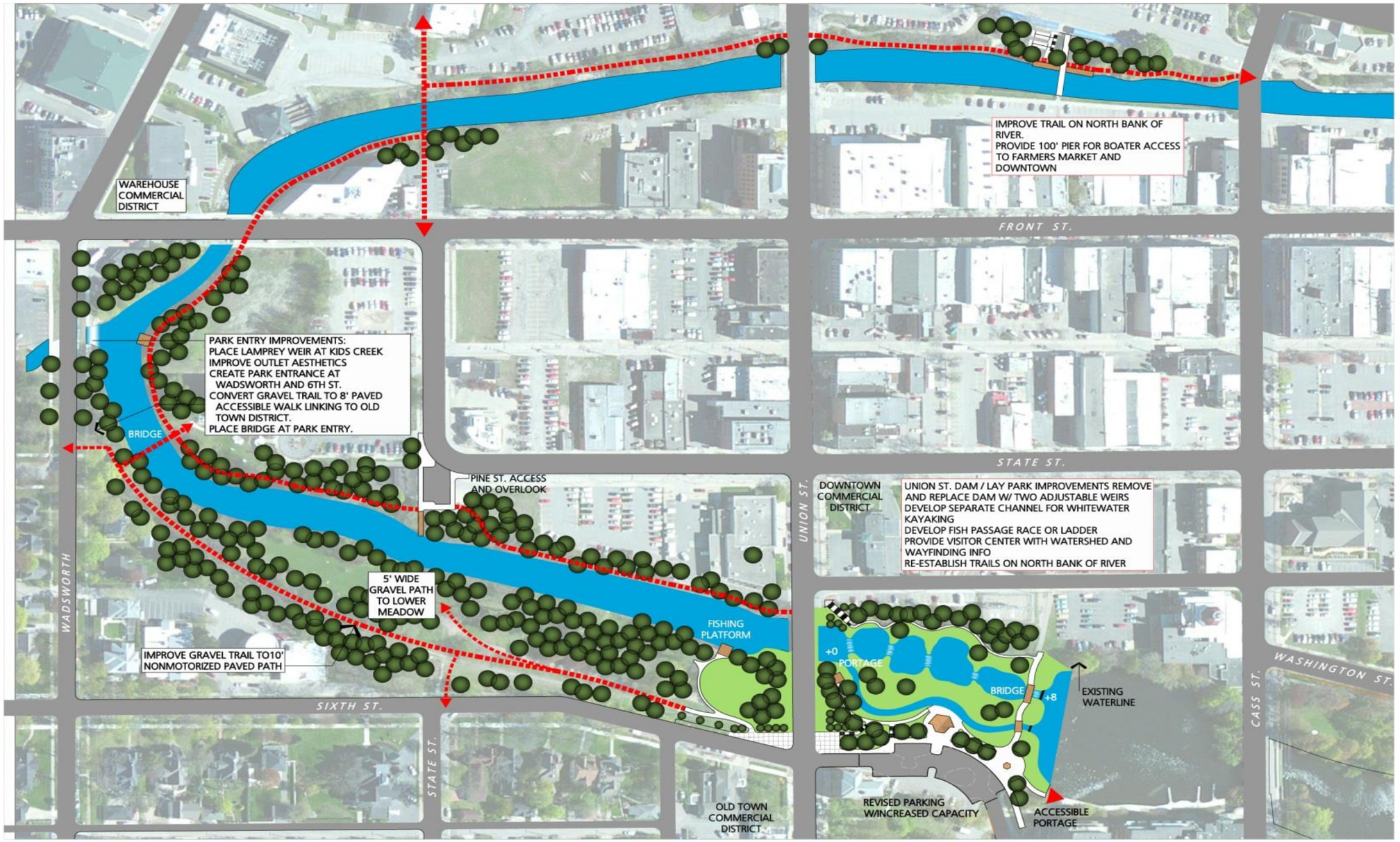


FIGURE 30. Map of Zone 5 –Traverse City Zone Enlargement

SOURCE: Beckett & Raeder Inc., 2012

TABLE 41. Zone 5 Actions and Related Goals/Objectives (Encompassing Critical Areas #4, #5, and #6)

	Zone 5 Actions	Goals/ Objectives Addressed	Priority	Milestones	Estimated Costs	Potential Partners	Y1: 2017	Y2: 2018	Y3: 2019	Y4: 2020	Y5: 2021	Y6: 2022	Y7: 2023	Y8: 2024	Y9: 2025	Y10: 2026
Shoreline Stabilization and Protection Strategies																
Z5.SS.1	Stabilize severe and moderate streambanks along Kids Creek noted in the Kids Creek Action Plan. *See Zone 4 Tasks*	1.1, 1.2	High	30 sites by 2018	Included in Zone 4 Task											
Z5.SS.2	Work with residents and municipalities in the Kids Creek subwatershed to install riparian buffers where possible.	1.1	Medium	--	$75/LF											
Z5.SS.3	Work with the DEQ to develop and implement plans to stabilize sections of Kids Creek stream channel where needed to restore natural function, eliminate erosion, and transport storm events effectively. This will most likely entail the creation of sections of two-stage ditches along the creek to match the pattern dimension and profile to that of other sections of the creek so it can reduce flow velocities on the banks and store more water during times of high flow. Site #1: Tributary A along 6th street and Elmwood Ave Site #2: Kids Creek main branch u/s of Silver Lake Road	1.1, 1.2	High	Site 1 - by 2019 Site 2 - by 2023	Site 1 - $250,000 Site 2 - $500,000											
Z5.SS.4	Monitor streambanks upstream of Union Street Dam to determine if they are slumping and how severe the problem may be. If necessary, work with the City of Traverse City and other stakeholders to determine a solution.	1.1, 1.2	Medium	Set up monitoring benchmarks by 2017	TBD (depends on BMP chosen)											
Z5.SS.5	Work with the City of Traverse City and the Downtown Development Authority to stabilize river access sites from Boardman Lake to the Mouth.	1.1, 1.2	Medium		TBD (depends on BMP chosen by City)											
Stormwater Strategies																
Z5.St.1	Complete monitoring and assessments in the Kids Creek subwatershed to determine potential priority locations for LID BMP installations to reduce stormwater inputs to creek.	1.1	High	Complete by 2020	$40,000	TWC MDEQ										
Z5.St.2	Implement stormwater BMPs in Kid's Creek including low impact design elements, riparian buffers and filter strips, and stormwater filtering and retention systems.	1.1; 1.2	High	One large-scale BMP/yr	~$200,000/project $2,000,000 total	TWC MDEQ EPA LGOV										
Z5.St.3	Implement stormwater BMPs in the urban areas of Traverse City and Garfield Township to reduce runoff impacts to Boardman River and Lake.	1.1	Medium	1st project by 2019 2nd project by 2022 3rd project by 2025	$200,000/project $600,000 total	TWC LGOV DEQ										
Transportation/Stream Crossings Strategies																
Z5.TSX.1	Install road crossing BMPs at priority locations in the Kids Creek subwatershed. *See general road crossing task for details*	1.1, 1.4	Medium	1st crossing by 2019 2nd crossing by 2022 3rd crossing by 2025	~$200,000/crossing (Depends on site & Selected BMP) ~ $600,000 total	TWC GTCD TC LGOV NRCS RC										
Z5.TSX.2	Replace the South Airport Road crossing if deemed necessary by monitoring accumulated sediments *See Monitoring task in Zone 4 related to Sabin Dam removal*	1.1, 1.4	Medium	Depends on monitoring results	~$4 million	GTCD RC										
Planning, Zoning, and Lane Use Strategies																
Z5.PZL.1	Continue discussions and work with the City of Traverse City to determine whether storm water may be addressed through alternative funding structures, such as a fee system or public utility, to improve water quality in priority areas and incentivize LID projects.	1.1	High		S = $5,600	TWC TC										

	Zone 5 Actions	Goals/ Objectives Addressed	Priority	Milestones	Estimated Costs	Potential Partners	Y1: 2017	Y2: 2018	Y3: 2019	Y4: 2020	Y5: 2021	Y6: 2022	Y7: 2023	Y8: 2024	Y9: 2025	Y10: 2026
Z5.PZL.2	Upgrade or update applicable ordinances for Traverse City and Garfield Township to accommodate and encourage more innovative forms of stormwater management, including LID.	1.1, 1.2, 1.4	High	Ongoing	S = $3,000/yr $30,000 total	TWC TC Garf.Twp										
Z5.PZL.3	Work with Traverse City on recommendations to update ordinances to improve preservation of urban vegetation resources to manage stormwater, particularly along shorelines, and ensure adequate water setbacks for all districts	1.1, 1.2, 1.4	High	Recommendations made by 2019	S = $30,000	TWC TC										
Habitat, Fish, and Wildlife Strategies																
Z5.HFW.1	Hire a professional consultant or firm to lead stakeholders through a neutral process that results in a recommendation to the MDNR and GTB regarding the passage of non-native Great Lakes fish in the Boardman River above Union Street Dam.	1.2, 1.4	High	By 2017	$25,000	BDIT										
Human Health Strategies																
Z5.HH.1	Conduct E.Coli monitoring on Kids Creek in Traverse City urban areas.	1.1	Low	Monitoring every 5 years	$2,000	TWC GTHDept TC										
Hydrology and Groundwater Strategies																
Z5.HG.1	Implement cleanup or remediation efforts in the Boardman Lake area to improve water quality following recommendations made in WQ Monitoring task below.	1.1	Low	Funding secured and project initiated by 2024	TBD	TWC TC GarfTwp MDEQ EPA										
Water Quality Monitoring Strategies																
Z5.WQ.1	Conduct monitoring to evaluate current status of areas in southern Boardman Lake and downstream of Boardman Lake outlet previously identified in the Boardman Lake WS Plan as contaminated.	1.1	Low	Monitoring by 2021 Remediation started by 2023	Monitoring: $25,000 Remediation: TBD	TWC TC MDEQ EPA										
Z5.WQ.2	Seek long-term funding for the installation and support of a USGS gauging station below Union Street Dam	1.1	High	Installed by 2017	$25,000	TC GTB USGS										
Invasive Species Strategies																
Z5.IS.1	Design and implement Union Street Dam modifications to limit passage of sea lamprey upstream.	1.4	Low	By 2025	>$2million	BDIT										
Sustainable Economic Development Strategies																
Z5.Econ.1	Continued business growth in Traverse City encouraged through zoning and downtown development planning, particularly in retail, health care, tourist/ lodging, financial service center, high-tech and ecosystem protection industries.	2.1	Low	Incentive program/mechanisms established by 2017 Ongoing implementation	S = $3,500-$7,000 per year Total = $35,000–$70,000	LGOV										
Z5.Econ.2	Maintain a strong emphasis on compact mixed use development employing Complete Street and walkability strategies.	2.1; 3.2	High	New development projects all incorporate complete streets strategies	N/C	LGOV										
Z5.Econ.3	Continue to expand regional access to high-level technical and scientific degrees that support development of creative class employees and new technology-based business.	3.1	Low	Postsecondary technical and scientific courses and degree offerings at local colleges increased by 20 percent by 2019	S = $11,200 for planning Program costs TBD	NWMW NMC										

	Zone 5 Actions	Goals/ Objectives Addressed	Priority	Milestones	Estimated Costs	Potential Partners	Y1: 2017	Y2: 2018	Y3: 2019	Y4: 2020	Y5: 2021	Y6: 2022	Y7: 2023	Y8: 2024	Y9: 2025	Y10: 2026
Z5.Econ.4	Provide economic and community development incentives to entrepreneurial business efforts that help protect and/or allow people to experience the region's high-quality natural resources.	2.2; 4.1; 4.2	Low	Priority entrepreneurial projects identified by 2018 Funding for economic incentives secured by 2019	TBD	TBEDC MEDC TCACC										
Z5.Econ.5	Promote intergovernmental agreement between Traverse City and Kingsley to coordinate events, marketing, and commercial development.	2.1; 2.3;3.2	Low	Agreement developed and adopted by Traverse City and Kingsley	S = $2,800	LGOV TCACC										
Z5.Econ.6	Expand affordable housing opportunities to accommodate the needs of the Traverse City worker market.	3.3	Low	Affordable housing plans completed by 2018 At least one affordable housing project completed by 2020	TBD	LGOV MSHDA										
Z5.Econ.7	Promote the Northwest Michigan Regional Agriculture Business Services Partnership and other regional initiatives that focus on food innovation strategies. The region is uniquely positioned with consumers and producers of food products, which create a foundation for expansion.	2.2; 2.4	Low	Partnership efforts promoted as part of Prosperity Plan outreach and education materials	S = $3,500 per year Total = $10,500	NN MSU-E MSU Product Center Michigan Small Business & Technology Development Center Northern Lakes Economic Alliance MEDC										
Z5.Econ.8	Complete construction of the boardwalk along the Boardman River in downtown Traverse City to enhance views and access to the river and support local economic growth.	2.1; 2.3; 4.3	High	Design and feasibility completed in 2016 Project implemented by 2018	$7,000 for design and engineering Implementation costs TBD	TC-DDA										
Recreated-Related Strategies																
Z5.Rec.1	Enhance the Union Street Dam to offer a more natural overflow feature that better accommodates recreation boaters.	4.1	Medium	Feasibility and design studies completed in 2017, project implemented in 2018	$100,000–$500,000	TC MDNR user groups equipment manufacturers GTC										
Z5.Rec.2	Improve contiguity of canoe and kayak recreation by improving and designating boat access at logical locations.	4.1	Medium	Identify priority access points by 2017; funding secured by 2018; at least 3 new access sites installed by 2019	$1,000–$5,000 per site Total = $15,000	GTCD MDNR user groups GTC TC										
Z5.Rec.3	Improve and expand existing fishing access by providing new or updated piers, platforms, and developed access points in Traverse City and Boardman Lake, including infrastructure to create opportunities for anglers with physical limitations. (Example: Medalie Park) *See Zone 5 Maps (Figures 29 and 30)*	4.1; 4.3	High	Priority access points identified by 2017; project planning complete and funding for at least two sites secured by 2018	$10,000–$30,000 per project Total = $60,000	GTCD MDNR GTC user groups										
Z5.Rec.4	Improve walkability along the river from Boardman Lake to Clinch Park by improving physical connection of pathways and directing pedestrians to trail access. *See Zone 5 Map (Figure 30)*	4.2	High	Design/engineering by 2017; project(s) implemented by 2020	$45,000–$75,000	LGOV TART MDOT										

	Zone 5 Actions	Goals/ Objectives Addressed	Priority	Milestones	Estimated Costs	Potential Partners	Y1: 2017	Y2: 2018	Y3: 2019	Y4: 2020	Y5: 2021	Y6: 2022	Y7: 2023	Y8: 2024	Y9: 2025	Y10: 2026
Z5.Rec.5	Establish designated safe routes between recreational facilities at Kids Creek Park and West Middle School, and between Hickory Hills, Grand Traverse Commons, and Clinch Park. *See Zone 5 Map (Figure 30)*	3.2; 4.2	Medium	Safe routes audits completed by 2018 Safe routes improvement projects implemented by 2020	Audit and planning = $15,000–$25,000 Implementation TBD	LGOV TART MDOT										
Z5.Rec.6	Complete the TART Boardman Lake Trail, which will provide a full loop around Boardman Lake. *See Zone 5 Map (Figure 30)*	3.2; 4.2	High	Final planning and design completed Trail completed by 2018	$300,000	TART LGOV MDNR										
Z5.Rec.7	Hannah Park: Create park entrance at Wadsworth and 6th Street, convert gravel trail to 8' paved accessible walk linking to Old Town District. *See Zone 5 Map (Figure 30)*	3.2; 4.2	Low			TC TART										

SOURCE: Public Sector Consultants Inc., 2013, based on input from the Leadership Team.

The total estimated cost[12] of the implementation actions is more than $88 million (Table 42) over the next 10 years. As some of the proposed actions are further planned and designed, the total cost estimates will be updated. Table 42 breaks down total estimated costs by zone.

TABLE 42. Estimated Implementation Costs by Watershed Zone

Zone	Total estimated costs: Water Quality Tasks	Total estimated costs: Economic/Recreation Tasks	Grand Total by Zone
Watershed Wide	$5,339,300	$350,150	$5,689,450
Zone 1: Headwaters and Eastern Watershed	$5,805,000	$11,827,900	$17,632,900
Zone 2: Southern Communities	$2,078,500	$11,323,300	$13,401,800
Zone 3: Mid-Watershed	$1,835,900	$10,666,400	$12,502,300
Zone 4: Lower River	$17,301,200	$10,648,000	$27,949,200
Zone 5: Boardman Lake to River Mouth	$10,132,600	$1,076,500	$11,209,100
TOTAL	**$42,492,500**	**$45,892,250**	**$88,384,750**

Of these total estimated costs, approximately $42.5 million is for water quality and environmental activities, $44 million for sustainable economic development activities, and $1.5 million for improved recreational efforts. Water quality and environmental activities can be further broken down into specific implementation categories and by zones (Table 43). Zone 4 tops the costs for water quality tasks with ~$17 million, mainly due to dam removal efforts in the Hydrology and Groundwater category. Zone 5 is second with top costs for transportation stream crossing improvements and stormwater BMPs (Table 43).

[12] These are not full implementation costs because many of the actions have costs "to be determined" based on further planning and design work. Where a projected cost range was provided, the high end of costs was used in the summary table.

