June 19, 2014 Draft

Water Technology Project # 13399.01

Project Description: The Traverse City Water Feature was conceived as an interactive, educational water playground for citizens and visitors to downtown Traverse City, MI. Designed and constructed during 2012/2013, the Water Feature is located in Clinch Park, a waterfront park in downtown Traverse City. Part of Clinch Park's bay front plan, the Water Feature work was part of a more general scope which included landscape areas, a concessions & bathhouse building, an accessible kayak launch, a playground, walkways, decks and civil improvements. The intent of the Water Feature is to provide an inter-active, educational water feature for the public to play in. (Photo 01) The design of the Water Feature is intended to emulate the natural water cycle. (Photo 02)

It is understood that the Water Feature opened in late 2013, and experienced multiple issues and concerns immediately. Water Technology, Inc. was engaged in early 2014 to review project documentation and to conduct a site visit for the limited purpose of commenting on issues and offering options for restoration/renovation. The scope of this review is limited to the Water Feature, its features and systems. Other aspects of the project, such as buildings, playgrounds, and other siteworks are outside the scope of this review.

Facts: The Water Feature is intended for public use, therefore its design and construction are governed by the Michigan Department of Environmental Quality Water bureau (MDEQ) Public Act and Rules Governing Public Swimming Pools (CODE)

Documents Reviewed:

Drawings:

Drawing #	Title	Date	Notes
NA	Cover	06.28.12	
1-1	Survey	2.2012	
C1.1	General Development	06.28.2012	From "As -Built" Set, No Date change on drawing, No clouding of revisions.
C5.1.1	Materials Plan East	06.28.2012	
C5.4	Enlargement Plan	06.28.2012	
C6.4	Grading Plan	6.28.2012	PRI 9.12.12, as constructed 07.24.13 No clouding of revisions
C6.4	Grading Plan	06.28.2012	
C7.1	Utility Plan	06.28.2012	S.P.Revisions 7.24.13 (revisions clouded)
C7.1	Utility Plan	06.28.2012	7.12.13
C7.2	Utility Plan	06.28.2012	
C8.4	Site Details	06.28.2012	
C8.5	Site Details	06.28.2012	
C8.6	Site Details	06.28.2012	
C8.7	Site Details	90% Owner Review 4.13.12	
		100% Owner Review 05.4.12	
		100% DNR Review 05.29.12	
		100% DNR Review 06.07.12	
E2	Electrical Floor Plan	06.28.2012	
E3	Electrical Schedule	06.28.2012	
ME1	Mechanical and Electrical Site Plan	06.28.2012	
P2	Plumbing	06.28.2012	
W1.1	Water Feature Schematic	06.28.2012	From "As Built" set, No date change on drawings (revisions clouded)
W1.1	Water Feature Schematic	06.28.2012	

Specifications:

Project Manual for Clinch Park Phase - 1 6/28/2012

Submittals:

Clinch Park Fountain – Fountain People 10/24/2012

Data Sheets - 10/24/2012

Other:

MDEQ – EQC 1753 (01/2005) Public Swimming Pools	(CODE)
DEQ Construction Permit Application	06/05/2012
Letter to Mr. Brett Davis from MDEQ	07/22/2013
MDEQ Inspection Report	08/27/2013
Letter to MDEQ from David H. Graves, PE	Not Dated
Photographs	Various
Fountain People – Website – For Feature Information	

The Project Team Consists of:

Design:

Hamilton Anderson Associates	Landscape and Prime Consultant
Fleis and Vanderbrink -	Civil Engineer
Soils and Structures, Inc.	Geotechnical
Nealis Engineering	MEP
SDI Structures	Structural

Construction:

Lightning Turtle Landscape	Water Feature Construction
The Fountain People	Water Feature Equipment

Issues:

1. **The Water Feature area and pad floods in moderate to heavy rains:** The Water Feature is located adjacent to the Traverse City Marina, near a parking lot and kayak launch at the edge of West Grand Traverse Bay. The site is relatively flat, with grades on drawing C6.4 ranging from 583.80 to 587.30. The rim elevation of the Water Feature is generally 584.0, placing it at a lower point on the site (Photo 03). Site grading generally slopes towards the Water Feature, including paved walkways. The grading plan indicates the site sloping to the North and East, the sidewalk has an edge along it's east side, sloping towards the Water Feature, a landscape berm and seat wall trap run off water onto the

Water Feature along the north side (Photo 04). There are no provisions to shed site water away from the Water Feature and it's immediate surroundings

Comments:

The location and grade elevation selection of the Water Feature does not meet MDEQ code requirements:

"R325.2121 Sites

"(d) Have drainage that is adequate to prevent flooding, drainage and nuisance."

