

**waterWORKS** | the effects of sustainable water management on mid-western cities

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# The Great Lakes Basin

In the mid-18th century, when Traverse City, MI was established little was known about the lasting effects of industrialization and waste management on ecological systems. For the next century large ports and factories dominated the lakes and rivers of the Midwest in the name of commerce. Infrastructural improvements such as sewage systems, rainwater control, dams, and drinking water systems were developed with little regard to the ecological impact on these waterways. Such growth has caused the contamination of 75% of the major rivers that flow into the Lake Michigan Basin.

Traverse City, MI is the fastest growing city in northern Lower Michigan, and was established roughly at the same time period as Chicago. The city is situated on the mouth of the Boardman River at Lake Michigan and has a surrounding population of roughly 120,000 people, with an influx of approx. 2 million tourists in the summer months. Historically the wastewater treatment plant has been unable to handle the 14,178-lbs/day of untreated water. Massive raw sewage overflows occurred in 2001 and 2002 prompting a \$31 million upgrade, but the new 20,200-lbs/day limit is only a temporary solution. Four dilapidated hydroelectric dams are in the process of being removed from the river. This will cause a drastic shift in the rivers current ecology and open the waterway for invasive species. The river is treated with a back alley approach with little cultural connection to the urban condition. Rainwater is flushed from the surrounding paved areas directly into the river causing further pollution to the system.

Water shortages will be a global problem by the year 2025. With the Great Lakes Basin accounting for 95% of the fresh water in the United States it will soon become our most valuable natural resource. In re-defining urban relationships to the Great Lakes a healthy, ecologically stable, and regenerative water system can become our greatest national asset. Providing a prototype solution for one of these urban areas (Traverse City, MI) may set a precedent for long term protection of the Great Lakes.

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**One third**  
of the counties in the  
**United States** will face water  
shortages by the year **2050**

Source: The Natural Resource Defence Council

The **Great Lakes Basin**  
contains the **largest** body  
of **fresh water** in the world