TABLE 43. Implementation Costs by Category and Zone

Strategy	Watershed Wide	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Total by Category
Shoreline Stabilzation and Protection	$369,800	$20,000	$ -	$587,500	$575,000	$750,000	$2,302,300
Stormwater	$2,000,000	$200,000	$ -	$17,500	$600,000	$2,640,000	$5,457,500
Transportation/Stream Crossings	$1,000,000	$ -	$ -	$25,000	$900,000	$4,600,000	$6,525,000
Planning, Zoning, and Land Use	$278,000	$65,000	$18,000	$61,500	$67,100	$65,600	$555,200
Land Protection and Management	$49,500	$ -	$ -	$5,000	$5,600	$ -	$60,100
Habitat, Fish, and Wildlife	$449,000	$30,000	$ -	$538,400	$ -	$25,000	$1,042,400
Human Health Strategies	$75,000	$ -	$ -	$ -	$ -	$2,000	$77,000
Hydrology and Groundwater	$50,000	$450,000	$ -	$ -	$13,000,000	$ -	$13,500,000
Water Quality Monitoring	$745,500	$40,000	$ -	$40,000	$91,500	$50,000	$967,000
Wetland	$52,500	$ -	$ -	$500,000	$ -	$ -	$552,500
Invasive Species	$120,000	$ -	$ -	$51,000	$51,000	$2,000,000	$2,222,000
Agriculture	$15,000	$ -	$2,060,500	$ -	$2,011,000	$ -	$4,086,500
Wastewater and Septics	$135,000	$5,000,000	$ -	$10,000	$ -	$ -	$5,145,000
Water Quality Action Tasks Sub-total	**$5,339,300**	**$5,805,000**	**$2,078,500**	**$1,835,900**	**$17,301,200**	**10,132,600**	**$42,492,500**
Sustainable Economic Development	$258,400	$11,646,900	$11,304,300	$10,541,400	$10,528,000	$101,500	$44,380,500
Recreation-Related	$91,750	$181,000	$19,000	$125,000	$120,000	$975,000	$1,511,750
Economic/Recreation Tasks Sub-total	**$350,150**	**$11,827,900**	**11,323,300**	**$10,666,400**	**$10,648,000**	**$1,076,500**	**$45,892,250**
Total by Zone	**$5,689,450**	**$17,632,900**	**$13,401,800**	**$2,502,300**	**$27,949,200**	**11,209,100**	
GRAND TOTAL	**$88,384,750**						

10.4 INFORMATION AND EDUCATION STRATEGY

A key component to all watershed plans is the development of an Information and Education (IE) Strategy to address the communication needs associated with implementing the plan. The IE Strategy highlights the current and planned efforts to inform, educate, and engage residents and visitors to the Boardman River watershed about its ecological, economic, and social assets and issues. This IE Strategy follows the detailed IE Strategy developed for the Grand Traverse Bay Watershed Protection Plan that was developed in 2005 and lists more than 60 tasks. The common goal of that IE Strategy is to "establish and promote educational programs that support effective implementation of watershed planning goals, objectives and tasks; and increase stewardship." The IE Strategy for the Boardman River Watershed Prosperity Plan encompasses virtually all of the discussed and listed goals, objectives, target audiences, messaging, and strategies/tasks in the Grand Traverse Bay Watershed Protection Plan. This is because most of the tasks are not subwatershed or location specific, but geared instead toward messages to particular audiences on particular topics. These tasks could be used in both the larger Grand Traverse Bay watershed, as well as the Boardman River subwatershed. The Grand Traverse Bay Watershed Protection Plan's IE Strategy is included in Appendix B.

Stakeholder Input

During the process of developing the Prosperity Plan, a variety of means were used to gather input from and help educate the public and other stakeholders about the Boardman River watershed, including meetings with public officials and related stakeholder groups and several open house meetings for the general public. In addition, input received from the public through several related planning efforts, including the Boardman River Dams Ecosystem Restoration Project, the Grand Vision planning effort, and community surveys conducted as part of the Grand Traverse Bay Watershed Protection Plan, was used to shape the development of goals, objectives, and strategies for the Prosperity Plan's IE Strategy.

Goals and Objectives

The specific goal of the Prosperity Plan's IE Strategy is:

> Through education and engagement efforts, create community ownership of the Boardman River Watershed Prosperity Plan and community capacity that will assure implementation of recommended actions and achievement of the goals and objectives.

Fixing an erosion problem at a road-stream crossing does not involve a high degree of public involvement. But, developing and carrying out a regional vision for stewardship of water resources will require the public and community leaders to become more knowledgeable about the issues and solutions, more engaged and active in implementing solutions, and committed to both individual and societal behavior changes.

The objectives of this plan focus on building awareness, educating target audiences, and inspiring action and stem from Goal 5 of the Prosperity Plan: Through education and engagement efforts, create community ownership of the Boardman River Watershed Prosperity Plan and community capacity that will assure implementation of recommended actions and achievement of the goals and objectives.

- **Objective 5.1** Cultivate the development of local public and private watershed champions (both individual and organizational) through training, organizational capacity building, and opportunities for leading implementation efforts.
- **Objective 5.2** Foster an ongoing culture of prosperity stewardship among watershed residents by integrating stewardship learning into education at all levels, providing regular information to the

public on the overall economic, ecological, and social health of the watershed, and providing organized opportunities for residents and businesses to participate in the implementation of the watershed plan.

- **Objective 5.3** Create a watershed prosperity stewardship ethic among visitors to the region so they might help protect and promote the region as a high-quality destination.

Target Audiences and Messaging

As stated earlier, the IE Strategy for the Prosperity Plan will follow the same target audience and messaging as the Grand Traverse Bay Watershed Protection Plan (Appendix B). The targets are divided into user groups and decision-making groups and general message outlines.

User Groups

- **Household (H):** general public throughout the watershed.
- **Riparian landowners (RL):** due to their proximity to the Boardman River and other waterbodies.
- **Agriculture industry (AI):** including crop, forestry, and animal businesses.
- **Business and industry (BI):** particularly major economic clusters in the Boardman River watershed as identified in Chapter 7.
- **Tourists/visitors (T):** this is a major industry and user of watershed amenities. The greater Grand Traverse Bay watershed is host to hundreds of thousands of visitors each year, and this sector is both an opportunity and stressor on the system.
- **Developers and real estate industry (DR)**
- **Educators (E):** K–12, postsecondary.
- **Partner organizations and special target audiences (PO)**: There are a substantial number of existing watershed, environmental, business, economic development, social services, faith-based, and recreation groups in the watershed that are all actively working to educate and inform relevant stakeholders. These groups will be a target for joint outreach efforts.

Local Government Decision Makers

- **Elected and Appointed Officials**: township, village, city, and county commissioners; planning commissions; zoning board of appeals; road commissioners; drain commissioners; etc.
- **Governmental Staff**: planners, managers, township supervisors, zoning administrators, etc.

Communication Strategies and Tasks

Since most education work is done by topic, and is not necessarily watershed-specific as stated above, virtually all of the more than 50 IE tasks listed Grand Traverse Bay Watershed Protection Plan IE Strategy can be used for the Boardman Prosperity Plan's IE tasks (Appendix B). For example, Task 1 in the Grand Traverse Bay Watershed Protection Plan's IE Strategy under the Shoreline Protection category discusses educating the public about environmentally-friendly lawn care, maintenance, and the application and use of fertilizers and pesticides. This topic is important, not subwatershed specific, and would cover an educational need for the Boardman River watershed as well.

The Leadership Team addressed additional educational tasks specific to the Boardman River watershed, which support the concept of this plan being a "Prosperity Plan" in addition to a watershed plan. Table 44 summarizes these suggested IE activities. They span the entire watershed and are not broken down into specific watershed zones, as was done with the implementation tasks in the Chapter 10.3. Specific locations and ideas for some of these tasks are noted on the Zone maps as well (Figures 24-30).

Action Plan to Implement Strategies

Several critical and priority areas for the Boardman River watershed have been identified, and the plan for rolling out the IE Strategy will correspond to these priority areas (Figures 20 and 21). Additionally, the IE Strategy will support other implementation efforts to control nutrient loading, sedimentation, the impacts of stormwater throughout the watershed, and other pollutants outlined in Chapter 10.3.

The Grand Traverse Bay Watershed Protection Plan IE Strategy tasks use a diverse set of methods and delivery mechanisms. Workshops, presentations, demonstration projects, brochures, public and media relations, websites, and other communications tools will be used for the different tasks and target audiences to stimulate more and better collaboration in the area of public education.

Additionally, the Grand Traverse Bay Watershed Protection Plan is slated for an update in 2017-2018. During that updating process the IE Strategy will also be revised to include new and relevant content related to communications and outreach strategies in the watershed. Once the update is complete and approved, the corresponding Appendix B in the Boardman River Prosperity Plan will be updated as well.

TABLE 44. Information and Education Tasks Specific to Boardman River Watershed

I/E Measure/Method		Target audience	Priority	Potential project partners	Potential cost	Timeline
Water Quality and Environmental Strategies						
IE.WQ.1	Develop and disseminate multimedia natural resources education/ interpretive campaign throughout the watershed, including printed, audio visual and media materials	All	High	GTCD LIAA TWC GTB	$50,000–$100,000 upfront $20,000 annually	Ongoing
IE.WQ.2	Adopt and integrate Boardman River watershed stewardship into K-12 programs	H, PO, RL, E	High	GTCD school districts NMC	$10,000 in years 2 and 6 $20,000 total	Ongoing
IE.WQ.3	Conduct outreach on controlling the spread and introduction of invasive species. 1. Reprint existing brochures “Plan Before You Plant” and “Go Beyond Beauty.” 2. Create new door hangers for Top 20 invasive species in watershed. 3. Create boot-brush stations at every trailhead/campground/etc. in watershed. 4. Reprint existing “Invasive Species Field Guide.” 5. Host two public work bees a year to both educate volunteers on invasive species and remove them from a site. 6. Provide free presentations to various groups (at least 25 per year).	H, E, T, PO	Medium	ISN	1. $15,000 as needed 2. $12,300 3. ~$240,000 (400 locations @ $600/ea) 4. $10,000 5. $4,000 6. $11,000/year (staff time only) 7. $3,000/yr (staff time only)	Ongoing,as needed
IE.WQ.4	Include Boardman River watershed information in annual Freshwater Summit	All	Medium	TWC GTCD MSU-E NMC	$5,000/year $50,000 total	Ongoing
Sustainable Economic Development IE Strategies						
IE.Econ.1	Connect Boardman River watershed branding and marketing efforts (website, materials, events) with broader Pure Michigan, Experience Up North, and other recreational marketing efforts to leverage activities and messaging.	T, DR, PO, BI	High	MEDC TACVB Northern Michigan Magazine	<$5,000/year	Ongoing

I/E Measure/Method		Target audience	Priority	Potential project partners	Potential cost	Timeline
IE.Econ.2	Develop a best practices case study(studies) on integrating economic, environment, and social planning efforts aimed at helping elected officials/ decision makers in other communities successfully undertake similar efforts	LG, PO	High	TWC Rotary LIAA	$20,000	2017-2018
IE.Econ.3	Maintain a Boardman River watershed website, which provides information on the natural, economic and social resources and directs people on how they can participate in watershed prosperity efforts (www.theboardman.org)	All	Medium	TWC GTCD LIAA	<$10,000/year <$100,000 total	Ongoing
IE.Econ.4	Promote the Northwest Michigan Regional Agriculture Business Services Partnership and food innovation hub efforts	AI, BI, T	Medium	NWMCOG MSUE MSU Product Center Michigan Small Business and Technology Development Center Northern Lakes Economic Alliance MEDC	<$5,000/year <$15,000 total	2017-2019
Recreation-Related Strategies						
IE.Rec.1	Education/Interpretation kiosks at key recreation and watershed entry sites that provide watershed natural resource, recreation and visitor information	H, T	High	GTCD TWC TACVB TART MDEQ MDNR GTB TCACC	Costs vary: approx. $3,000–$7,000 per site $60,000–$100,000 total for kiosk installation costs TBD	2017-2018
IE.Rec.2	Create a Boardman River watershed Visitor Center in Kalkaska *Add “Headwaters” Visitor Center at US131/M72 junction in Kalkaska (restrooms, parking, trail map) *See Zone 1 Map (Figure 24)* *Renovate Mill Pond Park; Add “Headwaters” Visitor Center (restrooms, parking, trail maps) *See Zone 1 Map (Figure 24)*	H, T, RL, E	Medium	CVB MDNR MDEQ Village of Kalkaska	TBD	2021-2023

I/E Measure/Method		Target audience	Priority	Potential project partners	Potential cost	Timeline
IE.Rec.3	Improve Village of Kalkaska's 'Clubhouse' on Island Lake Road: promote as regional snowmobile, mountain biking, and ORV trailhead; improve parking; new outdoor pavilion; new Visitor Center with restrooms, trail maps, watershed education information, and large fireplace. *See Zone 1 Map (Figure 24)*	H, T, RL, E	TBD	GTCD	TBD	TBD
IE.Rec.4	Improve Boardman Township Park at Supply Road: Visitor Center promoting fishing headwaters, trail maps, watershed education information, parking *See Zone 1 Map (Figure 24)*	H, T, RL, E	TBD	GTCD	TBD	TBD
IE.Rec.5	Access/Wayfinding Portal at Brown Bridge area: TART and hiking trail access; fishing trail access; water trail access *See Zone 3 Map (Figure 26)*	H, T, RL, E	TBD	GTCD	TBD	TBD
IE.Rec.6	Create Visitor Center or Wayfinding Portal Shelter by newly exposed bottomlands of Boardman River after Boardman Dam removal. Reconstruct parking area; include watershed and wayfinding information. Provide accessible path to river's edge. *See Zone 4 Map (Figure 27)*	H, T, RL, E	TBD	GTCD	TBD	TBD

Chapter 11. Evaluation and Oversight

As projects and tasks identified in the Prosperity Plan are implemented, they will be monitored and evaluated for success. The Plan will be evaluated both in terms of progress in implementing proposed tasks, as well as success in improving and protecting water quality as well as environmental, economic, and social prosperity in the watershed. Since this watershed plan contains goals and tasks related to both water quality protection and improvement, as well as social and economic prosperity, oversight of the evaluation process will be assigned to two different groups. The Watershed Center Grand Traverse Bay (TWC) will assume responsibility for evaluation of all water quality-related aspects of this plan, and the Leadership Team will be tasked with evaluating the environmental, economic, and social prosperity-related issues.

11.1 EVALUATION STRATEGY FOR WATER QUALITY ISSUES

An evaluation strategy will be used to measure progress during the Boardman River Prosperity Plan's implementation phase and to determine whether or not water quality is improving. The timeline for the evaluation is approximately every five years, with ongoing evaluation efforts completed as necessary. The first aspect of the evaluation strategy measures how well the Prosperity Plan is being implemented and whether project milestones are being met. The second aspect will evaluate water quality in the watershed. The following sections address each of these issues.

Water Quality: Evaluation Strategy for Plan Implementation

An evaluation strategy for plan implementation will be used to determine progress in completing the water quality-related recommended actions and tasks identified in the plan. This aspect of the evaluation strategy was developed to measure progress during the implementation phase of the Prosperity Plan and to provide feedback during implementation. The ongoing evaluation will be conducted through a Boardman River Watershed Plan Implementation Team (BR-WPIT) to be formed in 2017. It is anticipated that some members of the existing Prosperity Plan's Leadership Team will serve on this committee, as well as other local stakeholders interested in water quality issues. The BR-WPIT will be modeled after a current, successful WPIT model in the Elk River Chain of Lakes (ERCOL), which is another major subwatershed to the Grand Traverse Bay watershed. TWC partners with Tip of the Mitt Watershed Council to run the ERCOL-WPIT.

The BR-WPIT is expected to meet quarterly to discuss progress on implementing the Prosperity Plan and work together to move forward with accomplishing priority tasks and projects. The BR-WPIT will review the recommended tasks and actions annually during one of their quarterly meetings and identify what has been accomplished during the last year. In addition, plan tasks, priorities, and milestones will be assessed every five years to ensure the plan remains current and relevant to the region, is being implemented as scheduled, and is moving in the right direction. As priority actions are accomplished, lower priority actions may be reassigned to be medium or high priority. In addition, new recommendations may be added in response to new issues and concerns, methodologies, data, and as other information is learned.

The evaluation will be conducted by analyzing the existing Prosperity Plan water quality-related goals and objectives, as well as the water quality and environmental strategies implementation tasks and milestones in Chapter 10 to determine progress. Key milestones include completing dam removal projects, installing stormwater reduction BMPs in the Kids Creek subwatershed, completing streambank erosion restoration projects, repairing transportation crossings, and updating zoning ordinances. The proposed timeline for each task will be reviewed to determine if it is on schedule. Other anecdotal evidence (not attached to specific plan milestones) also will be noted that indicates the protection plan is

being successfully implemented, such as an increase in the amount of updated or new zoning ordinances that deal with water quality and natural resource protections in watershed townships and municipalities.

Additionally, a number of other evaluation tasks will be completed due to the variety of tasks involved in the Prosperity Plan. They will include, but are not limited to, the following:

- Document the effectiveness of BMP implementation by taking photographs, completing site data sheets, and gathering physical, chemical and/or biological site data. Work with partners to develop a standardized methodology implementation (see proposed comprehensive monitoring program outlined in Chapter 11.2).
- Use focus groups to evaluate specific projects throughout plan implementation as needed.
- Conduct targeted surveys of project partners by direct mail, phone, or website to assist in gathering information.
- Maintain a current list of future target projects, the status of ongoing projects, and completed projects, along with their accomplishments. Keep track of the number of grants received and the dollars committed in the watershed region to implement aspects of the plan.

Additional development of the strategy will occur as the implementation phase unwinds.

The Grand Traverse Bay Watershed Protection Plan describes a process called "Measuring and Evaluating Social Milestones" in its evaluation discussion in Chapter 7.5. This is also relevant to the Boardman River Watershed Prosperity Plan as well, and is excerpted below:

> **Measuring and Evaluating Social Milestones**
>
> Chapter 7.4 outlines an Information and Education Strategy that addresses the communication needs associated with implementing the Protection Plan. The strategy is important because developing and carrying out a regional vision for stewardship of the region's water resources will require the public and community leaders to become more knowledgeable about the issues and solutions, more engaged and active in implementing solutions, and committed to both individual and societal behavior changes. Residents, local officials, homeowners, and the like must be educated and motivated to adopt behaviors and implement practices that result in water quality improvements.
>
> In this respect, it is important to measure and keep track of the social impacts of the Grand Traverse Bay Watershed Protection Plan. Project managers must find out what types of outreach are working in their communities and what types are not, along with how people's attitudes and behaviors are impacted. Just how much is social behavior changing because of the plan's implementation? To answer this question, social impacts must be included when evaluating the progress of plan implementation.
>
> Key social evaluation techniques that will be used to assess the implementation of the IE Strategy, as well as other watershed BMPs, include:
>
> - Continued cooperation between area organizations submitting proposals to implement aspects of protection plan.
> - Social surveys (and follow up surveys) for homeowners, local officials, students, farmers, etc. to determine watershed and water quality awareness.
> - Determining any increases in 'watershed friendly' design and construction (anecdotal evidence will be used).

- Increased awareness (from both the general public and local government officials) regarding the necessity of stormwater improvement.
- Increase in the number of communities implementing stormwater ordinances.
- Continued requests to do Freshwater Focus (increases in positive feedback after printing).
- Incorporating feedback forms into educational and public events and posting them on The Watershed Center website www.gtbay.org.
- Determining the number of environmental efforts/projects in the watershed and how many organizations are currently working to protect water quality in the area. Maintaining a list of ongoing projects and completed projects, along with their accomplishments.

In a social survey conducted in summer 2002, the most significant finding was the identification of a major gap in knowledge among watershed residents: 60% of respondents answered "don't know" when asked which watershed they lived in. This basic fact indicates that watershed partner organizations have a long way to go in informing and engaging the public in watershed issues. A major social milestone to achieve by 2010 is to increase awareness of Grand Traverse Bay watershed residents knowing which watershed they live in from 40% up to 75%. (This is a realistic goal, considering the average American moves once every five years; so in any given year approximately 20% of the residents are new to the area.)