"(f) Avoid the pollution of the swimming pool."

The Water Feature's site location, grade elevation and detailing do not meet the code requirements. During rain events, city staff stated that leaves, grass clippings, mulch and other debris flood onto the surface of the Water Feature and into its circulation system.

Recommendations:

The best way to mitigate the flooding and debris to the system is to prevent its entry on the Water Feature in the first place. Options to accomplish this include:

- Lowering landscape and turf grades adjacent to the Water Feature, providing a 4" to 6" curb to prevent water and debris washing onto Water Feature. This is a typical industry detail. (Photo 05)
- Developing landscape berms to direct site watershed around and away from the Water Feature.
- Installing trench drains along walks to collect and remove the water sheeting across the walks and decks. These drains would require a piping system to remove the water to a suitable location.
- Develop a drainage "barrier" around the spray pad. This would include a walk way of approximately 4'minimum, sloped away from the pad, around the Water Feature. Loose rocks in the landscape area would be grouted in, the center landscape area would be lowered and provided with a landscape area drain, piped to a suitable location. Increasing the apron size would provide the additional benefit of area for observers and other activities such as stroller parking.

2. **Concrete curbs were added to select locations to contain and direct the water flow, in lieu of the domed finish surface described in 1/C8.4:** Approximately 45 LF of 6" x 8" concrete curb was installed at the east and west

junctions of the water feature runnels (troughs)(Photo 06). It was represented by city staff that the curb was installed at the recommendation of Hamilton Anderson in "trade" for the domed finish which consisted of 12 each 4' radius rebar circles and 17 each 4' partial rebar circles embedded into the domed surface. A circular pattern is also indicated on the drawing, but not described. A Change Order, Change Directive or Work Order adjusting the contract terms was not included in the documentation provided.

Comments: The concrete curbs, as installed, present a safety concern in the form of trip and fall hazard and sharp corners (Photo 07). The domed surface described in the contract documents is extremely intricate and labor intensive, if the "trade" for the curbs is what happened, the city did not receive an equal value in this trade.

Recommendations: The curbs should be reviewed and leading edges and sharp protrusions should be ground down. A better detail would have been a curb flush with the Water Feature's edge, tapering to provide a curb away from the play area. The City should reconcile values for work traded.

3. **The domed surface is slippery when wet.** The domed surface is described on C8.4 as an 8" shotcrete domed surface (Photo 08). As mentioned previously, #4 reinforcing (1/2" bars) were intended to be installed in circles; the reinforcing "stamped ½ of bar diameter (1/4") into shotcrete." There are also series of concentric circles shown on the drawing, these circles are not defined. The Project Manual lists two concrete sections in the specifications, 033000 Cast In Place Concrete and 033713 Shotcrete. Section 033000, part 3.8 B. requires a float finish, further describing the finish as "..left with a uniform, smooth, granular texture." Section 033713, part 3.8 C.1. describes a medium sandblast finish, 3.8 C.2. requires that the contractor verify the finish suitability with a mockup. This section further requires "concrete sidewalk with sandblast finish to meet minimum ADA coefficient of friction requirements. 0.6 minimum."

   Comments: The domed surface, based upon its intended use, should be a non-slip surface. The drawings do not describe the concrete finish on the dome. There is no note on the drawings referencing "non-slip" or providing a non-slip criteria. The connective circles shown may have been etched rings or ridges, but are not detailed. The reinforcing steel embedment may have helped, but were not installed. The detailing of the embedded reinforcing steel is not clear; two issues which would have arisen include the circles not conforming to the curve of the dome, and how to resolve the intersections of the reinforcing circles. Another

issue with this detail would have occurred later, as the reinforcing bars rusted and expanded, damaging the adjacent concrete.

Recommendations: The domed surface can be acid etched or sand blasted to provide a non-slip surface. Water Technology, Inc. recommends that a small test area be used to establish how aggressive the surface needs to be. Care should be taken to protect the grating, which may be affected by the acid wash method.

4. **The "Arched Rain Bar" feature does not work properly.** The feature is intended to provide two 17' -0" long curtains of water in a rain like effect. The water is to fall onto the dome and wash down the surface to the perimeter surface grating. When started, the Arched Rain Bar (ARB) created the effect unequally, showering one end of the bar, leaving approximately 1/2 of the dome with little water effect (Photo 09).