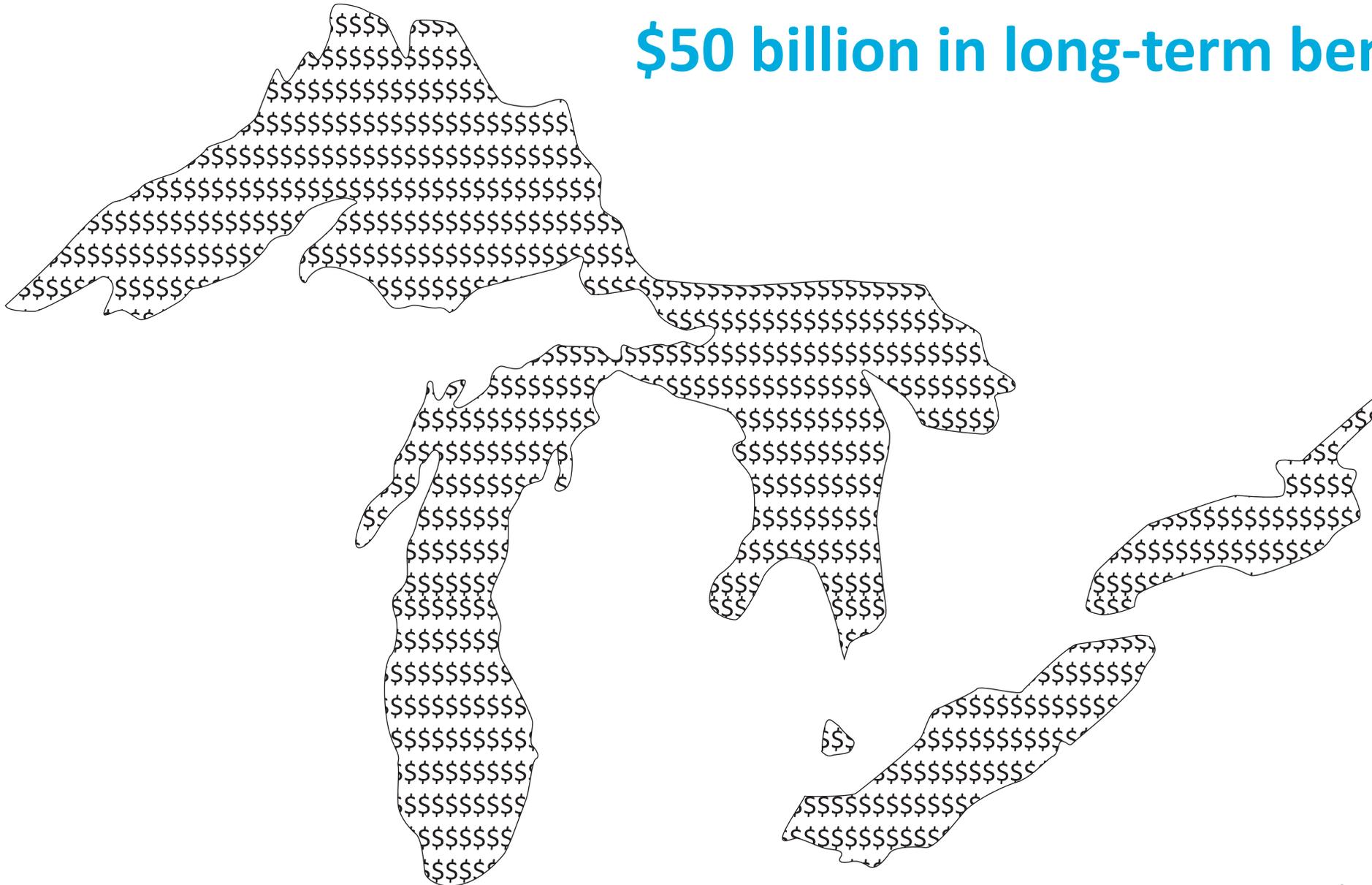
18% of fresh surface water

81% of total fresh water



“Implementing the Great Lakes  
Regional Collaboration Strategy will generate

**\$50 billion in long-term benefits”**



# Lake Michigan

water cycle

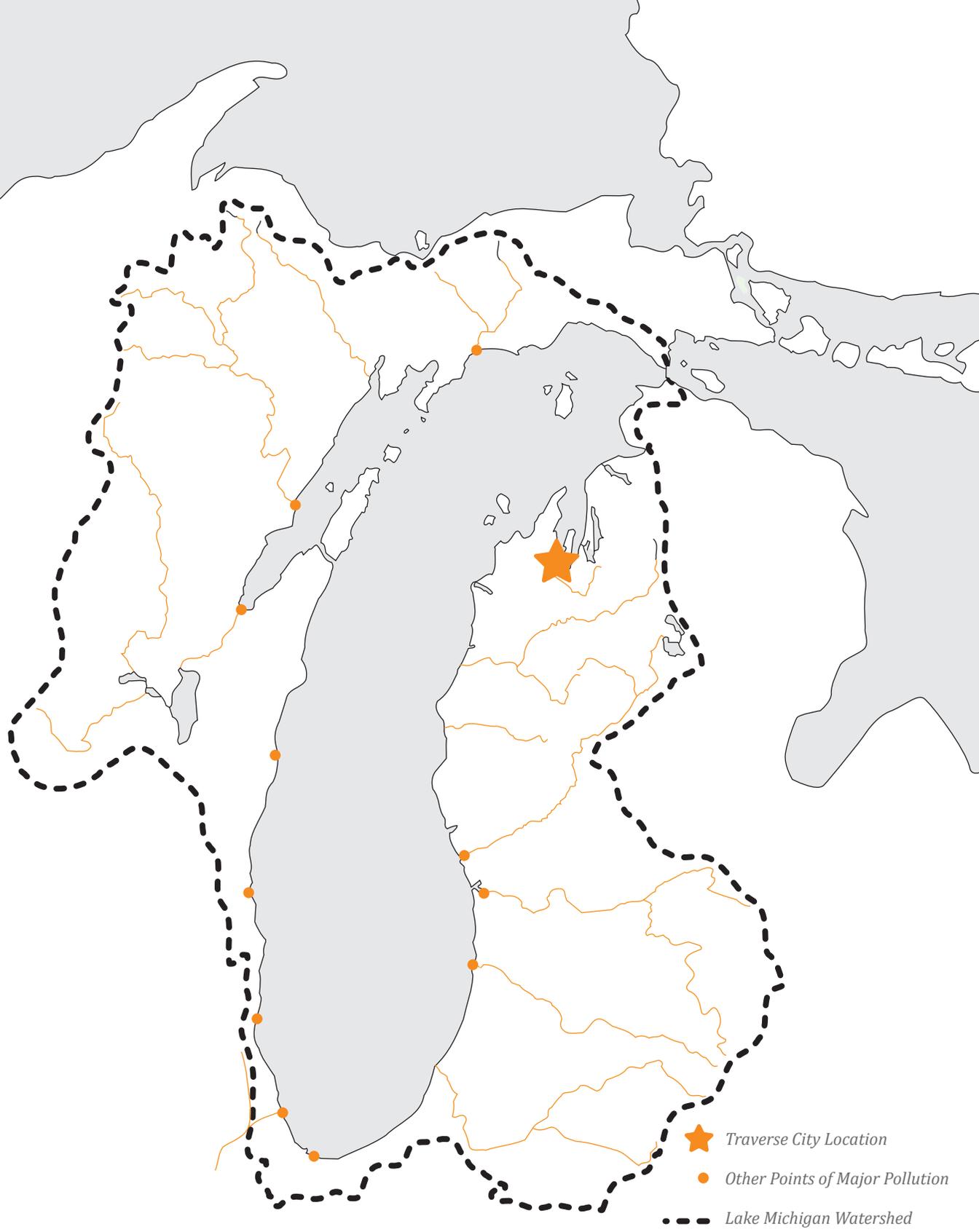
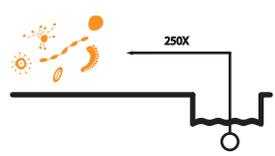
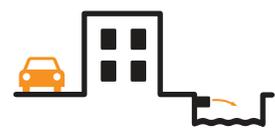
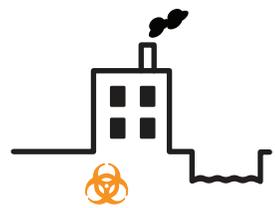
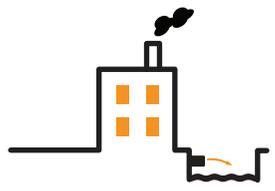


# Lake Michigan

## contamination

Direct Input

Indirect Input



★ Traverse City Location

● Other Points of Major Pollution

--- Lake Michigan Watershed

# Traverse City



# Traverse City Site Conditions

## Unutilized Sites

The majority of the waters edge consists of parking lots and un-utilized 'green' space. The rivers edge directly north of downtown is treated as a back ally with little Social/Cultural connection to the urban fabric. Rainwater runoff has become the major polluting factor from these sites.

## Boardman River

The section of river which runs from Boardman Lake to Lake Michigan has historically been the most polluted section of river. The river is part of the Boardman Lake Watershed. pollutants finding there way into this watershed inevitably end up in the Boardman River and eventually Lake Michigan. The Union St. Dam is currently non-operational and its demolition is under discussion.

## Waste Water Treatment

Massive raw sewage overflows occurred in 2001 and 2002 prompting a \$31 million upgrade, but the new 20,200-lbs/day limit is only a temporary solution. Partially treated sewage from surrounding septic tanks are converted into fertilizer at the facility. This fertilizer, which is used on city greenspace, has been a contributing factor to water pollution in the area.

## Boardman Lake

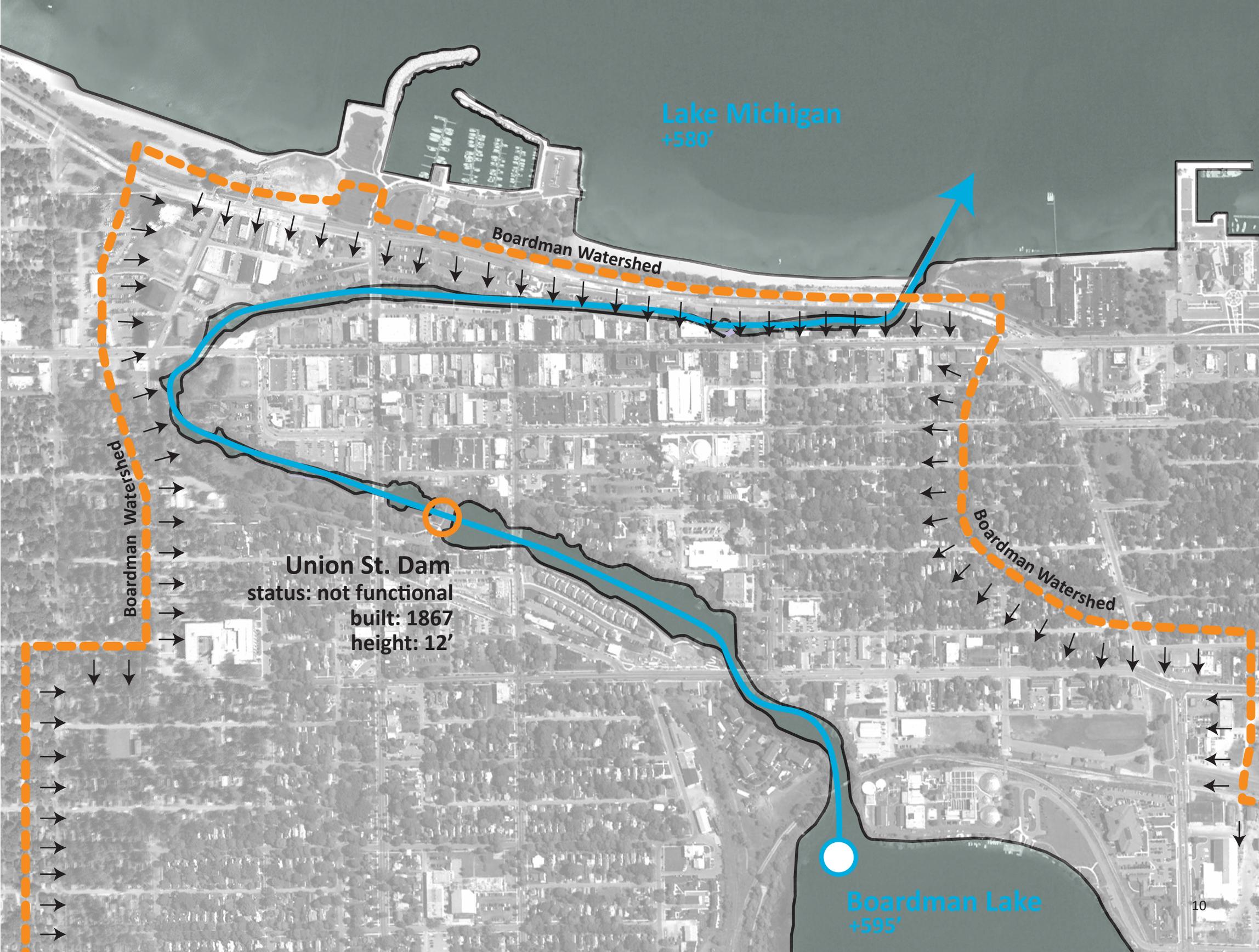
43 sites of environmental contamination exist within the watershed of Boardman Lake. Nutrient contamination, bacterial contamination, and heavy metals have been detected in the watershed. Poor aquatic organism population has been recorded. A 'dead zone', devoid of life has been identified in parts of the lake.