Water Quality: Evaluation Strategy for Determining Water Quality Improvement

It is essential to the success of this watershed planning effort that water quality in the Boardman River watershed be maintained and improved in critical areas. There must be no deterioration in the quality of the water throughout the watershed.

The EPA dictates that watershed management plans must outline a set of criteria to determine whether proposed load reductions in the watershed are being achieved over time and that substantial progress is being made toward attaining water quality standards. In the case of the Boardman River watershed, overall water quality is good (Section 2.4) with some pollutant threats; therefore no specific watershed goals were made regarding load reductions. The TMDL for Kids Creek, the only 'impaired' water body, is not yet complete. However, when that is completed by the MDEQ, any proposed load reductions will be incorporated into this evaluation strategy and be used to measure water quality improvement in Kids Creek.

The evaluation strategy for the Prosperity Plan's success in protecting water quality is based on comparing criteria with monitoring results. Parameters monitored and monitoring locations will be driven by the monitoring programs identified in the proposed comprehensive monitoring program outlined in Chapter 11.2. However, all aspects of that monitoring plan have not yet been funded. In addition, other data will be used from MDEQ's five-year cycle monitoring at various locations of the Boardman River and their Beitner Road integrator site, as well as data from other agencies and organizations including the U.S. Geological Survey, U.S. Army Corps of Engineers, and The Watershed Center.

A set of criteria were developed using existing water quality data, summarized in Section 2.4, to determine if water quality is being maintained or improved in the Boardman River watershed. Detailed criteria that will be used to determine whether these metrics are being achieved include:

- **No statistically significant increase in watershed-wide averages of phosphorus or nitrogen in the Boardman River, tributaries, and inland lakes** from previous MDEQ monitoring cycles.

- **Total Phosphorus concentrations in Boardman River and tributaries remain below 0.02mg/L (Boardman River mouth = 0.03 mg/L).** Phosphorus concentrations in surface waters are not regulated by the State of Michigan or the USEPA. However, the USEPA recommends that total phosphorus concentrations in streams discharging into lakes not exceed 50 parts per billion (0.05 mg/L).
- **Total nitrogen concentrations in Boardman River and tributaries remain below 1 mg/L**.
- **Dissolved oxygen levels in all waterbodies remain above 7 parts per million**.
- **Reduce nutrient inputs from stormwater in urban areas.** The EPA's Spreadsheet Tool for Estimating Pollutant Loads will be used to determine the reduction in nutrient (TP and TN) inputs from stormwater reduction BMPs implemented.
- **Maintain or reduce sediment loads in tributaries and stormwater draining into Boardman River and tributaries.** The EPA's Spreadsheet Tool for Estimating Pollutant Loads or other similar models will be used to determine the reduction in sediment inputs from BMPs implemented.
- **Water temperatures are maintained at a level to support coldwater species** during the summer where appropriate throughout the watershed.
- N**o *E. coli* levels exceeding Michigan and USEPA water quality standards** for both single day measurement (>300 *E. coli* per 100mL of water) and 30-day geometric mean measurement (>130 *E. coli* per 100mL of water in five samples over 30 days).
- **Maintain or improve aquatic macroinvertebrate community diversity in streams** that have been monitored and expand monitoring efforts to document and assess aquatic macroinvertebrate diversity in other streams throughout the watershed.
- **Fish populations represent healthy and diverse fish communities** that meet local management objectives for the Boardman River and its tributaries.
- **Goals and objectives for controlling invasive species outlined in the Invasive Species Management Plan for the Boardman River are met** (see http://www.theboardman.org/userfiles/ filemanager/185/).

Water Quality Monitoring Plan

Monitoring is essential to evaluate effectiveness of the collective watershed efforts or individual actions. Meeting the metrics for the evaluation strategy described above for determining any water quality improvement from the implementation of the Prosperity Plan hinges upon continued and expanded monitoring in the Boardman River watershed.

The Leadership Team drafted a proposed comprehensive monitoring plan for the watershed indicating locations and parameters not yet being monitored (Table 45) that should be added to existing plans by other organizations (Table 46). Table 45 lists the parameters, frequency, locations, and potential partners for each sample task. The following monitoring locations, previously summarized in Tables 4-10 and Figure 8 from Chapter 2.4 on Water Quality, should be used whenever possible to continue to have a baseline to monitor against

- Site #1 Boardman River at Beitner Road
- Site #2 East Creek at Mayfield Road
- Site #3 Beitner Creek at Beitner Road
- Site #4 Boardman River at South Airport Road
- Site #5 Boardman River downstream of Boardman Lake
- Site #6 Boardman River Mouth
- Site #7 Kids Creek
    - at M-37/US-31

- 1/2 mile downstream of Silver Lake Road
- upstream of 11th Street
- at Oak Street
- Tributary A (Cedar Run Road)
- Tributary A (hospital parking lot by 6th Street)
- Tributary A (upstream of Elmwood Avenue)
- Tributary A (downstream of Elmwood Avenue)
- Tributary D (M-37/US-31)

As described in the previous section, evaluation of water quality improvement will include using data gathered by other organizations. Significant data will be used originating from the MDEQ as part of their five-year cycle monitoring at various locations of the Boardman River, as well as their Beitner Road integrator site. Data gathered by the MDEQ are mainly nutrients (Total Phosphorus and nitrates/nitrites) and macroinvertebrates.

In addition, The Watershed Center (TWC) will continue their annual Adopt-a-Stream program, which utilizes volunteers to sample and identify macroinvertebrates in tributaries to the Boardman River twice a year. These surveys are not as in-depth as the 'P51' survey procedures the MDEQ uses, but they do produce valuable data that can indicate general information on stream health. TWC uses the results to determine areas in the Boardman that may require further investigation by the MDEQ or others.

TWC will also continue their beach monitoring program in conjunction with the Grand Traverse County Health Department. Water samples are tested for *E. coli* once a week during the swimming season (typically from Memorial Day to Labor Day) at various public beaches. Results are entered into the MDEQ BeachGuard database (http://www.deq.state.mi.us/beach/). Clinch Park, near the outlet of the Boardman River, is currently included in the monitoring program. However, other inland lake beaches within the Boardman River watershed with public swimming access should be included for testing as spot checks for potential bacterial contamination (Table 45). TWC has included inland lake testing in their beach monitoring program, but does not have monitoring sites chosen yet in the Boardman River watershed.

Other macroinvertebrate data will be gathered in the coming years from the Au Sable Institute in partnership with Trout Unlimited as part of their pre- and post-dam removal monitoring of macroinvertebrates in the Boardman River (Table 46). This research is summarized and is available on their website at http://ausable.org/research/boardman_river_restoration_research/.

TABLE 45. New Locations/Parameters to be added to Boardman River Comprehensive Monitoring Plan

Parameter	Location	Frequency	Potential Partners
Nutrients (phosphorus, nitrogen)	Three locations along the mainstem Three tributary locations Inland lakes over 30-acres in size	Mid April and Early September; yearly	LA GTCD TWC
Suspended solids	Three locations along the mainstem Three tributary locations Inland lakes over 30-acres in size	Mid April and Early September; yearly	LA GTCD TWC
E. coli	1. Kids Creek (at least 3 locations from previous studies) 2. Inland lakes with public beach sites 3. Mouth of Boardman River	1. 2 dry weather, 5 wet weather; every 5 years 2. Once/week during between Memorial and Labor Days (add to TWC's Beach Monitoring Program). Two years for each beach, if no issues then stop. 3. 2 dry weather, 5 wet weather; every 5 years	TWC LA LGOV HD
Dissolved oxygen	Three locations along the mainstem Three tributary locations Inland lakes over 30 acres in size, 2 sites/lake	Once in June, July, and August; 3 times/day; yearly	LA GTCD TWC
Water temperature	Three locations along the mainstem Three tributary locations	Weekly for a year, every 5 years	LA GTCD TWC

TABLE 46. Existing Monitoring Plans in the Boardman River Watershed

Parameters	Organization	Monitoring Plan (if known)
Macroinvertebrates	MDEQ TWC Au Sable/TU	• Every 5 years, various locations from list in Tables 9 and 10 in Chapter 2.4; sites on Kids Creek will be included as part of "Impaired Waters List" monitoring. • Part of Adopt-A-Stream program, see website for specific locations (http://www.gtbay.org/our-programs/adopt-a-stream/). Currently, 8 creeks are included in the monitoring program: Kids, Miller, Jack's, Beitner, Jackson, Carpenter, Twentytwo, and Parker Creeks. TWC has plans to add at least two more sites to this list in the next 5 years. Sites are monitored twice/year for macroinvertebrates (down to Order, i.e. Trichoptera, Ephemeroptera) and are rated as either Excellent, Good, Fair, or Poor) • Boardman Dams pre- and post-dam removal monitoring; see Au Sable website for locations (http://ausable.org/research/boardman_river_restoration_research/)
Nutrients (phosphorus, nitrogen)	MDEQ	5-year cycle, various locations
E.coli	TWC	Clinch Park beach, part of annual beach monitoring program; once/week during swimming season; ~$1,000/year
Fish populations (fish shocking)	MDNR	• Boardman River @ Ranch Rudolf (Status & Trends Long Term Fixed Site). Rotating sample schedule where they sample three years, then don't sample for three years, then come back for another three repeatedly. The next cycle for this location will be 2017, 2018, and 2019. Cost ~ $2,200/year • Boardman River @ Brown Bridge Road (Long Term Evaluation Site); 2016-2020; cost ~ $2,200/year • Boardman River @ TBD Site below Sabin Dam; 2016-2020; cost ~ $1,500/year

11.2 OTHER EVALUATION STRATEGIES

Upon approval of the Boardman River Watershed Prosperity Plan, the Leadership Team will undertake Phase II: transitioning to a permanent organizational structure that is capable of most effectively implementing the recommended actions in the plan. The Leadership Team will be reaching out to partner organizations and key stakeholders to identify necessary institutional arrangements, collaborative structures, and key paths that will enable partnering among communities and help to establish (or strengthen) public-private partnerships for implementing Prosperity Plan strategies. Given the significant overlap in goals and geography, a key first step in this process will be evaluating how the Boardman River Watershed Prosperity Plan fits within or under the structure for implementing and advancing the Grand Vision over the long term. There are numerous other related organizations and efforts in the region, and the Leadership Team will assess whether the institutional framework should be a network of existing partners or a more formal structure. The Leadership Team and/or new institutional structure will pursue any administrative, legislative, legal, or financial resources necessary for finalizing the implementation structure.

The evaluation tasks below have been temporarily assigned to the Leadership Team, but this will be revisited once the Phase II organizational structure is decided.

As the institutional structure for ongoing implementation of the Prosperity Plan is established, the Leadership Team and other key stakeholders will finalize a comprehensive evaluation plan early in Year 1 of Phase II. The evaluation process will be participatory in nature, involving multiple stakeholders in both the final design of evaluation tools and the implementation and oversight of evaluation activities. The evaluation process will not be done by a third-party contractor because it is neither practical nor in the best interests of building the capacity and ownership of the Leadership Team.

The evaluation will be designed to answer at least the following overarching evaluation questions:

- To what extent have the actions outlined in the Prosperity Plan been completed?
- To what extent have there been changes in key social, ecological, and economic indicators? Are these changes greater than what could have been expected through typical planning and implementation efforts?
- To what extent are partners doing business differently?
- To what extent have diverse partners been actively involved in the implementation of the plan?
- Are partners considering the social, ecological, and economic implications of decisions/actions more than previously? If so, what evidence is there of this and what impact has this had?

Evaluation Strategy for Plan Implementation

The Leadership Team will facilitate efforts to evaluate progress in implementing all of the strategies identified in the Prosperity Plan and ensuring that milestones are being met and that business is being done in new ways. On an annual basis, the Leadership Team and its partners will review progress in completing tasks and achieving milestones and will report progress to partner organizations and other stakeholders through ongoing outreach efforts (such as online dashboards, newsletters, or public forums). The two methods described below will be used to monitor the process of implementation.

- **Method 1. Aligned Actions Partner Database.** Central repository for all action-related information and online "hub" to connect partners virtually to share knowledge and resources.
- **Method 2. Community Engagement Survey.** Designed to measure respondents' awareness and use of and personal alignment with the plan.

Method 1: Aligned Actions Partner Database

With an initiative of this scope, where multiple independent partners are working across sectors and geographic distances, keeping track of progress on aligned actions will be an immense task. In the first year of Phase II, the development of a web-based, secure common database where each community partner can login to a common portal and contribute information about their actions will be explored. The database could serve a dual purpose to serve as the central repository for Prosperity Plan action information as well as be the virtual "hub" that enables partners to be informed of progress, find collaborators, self-organize, and share information, knowledge, and ideas. It could:

- Make all efforts and progress highly visible to peers. All partners will be informed of actions in real-time and will be better able to determine how their actions align with the greater collection of actions.
- Allow activity leads to solicit new resources for projects from peers; actions could have a space for "needed resources" to announce the need for volunteers, equipment, partners, etc.
- Include a place for "new ideas," where partners can pitch potential projects and use the platform as a vehicle for self-organizing around projects of mutual interest.
- Include a discussion forum for peers where anyone can pose a question and solicit a peer (crowd)-sourced response. (This would help unlock the knowledge resources between disparate players.)
- Enable dashboard-like reporting on the number of "actions in progress" related to goals and "actions completed."
- Serve as the repository for secondary data collected to inform the impact-level prosperity indicators chosen. (These data could also be displayed in a dashboard-like format.)

A shared database platform will require significant buy-in from community partners to be successful. Considerable effort will be made to engage partners in the consideration of a system. If it is decided to create a shared system, partners will be involved in the creation of the system to help ensure the system has value for them beyond a simple tracking mechanism and increase the likelihood of full adoption of and participation in the system by all partners.

As with all evaluation methods, other regional initiatives will be consulted during the planning phase to determine if there are efficiencies to be gained by partnering. For instance, the Grand Vision has developed a Salesforce system for central contact and activity information. The possibility of expanding that system for this use will be explored.

For each action, possible Action-Level Indicators to track in a shared system will include**:**

- Action/Activity/Project-Title
- Location/Zone
- Date Initiated/Completed
- Lead Entity
- Entity Type (local government, nonprofit, business/industry, educators, agriculture industry, etc.)
- Key Partners
- Partner(s) Type
- Prosperity Plan Goal(s) and Objectives Action is Aligned With
- Primary Action Type (water quality and environmental, sustainable economic development, recreation-related)
- Resources Committed
- Resources Needed
- Update w/Date Field (open)

Tracking these indicators will enable the Implementation Team to determine which goals are being actively worked on, whether certain goals and strategies need more outreach attention, the extent that diverse sectors are engaging in project work, the extent of cross-sector partnerships, the unmet resource needs of partners, and the changes in each of these over time.

Alternative action-level data tracking methods will be employed in Year 1 of Phase II while the shared database idea is being fully explored. If it is determined that a shared database is not feasible, these alternate methods will continue in subsequent years. These may include an annual partner audit, by phone or survey, to determine what actions they have under way or recently completed that will help further any of the Prosperity Plan goals and objectives. There will also be an opportunity to include action/project-based questioning on the community survey (Method 2).

Regardless of collection method, action-level information will become part of a publically available dashboard. Detailed action information will be reviewed at least annually by the Leadership Team and partners to determine if sufficient progress is being made and to enable mid-course adjustments and deeper levels of implementation.

Method 2: Community Engagement Survey

From the beginning of the process to develop a watershed prosperity plan, the Leadership Team has emphasized the importance of fostering and expanding an actively engaged citizenry and identifying appropriate measures of community engagement will be an important part of evaluating the Prosperity Plan's success.

An online community survey will be developed that will be shared with those target audiences identified for the education and outreach activities of this plan, including but not limited to:

- Household: general public throughout the watershed.
- Riparian landowners: due to their proximity to the Boardman River and other waterbodies.
- Agriculture industry: including crop, forestry, and animal businesses.
- Business and industry: particularly major economic clusters in the Boardman River watershed as identified in Chapter 6.
- Tourists/visitors: this is a major industry and user of watershed amenities. The greater Grand Traverse watershed is host to hundreds of thousands of visitors each year, and this sector is both an opportunity and stressor on the system.
- Educators: K–12, postsecondary.
- Students
- Local government decision-makers
- Developers and real estate industry
- Partner organizations and special target audiences: there are a substantial number of existing watershed, environmental, business, economic development, social services, faith-based communities, and recreation groups in the watershed that are all actively working to educate and inform relevant stakeholders. These groups will be a target for joint outreach efforts.

The survey will be designed to measure the respondents' awareness, use, and personal alignment with the plan. This may also be an opportune time to collect action information from a wider audience that is not directly engaged with the partner database. Ideally, it will be implemented on an annual basis. Indicators to be measured with the community survey will include respondents':

- Awareness of the Boardman River Prosperity Plan.
- Extent to which they agree with the guiding principles of the plan (e.g., preserving prosperity attributes, broad diverse economy, diversity of use, public involvement and education, integration

with regional initiatives, balancing increased tourism with quality of life to area residents, and sustainability of the plan).
    - Extent to which they are doing business in a new way since the plan was introduced.
    - Their use/consideration of the plan in personal or professional decision making.
    - More cross-sector partners.
    - Greater consideration for the social, economic, and environmental implications of decisions/ actions.
    - Greater awareness and consideration of the bigger picture and how their efforts contribute to a community-level, shared goal/outcome.
- Extent to which they feel that the underlying assumption of the plan is valid – that considering social, economic, and environmental concerns together improves all concerns more than if they were considered in isolation.

Evaluation Strategy for Environmental, Economic, and Social Prosperity

While tracking progress in implementing tasks and achieving milestones is critical to maintaining momentum and effort, achieving and maintaining prosperity throughout the watershed will require regular review and evaluation of whether the Prosperity Plan is actually helping to protect and improve economic, ecological, and social prosperity in the watershed. A 'Watershed Prosperity Index,' described below, will be used to monitor the success in achieving the Prosperity Plan goals and objectives.

Watershed Prosperity Index

The Watershed Prosperity Index will track indicators relating to the status of economic conditions, housing, arts and culture, recreation offerings, and educational achievement in the watershed. The Leadership Team has identified 22 initial metrics for tracking the status those indicators, drawing on measures identified in Chapters 7, 8, and 9 to evaluate long-term success in achieving the Prosperity Plan goals (Table 47). The table includes baseline data collected as part of the Prosperity Plan development. Additional data will be collected in the first year of program implementation. During implementation roll-out, stakeholders will be asked for additional input on the list of target measures, and targets will be refined as needed. Success will be measured in the numbers of metrics being met or maintained. The Leadership Team will review these metrics and revise the table every five years to monitor and evaluate changes over time in these environmental, economic, and social prosperity indicators.