   Comments: The Arched Rain Bar feature, as conceived and detailed could not create the effect intended. The ARB consists of two intersecting 8" pipe arcs, with 315 ea. ¼" holes drilled into the underside of each arched pipe. The intended effect was that of rain falling across the 17' – 0" span of the area with the holes drilled (see 8/C8.4). The feature's water supply is from one side and consists of a single 4" pipe connected to the ARB manifold (P2, ME1, and W1.1). Drawing P2 defines the pipe size as 4", drawing ME1 routes the pipe to one end of the feature, drawing W1.1 shows the 4" pipe splitting into two 3" feeds. Drawing C8.4 requires baffled ends, a detail shows a 3" threaded pipe coupling at baffled ends, a leader line for this note goes to one end. A simple calculation reveals that the number of ¼" holes equals 30.92 in^2 of open area. A 4" pipe has 12.73 in^2 of open area. This in-balance results in the feature having water at one end, and being starved at the other end. According to Staff, the Aquatic's subcontractor, "Lightning Turtle" has plugged some of the ¼" openings (Photo 10), in order to get the feature working.

   The feature is listed in the project manual as an "Arched Water Feature", item# AM-RPWF/S304, manufactured by West Gate Sheet Metal. A phone conversation with Tom Sterling of West Gate revealed that West Gate bid on the project, but was not successful. Tom did not know who fabricated the piece. Detail 8/C8.4 has a note requiring the manufacturer to provide specifications and design for approval prior to fabrication. No submittal for this feature was included in the reviewed documents. No information was provided in the design documentation as to the feature water requirements.

Recommendations: The Contractor has attempted to balance the feature and create the effect intended by plugging approximately one half of the opening with plastic plugs (Photo 10). This strategy has proven somewhat successful. Reducing the open area of the feature will allow the feature pipe to "fill", and create the effect intended. The balance of the feature in this manner will be by trial and error. Water Technology, Inc. recommends plugging approximately 2/3 of the holes of the first third of the supply side of the feature, the middle row of the center third of the feature, and every other hole the downslope third of the feature as an initial balance point. A second solution would be to add an additional water supply, symmetrical to the first to balance the supply. It should be noted that this second supply would over-take the existing feature pumps, piping and reservoir capacity. The additional water supply (4") is not sufficient to balance the open area of the holes, but would significantly reduce the in-balance. A third option would be to plug all of the openings, and provide new openings in a level plane along the sides of the pipes. Thus the feature pipe would "fill" to an equal point, and then spill equally across the openings. A fourth option would be to tap the openings, and replace with a threaded ¼" reducer, reducing the hole size to 1/8".

5. **The "Arch Rain Bar Feature" is climbable.** The ARB consists of two 8" stainless steel pipes, curved to a 24.5' radius, which starts at grade and is 10' above the top of the domed surface at its apex (See 2/C8.6). Stainless steel lettering spelling "William G. Milliken WaterScape" are welded to the sides of the pipe.

Comments: The ARB pipe finish is listed in the specifications as "SSPC- SP-6". This standard is the "Society of Protective Coatings" standard. The standard covers the use of blast cleaning abrasives to achieve a defined degree of cleaning of steel surfaces prior to the application of a protective coating or lining system. The primary functions of blast cleanings before coatings are:

(a) Remove material from the surface that can cause early failure of the coating system and

(b) to obtain a suitable surface roughness and to enhance the adhesion of the new coating system. (From sspc-sp6/NACE No.3 Appendix A; A1).

There is no finish specified for this feature. The combination of the low arc of the arch, the fact that is springs from grade, and the surface roughness of the piping make the feature an attractive challenge to climb. Staff reported seeing parents assisting their children in starting to climb the feature. The feature's maximum height of 10' above the concrete surface makes a fall a serious issue. The

lettering which is welded to the piping poses both a cut and strangulation hazard (Photo 11). Additionally, the feature low arc leaves very little headroom at the perimeter of the dome where the arches rest. At the outside edge of the dome, the clearance is about 24". A clear headroom of 7' – 0" is not met until 7' inside of the edge of the dome play area.

Recommendations: Due to the obvious nature of the hazards presented by the feature, Water Technology, Inc. recommends immediately placing signage at the feature stating "No Climbing" & "Fall Hazard". The feature should also be reviewed by the City's risk management and insurance administrators. The following recommendations should also be reviewed by these risk management personnel prior to implementation.

A) Paint the ARB with a gloss finish, making it slippery and less likely to be climbed. The finish will have the added benefit of protecting the steel. Additionally, if some of the holes are to be permanently filled (see #4 above), the paint finish will reduce the visual impact.

B) Remove the lettering, replace with lettering that is flush with pipe surface.

C) Protect area under rain arches to reduce head clearance issues. Options include barriers, large rocks (although these likely will still be climbed) an un-walkable surface (such as grouted stones) or surface warnings.

D) Remove the ARB, replace with a standard feature designed for this use.