Traverse City is a **tourist**  
based **economy** with over  
**2,000,000** visitors annually

77% of visitors come for outdoor leisure  
Average visitor spends \$106 per day





Lake Michigan  
+580'

Boardman Watershed

Boardman Watershed

Boardman Watershed

Union St. Dam  
status: not functional  
built: 1867  
height: 12'

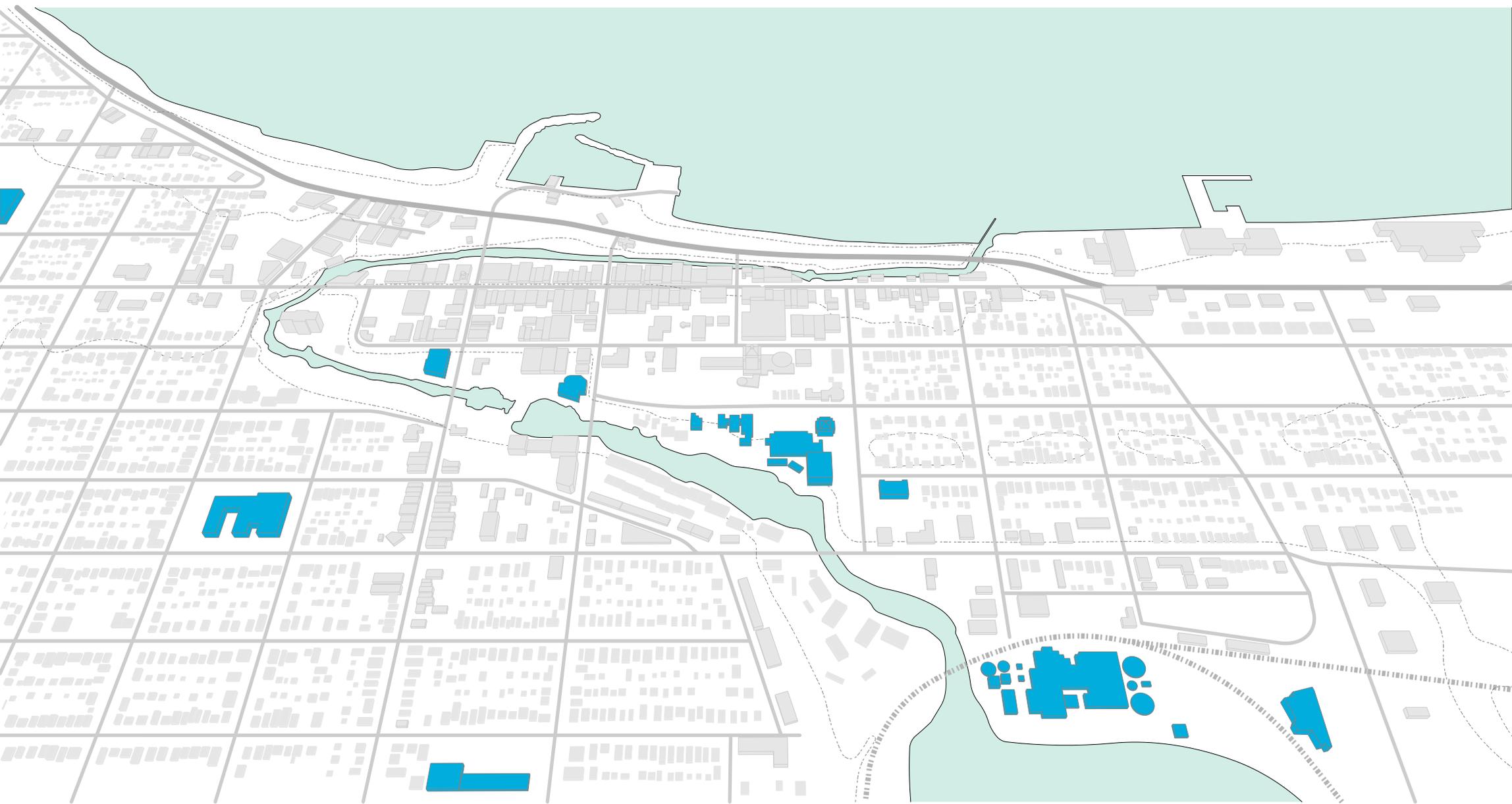
Boardman Lake  
+595'