TABLE 47. Potential Metrics for Evaluating Prosperity Plan Success

Indicator	Measure	Traverse City	Kingsley	Fife Lake	South Boardman	Kalkaska
Job sector diversity (private v. public)	Higher than state average	▲	▲	△	▲	▲
Diversity of Job Base Ratio (manufacturing to retail)	Higher than state average	▲	▲	▲	△	△
Diversity of Job Base Ratio (retail to retail, arts, etc.)	Higher than state average	▲	▲	▲	▲	▲
Knowledge occupations as a % of workers aged 16+	Higher than state average	△	△	▲	△	△
# of nonservice jobs per 1,000	Higher than state average	tbd	tbd	tbd	tbd	tbd
% of population over age 25 with a bachelor's or higher degree	Higher than state average	△	▲	▲	▲	▲
% of population over age 25 with an associate's degree	Higher than state average	△	△	△	△	▲
% of population over age 25 with no high school diploma	Lower than state average	△	△	△	△	▲
% of population uninsured	Lower than state average	▲	▲	▲	▲	▲
Rate of home ownership	Higher than state average					
% of families receiving food stamps	Lower than state average	△	▲	▲	▲	▲
% of households commuting by public transit	Higher than U.S. average	tbd	tbd	tbd	tbd	tbd
# of transit routes	Increased from previous reporting period	tbd	tbd	tbd	tbd	tbd
Average work commute time	Lower than state average	△	▲	▲	▲	△
# of entertainment/cultural establishments per capita	Higher than state average	tbd	tbd	tbd	tbd	tbd
% of registered voters	Higher than state average	tbd	tbd	tbd	tbd	tbd

Indicator	Measure	Traverse City	Kingsley	Fife Lake	South Boardman	Kalkaska
# of waterbodies NOT attaining water quality standards	none	▲	▲	▲	▲	▲
# of waterbodies with good to excellent water quality	No harmful changes to water quality or biological indicators from previous MDEQ monitoring cycle	▲	▲	▲	▲	▲
# of fish consumption advisories	None other than statewide advisories	▲	▲	▲	▲	▲
# miles of trails (all)	Higher than previous reporting period	tbd	tbd	tbd	tbd	tbd
# fishing licenses per capita	Higher than state average	tbd	tbd	tbd	tbd	tbd
# of paddling days on the river	Higher than previous reporting period	tbd	tbd	tbd	tbd	tbd

▲= not achieving metric
▲= achieving metric

SOURCE: Summarized by Beckett & Raeder, Inc. and Public Sector Consultants using U.S. Census Bureau 2010, Michigan Economic Development Corporation (MEDC) data available at http://ref.michigan.org/medc/miinfo/places/); MDEQ 2010; ESRI Business Analyst Online ND; U.S. Bureau of Labor Statistics 2012

Chapter 12: Conclusions and Next Steps

The Boardman River watershed is a beautiful ecological, social, and economic asset for Michigan and its visitors. The watershed is home to many of the state's most important fish and wildlife species, supports a diverse array of service, agricultural, manufacturing, and resource extraction industries, and provides a wide array of opportunities for high-quality recreation and cultural activities.

The removal and modification of the Boardman River dams is one of the most significant dam removal projects in Michigan and the United States, and offers a rare and unique opportunity to restore aquatic habitat in the river and expand associated economic and recreational offerings. But capitalizing on the environmental and economic benefits of the existing and restored natural amenities in the watershed requires deliberate and long-term cooperation among and investment from residents, visitors, businesses, and decision makers to balance the sometimes competing needs of people and nature.

The Boardman River Watershed Prosperity Plan lays out a roadmap for monitoring, protecting, enhancing, and leveraging the region's natural, cultural, economic, and recreational assets in a manner that will maintain and improve the high quality of the Boardman River watershed's resources. The goals, objectives, and strategies identified in this plan will allow residents, visitors, businesses, and other stakeholders to engage in the management of the watershed's remarkable resources and make strategic investments that will help protect the resources and raise the level of prosperity for all watershed residents. The water quality and environmental recommendations outlined in Chapter 10 of the Prosperity Plan will provide guidelines to all types of organizations for taking action during the implementation phase of the project and will be a useful tool in addressing current and future water quality threats to the watershed.

The plan is ambitious and will require substantive engagement and investment by a multitude of stakeholders and builds on the momentum of more than a decade of regional planning and cooperation. All of the activities identified and recommended in the plan should be undertaken in the broader context of other regional efforts such as the Grand Vision, Boardman River dams implementation plans, the Grand Traverse Bay Watershed Protection Plan, the Boardman Valley Plan, master plans for all of the watershed communities, the Northwest Michigan Comprehensive Economic Development Strategy, and other regional recreation, resource, and economic planning efforts.

While none of the designated uses for the Boardman River watershed are impaired on a watershed-wide scale, threatened designated uses include the coldwater fishery and other indigenous aquatic life and wildlife. Excessive nutrient loading and sedimentation are two of the known pollutants that are threatening these designated uses in the Boardman River watershed. Other issues that threaten these designated uses include thermal pollution, loss of habitat, hydrologic flow alteration, invasive species, toxic substances, and pathogens. All of these factors degrade water quality, destroy aquatic habitat, and reduce the number and diversity of aquatic organisms. Currently an approximate 4-mile section of Kids Creek near its confluence with the Boardman River is not supporting designated uses due to flow regime alterations, sedimentation/siltation, and other human-caused substrate alterations, all caused by stormwater. A list of watershed pollutants was developed in a comprehensive table listing watershed stressors, sources, and causes (Table 20) to identify water quality problems and provide guidance for future implementation projects to protect the quality of the watershed.

Priority and critical areas in the watershed were delineated to identify specific areas in the watershed that are most sensitive to environmental impacts and have the greatest likelihood to affect water quality and aquatic habitat (Figures 20 and 21). It is in these areas that the bulk of implementation efforts should be focused. Additionally, by focusing on reducing and/or eliminating pollution stemming from stormwater runoff, streambank erosion, transportation crossings, lack of riparian buffers, agricultural lands, and the

reduction of wetlands, the bulk of pollution entering the watershed will be addressed. Priority should also be given to implementation tasks (both BMPs and educational initiatives) that work to reduce the effects from these sources.

The Boardman River Watershed Information and Education Strategy highlights the actions needed to successfully maintain and improve watershed education, awareness, and stewardship for the watershed. It lays the foundation for the collaborative development of natural resource programs and educational activities for target audiences, community members, and residents and closely follows the already developed Information and Education Strategy for the Grand Traverse Bay Watershed Protection Plan.

A Prosperity Plan Implementation Team has already been formed and outreach with watershed communities on their priorities for implementing the plan been completed. To help work toward achieving the sustainable economic and recreational goals and tasks identified in the Prosperity Plan, the team has met individually with each watershed community (political, business, civic, and community organizations) to identify their priorities and key short-term actions, find ways to leverage funding and effort across communities, and ensure that local plans and regulations fully support the goals of the Prosperity Plan. Each community identified key capital projects they would like to accomplish over the next 10 years (Appendix C). While not all of the capital projects outlined in Appendix C are watershed-based and relate to a sustainable economy, it does show the large amount of work planned in the community in the near future, and provides a good starting point for work toward a sustainable economy.

Work will continue on the monumental dam removal process that will bring substantial ecological, economic, and recreational improvements and opportunities to the watershed. This work will include not only dam removal efforts, which are slated to be completed by 2018, but streambank stabilizations, invasive species management, and land protection that go along with it as well. Additionally, continued invasive species monitoring, erosion control, and instream habitat improvements will be necessary over the next 10 years.

TWC will continue work on their Kids Creek Restoration Project, targeting restoration and water quality improvement in the watershed's only impaired water body. This work is already well under way and will be a critical element of improving water quality in the Boardman River watershed. Planned tasks in the next several years include a variety of Low Impact Development installations throughout the Kids Creek subwatershed designed to improve the quality and reduce the quantity of stormwater runoff into the creek.

Additional future efforts for the Boardman River watershed include:

- Building partnerships and seeking funding for implementation activities.
- Conducting urban stormwater improvement BMPs in Traverse City.
- Restoring and improving severe transportation crossings and streambank erosion sites.
- Working with local communities to improve water quality-related zoning ordinances.
- Participation in regional and local planning efforts to ensure habitat connectivity and water quality issues are considered.
- Ongoing monitoring to assess environmental conditions.
- Implementing information and education initiatives.

With the level of cooperation and investment outlined in this plan, the vision of the Boardman River as a critical performing asset in the watershed communities, and one that contributes to the overall quality of life for present and future generations of residents, businesses, and visitors, can be achieved.

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Appendix A: BMP Cost Estimates

Best Management Practices Cost Estimates*

Task	Costs	Units	Output	Notes	Source
Agriculture					
Conservation Tillage	$ 10.00	acre			NRCS
Fertility Testing	$ 2.75	acre		Lab testing done to MSU standards	MDA Conservation Service 1992 adjusted for inflation
IPM	$ 5.75	acre			MDA Conservation Service 1992 adjusted for inflation
Windbreaks	$ 2.00	foot		4200 feet needed for a square 40 acre field. Protects ten times as trees are high	NRCS
Cover Crop	$ 14.00	acre		sweet clover if using forage for harvest results in gain of $125/acre	NRCS
Critical Area Planting	$ 1,300.00	acre		Includes: grading, planting, herbicides, mulch, and labor.	NRCS
Livestock Exclusion	$ 3.50	foot			NRCS
Agriculture Crossing	$ 1,200.00	crossing	2/day		NRCS
Watering site	$ 5,100.00	site	.5/day	Well, pump, pipe and water facility	NRCS
Rental Rate	$ 58.00	acre		10 year lease $150/acre with grants	NRCS
Riparian Forested Buffer	$ 900.00	acre		Use of herbicides and establishiment and maintenance	NRCS
Riparian Herbaceous Buffer	$ 225.00	acre		On tilled land includes establishment and maintenance	NRCS
Filter Strip	$ 190.00	acre		establishment, herbicides, fertilizer, and lease	NRCS
Zebra Mussel Control	$ 440.00	acre		Irrigation system to control Zebra Mussels for a 1800 acre establishment	American Water Works Association, 1990 adjusted for inflation
Solar Irrigation Pump	$ 2,500.00	unit	3/day	Pump, controller, pipe, and collector	www.solarelectric.com
Waste Storage Lagoon	$ 45,000.00	unit			NRCS
Stream Erosion					
Live crib wall	$ 25.00	square foot	25 ft/day	see habitat restoration	Rogue River National Wet Weather Demonstration Project
Live staking	$ 2.50	stake		with 3 crew and foreman	Rogue River National Wet Weather Demonstration Project

Vegetated geogrid	$	20.00	square yard	with 3 crew and foreman	Rogue River National Wet Weather Demonstration Project
Live fascine	$	9.00	foot	with 3 crew and foreman	Rogue River National Wet Weather Demonstration Project
Brush layer	$	13.00	foot	with 3 crew and foreman	Rogue River National Wet Weather Demonstration Project
Branch packing	$	25.00	foot	with 3 crew and foreman	Rogue River National Wet Weather Demonstration Project
Coconut roll	$	15.00	foot	with 3 crew and foreman	Gull Lake Shoreline Project
Joint Planting	$	9.00	stake	with 3 crew and foreman	Rogue River National Wet Weather Demonstration Project 4 member crew with foreman
Riprap	$	60.00	square yard	includes geotextile fabric: 2 member crew and foreman using heavy equipment	Means 1996 and adjusted for inflation: Includes heavy equipment rental
Tree revetments	$	12.00	foot	with 3 crew and foreman	Means 1996 and adjusted for inflation
Bank Shaping	$	15.00	cubic yard	With Heavy Equipment	NRCS
Average Bio-Engineering	$	22.00	foot	Using soft methods only	NRCS
Average Streambank Restoration	$	32.00	foot	Using hard methods and bioengineering	NRCS
Hydroseeding and Mulch	$	2,200.00	acre		NRCS
Tile Outlet					
Riprap	$	75.00	square yard	includes geotextile fabric: 2 member crew and foreman using heavy equipment	Means 1996 and adjusted for inflation
Vegetated geogrid	$	20.00	square yard	includes geotextile fabric: 2 member crew and foreman	Means 1996 and adjusted for inflation
Pipe	$	30.00	linear foot	10" pipe steel: 3 member crew, foreman, backhoe	Means 1996 and adjusted for inflation
Inlet/outlet structure		$3,500	each	concrete with riprap splash pool and vegetated geogrid slopes	Means 1996 and adjusted for inflation
Soil Stabilization/Repair		$2.50	square yard	2 member crew and foreman with heavy equipment	Means 1996 and adjusted for inflation
Trash and Debris					
Volunteer Mobilization	$	60.00	day	Includes flyers, meetings, and memberagement	
Tree removal	$	325.00	hour	includes crew, equipment, and removal fees	Means 1996 and adjusted for inflation: Includes heavy equipment rental
Waste hauling fees	$	75.00	load	should include a $2 tip fee for each tire	

Heavy Obstructions	$ 890.00	each		includes, crew, equipment, and removal fees	Means 1996 and adjusted for inflation: Includes heavy equipment rental
Rill and Gully					
Berm and Tube	$ 1,500.00	each		with 3 crew, foreman, heavy equipment and materials	NRCS
Water Bars	$ 300.00	each			NRCS Nebraska Cost Estimator
Grassed Waterway	$ 690.00	acre		Best case Scenario with loose soil, no brush, and already tilled ($2245 ave.)	Means 1996 and Rogue River National Wet Weather Demonstration Project
Grassed Waterway	$ 3,800.00	acre		Worst Case Scenario in hard soil, with brush and dense vegetation ($2245 ave.)	Means 1996 and Rogue River National Wet Weather Demonstration Project
Stone Spillway	$ 9.50	square yard		3 member crew, foreman, heavy equipment and material	Means 1996 and adjusted for inflation
Diversions	$ 3.75	linear foot		grassed terrace to divert flow from tilled earth	NRCS and Means 1996
Habitat restoration					
Wetland Restoration	$ 2,350.00	acre		average of $500/acre and up	NRCS and Zbiciak
Channel block	$ 340.00	log structure	3-4/day	single log	Rogue River National Wet Weather Demonstration Project
Channel block	$ 480.00	log structure	2-3/day	triple height log	Rogue River National Wet Weather Demonstration Project
Channel block	$ 1,600.00	log structure	.5-1/day	crib wall: requires heavy equipment	Rogue River National Wet Weather Demonstration Project
Boulder Cluster	$ 59.20	cluster	25/day	varies depending on distance moved: requires heavy equipment	Rogue River National Wet Weather Demonstration Project
Cover logs	$ 290.00	log structure	5-10/day	3 member crew (requires heavy equipment)	Rogue River National Wet Weather Demonstration Project
Root wads	$ 300.00	wad	6-8/day	4 member crew (requires heavy equipment)	Rogue River National Wet Weather Demonstration Project
Tree Covers	$ 172.00	tree	8-12/day	If dropped in place or already in stream (requires heavy equipment)	Rogue River National Wet Weather Demonstration Project
Tree Covers	$ 215.00	tree	4-8/day	If they must me moved to site (requires heavy equipment)	Rogue River National Wet Weather Demonstration Project
Crib wall	$ 9.50	square foot	120+ feet/day	If done with heavy equipment	Rogue River National Wet Weather Demonstration Project
Crib wall	$ 36.50	square foot	20-30 feet/day	If done by hand	Rogue River National Wet Weather Demonstration Project
Log or Bank Shelter	$ 1,080.00	log structure	2/day	use in small streams with a low gradient (requires heavy equipment)	Rogue River National Wet Weather Demonstration Project
Deflectors	$ 390.00	log structure	2 pairs/day	requires highly experienced foreman to correctly size and place the structure	Rogue River National Wet Weather Demonstration Project

Channel Constrictors	$ 2,520.00	structure	1 pair/day	requires highly experienced foreman to correctly size and place the structure	Rogue River National Wet Weather Demonstration Project
Cross log	$ 680.00	structure	1-2/day	requires highly experienced foreman to correctly size and place the structure	Rogue River National Wet Weather Demonstration Project
Wedge and "K" dams	$ 1,360.00	dam	1/day	requires highly experienced foreman to correctly size and place the structure	Rogue River National Wet Weather Demonstration Project
Soil Stabilization					
Mulch	$ 500.00	acre		Using farm equipment	NRCS
Geotextile Fabric	$ 4.50	square yard		3 member crew, foreman, and material	Means 1996 adjusted for inflation
Seeding	$ 450.00	acre		includes site preparation using heavy equipment and 3 member crew	Means 1996 adjusted for inflation
Sodding	$ 13,068.00	acre		includes site preparation using heavy equipment and 3 member crew	Means 1996 adjusted for inflation
Check Dams	$ 15.00	linear foot		includes site preparation using heavy equipment and 3 member crew	Rogue River National Wet Weather Demonstration Project
Silt fence	$ 1.75	linear foot		Done with 3 member crew	Rogue River National Wet Weather Demonstration Project
Sediment Trap	$ 175.00	each		Done with 3 member crew	Rogue River National Wet Weather Demonstration Project
Road Crossing					
Box Culvert	$ 382.00	linear foot		36" culvert: excavation, crew, foreman, transporation, and installation	NPC Inc.
Bridge	$ 1,125.00	linear foot		72" culvert: excavation, crew, foreman, transporation, and installation	Bark River Culvert and Equipment
Cleaning	$ 8.50	cubic yard		Backhoe excavation of sediment	Rogue River National Wet Weather Demonstration Project
Equipment and Operator Rental					
Loader	$ 150.00	hour		includes operator	Rogue River National Wet Weather Demonstration Project
Excavator (backhoe)	$ 175.00	hour		includes operator	Rogue River National Wet Weather Demonstration Project
Dozer	$ 150.00	hour		includes operator	Rogue River National Wet Weather Demonstration Project
Crew	$ 30.00	hour			Rogue River National Wet Weather Demonstration Project
foreman	$ 50.00	hour			Rogue River National Wet Weather Demonstration Project
Design & legal				typically 25% to 30% of construction costs	Rogue River National Wet Weather Demonstration Project

Mobilization				3 to 5% of construction costs	Rogue River National Wet Weather Demonstration Project
Land Clearing	$	300.00	acre	clearing and grading smooth	NRCS
Excavation	$	3.50	cubic yard		Means 1996 and NRCS
Backfill	$	12.00	cubic yard		Means 1996 and NRCS
Grade and Compact	$	2.00	square yard		Means 1996 and NRCS

