

# Lake Carmi Aeration Project

## Inspection Services RFP

### Summary Description

The proposed project consists of the installation of a Diffused Aeration System in the central basin of Lake Carmi. Equipment installed includes two Compressor Stations, two Air Manifold Stations, up to 275,000 feet of self-sinking airline and 80 Air Diffusers on the lake-bottom with an option to add up to 20 more diffusers if data and conditions require within the first two years of operation.

A detailed description of system components and construction methods follows:

### Aeration Equipment

- **Two land-based Compressor Stations each consisting of:**
  - An electrical “H” Frame with a main breaker box and Variable Frequency Drive Compressor Controller.
  - A 30 HP Rotary Claw Compressor housed in a custom engineered sound-reducing, weather proof, stainless steel enclosure. (*Figure 1*)
  - A 12-foot x 12-foot privacy and security fence that will enclose the compressor unit and electrical “H” frame. The fence will be of wood construction and designed to match the existing structures in Carmi State Park. Vegetative screening with native tree and shrub species can be used to further naturalize the site.
  - Each compressor station will occupy 144 square feet of area including the fencing and will be located more than 50 feet from any delineated wetland boundary. **Figures 6 & 7 pages 13 – 14.**
  - Electrical supply lines will be directionally drilled underground from existing power-source locations to each compressor as indicated on the site maps in **Figure 7**. An electric meter and main panel disconnect will be installed at each power location. Power supply will be 200-amp, 230-volt, single phase power similar to a connection for a home or cottage.
  - A main 2” airline will be directionally drilled from each Compressor Station to its respective Manifold Station located near the lake-shore. Using directional drilling for both the electric and air supply lines we are minimize disturbance of vegetation and habitat, construction nuisance and potential for erosion of sediments. **Figure 8 page 15.**
  - A landscaped pad will be constructed for each Compressor Unit. The pad will be a maximum of 10’ by 8’ for a total of 80 square feet per Compressor Station. The Compressor Station will sit on 6 concrete footer blocks. Landscape timbers or similar preferred material will be used to define the 8’ x 8’ pad. Landscape weed barrier and a maximum of 3” of river rock will be used within the 80 square foot pad to reduce weed growth and create a landscaped area under each Compressor. The river rock represents less than .8 cubic yards of river rock added for each Compressor Station.

## Figure 1: Compressor Stations

### Compressor Station Examples Prior to Fence Construction



This picture shows a Compressor Station wrapped for Winter with the smallest landscape pad possible.



Larger landscape pad to accommodate Electrical Stack and establish a level area on a boat ramp installation

### Compressor Stations With Fencing



- **Two Air Manifold Stations each consisting of:**
  - A Stainless Steel insulated and weatherproof enclosure measuring approximately 48”L x 48”W x 30”tall.
  - Two (up to) 30 Port Stainless Steel Air Manifolds each with a main valve and individual valves for each airline/diffuser going to the lake. This allows for both zone control of the system by manifold and individual control of each diffuser in the lake. **(Figure 2)**
  - Each Manifold Station will occupy a maximum of 49 square feet.
  - A landscaped pad will be constructed for each Manifold Station. The pad will be a maximum of 7’ by 7’ for a total of 49 square feet per Manifold Station. Each Manifold Station will sit on 4 concrete footer blocks. Landscape timbers or similar preferred material will be used to define the 7’x 7’ pad. Landscape weed barrier and a maximum of 3” of river rock will be used within the 49 square foot pad to reduce weed growth and create a landscaped area under

each Compressor. The river rock represents less than .5 cubic yards of fill added for each Manifold Station.

- The Manifold Station will be located between 10 to 20 feet from the Mean Water Level (MWL).
- Up to 50 airlines will be connected to fittings underneath the Manifold Box and enter the ground beneath the Manifold Box. These lines will then be run underground in a 2' wide by 2' deep by a maximum of 20' long trench to the mean water level/shoreline of the lake. Once installed, the trench will be filled and restored with native plants/seed mix. The shoreline will be restored with native plants and/or natural rip-rap stone to obscure where the airlines enter the lake.