6. **The LED light on the ARB are inappropriate for an interactive water feature, and are operationally difficult to winterize**. Located below each side of the ARB are 8 LED Light Fixtures. The fixtures are specified as" LED- 180N: Lumen 180 18" Linear LED light with 30' underwater cable and stainless steel niche housing with rock guard." The fixture appears to be manufactured or sourced through "The Fountain People", as well as the fixture enclosure.

   Comments: Staff reported three concerns with the lighting: sharp edges of the slots in the "rock guard" cover (Photo 12), heat of the fixture and cover when in operation, and the winterization of the fixture, which requires disconnecting the wire junction for each light and re-wiring every spring. The sharp edges of the rock cover were also noted by the inspecting MDEQ official (see MDEQ Report of 08/27/13, item 17./12.), requiring staff to install a plexi- glass plate between the rock guard and the fixture(Photo 13). This has the added benefit of preventing water and debris from collecting in this void. It is unclear form the manufactures literature if the fixture is intended for use as a "dry" fixture. Winterization instruction prepared by The Fountain People (O&M P12732) states, under the heading "Winterizing Niche Type Underwater Light Fixtures" to "disconnect wire connections". The O & M manual also states that "Only persons qualified and

authorized should be allowed to operate or maintain this electrical equipment," placing an operational burden on the City.

Recommendations: Staff's action of installing plastic guards has mitigated an obvious concern. The City should contact the manufacturer to establish if this installation impacts the fixture's operation or warranty in any way. If concerns are expressed by the manufacturer, an alternate cover should be requested. During the next operating season, the City should also measure the surface temperature of the stainless guard to establish if operating with the lights is feasible. It is also recommended that the City investigate the potential of installing waterproof plugs on the fixtures to simplify winterization. It should be noted that the current LED-180N offered on The Fountain People's website is equipped with an IP68 waterproof connector. The addition of a waterproof connector may be done by a local electrician, or by returning the fixture to the manufacturer. If this installation is contemplated, developing a test cable with the plug is suggested, so that it can be established that the plug can make the pulls in the spring. Another option may be to pull the wire and have the plugs field installed at the niche location. This should be verified with the manufacturer and against code requirements. Alternate solutions would be to abandon the in deck lighting and develop an alternate lighting plan, or to abandon lighting the feature.

7. **The perimeter stream trough does not flow properly, has areas that pond water, and traps debris**.

   The perimeter stream trough is made up of iron gates with a decorative pattern(Photo 14). Specified in the project manual as "Water Weir Trough" by West Gate Sheet Metal, the installed product has an IRON AGE stamp, it is presumed that the grates were manufactured by IRON AGE DESIGNS of Burien, WA(Photo 15). This was confirmed with a search of the IRON AGE WEBSITE, which contained a drawing labeled "Clinch Park".

   Comments: The perimeter stream trough is intended to imitate a stream, with water running along the stream, conveyed by the trough to the eight drains located at the perimeter of the Water Feature area. The trough is made up of a series of cast iron "gutter" plates (See 2-7/C8.4). The gutter plates are a custom fabrication from IRON AGE, as the website describes the product as their Janis radial trench grating, 1" thick, with no openings greater than ½". The gutter is made up of grating of this pattern without any openings. This grating (with openings) was originally installed over the drain locations, staff reported that

there was inadequate open area, causing flooding of the Water Feature (Photo 16). Staff replaced the grating with plastic for the initial season and made custom grates from the gutter product for the next season(Photos 17 & 18). The gutter material's pattern and fabrication result in it having depressions which trap debris and water. Drawing C6.4 documents the slope of the gutter, which has a high point of 584.79 to a low point of 584.0 (a 1.48% slope) for the dome area gutter. The gutter around the landscape area falls .64', providing a 1.25% slope. There is ponding water in two areas of the trench(Photo 19). The reduced slope around the landscape area, combined with its longer run, means very little water will run in this portion of the gutter (Photo 20). The reduced water flow, with a very shallow slope and a gutter material likely to trap debris and water makes ponding almost inevitable. With the amount of landscaping and vegetation immediately adjacent to the water feature, organics are likely to be trapped in the ponding areas, providing opportunity for bacteria growth.

Recommendations: The combination of low slope with a patterned corrugated surface, makes the trapping of debris and ponding areas likely. Corrective actions could include: replacement of the cast plates with a smoother gutter trough material; "filling" portions of the voids in the pattern with a material to reduce the voids while leaving the top of the pattern intact. Another potential solution would be to introduce additional water flow into the landscape channel. Increasing the water in this channel will increase its flow reducing the likelihood of stagnation. The ponding area in this channel should be corrected.