*** Prices are in 2002 dollars**

Information and Education Cost Estimates

Task	Costs	Units	Notes	Source
Promotional				
Flyer	$ 0.28	each	black and white	Grand Valley Community Survey
T-shirts	$ 12.50	each	Three color m,l, and XL	Grand Valley Community Survey
Video Production	$ 6,000.00	each		Grand Valley Community Survey
Telephone book inserts standard	$ 0.07	each	min order of $2500	Verizon Super Pages
Telephone book inserts new resident	$ 0.20	each	min order of $2500	Verizon Super Pages
Bathroom Advertising	$ 75.00	each/month	monthly rate for 11"x 17" plus $95 design and $2 reproduction	Johnny Avertising
Bathroom Advertising	$ 35.00	each/month	monthly rate for 8.5" x 11" plus $95 design and $2 reproduction	
Newspaper Ad	$ 32.00	square inch	Sunday paper full page ad about $4000	Muskegon Chronicle
Newspaper insert	$ 0.05	each	Cost of service only, reproduction is not included (1 sheet max)	Berrien County Drain Commission
Utility bill inserts	$ 0.50	each	Reproduction and distribution	Grand Valley Community Survey
Yellow Pages Ad	$ 5,000.00	each/year	Half Page Add in Yellow Pages	Verizon Super Pages
Watershed Logo Signs	$ 90.00	each	11x17" sign	Grand Valley Community Survey
Operational				
Project Manager/year	$ 29,120.00	$15/hour		Bear Creek Watershed Project
Intern/year	$ 20,800.00	$10/hour		Bear Creek Watershed Project
Vehicle/year	$ 15,000.00	each	does not include maintenance or insurance	Bear Creek Watershed Project
Mileage	$ 3,840.00	$0.32/mile		MDEQ
Fringes (20%)	$ 13,752.00		20 percent of total	MDEQ
Community Development				
Oridinance Development	$ 8,000.00		lawyer fees and meetings	Grand Valley Community Survey
Education				
School Presentation	$ 250.00	each	plus 20 hours preparation	Grand Valley Community Survey
4H Program	$ 39,000.00	annually	Management, Staff, and programs	Bear Creek Watershed Project
Demonstration Sites				
Agriculture	$ 1,350.00	each		Grand Valley Community Survey
demonstration booth	$ 200.00	each		Grand Valley Community Survey
Outreach				
Riparian Club	$ 8,000.00	annually		Grand Valley Community Survey
field trips	$ 16.00	each student		Grand Valley Community Survey

phone hotline	$	1,142.00		first year startup	Bell South
Oil recycling container	$	2.79	each	min order of 300 and $750 delivery	GEOPlastics
Adopt-a-Stream Program	$	3,200.00	annually		Grand Valley Community Survey
Evaluation					
Water Quality Monitoring	$	180,000.00	annually		Bear Creek Watershed Project
Stream Monitoring	$	25,000.00	annually		Bear Creek Watershed Project
Fieldwork					
Canoe trip	$	250.00	each		Grand Valley Community Survey
Watershed tours	$	200.00	each		Grand Valley Community Survey
Public Relations					
Public Meetings	$	250.00	each		Grand Valley Community Survey
Workshop	$	500.00	each	plus 40 hours preparation	Grand Valley Community Survey
Committee Meeting	$	25.00	each		Grand Valley Community Survey
Newsletters					
Mailing	$	0.30	each	bulk non-sorted	USPS
	$	0.12	each	presorted bulk mail rate	USPS
	$	600.00	year	application and accounting fees for bulk mailing	USPS
Color glossy	$	2.30	each		Allegan Conservation District
Inserts	$	0.12	each	black and white	Berrien County Drain Commission
Envelopes	$	0.03	each	business envelopes box of 500	Staples.com
Letter	$	0.27	each	envelop, postage, and form letter	

Appendix B: Grand Traverse Bay Watershed Protection Plan Information and Education Strategy

Grand Traverse Bay Watershed Protection Plan
Information and Education Strategy

This Information and Education (IE) Strategy addresses the communication needs associated with implementing the Grand Traverse Bay Watershed Protection Plan.

During the planning process, a variety of means were used to not only inform the public and other stakeholders regarding the planning process and outcomes, but to assess stakeholders' knowledge of watershed issues and concerns (Appendix A).

Newsletters, public meetings, presentations to clubs and civic groups, a project website and other tactics were used to keep stakeholders up-to-date with the planning process. At a series of meetings for both the public and governmental officials, a couple of simple assessment tools were used to gather input that was used in developing the plan. In addition, a phone survey was conducted regarding watershed residents' knowledge, behaviors and attitudes about the watershed and watershed issues. A series of focus groups were conducted with participants from various market segments (industry, small business, agriculture, etc.) to assess the attitudes of the business sector regarding water quality issues, barriers to protecting water quality from a businessperson's perspective and other relevant topics.

Other research, both regional and national, was utilized to develop this plan (Biodiversity Project 2003, Dement 1995, Roper 2001, Wolf HRWC).

Local Research Findings

During summer 2002 nearly 400 local residents were interviewed via phone utilizing a survey instrument developed by Northwestern Michigan College's MTEC Research Services and Watershed Center staff.

The most significant finding of the survey was the identification of a major gap in knowledge amongst watershed residents. 60% of the respondents answered "don't know" when asked which watershed they lived in. This basic fact indicates that watershed partner organizations have a long way to go in informing and engaging the public in watershed issues.

Although many area residents routinely express concern about environmental issues, there is a lack of understanding of the key issues that face the watershed. Residents perceive that business and industry (17%) and sewage treatment plants (16%) are the main causes of water pollution to the bay. In truth, the Grand Traverse Region is dominated by non-smokestack industries and comparatively few discharge permit holders. While there have been problems in the last few years with accidental and deliberate partially treated sewage discharges in both Traverse City and the Village of Suttons Bay; and a looming problem with septic systems and wastewater treatment in the Village of Northport, the primary sources of excess nutrients in the bay are non-point sources.

Additionally, when asked what they believe to be the "least cause of water pollution in the Bay, and area lakes, streams and rivers," respondents indicated the "day to day actions of individuals" as the second least likely pollutant. These two findings would seem to indicate that the general

public sees sources outside their individual control to be more responsible for existing and potential water quality problems.

Information Source	Percent
Newspaper	46.6%
TV News	13.7%
Environmental organization newsletters	7.3%
Friends, neighbors, coworkers	5.2%
Other organizations (churches, clubs, etc)	2.6
Magazines	2.3
Radio	1.6
Schools	1.3

Other key findings relevant to the development of this plan include data regarding where respondents get their information about the environment and water quality.

When this question was cross-tabulated with the respondents' age, more detail was revealed about where specific age demographic groups obtain their information about the environment.

Age Range	Preferred Source		Education Level	Preferred Source
18-25	Schools		**Graduate Degree**	Environmental newsletters or friends, neighbors and relatives
26-35	TV News		**Some post grad**	Environmental group newsletters, newspapers
36-55	Newspapers		**College degree**	Environmental group newsletters, newspapers
56-65	Environmental Newsletters		**Some college, high school or some high school**	Television news
66+	Newspapers			

Additional cross-tabulations were run to determine links between existing "environmentally-friendly" behaviors or education level and the respondents' perceptions and level of knowledge about water quality issues. The results indicate a correlation between existing environmentally-conscious behaviors and the depth of understanding about regional water quality issues.

- Respondents indicating they do recycle materials, other than cans or bottles, were more likely to indicate they think lawn fertilizers are the main cause of water pollution. Those who do not recycle materials other than cans or bottles were more likely to indicate they think either sewage treatment plants or recreational boating are the main cause of water pollution.

- Respondents that recycle materials other than cans or bottles were also more likely to indicate they think sewage treatment plants are the least cause of water pollution. Respondents who do not recycle think excavation and construction are the least causes of pollution.

- Respondents reporting some post-graduate study were more likely to indicate they think sewage treatment plants are the least cause of pollution. Respondents reporting some college were more likely to indicate they think agriculture and the day to day actions of individuals were the least cause of water pollution. Respondents reporting some high

school were more likely than other educational groups to indicate they think recreational boating, exotic species and lawn fertilizers are the least cause of water pollution.

Other Research Findings

Recent regional and national research surveys regarding the environment confirm the basic findings of the Grand Traverse Bay surveys. A recent Roper study (Roper 2001) indicates that while there is increasing public concern about the environment, the majority of the public still does not know the leading causes of such problems as water pollution, air pollution and solid waste. This finding was also confirmed in work done by The Biodiversity Project as part of their Great Lakes Public Education Initiative. Their research involved both a public opinion poll and a survey of organizations, agencies and institutions engaged in public education efforts on Great Lakes topics. An excerpt follows:

> "...organizations are making a concerted effort to provide reliable information to people who can make a difference when it comes to improving the environmental conditions in the Great Lakes Basin. However, the public opinion poll shows that, for the most part, people are just not grasping the importance of the issues facing the Great Lakes in three important ways: the seriousness of the threats, the need for urgency in taking action to address the threats, and ways that individuals can make a difference. This led us to examine the discrepancy between the level and focus of current communications and public education efforts and the gaps in public awareness. Because of this discrepancy, we concluded that the public knowledge gaps are likely to be attributed to other factors besides the content and volume of materials. Likely factors include the following three points.
>
> - Limited use of targeting (tailoring messages and delivery strategies to specific audiences).
> - Heavy reliance on printed materials and the Web – reaching already interested knowledge seekers; limited use of television and other communication tools that reach broader audiences.
> - Multiple, complex, detailed information as opposed to broad, consistent unifying themes."

The report goes on to conclude that educators need "to pay attention to a full spectrum of factors that act as barriers to the success and impact of public outreach." Factors to be considered include:

- **Targeting** – Avoid the one-size-fits-all approach.
- **Delivery** – As resources allow, use the mediums and venues that best reach the target audience. Brochures are easy, the web is cheap, but television is the most used source of information about the environment.
- **Content** – Facts and figures are important to validate a point, but it is important to address the emotional connection needed to address why people should care, why the issue is relevant, effective solutions and what your audience can do about it.
- **Context** – Many environmental threats are viewed by the public as long term issues. Issues need to be communicated in a way that makes them more tangible. Beach closings, toxic pollution, sewage spills and water exports tend to feel more immediate than loss of habitat, land use planning and other big picture issues that citizens feel more disconnected from.

The study identified a list of educational needs and actions that should be incorporated consistently in educational efforts:

- Promote understanding of the system.
- Make the connection to individuals.
- Be local and specific.
- Include a reality check on "real threats." (For example, industrial pollution was a hot topic ten years ago but, many organizations have shifted their education focus to other current and emerging threats, such as stormwater runoff, biodiversity, etc, but the public has not caught up with this shift.)
- Emphasis on "why is this important to you" messages.
- Make the connection to policy.

Research Summary

Both local and regional research indicates that there are considerable gaps in the public's knowledge and understanding of current environmental issues. But, this knowledge gap is tempered by keen public interest and concern for the environment. Watershed organizations need to do a better job of making issues of concern relevant to their audiences. There is a need for ongoing, consistent and coordinated education efforts targeted at specific groups, addressing specific threats.

The following IE strategy addresses some of these concerns. Both local and regional opinion research findings will be considered carefully when developing messages and delivery mechanisms for IE strategy implementation.

Goals and Objectives

The goal of the IE strategy is to ***"Establish and promote educational programs that support effective implementation of watershed planning goals, objectives and tasks; and increase stewardship."*** Fixing an erosion problem at a road stream crossing does not involve a high degree of public involvement. But, developing and carrying out a regional vision for stewardship of water resources will require the public and community leaders to become more knowledgeable about the issues and solutions, more engaged and active in implementing solutions and committed to both individual and societal behavior changes.

The objectives of this plan focus on building awareness, educating target audiences, and inspiring action. Five major objectives have been identified:

- To raise community awareness and knowledge of the bay and the entire watershed, the interconnectedness of the system and the role that an individual's day-to-day activities play in protecting the resource.
- To develop a set of consistent messages that can be used by partners in a variety of communications.
- To involve citizens, public agencies, user groups and landowners in the implementation of the watershed protection plan.
- To regularly inform stakeholders about the watershed, implementation activities and successes and opportunities to participate.
- Motivate target audiences to adopt behaviors and implement practices that result in water quality improvements.

Target Audiences

A number of diverse regional audiences have been identified as key targets for IE strategy implementation. The targets are divided into user groups and decision-making groups.

User Groups

Households – The general public throughout the watershed.

Riparian Landowners – Due to their proximity to a specific waterbody, the education needs of riparian landowners are different.

Agriculture Industry – Agriculture represents a significant economic segment within the Grand Traverse Bay watershed. Fruit orchards and vineyards dominate significant portions of the landscape and row crops, like potatoes and corn, are also well represented.

Business and Industry – There is a fairly diverse mix of business and industry segments within the watershed, although, luckily, very little traditional "smokestack" type industry is present. Tourism, agriculture, retail and other service industries dominate the mix, with manufacturing and construction following.

Tourists – Tourism is the number one industry in the Grand Traverse Region. This area is known for its scenic beauty and recreational opportunities and it is estimated that the Grand Traverse Region plays host to more than hundreds of thousands of visitors in any given year. This influx of people puts a noticeable strain on area infrastructure and often the environment. There is a growing concern that this important economic segment is possibly destroying the very reason why it exists, and that the region's tourism "carrying capacity" may soon be reached. Steering committee members and attendees at both public and government stakeholder meetings cited the need to "educate tourists about their role in protecting our environment."

Builders/Developers/Real Estate – The Grand Traverse region is one of the fasting growing areas in Michigan in terms of population and land use. The area has enjoyed a boom in both residential and commercial development that has lasted more than a decade and shows no signs of slowing down significantly, despite the economic problems much of the nation is experiencing. Members of the development industry segment play a crucial role in this growth and providing ongoing education opportunities about their role in protecting water quality and environmental health is critical.

Education – Area educators and students, primarily K-12.

Partner Organizations – The Grand Traverse Bay watershed region boasts an impressive list of watershed partner groups with a broad range of expertise and important ongoing protection, restoration and education programs. Providing ongoing learning opportunities to watershed partner organizations regarding current research, BMPs, emerging issues and trends is important to keep implementation work moving forward.

Special Target Audiences: In addition to the above, certain user groups such as recreational boaters, other sports enthusiasts, garden clubs or smaller audience segments may be targeted for specific issues.

Local Government Decision Makers

Elected and Appointed Officials – Township, village, city, and county commissioners; planning commissions; zoning board of appeals; road commissioners; drain commissioners; etc.

Governmental Staff – Planners, managers, township supervisors, zoning administrators, etc.

Message Development

General message outlines have been established for each target audience. These messages will be refined as implementation moves forward. They may also be modified or customized depending on the message vehicle.

Target Audience	Messages
Households	• Watershed awareness, the water cycle, key pollutant sources, how individual behaviors impact the watershed • Water quality-friendly lawn and garden practices • Housekeeping practices and the disposal of toxic substances • Septic maintenance • Managing stormwater on your property
Riparian Landowners	• Watershed awareness, the water cycle, key pollutant sources, how individual behaviors impact the watershed • Riparian land management including the importance of riparian buffers • Water quality-friendly lawn and garden practices • Septic system maintenance • Housekeeping practices and the disposal of toxic substances
Agriculture Industry	• The importance of establishing sound agricultural BMPs • Advantages of and opportunities for buffer and filter strips • Impacts of fertilizer/pesticide use and mitigation options • Impacts of livestock waste and mitigation options • Farmland conservation opportunities
Business and Industry	• Watershed awareness, the water cycle, key pollutant sources, how individual behaviors impact the watershed • Proper toxic chemical use, storage and disposal • Advantages of and opportunities for innovative stormwater management • The leadership role area businesses can play in protecting the watershed

Target Audience	Messages
Tourists	• Watershed awareness, the water cycle, key pollutant sources, how individual behaviors impact the watershed • Help us protect the beauty that you enjoy when you are a guest • Clean boating practices • Their role in controlling the spread of aquatic invasive species
Builders, Developers, Real Estate	• Advantages of and opportunities for Low Impact Development • Identification and protection of key habitats and natural features: aquatic buffers, woodlands, wetlands, steep slopes, etc. • Advantages of and opportunities for open space protection and financial incentives for conservation • Impact of earthmoving activities, importance of soil erosion and sedimentation control practices, construction BMPs • Watershed awareness, the water cycle, key pollutant sources, how individual behaviors impact the watershed
Education	• Adoption and promotion of a state-approved watershed curriculum in K-12 schools. • Watershed awareness, the water cycle, key pollutant sources, how individual behaviors impact the watershed • The connection between watershed organization's programs and school activities • Active participation in watershed protection activities and stewardship
Partner Organizations	• Consistent communication about key watershed issues to members and residents • Active participation in watershed activities and stewardship projects • Sharing data and developing comprehensive assessments of the health of the watershed
Local Government Decision Makers	• Watershed awareness, the water cycle, key pollutant sources, how individual behaviors impact the watershed • The leadership role that local governments can play in protecting the watershed • The importance of establishing sound, enforceable natural resource protection ordinances • Economic impact and advantages of environmental protection

Communication Strategies and Tasks

A complete list of tasks by category follows this narrative; the categories are the same as those used to outline the implementation tasks in Section 7.3. Over the next year, these tasks will be further organized by target audience.

Action Plan to Implement Strategies

Several priority areas for the Grand Traverse Bay watershed have been identified and the plan for rolling out the IE Strategy will correspond to these priority areas (Table 25, Figure 17). Additionally, the IE Strategy will support other implementation efforts to control nutrient loading, sedimentation, the impacts of stormwater throughout the watershed and other pollutants outlined in Section 7.3.

In the first year or two of implementation, considerable time and effort will be put toward introducing stakeholders to the watershed protection plan and its various findings and conclusions. Work to build awareness of basic watershed issues, pollutant sources and how individual behaviors impact the health of the watershed will also be completed.

The IE Strategy tasks use a diverse set of methods and delivery mechanisms. Workshops, presentations, demonstration projects, brochures, public and media relations, web sites and other communications tools will be used for the different tasks and target audiences. Broadcast media, most importantly television, is beyond the reach of most area partner organizations – at least at a level of reach, frequency and timing that can be expected to have any impact on awareness and behavior. This is a barrier to utilizing this effective medium, but effort will be placed on building coalitions that can pool resources to address larger picture issues through broader-based, more long-term communications efforts. It is hoped that this plan may be used to stimulate more and better collaboration in the area of public education.