**Figure 2: Manifold Station**

**Manifold Station Example**



- **Up to 275,000 feet of Sinking Airline and required fittings**
  - Up to 275,000 feet of lead-free 100% flexible PVC airline will connect up to 100 Air Diffusers to the Manifold Station. Eighty Diffusers and 215,000 feet of airline will be installed initially with an option to add up to 20 additional diffusers and airline during the first two years of operation of the system if conditions and data warrant.
  - The Airline is 1.12” Outside Diameter (OD).
  - The Airline weighs approximately 1 lb. per linear foot. It is self-sinking and cannot float even when filled with compressed air.
  - Each diffuser will be connected back to the manifold in a “home run” configuration as depicted in the site plans below.
  - The 40 airlines for each system will be bundled together and run through a 2’ 2’ trench from the Manifold Station to the MWL. The airlines will continue to run as a bundle from each Station for 100 to 200 feet from the MWL which corresponds to a depth of at least ten feet before each line branches to run to its designated diffuser location.
  - All fittings connecting airlines and diffusers will be brass or stainless steel.

**Figure 3: Airline  
Staging Airline Prior to Installation**

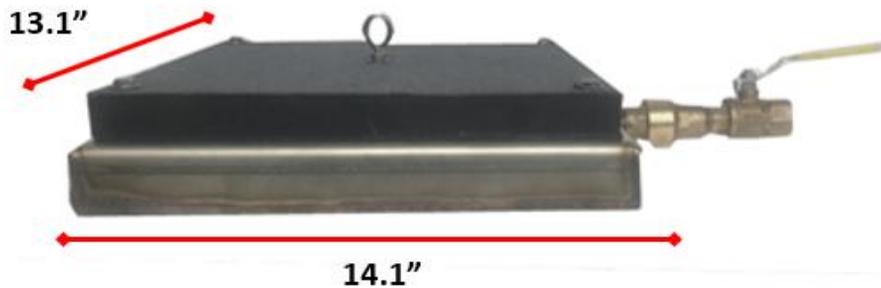


- **Air Diffusers**

- Eighty EB-1290 Micro-Porous Ceramic Air Diffusers (US Patent # 9688553) will be installed in the locations noted in the site maps below with an option to install up to 20 more diffusers during the first two years of operation if conditions and data require.
- Each Diffuser is 13.1"x 14.1" and 3" high. Each diffuser weighs approximately 19 lbs. and designed to sink and rest flat on the lake-bottom when properly installed.
- The diffusers are designed and have been thoroughly tested under field conditions NOT to stir up bottom sediments during their operation.
- The Airlines and the Diffusers together will occupy a total of .56 acres of lake-bottom with 100 diffusers and airline. **This represents less than 0.04% of the surface area of the bottom-land of Lake Carmi.**

Figure 4: Diffuser Technology

**EB-1290 Micro-Porous Diffuser**



**Diffused Aeration In Action**



## **Construction & Techniques**

### **Compressor Stations**

- A small Skid Steer will be used to create a 12'x12' level area at each of the two Compressor Stations. We anticipate minimal excavation of this area and will select and adjust each compressor site to require as minimal excavation as possible.
- A 10'x 8' landscaped pad will be constructed using landscape timbers or other preferred material, landscape weed barrier and up to 3 inches of river stone will be added as top fill over the weed barrier. Not more than .8 cubic yards of stone will be applied per Compressor Station.
- The remaining area within the 12' x 12' fenced in area weed barrier can be installed with mulch or river rock applied over the weed barrier as preferred. Generally, using river rock in this area reduces maintenance.
- Six 16" diameter by 6" thick concrete footer blocks will be set and placed under each of six legs of the compressor unit.
- The Skid Steer will be used to move the compressor into place.
- Post holes for a 12'x 12' perimeter fence will be dug, and a fence will be constructed of out of wood selected and stained to match the look and design standards of existing similar State Park Structures.
- Directional boring equipment will be used to run electric supply from two existing power locations (where new 200-amp, 230-volt single phase electrical services will be installed) to the Compressor Stations. This process will result in approximately a 2'x 2' disturbance of soil at the entry and exit points of the boring. Any disturbance of ground caused by the boring equipment will be restored as part of the construction effort.
- Once completed, any disturbance of soil or vegetation around the Compressor Station will be restored. Appropriate erosion control measures, such as straw matting and reseeded and/or silt fencing, will be taken as needed during and after construction.