Additionally, it is recommended that the loose rock area inside the channel be grouted in, leaving a limited number of loose rocks selected for inter-active play. The most likely solution will be a combination of these recommendations, after review of the impact and feasibility of each recommendation.

8. **Concrete around the spray ring is cracking and deteriorating.**

There are seven "Water Cages" on the spray area of the feature, shown on drawing 1/C85.5. Detailing is limited to 1/8" scale plan and section, with a note to see water feature specifications. The specifications refer to this item as W012: "Water Cage constructed from 1.5" red brass pipe, (30) machined stainless steel jets with domed head, (30) jet construction covers, anchor bolts with hardware, 1.5" NPT connections, creating a 48" diameter effects pattern." This information corresponds with a spray ring feature manufactured by "The Fountain People", specifically the EPR – 30, with 2.5' ring and 30 jets (Photo 21). This spray ring has a 2.5' diameter, placing the nozzles at 3.14" o.c. around the ring. There is

no detailing of the concrete at this feature. From the product cut-sheet, it appears that the manifold ring is 1 1/2" brass pipe, and that the nozzles are approximately ½" tall. The nozzles provided to the City appear to be standard dome head stainless steel bolts with a holes drilled in them(Photo 22).

Comments: The "water cage" or spray ring feature appears to be a fountain product adapted to an interactive spray pad. The product cut sheet shows the product installed in water, the manifold ring is shallow for a concrete installation. Detailing the installation with a control joint connecting the nozzles would have helped. Staff noted that winterization of the feature involves removing the 210 "nozzles" from the feature and replacing them with plugs. Staff further stated that some of the nozzles are very difficult to remove, as the threading of the "nozzle" goes through concrete(Photo 23).

Recommendations: Essentially this condition is the result of the wrong application of a product intended for another use. Given the project's shallow depth to the manifold and the limited spacing between nozzles, the concrete deterioration is not surprising. Winterization difficulties also highlight the fact that the product is not designed for this application. Corrective actions include removal of concrete around the rings and replacing with a joint between nozzles, re-furbishing the spray rings with a bushing that would be flush to the concrete finish, but recesses the nozzles, or placing a safety surface over the splash area of the feature to cover the concrete.

9. **Plant clippings, mulch, sand and other debris clog the system, requiring frequent cleanings by staff.** Staff reported system shut-downs for strainer cleaning as frequent as every ½ hour on busy days. The frequent shut-downs irritate patrons, and require inordinate staff resources. Shut downs are required to remove, clean and replace the strainer baskets in the filtration loop and the activity loop.

   Comments: The Clinch Park water feature is located in an urban beach front park. A sand beach is located less than 300' from the water feature. The water feature is surrounded by large trees and extensive landscaping, including a landscape island inside one of the gutter troughs. The water feature operates two distinct water systems, a filtration loop and an activities loop. Both systems are re-circulation systems, operating from a 2000 gallon reservoir. The reservoir consists of a single fiberglass tank. Water is collected from the spray features by 8 drains and conveyed to the reservoir via two 8" pipes (C8.5). The pipe sumps are covered by grating (see previous discussion items #7). There are two pumps

drawing water from the reservoir; a filtration pump (Hayward Tristar series, # SP3220EE) and an activity pump (PACO model 40957 LC, 604 GPM @ 40 TDH) Each pump has a strainer with a single strainer basket. As discussed previously, debris from the adjacent landscape area collects onto the feature. Staff reported that lawn mowing operations, plant fall, foot borne sand, grass and mulch are all found in the system..

Recommendations: There are several issues related to debris contamination: environment control, patron education and control and debris collection. Environment control, as discussed in issue #1, involved material which can be kept off the activity surface by controlling the area. This can be done by providing physical separation from plantings and mulch to the activity surface. The use of curbs, reduced-shedding plants and decks are recommended. A shower control station between the feature and beach is also suggested. Patron education and control is principally effected through signage. Advising patrons to rinse feet prior to using the feature, not allowing pets in the feature and asking for assistance in keeping the feature clean can be beneficial.

The final defense in debris control is to collect it. In line strainers will collect this material prior to the pump. A simple way to reduce the feature's downtime is to provide a spare strainer basket. The shut-down time is minimized to the basket substitution, cleaning the basket can be done after the system is re-started. A spare strainer basket is required by code (R325.2145 4(c)) for the filtration pump and is usual and customary for all pool and water activity strainer systems. An additional option would be to add a second strainer in parallel on the activity system, allowing he operator to switch between strainers for cleaning, and not shutting the activity off. The filtration pump has an integral strainer as part of the pump; installing a larger strainer in line to pre-strain may allow longer runs between strainer cleanings.