INFORMATION AND EDUCATION STRATEGY IMPLEMENTATION TASKS

GOAL 6: Promote and establish educational programs that support watershed planning goals, objectives and tasks, and increase stewardship.
Pollutants Addressed: All

Categories:

1. General
2. Shoreline Protection and Restoration
3. Road Stream Crossings
4. Agriculture
5. Hydrology
6. Habitat, Fish and Wildlife
7. Stormwater
8. Wastewater
9. Human Health
10. Wetlands
11. Invasive Species
12. Land Protection and Management
13. Development
14. Zoning and Land Use
15. Groundwater
16. Monitoring

Organization Acronyms:

All – Any Partner Group
CDs – All Conservation Districts
Chambers – Chambers of Commerce
City of TC – City of Traverse City
CGOV – County Governments
CRA – Conservation Resource Alliance
ERCOL – Elk River Chain of Lakes Steering Committee
GRNA – Grass River Natural Area
GTBOCI – Grand Traverse Band of Ottawa and Chippewa Indians
GTRLC – Grand Traverse Regional Land Conservancy
Health Depts. – Local Health Departments
ISEA – Inland Seas Education Association
LA – Lake Associations
LC – Leelanau Conservancy
LIAA – Land Information Access Association
LGOV – Local Governments
Local Papers – Area Newspapers (i.e., Record Eagle, Antrim County News)
MDEQ – Michigan Department of Environmental Quality
MDNR – Michigan Department of Natural Resources
NMC – Northwestern Michigan College
NWMCOG – Northwest Michigan Council of Governments
MLUI – Michigan Land Use Institute
MSU-E – Michigan State University Extension
NRCS – USDA Natural Resources Conservation Service
RCs – Road Commissions
Sea Grant – Michigan State University Sea Grant Program
OWTTF – Onsite Wastewater Treatment Task Force
TCCVB – Traverse City Convention and Visitors Bureau
TOMWC – Tip of the Mitt Watershed Council
TWC – The Watershed Center Grand Traverse Bay
USCG – United States Coast Guard

Other Organizations:

Area Libraries
Boat/Marine Retailers
County Park Departments
Garden Centers
Home Builders Association
Landscaping Companies
Local Businesses
Marine Patrol
MSU-E Groundwater Stewardship
Newcomer's Club
New Designs for Growth
Neighborhood Associations
Road Commissions
Realtors, Board of Realtors

Target Audiences Include:
Agriculture
Builder/Developer/Realtor
Business and Industry
Education
Households
Local Governments
Partner Organizations
Riparian Landowners
Tourists
General

Estimated Costs and Timeframe:
For costs associated with salaries, an average watershed technician rate of $35/hour was applied. For tasks to be completed by a specialized consultant, a rate of $50/hour was used. Tasks that will be done on a yearly or site by site basis are noted as such ($X/yr or $X/site). Further details are noted where applicable. Tasks that should be completed in the short-term were given a timeframe of 3 years; long-term tasks were given a timeframe of 10 years; tasks that should be undertaken annually or continuously were given a timeframe of "ongoing."

Task Milestones:
Project milestones for specific tasks in the IE Strategy were established where feasible. The milestones identify when the noted task should be completed. They are meant to guide implementation priorities and measure progress of the IE Strategy. Similar milestones were defined for the implementation tasks outlined in Section 7.4.

Milestones for the IE Strategy were harder to define because many of the tasks are ongoing. Additionally, the best way to conduct outreach activities is continually evolving and depends on the audience one is trying to reach. This is why many of the IE tasks are general and only outline the audience to reach and the message to convey, but don't include specifically how to convey that message.

Key milestones for the IE Strategy include publishing the annual Freshwater Focus, conducting workshops for landowners on proper lawn care and the benefits of riparian buffers, establishing an educational program for stormwater, and providing information in the protection plan to local government officials (Table 39).

TABLE 39: SUMMARY OF PROJECT MILESTONES FOR IMPLEMENTATION TASKS IN THE INFORMATION AND EDUCATION STRATEGY

Task	Milestone and Timeline
IE: General	
Task 1, Subtask A: Quarterly newsletter.	Publish 3-4 newsletters/yr
Task 1, Subtask B: Annual *Freshwater Focus*	One issue/yr
Task 6: Operate Baykeeper hotline	Hotline established by 2007
IE: Shoreline Protection and Restoration	
Task 1, Subtask A: Provide education materials and conduct landowner workshops re lawn care, soil testing, and fertilizers	Host at least one workshop each year
Task 1, Subtask D: Promotions with landscaping and garden centers to provide relevant information	Make initial contact with businesses by 2006; promotional program in place by 2007
Task 2: Shoreline and riparian landowner workshops about riparian buffers	Host at least one workshop each year
Task 3: Develop native landscaping education program	Program developed and in place by 2007
Task 6: Establish or identify already existing shoreline buffers for demonstration projects and invite the public for tours; produce accompanying brochure	Produce accompanying brochure for buffer demonstration sites by 2008
IE: Road Stream Crossings	
None	
IE: Agriculture	
Task 1: Identify existing farms with conservation practices to serve as a demonstration site; Invite the public for tours and workshops.	Establish 1-2 demonstration farms by 2010; Host annual tour for public at each farm
IE: Hydrology	
None	
IE: Habitat, Fish, and Wildlife	
None	
IE: Stormwater	
Task 1: Public education program regarding the control of stormwater	Public education program in place by 2007
Task 3: Storm drain stenciling	One stormdrain stenciling event/yr
IE: Wastewater and Septics	
None	

TABLE 39: SUMMARY OF PROJECT MILESTONES FOR IMPLEMENTATION TASKS IN THE INFORMATION AND EDUCATION STRATEGY CONT'D

Task	Milestone and Timeline
IE: Human Health Issues	
Task 3: Print and distribute brochures regarding beach monitoring and factors affecting public health at swimming beaches.	Brochure developed by 2006
IE: Wetlands	
None	
IE: Invasive Species	
None	
IE: Land Protection and Management	
None	
IE: Development	
Task 1: Educate developers and contractors on proper stormwater and sediment management at construction sites.	One-two workshop/seminar/site tour each year
Task 3: Develop watershed information packet for realtors, developers, and other businesses to hand out to customers, new homeowners, and others on activities the can do to improve/protect water quality on their property.	Information packet developed and ready for distribution by 2007
IE: Zoning and Land Use	
Task 1: Provide key public officials with summary version of GT Bay Watershed Protection Plan and basic recommendations	Plan summary provided by 2006
Task 2: Educate and inform local planning and zoning officials regarding up-to-date information on planning, zoning, and design innovations relating to the protection of water quality.	Host one-two educational workshops for local officials each year (in addition to face-to-face meetings and phone calls)
IE: Groundwater	
None	
IE: Monitoring	
Task 1: Expand marketing and promotion efforts for Stream Search program	Expand Stream Search program into Leelanau County by 2007
Task 4: Develop public attitude survey (as well as follow up surveys) to determine and monitor the public's awareness regarding watershed and water quality issues.	Develop and conduct first public attitude survey by 2008

Information and Education Strategy: General

Task 1: Regularly inform the public about activities, study findings, successful example projects, and opportunities for contribution in the Grand Traverse Bay watershed.

Subtask A: Publish quarterly newsletter.

Estimated Cost: $3,500 each
Timeline: Ongoing
Priority: High
Potential Project Partners: TWC
Target Audience: General
Milestone: Publish 3-4 newsletters/yr

Subtask B: Publish annual *Freshwater Focus* (State of the Watershed) tabloid summarizing the overall condition of the region's water resources and highlighting current research, implementation accomplishments, monitoring programs and other topics relevant to the water quality of the bay.

Estimated Cost: $10,000/year
Timeline: Ongoing
Priority: High
Potential Project Partners: TWC
Target Audience: General
Milestone: One issue/yr

Subtask C: Provide watershed information and news to the local and regional media on a regular basis in the form of press releases, PSAs, feature stories, story ideas, editorials, etc.

Estimated Cost: $25,000/year
Timeline: Ongoing
Priority: High
Potential Project Partners: All
Target Audience: General

Subtask E: Develop TV and radio ads, public service announcements, print ads, etc., focusing on relevant water quality issues and basic watershed messages.

Estimated Cost: $25,000 development/$100,000-200,000 per year in media placement costs
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, TOMWC, GTCD, CRA, ISEA
Target Audience: General

Task 2: Maintain and promote a comprehensive website containing information about the watershed along with activities, events, ways to get involved, plan documents, links to relevant organizations and resources, etc.
Estimated Cost: $7,500/year
Timeline: Ongoing
Priority: High
Potential Project Partners: TWC, LIAA
Target Audience: All

Task 3: Host periodic, regional "Water Summit" for regional stakeholders to address priority issues impacting water quality, review implementation efforts and accomplishments, share resources, etc.
Estimated Cost: $10,000/year
Timeline: Ongoing
Priority: High
Potential Project Partners: TWC, TOMWC, NMC, NWMCOG, MSU-E
Target Audience: Local Government, Partners, General Public, Community Leaders (special target audience)

Task 4: Establish educational signage and kiosks throughout the watershed at parks, demonstration projects, beaches, marinas, boat launches, etc.
Estimated Cost: $250,000
Timeline: 10 years
Priority: Medium
Potential Project Partners: CDs, TWC, TOMWC, MDNR, County Park Departments, RCs, ERCOL, LA, ISEA
Target Audience: General

Task 5: Develop "tourist stewardship" brochure for dissemination at area hotels and tourist attractions regarding key watershed issues and desired visitor behaviors (i.e., keep the beach clean, don't dump waste, etc.).
Estimated Cost: $5,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, TCCVB**,** Chambers, ERCOL, LA
Target Audience: Tourists

Task 6: Operate 1-800-BAYKEEPER hotline to provide concerned citizens with a means to report known or suspected environmental regulation violations, seek help or guidance, get questions answered, etc.
Estimated Cost: $2,500/year
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, Local Businesses (for sponsors)
Target Audience: General
Milestone: Hotline established by 2007

Task 7: Develop comprehensive set of watershed maps and make available to landowners, local governments and others.
Estimated Cost: $5,000
Timeline: 3 years
Priority: Medium
Potential Project Partners: TWC, LIAA, LGOV
Target Audience: Local Governments, General Public, Partner Organizations

Task 8: Create a set of resources such as publications, maps, and other references re watershed issues to be housed at area libraries for public use. Examples include Clean Water Act references, watershed plans, maps, land use planning and land protection information, limnology, relevant periodicals, research, government reports, etc.
Estimated Cost: $7,500 first year, $1,000 year after
Timeline: 3 years
Priority: Medium
Potential Project Partners: TWC, Area Libraries
Target Audience: General

Task 9: Create small displays that would include a watershed brochure and a suggestion/concern box that could be placed in high tourist traffic areas.
Estimated Cost: $2,500
Timeline: 3 years
Priority: Medium
Potential Project Partners: TWC, TCCVB**,** Chambers
Target Audience: Tourists, Households

Task 10: Provide training to local citizens regarding environmental advocacy and the Clean Water Act.
Estimated Cost: $7,500
Timeline: 3 years
Priority: Medium
Potential Project Partners: TWC, TOMWC, ERCOL, LA
Target Audience: Households, Riparians

Task 11: Publish watershed or region-wide "Environmental Resource Directory" on a regular basis including mix of resources lists, simple tips, and advertising to support. (TWC/Record Eagle)
Pollutant/Environmental Stressors Reduced: Toxics
Estimated Cost: $10,000
Timeline: 3 years
Priority: Medium
Potential Project Partners: TWC, Local Papers, MSU-E
Target Audience: General

Task 12: In partnership with area tourism industry reactivate hotel program encouraging guests to re-use towels and sheets to conserve water resources using brochures, tent cards, etc,

Estimated Cost: $10,000 first year, $5,000 annually
Timeline: 3 years
Priority: Medium
Potential Project Partners: TWC, TCCVB, Chambers
Target Audience: Tourists

Task 13: Host annual "Get to Know Your Watershed" guided and/or self-guided tours.

Estimated Cost: $5,000
Timeline: 10 years
Priority: Low
Potential Project Partners: TWC, TOMWC, CDs, GTRLC, LC, ERCOL, LA, GRNA
Target Audience: General

Task 14: Develop a watershed-wide speaker's bureau as a resource for civic clubs and organizations, workshops, conferences, etc.

Estimated Cost: $2,500
Timeline: 10 years
Priority: Low
Potential Project Partners: TWC
Target Audience: General

Task 15: Develop educational 10-12 minute video about priority watershed issues for use in presentations.

Estimated Cost: $15,000
Timeline: 3 years
Priority: Low
Potential Project Partners: TWC
Target Audience: All

Information and Education Strategy: Shoreline Protection and Restoration

Task 1: Educate the public about environment-friendly lawn care, maintenance, and the application and use of fertilizers and pesticides.

Subtask A: Provide education materials (brochures, door hangers, pamphlets, etc.) and conduct landowner workshops regarding 1) the need for soil testing prior to fertilizer application, 2) the proper use of residential and commercial fertilizers with respect to the application amount, timing, frequency, location, method, and phosphorus content, and 3) the appropriate use of pesticides, etc.

Estimated Cost: $25,000/year
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, CDs, TOMWC, MSU-E, ERCOL, LA, GRNA
Target Audience: Household, Riparians
Milestone: Host at least one workshop each year

Subtask B: Increase public knowledge of the consequences of improper disposal of lawn and garden chemicals through news articles, workshops, and other media sources.

Estimated Cost: $10,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, CDs, TOMWC, MSU-E, ERCOL, LA, GRNA
Target Audience: Households, Riparians

Subtask C: Provide information to the public regarding environment-friendly lawn care contractors, where to buy low-phosphorous fertilizers, alternatives pest management practices and products, etc.

Estimated Cost: $10,000
Timeline: 3 years
Priority: Medium
Potential Project Partners: TWC, CDs, TOMWC, MSU-E, ERCOL, LA, GRNA
Target Audience: Households, Riparians

Subtask D: Develop promotions with landscaping and garden centers to provide educational brochures and workshops regarding native planting, "green landscaping," etc.

Estimated Cost: $10,000
Timeline: 3 years
Priority: Medium
Potential Project Partners: TWC, CDs, TOMWC, MSU-E, LA Garden Centers, ERCOL, GRNA
Target Audience: Households, Riparians
Milestone: Make initial contact with businesses by 2006; promotional program in place by 2007

Subtask E. Develop a certification or recognition program for "earth-friendly" landscapers and related businesses.

Estimated Cost: $10,000
Timeline: 3 years
Priority: Medium
Potential Project Partners: TWC, CDs, TOMWC, MSU-E, ERCOL, LA
Target Audience: Households, Riparians

Task 2: Conduct shoreline and riparian landowner workshops to stress the benefits and importance of riparian buffers to protect water quality.

Estimated Cost: $10,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, CDs, TOMWC, MSU-E, ERCOL, LA, GRNA
Target Audience: Riparians
Milestone: Host at least one landowner workshop each year

Task 3: Develop native landscaping education program including workshops, demonstrations, and brochures.

Estimated Cost: $50,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, CDs, TOMWC, MSU-E, ERCOL, LA Landscaping Companies, GRNA
Target Audience: Households, Riparians
Milestone: Program developed and in place by 2007

Task 4: Initiate education efforts in Boardman Lake watershed that promote the essential link between land use and water quality protection and improvement. This includes promoting the retention or establishment of shoreline vegetative buffers, the minimizing of vegetation removal and mowing to the water's edge, and discouraging the dumping of grass clippings and other yard/solid wastes into the water.

Pollutant/Environmental Stressors Reduced: Changes to Hydrology, Loss of Habitat, Nutrients, Thermal Pollution, Toxics, Sediment, Pathogens

Estimate Cost: $15,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, LGOV

Task 5: Produce or distribute existing riparian and/or shoreline landowners' guidebooks.

Estimated Cost: $10,000
Timeline: 3 years
Priority: Medium
Potential Project Partners: TWC, CDs, TOMWC, MSU-E, LA
Target Audience: Riparians

Task 6: Establish or identify already existing shoreline buffers for demonstration projects and invite the public for tours; produce accompanying brochure.

Related Task: See Section 7.3 – Shoreline Protection and Restoration Task 4

Estimated Cost: $10,000
Timeline: 3 years
Priority: Medium
Potential Project Partners: TWC, CDs, TOMWC, MSU-E, LA, GRNA
Target Audience: Riparians
Milestone: Produce accompanying brochure for buffer demonstration sites by 2008

Task 7: Develop comprehensive composting education program including workshops and demonstrations.

Estimated Cost: $25,000
Timeline: 3 years
Priority: Medium
Potential Project Partners: TWC, CDs, TOMWC, MSU-E, GTBOCI, LA, GRNA
Target Audience: Households, Riparians

Task 8: Educate boaters and marina operators regarding environmentally-friendly boating and fueling practices including: avoiding illegal sewage and graywater discharges, fuel spills, engine maintenance, etc.

Estimated Cost: $25,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, MDNR, Marine Patrol, Boat/Marine Retailers**,** USCG, ERCOL, LA, ISEA
Target Audience: Recreational Boaters, Marinas (special target audience)

Task 9: Develop a realtor and developer educational program aimed at providing new homeowners with information regarding water quality and watershed issues at the point-of-sale.

Estimated Cost: $10,000
Timeline: 3 years
Priority: Medium
Potential Project Partners: TWC, TOMWC, Board of Realtors, ERCOL, LA
Target Audience: Builder/Developer/Realtor, Households

Information and Education Strategy:
Road Stream Crossings

Task 1: Host workshops for County Road and Drain Commissions to provide education regarding possible BMPs to establish at road crossings to reduce the harmful effects of sedimentation and stormwater runoff.

Estimated Cost: $5,000
Timeline: 10 years
Priority: Medium
Potential Project Partners: CDs, TWC, TOMWC, CRA, ERCOL, LA, GRNA
Target Audience: Local Governments

Information and Education Strategy: Agriculture

Task 1: Identify existing farms with conservation practices to serve as a demonstration site. Invite the public for tours and workshops.

Estimated Cost: $10,000
Timeline: 10 years
Priority: Medium
Potential Project Partners: MSU-E, CDs, NRCS
Target Audience: Agriculture, Households
Milestone: Establish 1-2 demonstration farms by 2010; Host annual tour for public at each farm

Task 2: Educate farmers using manure about proper manure management for their fields. Stress the use of 1) properly designed, constructed, and sited (including consideration of the proximity to surface waters) manure storage facilities, 2) properly maintained and operated manure storage facilities to prevent leaks, overflows, and the need for untimely emptying, and 3) applying manure to properly designated fields at appropriate times

Estimated Cost: $15,000
Timeline: 10 years
Priority: High
Potential Project Partners: NRCS, CDs, MSU-E
Target Audience: Agriculture

Task 3: Encourage farm market vendors to provide information about BMPs they are using on their farms.

Estimated Cost: $2,500
Timeline: Ongoing
Priority: Medium
Potential Project Partners: TWC, City of TC, LGOV, MSU-E, NRCS
Target Audience: Households

Information and Education Strategy: Hydrology

Task 1: Work with public officials to educate affected residents and others regarding key issues surrounding the removal of dams along the Boardman River.

Estimated Cost: $2,500
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, CDs, MDNR, MDEQ, MLUI, LGOV
Target Audience: Riparians

Task 2: Work with local officials when needed to educate them and affected citizens regarding key issues and benefits surrounding the removal of dam and other water control structures in the watershed.