# Traverse City Urban Conditions





**Commercial**

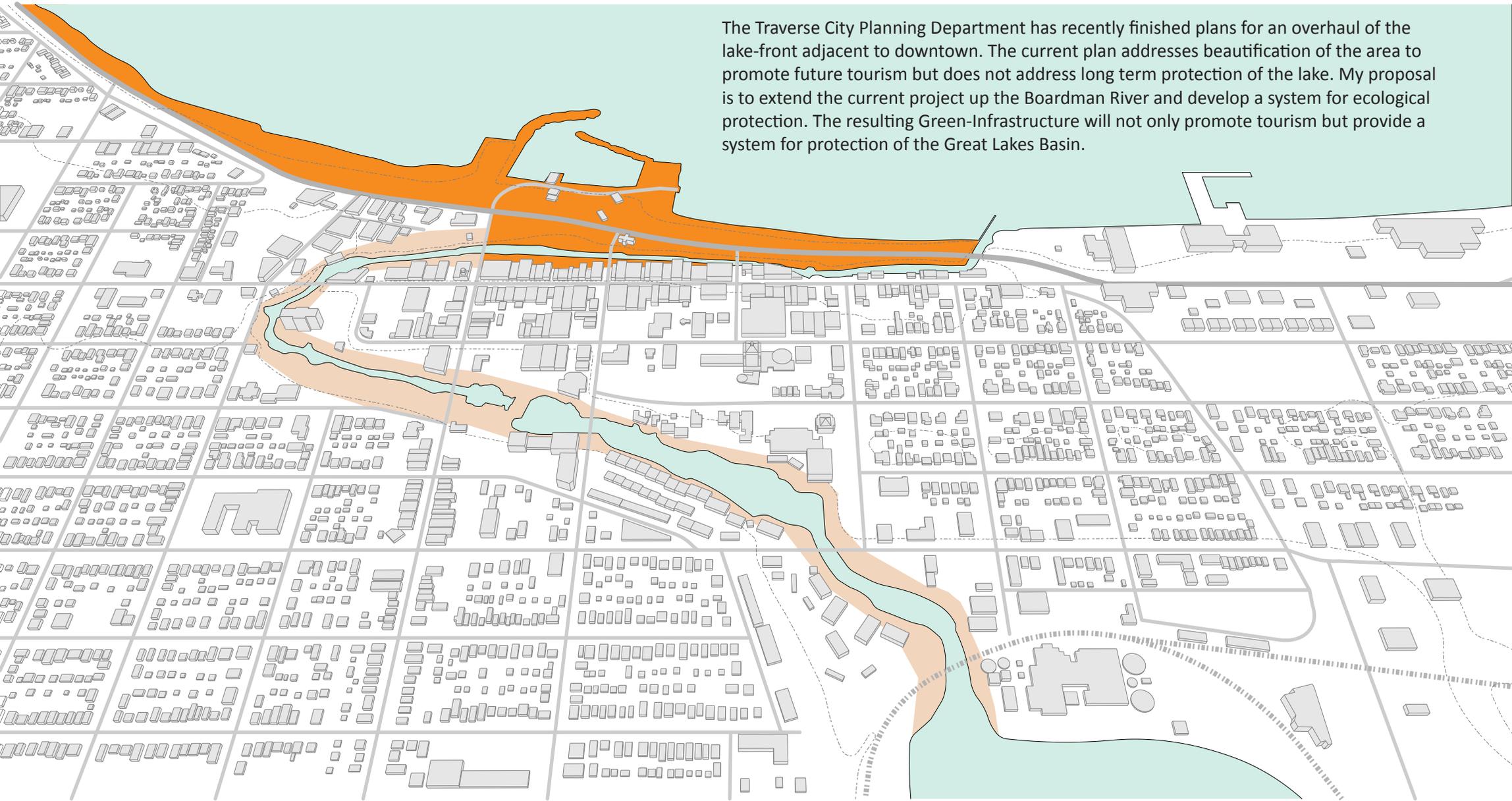


## City Buildings



Residential

The Traverse City Planning Department has recently finished plans for an overhaul of the lake-front adjacent to downtown. The current plan addresses beautification of the area to promote future tourism but does not address long term protection of the lake. My proposal is to extend the current project up the Boardman River and develop a system for ecological protection. The resulting Green-Infrastructure will not only promote tourism but provide a system for protection of the Great Lakes Basin.



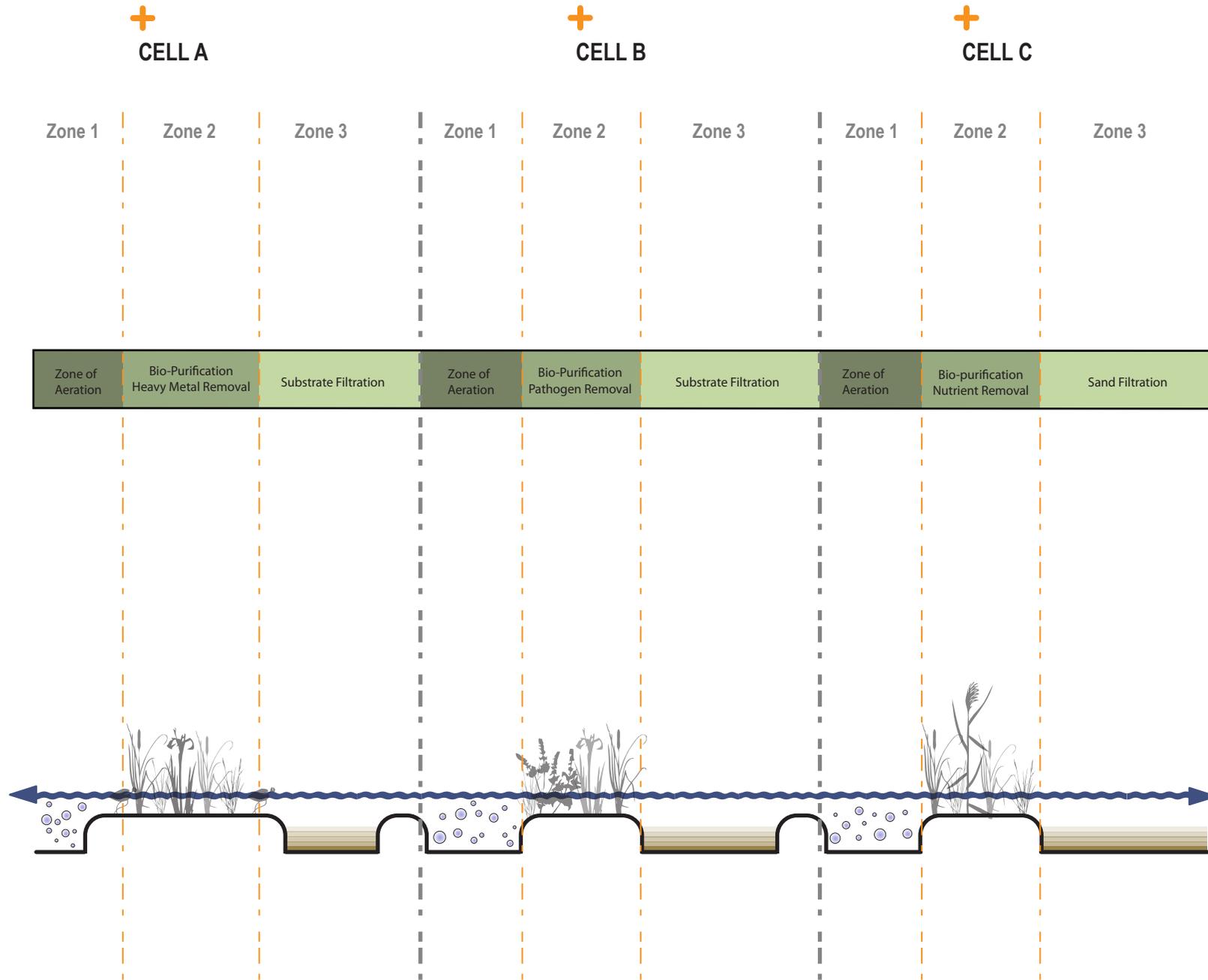
**Scope**   **Current** + **Proposed**



The current plan **addresses**  
**unwanted urban conditions**, but  
**not** long term **ecological protection**

# What is a Living Machine?

Generic 3 Cell Ecological System



By re-routing the river through living machine cells the water is cleaned before returning to larger bodies of water. This large living machine is divided into three 'Cells', each containing different aquatic plants which remove pathogens, heavy metals, and nutrients from the water.