Preventing debris from entering the system initially is the best practice. Staff has attempted to do this with customized debris strainers inserted into the gutter dropouts (Photos 24 & 25). This attempt has had minimal success reported, as staff still needs to clean strainer baskets and backwash every ½ hour. As discussed previously, proper spatial design between debris sources (plantings) and the feature is required. The creation of seating areas and walkways would benefit this effort. Another option would be the installation of a pre-screen settlement tank, which would allow for initial screening of debris and sand settlement.

10. **Spray ring nozzles clog frequently.** Staff reported that the nozzles of the spray rings clog with debris.

    Comments: As discussed in issues 1 and 9, the feature's system collects debris from its surroundings. Features with a small orifice will clog when used in a spraypad setting. Typical strainer baskets will not catch the small debris which is capable of blocking the spray ring nozzle orifice.

    Recommendations: In conjunction with recommendations 1, 9 and 13 (following), the best way to mitigate the clogging is to send more finely treated water to the rings. One method to do this would be, in conjunction with a filtration addition, to send filtered water to the spray rings. Another way to accomplish this would be to add filters onto the activity loop.

11. **The water feature uses excessive amounts of water.** As mentioned previously, the Clinch Park Water Feature is a recirculation system, re-using the water in the system.

    Comments: Staff reported water usage in excess of 7420 gallons last year over the 10 days the feature was open. Staff also expressed concern that the system may be competing with itself, the autofill adding water after morning start-up, and dumping this water at evening shut-down. Loss due to excessive winds should be negligible due to the features anemometer control. Staff reported no knowledge of leaks in the system.

    The reservoir tank total volume represents less than three minutes of the feature's flow. While there are no published national standards defining the sizing of the reservoir (recommendations range from a minimum of 4 times the flow to PWTAG's technical advisory of 20 times the flow), ASTMF2461-09 (6.5A) provides guidance that the reservoirs or holding tank sizing must consider and incorporate calculations for transit time, pipe size velocity and draw down due to external conditions and overflow.

    Water Technology, Inc. uses the greater of 4 times the flow rate or 4000 gallons to determine the operating volume of the reservoir. A reserve capacity of 1" of water over the feature area is recommended. Based on these criteria, the Clinch Park reservoir should be 4620 gallons. The existing Clinch Park reservoir is likely undersized by a factor of 2.5 times, if one considers that the overflow line reduces the tank's usable volume by about 10%, and the fill volume of the arched water feature another 5%.

Recommendations: Contrary to some opinion, a small reservoir volume is not beneficial to water feature operations. A reduced reservoir volume limits the dilution effect on containments, and makes chemical control and balance more difficult. Increasing the size of the reservoir to at least 4700 gallons is recommended. Given location of the feature, and debris experienced, a three stage tank is recommended. The first stage would be a settling stage to allow sand to settle out, the second stage would be a gravel strainer, and the third stage would be the suction chamber. The gravel strainer would act as the primary debris collector. Cleaning of the gravel strainer would consist of partial flooding of the second stage, and using a pool net to "Skim" Debris on a scheduled basis. At the end of the season this process would be used, as well as draining the tank and evacuating the sand.

12. **Installed piping is not code compliant.** MDEQ requirements state that piping is all able to withstand operating pressures of 160 pounds per square inch. Exposed feature piping in the mechanical room is labeled "Not pressure rated" (Photo 26).

Comments: MDEQ (R325.2137) (1)(E) requires that " all pool water piping is of the following. (e) rated to withstand operating pressures of not less than 160 pounds per square inch"

Project specifications do not establish requirements for feature piping. Section 131500 lists applicable codes and standards, but does not include MDEQ'S code in this list. Plumbing specifications do not reference PVC pipe standards, nor does the water feature piping under products. Neither section requested submittals on water feature piping and valves. Water feature general notes, found on sheet W1.1, does state that the installation shall comply with local plumbing codes (Note 1), and that interconnecting pipe and fittings "Shall be of copper, minimum schedule 40 PVC, stainless steel or fiberglass" (Note 4). Again these notes do not address or necessarily meet MDEQ requirements. This issue was addressed during the permit review process, cited in MDEQ's letter to Mr. Davis (Issue #6 of the 7/22/13 letter). The response from David Graves, PE states that "Schedule 40 pipe used was specified, and used for the work has a rating higher than 160 psi". While it is impossible to know what each installed pipe is, some exposed piping in the mechanical room bears a manufactures label "Non-Pressure Rated." This piping in the feature's mechanical room does not meet code requirements.

Recommendation: Excavate and evaluate piping, replace non-compliant piping.