Estimated Cost: $2,500 per occurrence
Timeline: 10 years
Priority: Low
Potential Project Partners: TWC, CDs, MDNR, MDEQ, MLUI, LGOV
Target Audience: Riparians

Information and Education Strategy: Habitat, Fish, and Wildlife

Task 1: Provide education to the general public on the importance of maintaining diverse wildlife habitats and developing wildlife corridors on their property.
Estimated Cost: $25,000
Timeline: 3 years
Priority: High
Potential Project Partners: CRA, CDs, NRCS, GRNA, ERCOL, LA
Target Audience: Households, Agriculture, Local Government

Task 2: Educate the public regarding CRA's Wild-Link program through 1) conducting tours to existing lands enrolled in Wild-Link program and 2) mailed packets of information to potential landowners.
Estimated Cost: $10,000
Timeline: 3 years
Priority: High
Potential Project Partners: CRA, CDs
Target Audience: Households, Agriculture, Local Government

Task 3: Educate public officials through workshops, demonstration tours, and information packets regarding the impacts of increased land fragmentation on wildlife habitat and corridors.
Estimated Cost: $10,000
Timeline: 3 years
Priority: High
Potential Project Partners: CRA, CDs, NRCS, GRNA, ERCOL, LA
Target Audience: Local Government

Information and Education Strategy: Stormwater

Task 1: Develop comprehensive public education program regarding the control of stormwater including the following components: door hangtags, utility bill inserts, workshops, brochures, newspaper articles, PSAs, radio and TV advertisement campaigns, radio talk shows, and print advertising.

Estimated Cost: $100,000/year
Timeline: Ongoing
Priority: High
Potential Project Partners: TWC, TOMWC, CDs, LGOV, GRNA, ERCOL, LA
Target Audience: Households, Riparians
Milestone: Public education program in place by 2007

Task 2: Provide general stormwater education for local units of government that stresses the benefits of 1) managing the amount of impervious surfaces in the watershed, 2) reducing the filling and development of wetlands, which provide temporary holding of stormwater, and 3) implementing stormwater BMPs and low-impact design practices to minimize stormwater flows. Examples of BMPs and low-impact design practices include:

- Vegetative Filter Strips: Filter Strips/Aquatic Buffers, Wet Swales, Dry Swales, Grass Channels
- Stormwater Filtering Systems: Bioretention and Surface, Perimeter, Organic, Underground, Pocket Sand Filters
- Infiltration Practices: Infiltration Trench or Basin, Porous Pavement
- Retention and Detention Ponds
- Other Low Impact Design Elements: Rain/Roof Gardens, Native Plantings, Riparian Buffers

(From the Center for Watershed Protection's Approaches to Stormwater Treatment and Stormwater Practice and Design CDs, Watershed Leadership Kit Volumes 4 and 5.)

Estimated Cost: $25,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, MDEQ, TOMWC, NWMCOG, GRNA, ERCOL, LA
Target Audience: Local Governments

Task 3: Implement an annual watershed-wide storm drain stenciling event involving municipalities, neighborhood associations, and other volunteer groups.

Estimated Cost: $3,500/year
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, LGOV, Neighborhood Associations, GRNA, ERCOL, LA
Target Audience: Households, Riparians
Milestone: One stormdrain stenciling event/yr

Task 4: Partner with neighborhood associations to host presentations and workshops on controlling stormwater on their properties, etc.

Estimated Cost: $5,000
Timeline: 10 years
Priority: Medium
Potential Project Partners: TWC, Neighborhood Associations, GRNA, ERCOL, LA
Target Audiences: Households, Riparians

Information and Education Strategy:
Wastewater

Task 1: Develop comprehensive public education program regarding septic systems including:

- Using proper septic system design for the site conditions and considering the proximity to bodies of water when siting them,
- Properly maintain existing septic systems, and
- Providing education regarding the development of alternative onsite wastewater treatment systems.

The following components will be used: door hangtags, utility bill inserts, workshops, brochures, newspaper articles, PSAs, radio and TV advertisement campaigns, radio talk shows, and print advertising.

Estimated Cost: $75,000/year
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, TOMWC, Health Depts., OWTTF, GRNA, ERCOL, LA
Target Audience: Households, Riparians

Information and Education Strategy: Human Health

Task 1: Implement a 'Do Not Feed the Waterfowl or Seagulls' campaign in watershed including PSAs, signage, articles, brochures, etc.
Estimated Cost: $100,000
Timeline: 10 years
Priority: High
Potential Project Partners: TWC, LGOV, GRNA, ERCOL, LA
Target Audience: Households, Tourists, Riparians

Task 2: Implement a 'Pick Up Your Pet Waste' program in urban areas throughout the watershed.
Estimated Cost: $100,000
Timeline: 10 years
Priority: High
Potential Project Partners: TWC, LGOV
Target Audience: Households, tourists

Task 3: Print and distribute brochures regarding beach monitoring and factors affecting public health at swimming beaches.
Estimated Cost: $5,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, Health Depts.
Target Audience: Households, Riparians, Tourists
Milestone: Brochure developed by 2006

Task 4: Educate the public regarding health risks associated with backyard trash burning and encourage alternative methods of disposal such as composting, recycling and utilizing hazardous materials disposal facilities and drop-off events.
Estimated Cost: $10,000
Timeline: 3 years
Priority: Medium
Potential Project Partners: GTBOCI, TWC, Health Depts., GRNA, ERCOL, LA, County Resource Recovery Departments
Target Audience: Households, Riparians, Agriculture

Task 5: Provide education regarding health risks to individuals and communities from improper disposal of hazardous wastes. Provide information regarding proper disposal of household hazardous waste and pharmaceuticals. Provide information on alternative products and methods and promote participation in household hazardous waste collection events.

Estimated Cost: $25,000
Timeline: 3 years
Priority: High
Potential Project Partners: GTBOCI, TWC, Health Depts., ERCOL, LA, GRNA, CDs, LGOV, County Resource Recovery Departments
Target Audience: Households, Riparians

Task 6: Encourage and promote the proper disposal of used electronic devices; provide information regarding disposal options and promote periodic drop off events.

Estimated Cost: $5,000
Timeline: Ongoing
Priority: High
Potential Project Partners: County Resource Recovery Departments, TWC, GTBOCI, ERCOL, LA, LGOV
Target Audience: Households, Riparians, Business and Industry

Information and Education Strategy: Wetlands

Task 1: Educate local governments, developers, contractors, and others through workshops and presentations, press releases, brochures, etc, regarding the ecological consequences of developing unregulated wetland areas, especially in headwater/recharge areas and along the Grand Traverse Bay shoreline.

Estimated Cost: $10,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, TOMWC, GRNA, ERCOL, LA
Target Audience: Local Governments, Builder/Developer/Realtor

Task 2: Educate the public and public officials regarding the benefits of wetlands through workshops, demonstrative site tours, newspaper articles, PSAs, radio and TV advertisement campaigns, radio talk shows, print advertising, etc.

Estimated Cost: $100,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, TOMWC, GRNA, ERCOL, LA
Target Audience: Households, Riparians, Local Governments, Builder/Developer/Realtor

Task 3: Educate and communicate to Great Lakes shoreline owners the current beach maintenance regulations, the value and proper care of emergent coastal wetlands, and the benefit of keeping these wetlands in a natural state. Disseminate existing brochures, mail letters, host 'town meetings', etc.

Estimated Cost: $10,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, TOMWC, LGOV
Target Audience: Riparians, Tourists, Local Governments

Task 4: Host a series of workshops and seminars throughout the watershed to educate public officials regarding appropriate and successful methods for restoring wetlands.

Estimated Cost: $10,000
Timeline: 3 years
Priority: Medium
Potential Project Partners: TWC, TOMWC
Target Audience: Local Governments

Information and Education Strategy:
Invasive Species

Task 1: Educate local residents and visitors regarding the negative impacts of and appropriate control and eradication measures for both aquatic and terrestrial invasive species (including Eurasian water milfoil, purple loosestrife, zebra mussels, etc).

Estimated Cost: $25,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, GRNA, MSU-E, ISEA, CDs, Sea Grant, GRNA, ERCOL, LA
Target Audience: Households, Riparians, Tourists

Task 3: Develop simple fact sheet or brochure to use as a handout at garden centers regarding terrestrial invasive species, including photos, drawings and eradication methods.

Estimated Cost: $5,000
Timeline: 3 years
Priority: Medium
Potential Project Partners: TWC, MSU-E, Sea Grant, GRNA, ERCOL, LA, Local Businesses
Target Audience: Households, Riparians

Task 4: Create and distribute a resource list for native plant species.
See related tasks under Shoreline Protection and Restoration category.

Estimated Cost: $5,000
Timeline: 3 years
Priority: Medium
Potential Project Partners: TWC, MSU-E, CDs, GRNA, ERCOL, LA
Target Audience: Households, Riparians

Information and Education Strategy:
Land Protection and Management

Task 1: Provide landowner education regarding voluntary conservation easements and other available land protection measures utilizing direct mail, publications, etc. Schedule bus tours of areas already in conservation easements to provide examples of successful efforts.

Estimated Cost: $50,000
Timeline: 10 years
Priority: High
Potential Project Partners: GTRLC, LC, CDs
Target Audience: Households, Riparians

Task 2: Develop a public awareness program to inform the public of ecologically sound riparian and coastal wetland land management practices.

See related tasks under Shoreline Protection and Restoration category.

Estimated Cost: $50,000
Timeline: 3 years
Priority: High
Potential Project Partners: GTRLC, LC, LGOV, MDEQ
Target Audience: Households, Riparians

Information and Education Strategy: Development

Task 1: Host workshops, seminars, and site tours to educate developers and contractors on proper stormwater and sediment management at construction sites.

Estimated Cost: $10,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, ERCOL, LA, Home Builders Association, Realtors
Target Audience: Builder/Developer/Realtor
Milestone: One-two workshop/seminar/site tour each year

Task 2: Compile information packet and host workshops, luncheons, or small seminars for area realtors providing them with basic information regarding environmental laws (wetlands, beach maintenance, onsite wastewater treatment, etc.) that might impact new homeowners.

Estimated Cost: $10,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, TOMWC, ERCOL, LA
Target Audience: Households, Riparians, Builder/Developer/Realtor

Task 3: Develop watershed information packet for realtors, developers, and other businesses to hand out to customers, new homeowners, and others on activities the can do to improve/protect water quality on their property.

Estimated Cost: $10,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, TOMWC, ERCOL, LA, Chambers, Newcomer's Clubs
Target Audience: Households, Riparians, Builder/Developer/Realtor
Milestone: Information packet developed and ready for distribution by 2007

Task 4: Encourage design, construction and maintenance of new and existing development in the watershed that utilizes Best Management Practices to protect water quality.

Estimated Cost: $10,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, ERCOL, LA, Home Builders Association, TOMWC, New Designs for Growth
Target Audience: Builder/Developer/Realtor, Local Government

Information and Education Strategy: Zoning and Land Use

Task 1: Provide key elected/appointed public officials (planning commissioners, etc.) with summary version of Grand Traverse Bay Watershed Protection Plan and basic recommendations relevant to local units of government.

Estimated Cost: $2,500
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, LA, GRNA
Target Audience: Local Governments
Milestone: Plan summary provided by 2006

Task 2: Educate and inform local planning and zoning officials regarding up-to-date information on planning, zoning, and design innovations relating to the protection of water quality. Utilize MDEQ book titled "Filling the Gaps: Environmental Protection Options for Local Governments".

Estimated Cost: $10,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, LGOV, NWMCOG, GRNA, LA
Target Audience: Local Governments
Milestone: Host one-two educational workshops for local officials each year (in addition to face-to-face meetings and phone calls)

Task 3: Develop an information packet for Zoning Boards of Appeals and Planning Commissions to assist them in developing reasonable conditions to place on requests for variances (i.e., installing or providing riparian buffers and/or other BMPs on site).

Estimated Cost: $10,000 initial year; $2,500/yr after packet is completed
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, LGOV, NWMCOG, GRNA, LA
Target Audience: Local Government

Task 5: Facilitate meetings between townships regarding the sharing of model ordinances that protect water quality and natural resources.

Estimated Cost: $5,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, TOMWC, LGOV, NWMCOG, LA
Target Audience: Local government

Information and Education Strategy: Groundwater

Task 1: Educate local governments, developers, contractors, and others regarding headwater and groundwater recharge areas (how they work, soils, vegetation, etc.) and why it is important to protect them and avoid overdeveloping them.

Estimated Cost: $25,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, MSU-E Groundwater Stewardship, CDs, ERCOL, LA
Target Audience: Local Government, Builder/Developer/Realtor

Information and Education Strategy: Monitoring

Task 1: Expand marketing and promotion efforts for TWC's Stream Search program utilizing public relations, giveaways for participants, sponsorships, etc.

Estimated Cost: $10,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC
Target Audience: General
Milestone: Expand Stream Search program into Leelanau County by 2007

Task 2: Provide ongoing information to stakeholders regarding research and monitoring efforts conducted by the TWC and various partner organizations in the watershed and what it means to various target audiences (through documents such as the annual *Freshwater Focus* newspaper insert, TWC website, press releases, etc).

Estimated Cost: $5,000
Timeline: 3 years
Priority: High
Potential Project Partners: TWC, ISEA, TOMWC, GTBOCI, ERCOL, LA, GRNA
Target Audience: All

Task 3: Enter results of WQ testing into TWC's online, interactive water quality database.

Estimated Cost: $5,000/year
Timeline: ongoing
Priority: High
Potential Project Partners: TWC
Target Audience: All

Task 4: Develop public attitude survey (as well as follow up surveys) to determine and monitor the public's awareness regarding watershed and water quality issues.

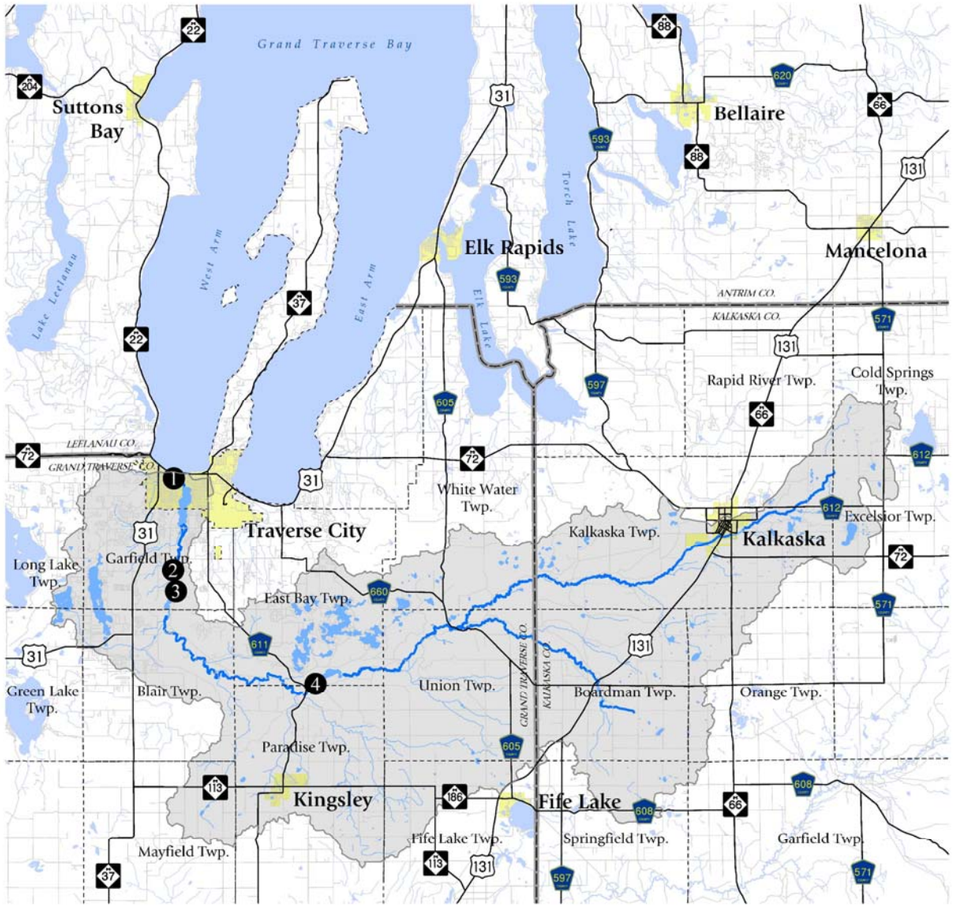
Estimated Cost: $15,000/survey
Timeline: ongoing
Priority: High
Potential Project Partners: TWC
Target Audience: All
Milestone: Develop and conduct first public attitude survey by 2008

Task 5: Maintain a list of ongoing and completed environmental projects in the watershed, along with their accomplishments and what organizations are working on them.