### **Manifold Stations**

- Because of the proximity to the shoreline and sensitive wetland areas, NO heavy equipment will be used in the construction and setting of the Manifold Stations.
- The directional boring of the main airline to the Manifold Stations will be done from the Compressor Station Locations so that there is no boring equipment at the Manifold Site. The pipe that surfaces at the manifold will disturb less than 4 square feet of where it emerges from the ground. We will target bringing the pipe up through the ground within the 7'x7' landscape pad where the Manifold Stations will be placed.
- A maximum 7'x 7' landscape pads will hand dug. A border of landscape timbers or other preferred material will be installed and weed barrier and up to a 4" layer of natural river stone or other preferred material will be used as top cover over the weed barrier. Less than .6 cubic yards of stone will be used for each Manifold Station.
- The Manifold Stations will be hand-carried to their locations so as not to disturb vegetation or soils in the sensitive areas around the Manifold Stations.

- A 2' wide x 2' deep by up to 20' long trench will be hand dug to provide an underground conveyance for the airlines from each Manifold Station to the MWL. We will schedule this activity such that the trench is dug and filled within a 48 hour period. Silt fencing will be used at the MWL to prevent erosion into the lake. Anti-erosion measures will be used such as straw matting. The filled trench will be re-naturalized with native plants and/or seed mix. At the MWL natural vegetation and natural rip-rap stone will be used to re-naturalize the shoreline and obscure where the airlines enter the lake when viewed either from shore or from the lake.

### **Airlines and Diffusers**

- Airline will be run by specialized boat and crew that enables the “unrolling” of the lines in 500-foot reels at the surface of the lake. As the line is fed off the back of the boat it sinks to the bottom. Every 500-feet the next roll is spliced to the previous roll using a brass hose coupler and 100% stainless steel hose clamps.
- Diffuser locations are mapped using a GPS/Sonar Depth Finder marking system prior to installation of the lines. Each diffuser site is also marked with a temporary physical buoy so that the spacing and placement can be visually checked and confirmed prior to installation. The marking is typically completed one-day before diffuser installation begins.
- During installation this same system is used to guide the boat to the designated diffuser location for each diffuser. The physical buoy is used as a cross-check. Once at the diffuser location, a diffuser is attached to the end of the airline using a stainless-steel hose clamp. A drop line is fed through the center I-ring of the diffuser and the diffuser is slowly lowered into place at the designated location. Once on the bottom, the drop line is used to set the diffuser properly to ensure it is flat on the lake-bottom. One end of the drop line is then released, and the drop line is retrieved back into the boat. Once the diffuser is placed, the temporary buoy is removed from the lake.
- The specialized installation boat is equipped to carry multiple rolls of airline with a draft of less than 18”. This allows the boat to maneuver close to shore without disturbing the lake-bottom. A shore-based crew member assists in making a hand-off of each line so that the boat can remain 20 to 25 feet from shore at the start of each run.
- The lines will be run straight out for 100 to 200 feet from the point on shore where they enter the water. This keeps the lines in a “bundle” for the first 100 – 200 feet. Once all lines are run for a system, we will use the crew and boat to complete the assembly of the lines into a bundle and secure the bundle with rope approximately every 20 feet.

**Figure 5: Airline Bundling**

**Airlines Bundled From Shore**



Once bundling is complete, the bundled lines will be buried by hand for as far as possible into the lake. Typically, the lines can be buried until water depth is 4 – 5 feet. On most installations, this allows us to bury the lines 25 – 50 feet from shore.