**CELL A**

- Step 1: Zone of Aeration -
- Step 2: Bio-Purification/Heavy Metal Removal



cattail



bulrush



iris



pond lily



smartweed



milkweed



common reed

- Step 3: Substrate Filtration



**CELL B**

- Step 1: Zone of Aeration
- Step 2: Bio-Purification/Pathogen Removal



common rush



bulrush



iris



water mint



cordgrass

- Step 3: Substrate Filtration



**CELL C**

- Step 1: Zone of Aeration
- Step 2: Bio-purification/Nutrient Removal



cattail



bulrush



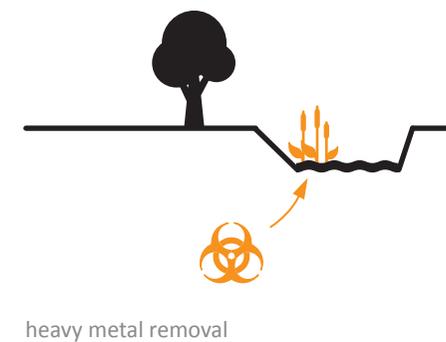
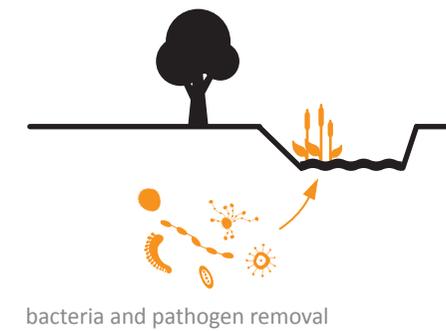
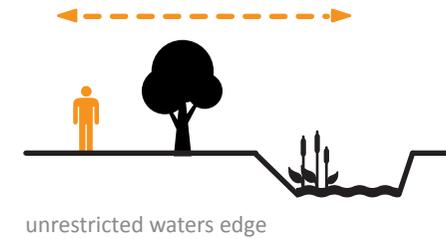
wool grass



common reed

- Step 3: Sand Filtration

**Results**



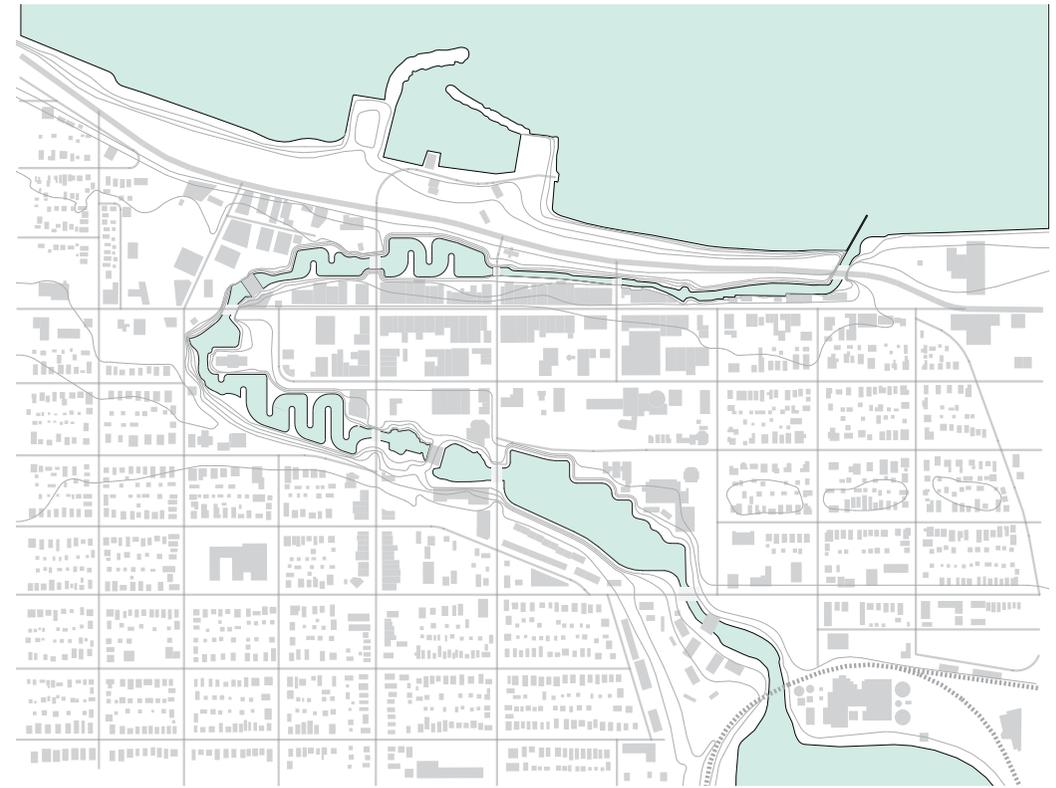
## Living Machine on Site

### Alteration to Current River

The first step in creating a viable living machine is to alter the current rivers path. By extending the length and surface area of sections of the river the water will have sufficient time to slow enabling cleaning by the native plant species. 3 points within the rivers length cause “bottleneck” conditions providing areas which are suitable for aeration of the water.