13. **The filtration seems undersized, requiring backwash of system every ½ hour on busy days.** Staff reported that during hot days the feature must be backwashed frequently. Backwash water is sent to a 150 gallon holding tank which acts as a retention basin, releasing water at a metered rate through a 1.5" pipe (Photo 27). Backwashing frequencies of every ½ hour were reported.

Comments: The filtration loop consists of the filter pump, a filter, Ultra Violet (UV) treatment and chemical treatment. Specific equipment includes:

- Filter pump, Hayward Tristar Model SP 3220EE; 79GPM@80TDH
- Filter Hayward pro-series, Model S310T@, 4.91 SQFT Filter Area
- UV Delta EP series, Model EP20, 30MJ/CM^2 at max flow rate of 70 gpm.
- Chemical Controller, Chemtrol Model 250

MDEQ does not specifically address interactive water playgrounds such as the Clinch Park water feature. The closest MDEQ comes to addressing this type of feature is requiring a 1 hour turnover for a wading pool. Review of adjacent Mid-Western state codes provides the following:

Code	Interactive Spray Feature	Wading Pool
Indiana		1 hour
Illinois	2	1 hour
Wisconsin	.5 hour	

The Model Aquatic Health Code (MAHC), currently in draft form, requires that the ratio of feature water to filtered water shall be no greater than 3:1 in order to maintain the efficiency of the filtration system. The Clinch Park Water Feature designer chose a .5 hour turnover (From DEQ Public Swimming Pool Construction Permit Application); basing their calculations on the 2000 gallon reservoir. The 79 GPM design flow will turn the 2000 gal tank and a 10% piping allowance in 30 minutes. The filter is operating at 16.09 GPM/SF, which is above the midpoint of its operating range (11 – 20 GPM, the lower the number, the more efficient the filter and the greater the capacity of the filter as related to filtration flow).

Given the location and proximity to landscaping a more conservative 11 GPM/SF would have been appropriate. Comparing the design to the MAHC requirements generates a 201 GPM filtration rate, at 11 GPM/SF the required filter area would be 18.3 SQFT, or four of the filters currently installed.

The UV system (Delta EP 20) is undersized with a 70 GPM maximum flow rate, which is below the design flow rate of 79 GPM. UV dosage effectiveness is based upon power and time, the installed system is not meeting the manufactures minimum dosing requirements, rendering the UV system essentially useless.

Recommendations: At a Minimum, the addition of a second filter of equal filter area to the existing is recommended. If other recommendations are implemented, (Specifically pipe replacement) Increasing the filtration to the MAHC standard is advisable along with the addition of two S360T2 filters, with 7.06 SQFT of filter area each. An alternative solution, worth considering in conjunction with #10 and #11 previous, would be to replace the existing filtration system with a combination reservoir/vacuum sand system. An engineering analysis of the cost of this system to a "parts" replacement method is recommended to evaluate the costs and benefits. Replacing the UV with a properly sized unit is also recommended.

14. **The auto-fill for the water feature is difficult to monitor and repair.** The water features auto fill consists of an 18" rod and float valve located in the reservoir tank (Photo 28). The MDEQ code requirement (R325.2126(b)) for a backflow device is provided in the mechanical room with a backflow preventer.

Comments: The only contract references to the auto-fill are found in the specifications (131500-2.3 C.7), which references a "mechanical water fill system w/quick fill valve "under part FWR-12732, 2000 reservoir system. In order to repair this valve, or utilize the "quick fill" valve, staff must enter the tank through the hatch and ladder, requiring staff to follow OSHA confined space procedures. There is no way to monitor the tank level without opening the tank. See also issue #10 above.

Recommendations: During design, a simple solution would have been to route two PVC lines to the mechanical room (1 for fill, one stilling) and placed the auto fill with an air gap in this room. This would have eliminated the need for a backflow preventer (and its yearly maintenance) and confined space entry. It is

WTI's recommendation that the auto-fill be re-located, specifically in conjunction with #'s 10, 11 mentioned previously.

15. **The Water Feature's storm water evacuation is limited to 38 gpm.** Water features require a method to remove excess water which they collect, typically from rain events. The design documentation originally planned for this by providing a 4" pipe connecting the reservoir tank to the sanitary sewer. In addition to being a code violation (MDEQ R 325.2126), this cross connection led to a backflow / contamination incident. The corrective action was to add an additional set of float controls to the sump pump (Photo 29) in the reservoir tank, which ejects water to a sump in the mechanical building. Staff reported the capacity of this pump as 38 gpm.

    Comments: The pump's capacity of 38 gpm represents the equivalent of .025" of rain per minute over the feature's area. Staff expressed concern that the pump's float valve may be at the autofill set point, resulting in conflict between the autofill and the sump pump. It is also noted that this has been allowed by MDEQ as a temporary solution, because the pump discharges into the sanitary sewer.