## Summary of Impacts and Encroachment

### Compressor Stations

- **144 square feet of area impacted by required structures per Compressor Station (288 square feet total).** Compressor Stations to be located more than 50 feet from any wetland boundary. The System B Compressor will be located more than 500 feet from the Mean Water Level of Lake Carmi. The System A Compressor will be located 200 feet from the Mean Water Level of Lake Carmi

#### Location of System A Compressor Station (Back Lot)

**369 Patton Shore Road, Franklin VT 05450**

#### Location of System B Compressor Station

**Lake Carmi State Park  
460 Marsh Farm Rd, Franklin, VT 05457**

- A maximum of 1.33 cubic yards of river stone and/or mulch per Compressor Station (2.66 cubic yards total) will be used as landscape fill within the 12'x12' Fenced Structure.

### Manifold Stations

- **49 Square feet of impervious surface per Manifold Station (98 square feet total)** will be added within 20 feet of the MWL in a wetland or wetland buffer area. Based on available mapping, the Manifold Station for System A is located on an area designated as Upland. The Manifold Station for System B will be located in area with Class II Wetlands. An experienced Wetlands Delineation Consultant will be retained to locate the Manifold Station B in a suitable and permissible location near the location indicated on the maps below.

#### Location of System A Manifold Station

**369 Patton Shore Road, Franklin VT 05450 (Lakefront Lot)**

#### Location of System B Manifold Station

**Lake Carmi State Park  
460 Marsh Farm Rd, Franklin, VT 05457**

### Airlines and Diffusers

- Up to 50 airlines will enter the water at the MWL from the Manifold Station via a 2' wide x 2' deep up to 20' long hand-dug trench from each Manifold Station. The system design calls for 40 lines and diffusers at initial installation with an option to add up to 10 additional lines and diffusers within the first two years of operation if the data and results deem it necessary. **The total impact of the trenching will be not more than 40 square feet for each System (80 square feet total).** The trenches will be filled and re-naturalized using native plants and/or seed mix. Where the lines enter the water, the shoreline will be re-naturalized using native plants and/or natural rip-rap stone as preferred.

- As the airlines enter the water from the MWL, they will be gathered and tied together as a bundle for up to 200 feet from the MWL. The bundle of airlines from each System will be approximately 2' wide and 6" tall. **This represents a maximum 400 square foot encroachment into the lake for the first 200 feet from the MWL. Bundling the airlines in this zone is the best way to minimize the impacts on potential spawning areas in the near-shore zone.** The Airline Bundles can be buried with a few inches of lake-bottom sediment by hand digging for the first 25 to 50 feet from shore depending on depth. Based on discussions with the US Army Core of Engineers burying the Airlines Bundles in this way will be permissible under the USACE Permitting Process.
- Beyond the area where the Airlines are bundled, each airline will then be run along the lake-bottom to its designated diffuser location where a diffuser will be connected and placed on the lake-bottom. **The total encroachment into the lake for the airlines and diffusers is 24,500 square feet.** This is the physical area occupied by the combined maximum of 275,000 feet of airline and 100 diffusers that would be installed in the lake under this project and permit.