Original River



New River

# Living Machine on Site

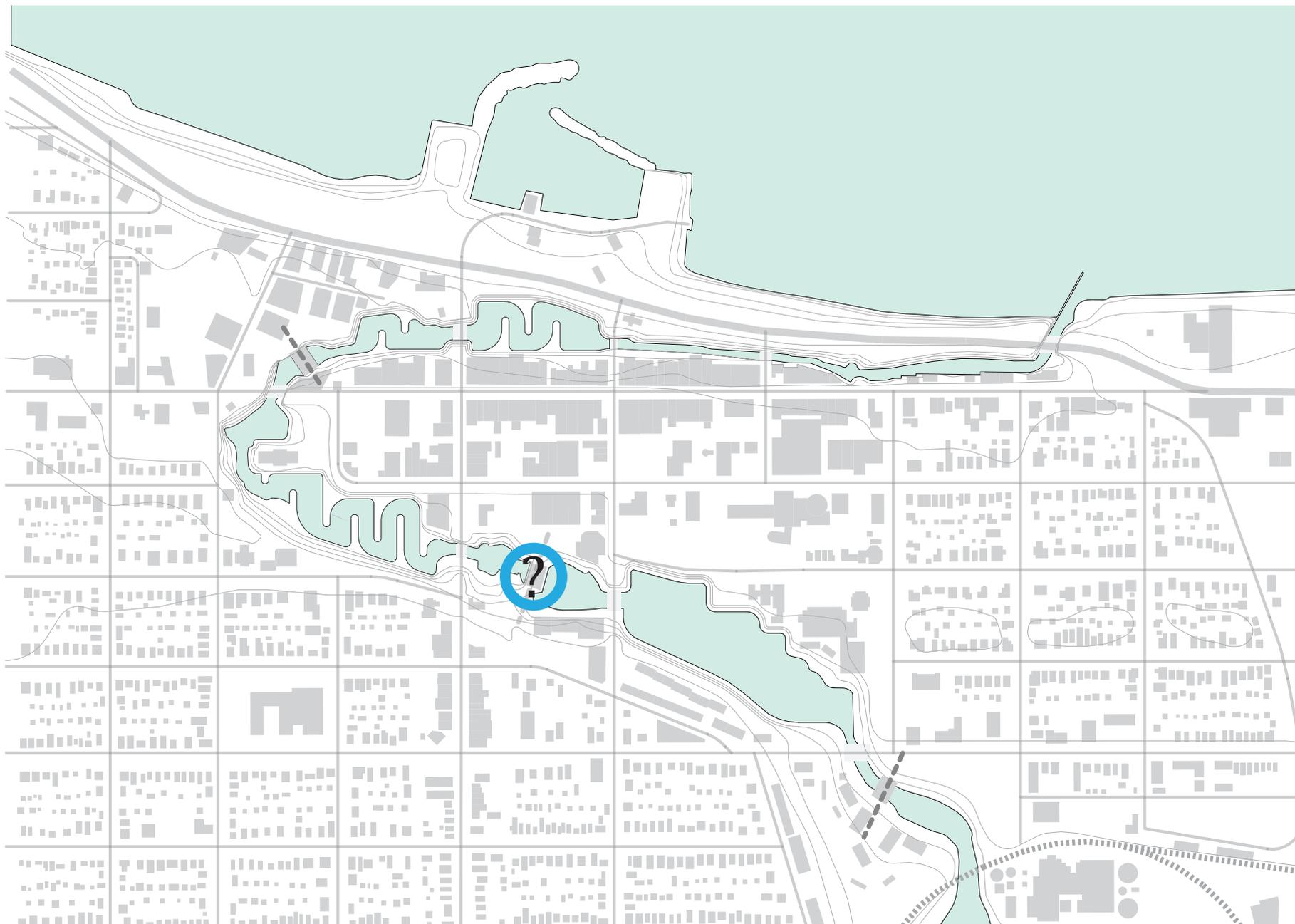
## 3 Cell Living Machine



## Programmed Points

### Urban Installments within the Living Machine

Within the 3 Cell Living Machine there are 3 points in which the system changes from one cell to another. These points provide a unique opportunity for the Urban Environment to overlap with the needs of the ecological system. These points become programmatically charged providing spaces of public activity which are enriched with the Traverse Cities Aesthetic of the “natural spectacle”.



In **2005** Michael Moore  
established the **Traverse  
City Film Festival**

six years later 106,000 tickets sold

+ 300,000 attending outdoor films  
in 5 days

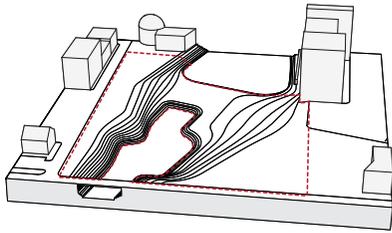
Traverse City the next Sundance?



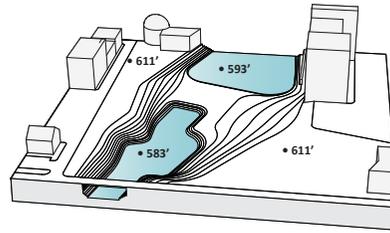
Traverse City Film Festival

# Process Diagrams

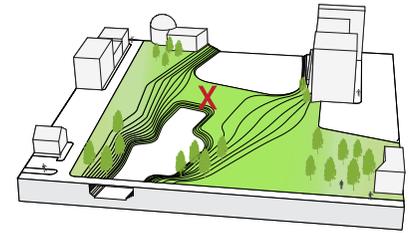
Existing Site Condition



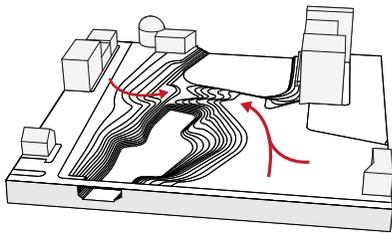
Existing Site Condition



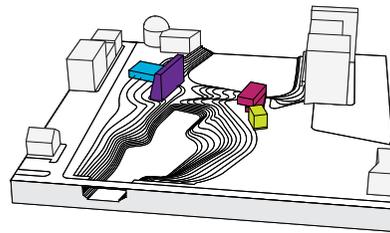
Existing Site Condition



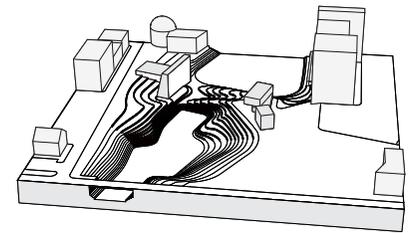
Push



Program

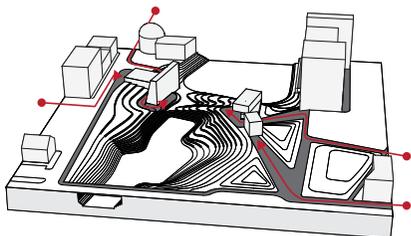


Seating

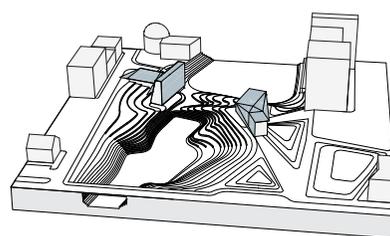


- Film Festival Offices
- Screen + Performance Space
- Projector + Concessions
- Gallery + Box Office