    Recommendations: The sump pump capacity is adequate for the water feature area itself, for the average rain events expected in Traverse City. As noted in issue #1 above, the feature's present drainage area is much greater than the feature itself, reducing the sump pump's adequacy. The pump's effectiveness is also limited in that it requires power to operate, it may be unavailable in a storm. City staff has investigated a "drywell" option, consisting of two 1200 gallon tanks, and approximately 3200 cubic feet of infiltration rock. This system will perform well, as long as the required backflow prevention is addressed.

16. **Chemical treatment reservoirs are difficult to monitor and fill, require service 3 times per week.** The water feature is treated with two chemicals; liquid chlorine as a sanitizer and muriatic acid as Ph balance. The chemicals are each kept in an in- ground vat located outside and to the west of the mechanical building (Photo 30). The chemical vats are listed in the specifications as PWA-30, and PWC 30, Dual application in ground or free-standing chemical storage tank and states that it shall meet "double wall" requirements. The chemical treatment reservoirs come complete with metering pumps and a lockable hasp.

    Comments: Staff expressed concern with access to the chemical tanks, both from a service standpoint and that they are exposed to park patrons. Located in a landscape area, the surrounding plantings render access to the units difficult (Photos 31 & 32). The units are accessed 3 times weekly to check chemical

levels and to fill. It can be anticipated that access will only get more constrained as the plants grow.

Recommendations: Re-Locate chemical reservoirs to inside the mechanical room. Construct two chemical closets to house the units, vented separately to exterior. This will allow City staff to easily monitor the usage. If demand warrants, this will allow the City to easily upsize chemical capacity to a two week supply. A two week supply is WTI's design standard.

17. **Pump skids are not grounded.**

Comments: It was noted during the site observation that the pump skids have grounding lugs, which do have grounding wires attached.

Recommendations: Test pump skids for grounding, if needed, provide grounding.

18. **The water feature requires on site staff during all operational hours.** Staff reported that in order to keep the feature operational, personnel are required on site to backwash, clean strainers and monitor systems.

Comments: There is no national metric for water feature operational staffing that Water Technology is aware of. Staff reported that a person is required on-site to operate the feature during all open hours of operations. WTI is unaware of any other spraypad with this type of operational burden.

Recommendations: Operational improvements will be dependent on selection and implementation of many of the recommendations contained in this report. Specifically, addressing items 1,9,10,13, 14 16 and 16 will provide the most operational benefit.

Draft 6/19/14

Clinch Park

Traverse City, MI

Photo 01

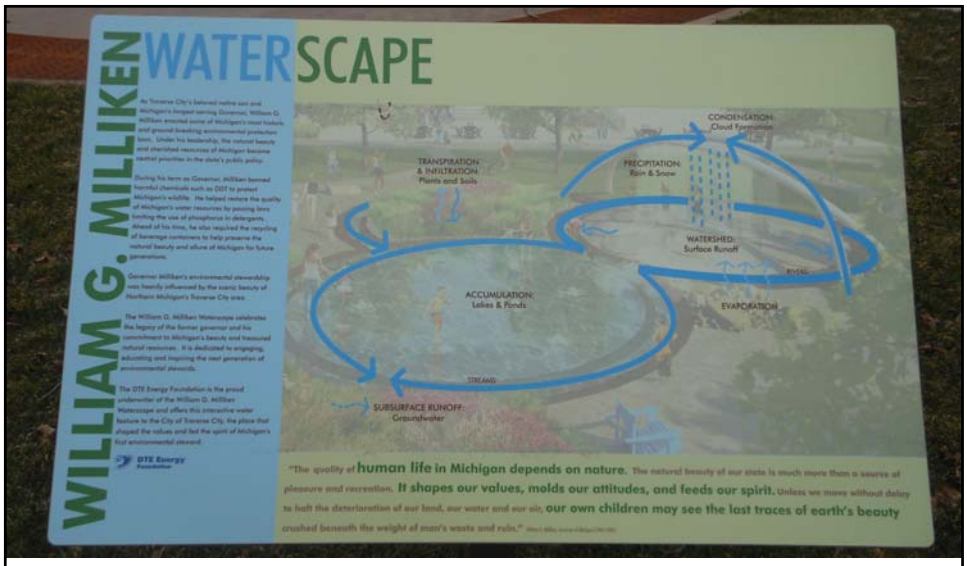

Photo 02

Photo 03

Photo 04

Photo 05

Photo 06

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Photo 08

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Photo 28

Photo 29

Photo 30

Photo 31

Photo 32