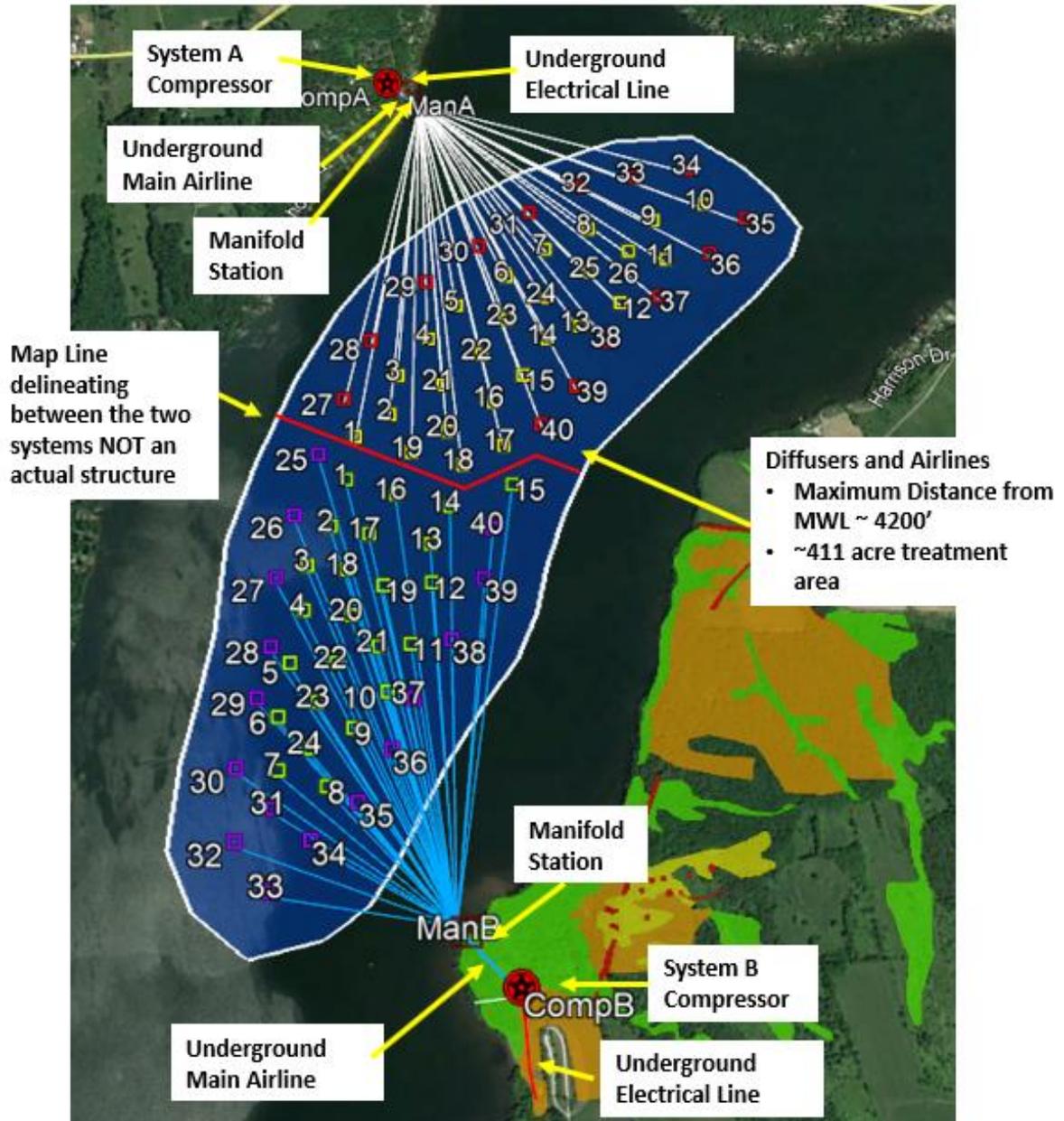
The treatment zone of the Diffuser Field is 416 acres roughly within the twenty-five foot depth contour of the lake.

**The Airlines and the Diffusers together will occupy a total of .56 acres of lake-bottom with 100 diffusers and airline. This represents .04% of the surface area of the bottom-land of Lake Carmi.**

- **Less than 10 Linear Feet of Shoreline in total will be impacted. Each system will impact 2 – 4 linear feet where the Airline Bundle enters the water from the 2' wide trench had-dug from the manifold.** The Shoreline will be re-naturalized with native plants and/or seed mix and natural rip-rap stone as preferred.

Site Maps and Drawings Detailing Proposed Locations and Impacts and Encroachments.