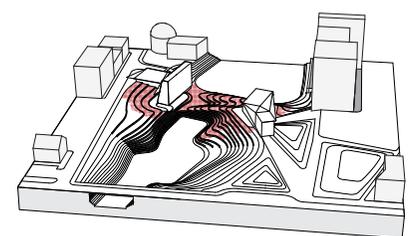
Circulation



Skin

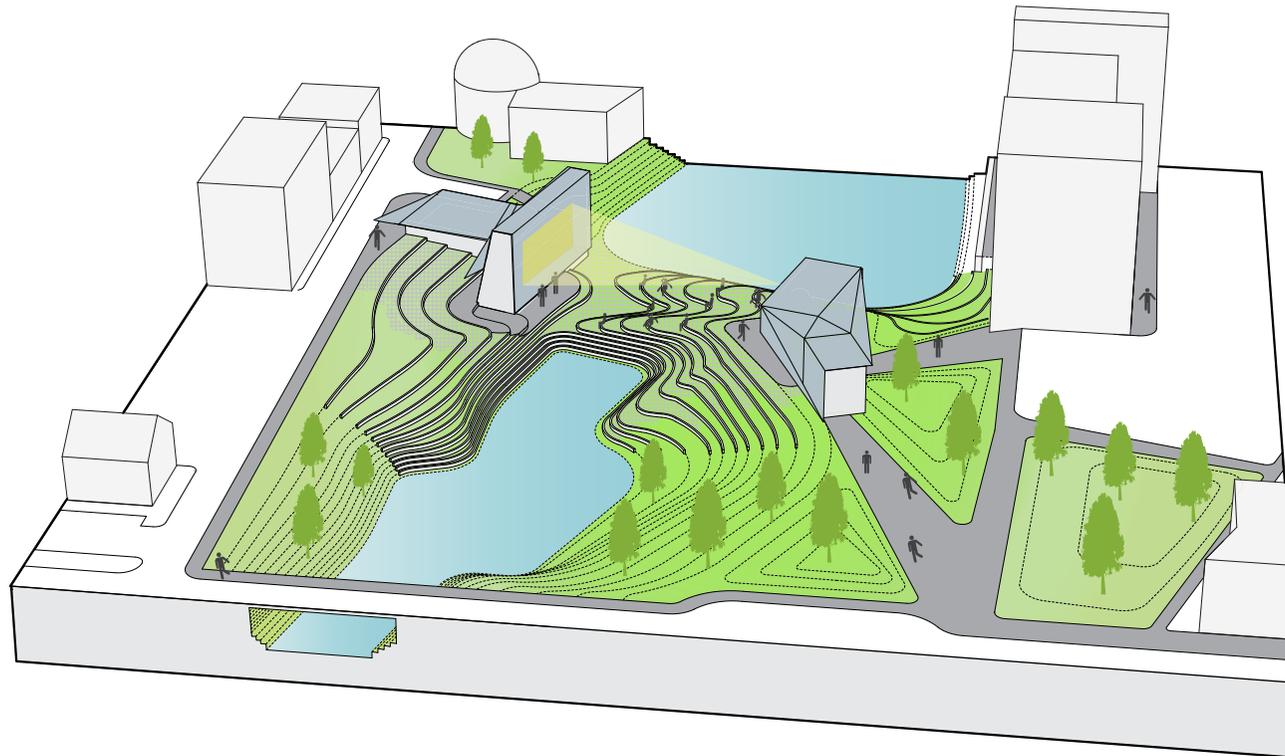


Permeable Surface

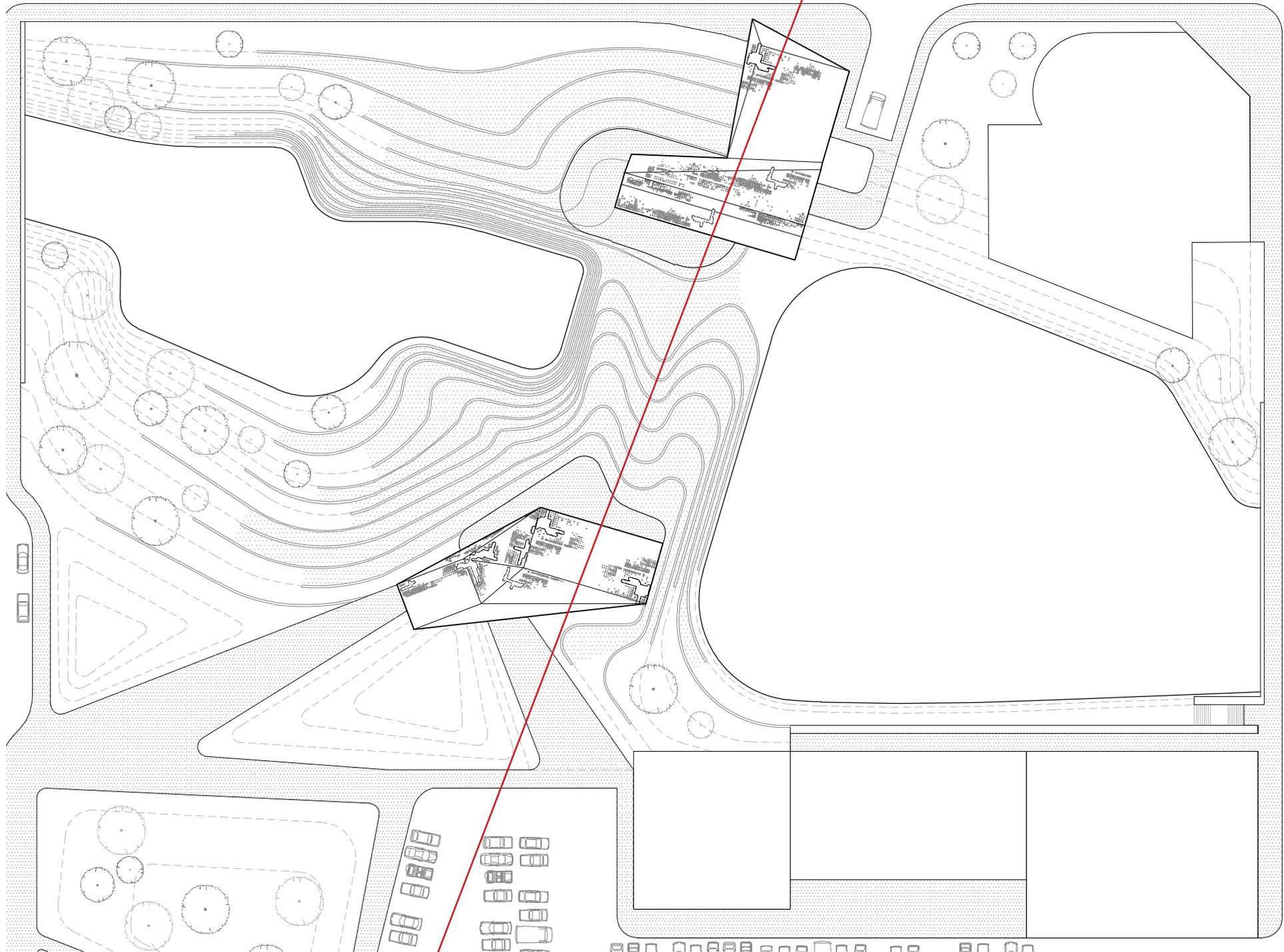


## Park Cinema

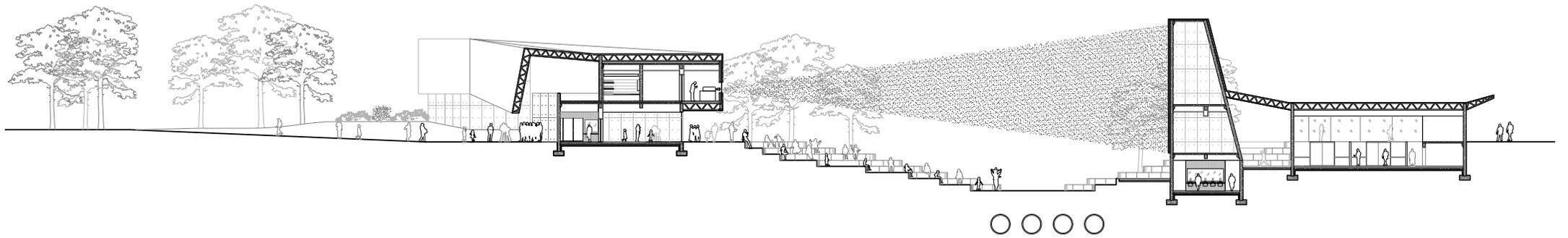
The idea behind this scheme is to take an existing piece of infrastructure, an earthen dam located at a pivotal point in Traverse City's green infrastructure plan, and re-define it as a public space. The "Traverse City Film Festival" has grown exponentially since it began in 2005. The festival's current need for event and office space along with the new wave of Cinema in the Park events provide the program for this space. The design provides a gradient between hard and soft surface, between ecology and urban environment. The resulting space is an example of how a programmatically charged element can exist within the macro infrastructure project.



# Site Plan

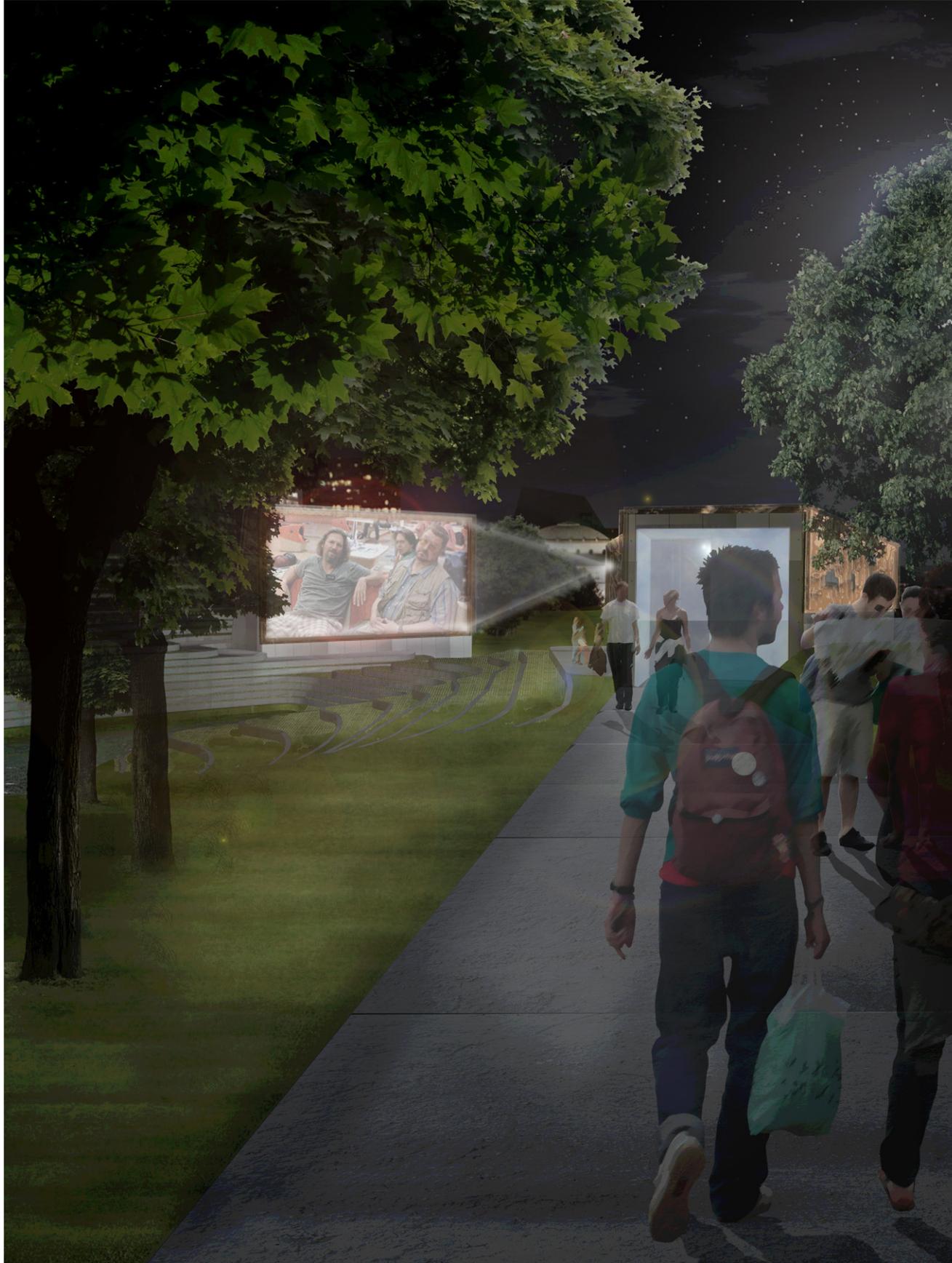


# Site Section











1. Olympic Sculpture Park, Seattle WA, Weiss/Manfredi
  - This park was developed as a public showcase for the Seattle Art Museum's large collection of sculpture. Built upon a brownfield site and bisected by two large transportation thoroughfares, this park is an attempt to revitalize the adjacent waterfront while tapping into cultural/social networks of the city. Existing infrastructural obstacles and 'green' solutions largely drove the projects design. It is relevant to my Masters Project because it is a built project that is successful in implementing 'green infrastructure' within the urban environment.
2. Shanghai Houtan Park, Shanghai CHI, Turenscape
  - This landscape project was the winning submittal for the ASLA 2010 professional awards. Built on a brownfield site adjacent to Shanghai's Huangpu riverfront, this project uses a large living machine to define the landscape and clean the polluted river water. The park provided the backdrop for Shanghai World Expo 2010. This project is useful in providing information on the implementation of large scale living machines.
3. Brooklyn Bridge Park, New York NY, Michael Van Valkenburgh Associates
  - The Brooklyn Bridge Park is a project dealing with the transformation of industrial sites adjacent to the Brooklyn Bridge into park space serving the surrounding community. Existing piers are reinterpreted into hybrid structures which blur the relationship between man-made and nature. Materials from existing buildings are reused throughout the park. This project provides a look into the adaptive reuse of industrial relics that could be useful in the design of my Masters Project.
4. Governors Island, New York NY, Rex NY
  - This project was the 2nd place winner in the competition for the re-imagining of Governors Island located just south of Manhattan. The large project of 172 acres was programmed as a public open space with a flexible plan for commercial development. Described as a development strategy Rex envisioned a 'Living Matrix' in which potential use is adaptable to growth and time. Program can be interchanged throughout the matrix without affecting the whole. This project is useful in its implementation of adaptable development strategies.

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