Estimated Cost: $500/yr
Timeline: ongoing
Priority: High
Potential Project Partners: TWC
Target Audience: N/A

Appendix C: Boardman River Watershed Capital Projects List

Boardman River Watershed Prosperity Plan
CAPITAL PROJECTS PROGRAM



THE BOARDMAN RIVER WATERSHED

Regional Context Map

ROTARY CHARITIES of TRAVERSE CITY

Participating Stakeholder Agencies

Grand Traverse Band of Ottawa and Chippewa Indians
Conservation Resource Alliance
The Grand Traverse Bay Watershed Center
Traverse Area Recreational and Transportation Trails, Inc.
Traverse City Downtown Development Authority
City of Traverse City
Kalkaska Downtown Development Authority
Grand Traverse Conservation District
Local Access and Information Association
Village of Kingsley

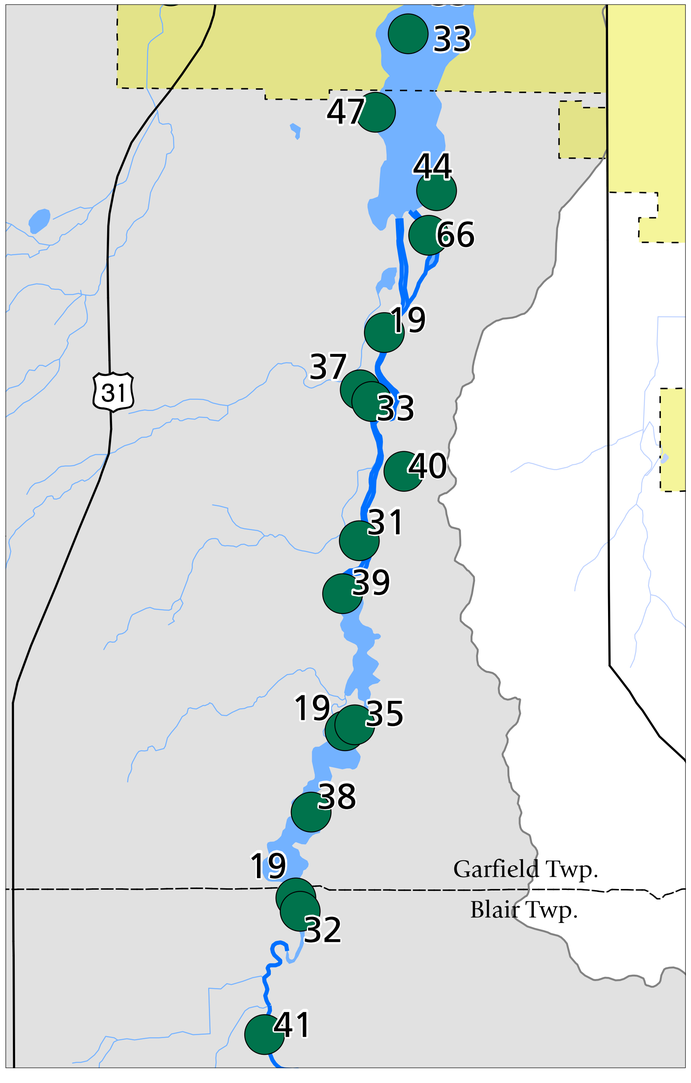
April 2016

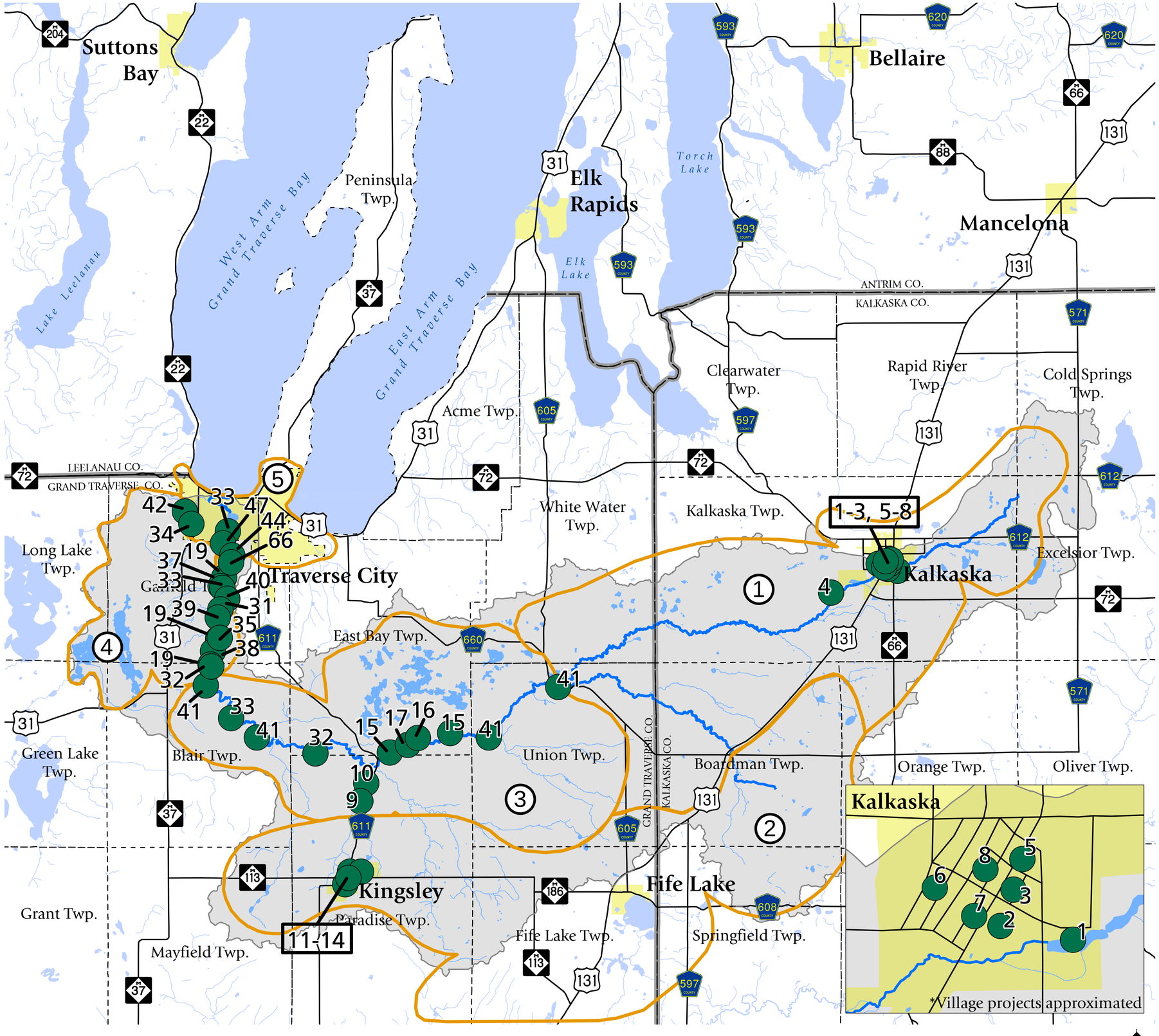
THE BOARDMAN RIVER WATERSHED

Capital Improvement Plan Projects

Data Sources: Michigan Geographic Data Library, Michigan DNR

- Boardman River Watershed
- City or Village
- Character Zones
- County Boundary
- Township Boundary
- Major Road
- Boardman River
- Planned CIP Projects





Beckett&Raeder

BOARDMAN PROSPERITY PLAN - CAPITAL PROJECTS

					Committed Funding						
MAP#	Zone	Project Name	Budget	Funds Available	*Federal*	*State*	*Other*	Balance Needed to Complete	Lead Agency	Timeframe	Access	Educational
1	1	Kalkaska Mill Pond Dam Removal	$ 350,000.00					$ 350,000.00	KCCD	Long	Y	
2	1	Railroad Square Development	$ 900,000.00	$ -	$ -	$ -	$ -	$ 900,000.00	KDDA	Mid		
3	1	Visitors Community Information Center	$ 200,000.00	$ -	$ -	$ -	$ -	$ 200,000.00	KDDA	Mid		
4	1	North Country Trail	$ 350,000.00	$ -	$ -	$ -	$ -	$ 350,000.00	KDDA	Mid		
5	1	Theater Renovation	$ 900,000.00	$ -	$ -	$ -	$ -	$ 900,000.00	KDDA	Mid		
6	1	New Library	$ 3,200,000.00	$ -	$ -	$ -	$ -	$ 3,200,000.00	KDDA	Mid		
7	1	US-131 Coordor (Redevelopment/Brownsfields)	$ 75,000.00	$ -	$ -	$ -	$ -	$ 75,000.00	KDDA	Near		
8	1	Multi-Family Housing (Site Identification)	$ 25,000.00	$ -	$ -	$ -	$ -	$ 25,000.00	KDDA	Near		
9	1	Kalkaska Intra-Village Trail	$ 3,000,000.00					$ 3,000,000.00	KDDA	Long		
		Zone 1 Subtotal	**$ 9,000,000.00**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 9,000,000.00**				
10	2	Garfield Road Snowmobile Trail Relocation (Mayfield Road)	$ 150,000.00					$ 150,000.00	GTCD	Long		
11	2	Kingsley Village - Mid School Trail and Nature Walk	$ 100,000.00					$ 100,000.00	Kingsley	Near		
12	2	Kingsley Village Rail-Trail (High School to Eden Road / Brown Street)	$ 400,000.00					$ 400,000.00	Kinglsey	Mid		
13	2	Kingsley Village to Mayfield Pond Non-Motorized Trail	$ 600,000.00					$ 600,000.00	Kingsley	Long		
14	2	Kingsley Redevelopment Projects	$ 500,000.00	$ 50,000.00	$ -	$ -	$ 50,000.00	$ 450,000.00	Kingsley	Mid		
		Zone 2 Subtotal	**$ 1,750,000.00**	**$ 50,000.00**	**$ -**	**$ -**	**$ 50,000.00**	**$ 1,700,000.00**				
15	3	Brown Bridge Recreation Bridges	$ 300,000.00				$ 300,000.00	$ -	GTCD	Near		
16	3	Brown Bridge Wood Installation	$ 200,000.00				$ 200,000.00	$ -	NRCS	Near		
17	3	Carrying Capacity Study after Dam Removals	$ 75,000.00					$ 75,000.00	GTCD	Mid		
18	3	Jaxson Creek Crossing (2 Crossings)	$ 500,000.00					$ 500,000.00	GTCD	Mid		
19	3	Universal Access Launches (5 Sites)	$ 500,000.00					$ 500,000.00	GTCD	Mid		
20	3	Bucks Landing Renovation (TC ID#849)	$ 30,000.00					$ 30,000.00	Traverse City	Mid	Y	
21	3	Crushed Limestone Bottomlands Trail (TC ID#850)	$ 23,750.00					$ 23,750.00	Traverse City	Near	Y	
22	3	Historic Brown Bridge Pedestrian Crossing (TC ID#847)	$ 250,000.00					$ 250,000.00	Traverse City	Near	Y	
23	3	Brown Bridge Interpretive and Navigational Signage (TC ID#851)	$ 20,000.00					$ 20,000.00	Traverse City	Near		Y

BOARDMAN PROSPERITY PLAN - CAPITAL PROJECTS

					Committed Funding						
MAP#	Zone	Project Name	Budget	Funds Available	*Federal*	*State*	*Other*	Balance Needed to Complete	Lead Agency	Timeframe	Access	Educational
24	3	Ranch Rudolph Road Parking Lot (TC ID#863)	$ 30,000.00					$ 30,000.00	Traverse City	Mid	Y	
25	3	Brown Bridge Overlook and Access Steps (TC ID#856)	$ 85,000.00				*$ 10,000.00*	$ 75,000.00	Traverse City	Near	Y	
26	3	Brown Brown Overlook and Historical Display	$ 15,000.00					$ 15,000.00	Traverse City	Mid	Y	Y
27	3	Brown Bridge Overlook and Display of Former Powerhouse (TC ID#855)	$ 15,000.00					$ 15,000.00	Traverse City	Mid		Y
28	3	Brown Bridge Upper Trail Connector (TC ID#51)	$ 80,000.00				*$ 2,500.00*	$ 77,500.00	Traverse City	Mid	Y	
		Zone 3 Subtotal	**$ 2,123,750.00**	**$ -**	**$ -**	**$ -**	**$ 512,500.00**	**$ 1,611,250.00**				
29	4	South Cass Street Bridge Repair	$ 852,000.00	$ 122,000.00			*$ 122,000.00*	$ 730,000.00	Traverse City	Near		
30	4	Boardman River Dam Removal	$ 8,400,000.00	$ 8,400,000.00	*$ 8,400,000.00*			$ -	USACE	Mid	Y	
31	4	Boardman River Trail, Boardman Lake to Nature Education Center, Keystone Soccer	$ 175,000.00					$ 175,000.00	GTCD	Mid	Y	
32	4	Boardman River Trail, Nature Education to Mayfield Pond Park	$ 50,000.00					$ 50,000.00	TART	Near		
33	4	Boardman Water Trails and Trail Town Planning	$ 40,000.00	$ 40,000.00		*$ 20,000.00*	*$ 20,000.00*	$ -	LIAA	Near	Y	Y
34	4	Buffalo Ridge Trail (Division and 14th along old railroad line)	$ 325,000.00					$ 325,000.00	Traverse City	Near		
35	4	Cass Road Bridge Replacement	$ 3,100,000.00					$ 3,100,000.00	GTCRC	Near	Y	
36	4	Dam Removal Feasibility, NEPA, USACE costs	$ 2,000,000.00	$ 1,300,000.00	*$ 1,300,000.00*	*$ -*	*$ -*	$ 700,000.00	USACE	Mid		
37	4	Miller Creek Road and Railroad Crossing	$ 450,000.00					$ 450,000.00	GTCD	Near		
38	4	Nature Education Reserve Non-Motorized Bridges (Sabin, Cass Rd. and Lone Pine)	$ 1,000,000.00					$ 1,000,000.00	GTCD	Mid	Y	Y
39	4	Sabin Dam Removal	$ 2,700,000.00	$ 1,755,000.00	*$ 1,755,000.00*		*$ -*	$ 945,000.00	USACE	Near	Y	
40	4	Garfield Township Templeton Property	$ 400,000.00					$ 400,000.00	Garfield Twp	Mid		
41	4	Universal Access Launches (2 Sites)	$ 200,000.00					$ 200,000.00	GTCD	Mid		
		Zone 4 Subtotal	**$ 19,692,000.00**	**$ 11,617,000.00**	**$ 11,455,000.00**	**$ 20,000.00**	**$ 142,000.00**	**$ 8,075,000.00**				
42	5	Kids Creek Restoration	$ 6,000,000.00	$ 3,200,000.00	*$ 3,200,000.00*			$ 2,800,000.00	Watershed Center	Near	Y	Y
43	5	200 East Front Block Alley Enhancements (TC ID#714)	$ 817,000.00	$ -				$ 817,000.00	Traverse City	Mid		
44	5	Boardman Lake / River Trail Grade Separated Crossing at South Airport Road	$ 1,593,750.00					$ 1,593,750.00	GTCRC	Mid	Y	Y
45	5	Boardman Lake Trail south of 8th Street Bridge (TC ID#316)	$ 515,000.00					$ 515,000.00	Traverse City	Long	Y	
46	5	Boardman Lake Avenue 8th to 14th (TC ID#864)	$ 3,564,750.00	$ -	*$ -*	*$ -*	*$ -*	$ 3,564,750.00	Traverse City	Mid		

BOARDMAN PROSPERITY PLAN - CAPITAL PROJECTS

					Committed Funding						
MAP#	Zone	Project Name	Budget	Funds Available	*Federal*	*State*	*Other*	Balance Needed to Complete	Lead Agency	Timeframe	Access	Educational
47	5	Boardman Lake Trail West 14th to S. Airport (TC ID#570)	$ 2,793,000.00					$ 2,793,000.00	Traverse City	Long	Y	
48	5	Carnegie Building Repairs (TC ID#924)	$ 170,000.00	$ 170,000.00			*$ 170,000.00*	$ -	Traverse City	Near		
49	5	Civic Square	$ 6,000,000.00	$ 1,000,000.00			*$ 1,000,000.00*	$ 5,000,000.00	Traverse City	Long		
50	5	Downtown Traverse City Storm Water Runoff	$ 2,000,000.00	$ -				$ 2,000,000.00	Watershed Center	Mid		
51	5	East Front Street, 300 Block Mid-Block Crosswalk	$ 100,000.00	$ 55,000.00			*$ 55,000.00*	$ 45,000.00	Traverse City	Near		
52	5	East Front Streetscapes (Boardman to Grandview Parkway) (TC ID# 717)	$ 915,000.00	$ 257,500.00			*$ 257,500.00*	$ 657,500.00	Traverse City	Near		
53	5	Eighth Street Bridge Repair (TC ID#58)	$ 900,000.00	$ 150,000.00			*$ 150,000.00*	$ 750,000.00	Traverse City	Near	Y	
54	5	Farmers Market	$ 2,000,000.00	$ 492,000.00			*$ 492,000.00*	$ 1,508,000.00	Traverse City	Near	Y	
55	5	Garland Street Reconstruction	$ 1,715,000.00	$ 1,315,000.00			*$ 1,315,000.00*	$ 400,000.00	Traverse City	Near		
56	5	Grandview Parkway Pedestrian Crossing (Hall and Union Streets)	$ 500,000.00	$ -				$ 500,000.00	Traverse City	Near		
57	5	Lower Boardman River Enhancements (TC ID#82)	$ 700,000.00	$ -				$ 700,000.00	Traverse City	Near	Y	y
58	5	North Cass Street Bridge Repair (TC ID#885)	$ 1,035,000.00	$ 100,000.00			*$ 100,000.00*	$ 935,000.00	Traverse City	Mid	Y	
59	5	Park Street Bridge Repair (TC ID#586)	$ 900,000.00	$ 150,000.00			*$ 150,000.00*	$ 750,000.00	Traverse City	Near		
60	5	Pine Street Pedestrian Way (TC ID#66)	$ 1,360,000.00	$ 1,360,000.00			*$ 1,360,000.00*	$ -	Traverse City	Near		
61	5	South Union Street Bridge (TC ID#186)	$ 602,500.00	$ 102,500.00			*$ 102,500.00*	$ 500,000.00	Traverse City	Near	Y	
62	5	Traverse City Pier (TC ID#778)	$ 5,754,000.00					$ 5,754,000.00	Traverse City	Long	Y	
63	5	Union Street Dam (Alternative 1B Passive Spillway and Dam)	$ 1,500,000.00	$ 975,000.00	*$ 975,000.00*		*$ -*	$ 525,000.00	Traverse City	Near	Y	
64	5	Union Street Dam River Enhancement and Park Improvements	$ 5,300,000.00					$ 5,300,000.00	Traverse City	Mid	Y	Y
65	5	Uptown/West Front Riverwalk from Union Street Dam to West Front Bridge	$ 1,200,000.00	$ 500,000.00			*$ 500,000.00*	$ 700,000.00	Traverse City	Near	Y	
66	5	South Airport Boardman Crossing							GTCRC	Mid		
67	5	Union Street Dam Outlet Relining (TC ID#172)	$ 400,000.00					$ 400,000.00	Traverse City	Near		
68	5	Union Street Dam Toe Drain (TC ID#168)	$ 50,000.00					$ 50,000.00	Traverse City	Near		
69	5	Storm Water Management [SAW] (TC ID#'s 944, 931 and 943)	$ 2,445,000.00			*$ 906,507.00*	*$ 1,537,937.00*	$ -	Traverse City	Near		
		Zone 5 Subtotal	**$ 50,830,000.00**	**$ 9,827,000.00**	**$ 4,175,000.00**	**$ 906,507.00**	**$ 7,189,937.00**	**$ 38,558,000.00**				
70	WW	Impaired Transportation Crossings	$ 1,000,000.00	$ -				$ 1,000,000.00	GTCD	Mid		
71	WW	Small Dam Removal	$ 500,000.00					$ 500,000.00	Watershed Center	Long		

BOARDMAN PROSPERITY PLAN - CAPITAL PROJECTS

					Committed Funding							
MAP#	Zone	Project Name	Budget	Funds Available	*Federal*	*State*	*Other*	Balance Needed to Complete	Lead Agency	Timeframe	Access	Educational
72	WW	Streambank Stabilization	$ 525,000.00					$ 525,000.00	GTCD	Ongoing		
		Watershed Wide Subtotal	**$ 2,025,000.00**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 2,025,000.00**				
		Total Capital Budget	**$ 85,420,750.00**	**$ 21,494,000.00**	**$ 15,630,000.00**	**$ 926,507.00**	**$ 7,894,437.00**	**$ 60,969,250.00**				

Near (0-5 Years) **Mid (6-10 Years)** Long (11+ Years)	Provides **direct** access to River (Y=Yes)	Provides **educational** opportunity (Y=Yes)