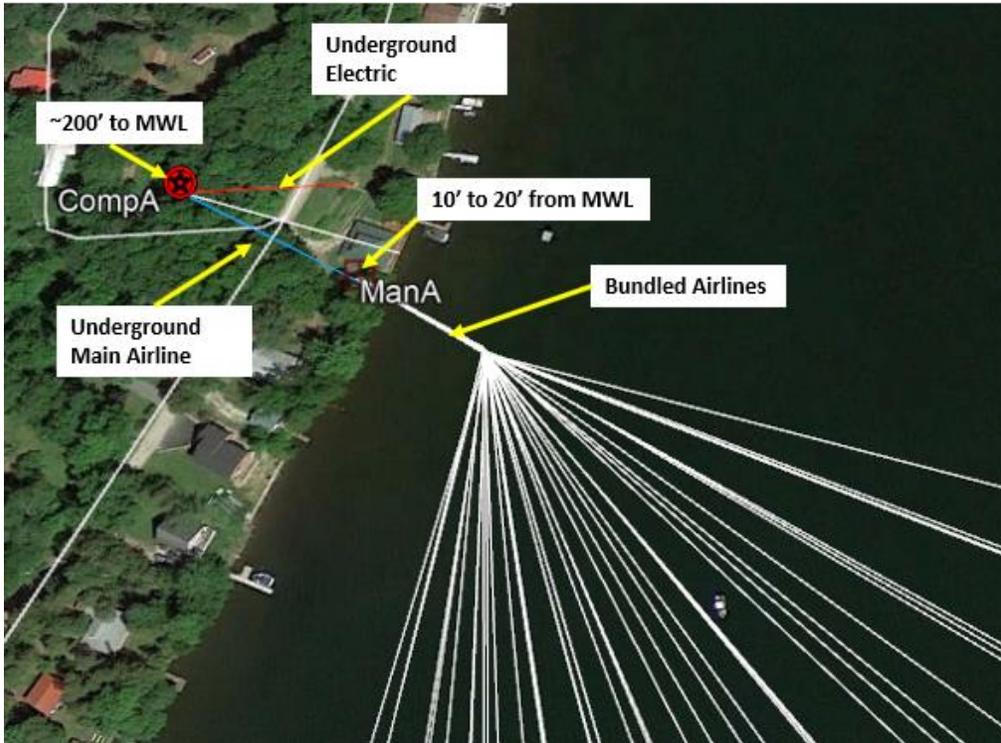
Figure 6: Lake Carmi Proposed Aeration System Site Plan



**Figure 7: Site Plan Details (Land Components)**

**Site Plan System A**

**System A Site Plan**



**Site Plan System B**

**System B Site Plan**

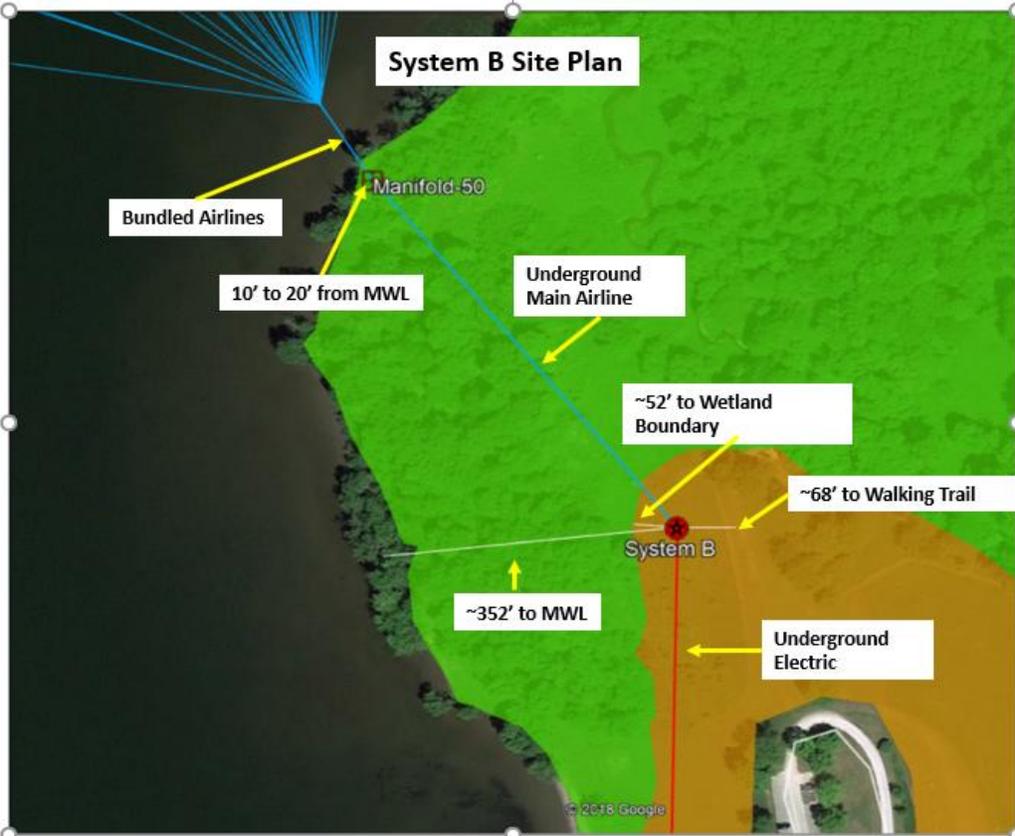
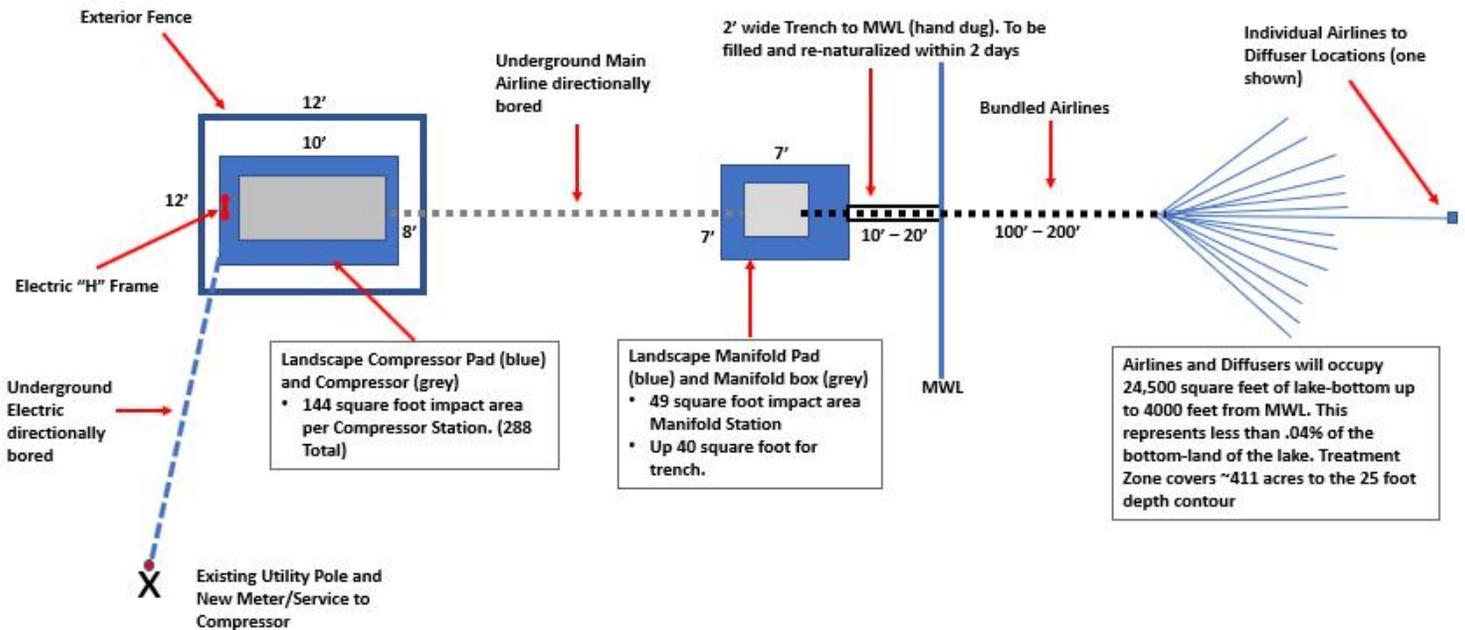


Figure 8: Plan & Section Views

Plan View Lake Carmi Aeration System Showing Impact Areas and Encroachment  
(Not to scale)

Representation for Both System A and System B



Section View Lake Carmi Aeration System (Not to Scale)

Representation for Both System A and System B

