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Get Pumped!

Case Studies in Pump-Station Replacement

Pumping systems are the heart of an irrigation system. As golf course superintendents, we depend upon the reliability of a pump station to deliver water upon demand throughout the heat of summer. There is no feeling worse than coming to work and discovering that the programmed irrigation cycle did not run because the pump station malfunctioned during the night. Even worse is when it occurs on a weekend when there is only an hour or two before play begins and it is forecasted to be in the 90s that day with low humidity and abundant sunshine.

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Pump-station technology has changed significantly since many of the original pump stations were installed at area clubs. Most systems were equipped with Volute centrifugal pumps that were later replaced with turbine centrifugal pumps. Now, vertical turbines are equipped with variable-frequency drives and sophisticated software to control the pumps, allowing them to match flow with demand and report the data back to a central computer. Pumping efficiency has drastically improved, resulting in decreased electrical use and less water hammer on pipe systems. Newer irrigation systems have more heads and larger main lines to increase coverage and decrease the amount of time that it takes to water the golf course.

In our area, this past winter saw the installation of a number of new pumping facilities to replace deteriorating and unreliable pumps. The purpose of this article is to explain when it is time for a pump station to be replaced, the planning involved, the construction process, how much it costs, and what to expect upon completion. The clubs that we will profile are Chicago Golf Club and Shoreacres.

A Tale of Two Pump Stations

Chicago Golf Club replaced a pump station and building this winter. The original building was constructed in the fall of 1914. The pumps had been updated in 1982 with two Pumping Systems Inc. vertical turbines. The pump station was prefabricated and consisted of an Aurora turbine direct-drive pump model 10RL, 8-stage coupled to a 50-horsepower General Electric motor with a cast-iron discharge header designed to provide 565 gpm at 300 feet (130 psi). The smaller, or jockey, pump was a 1,800-rpm Aurora turbine, model 8RL, 12-stage, 25 horsepower, also with a General Electric motor and cast-iron discharge head designed to provide 230 gpm at 300 feet. The pumps drew from a wet well that measures 8′ x 8′ with a depth of 14′. Two pipes fed the wet well from a pond located 30 feet to the west of the pump house.

The building that housed the pump station measured 16′ x 16′. The exterior was stucco painted white with a hip roof. The structure was constructed for a sum of $600 in 1914. The building was accessible through two sets of doors. The floor was originally poured concrete and had deteriorated significantly over the last 88 years of its existence. Inside, the area was cramped and dimly lit. In order to service any part of the pump or electrical components, it was necessary to step over pipes and around motors or tanks to gain access. To open the primary power disconnect, the door would have to be removed due to a discharge pipe that prohibited it from swinging open. Abandoned electri-

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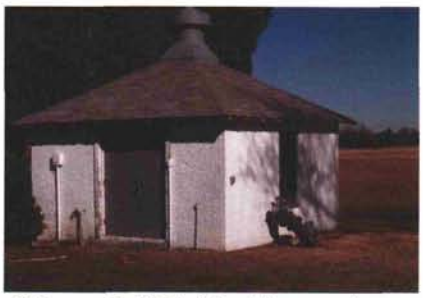
cal components and wires littered the walls, making diagnostic tasks for system failures a nightmare. No components were clearly marked and old wires were intertwined with replacement wire. The interior was lit by one 100-watt light bulb in the center of the structure. A flashlight was almost always required for any type of inspection.



Chicago Golf Club's old pump house.

Shoreacres' pump station and building were constructed in 1968. The pump station consisted of two 60-hp motors that produced approximately 1,000 gpm. The system lacked a jockey pump, so whenever there was a demand on the pump station, a 60-hp motor was turned on. The system functioned with mercury switches pumping water into a 3,000-gallon pressurized tank. The tank required periodic welding when pinholes would show up in the deteriorating steel, causing leaks.

Repair required shutting the entire system down, adding further stress to aging pipes when the system was pressurized following the repair. Due to their age, the pumps were operating at approximately 70% of the intended capacity, limiting the effective sprinkler coverage and increasing the amount of time it took to water the golf course. Shoreacres' irrigation system is automated on greens and tees and manual on fairways. A new irrigation system will be installed beginning this August.

Many factors come under consideration when selecting any product. Service, reliability and peer recommendations are always very important.

Getting Started

Chicago Golf Club's present irrigation system was installed in 1992. A double-row system replaced a single-row snap-valve manual irrigation system. The mainline sizing was designed to the maximum pump station output of 795 gpm. Brian Vinchesey of Irrigation Consulting and Engineering in Pepperell, Massachusetts was hired in the spring of 2000 to evaluate our irrigation system in order to find areas that could improve performance and efficiency.

After studying our system in detail, the consultant made a number of recommendations. One of them included replacing the pump station. As was the case with Shoreacres, a primary concern was the integrity of the hydro-pneumatic tank. The pressurized tank displayed sections of rust and deterioration that could potentially result in the tank rupturing and injuring people in the building.

Inside CGC's old pump station.

The wet well for the pumps was determined to be structurally sound and would be utilized with the new system. In July 2000, we presented the report to the green committee for its review. The action items of the report were prioritized. The first area to address was renozzling the existing sprinklers in order to improve their coverage. That improvement was scheduled for the fall of 2000. We slated mainline looping for the fall of 2001. During the early-morning hours of July 15, 2001, an electrical failure occurred within the control panel of the pump station, causing the pumps to shut off and the system to discharge. This was in the middle of a string of sunny, hot, 90-degree days. Approximately 40% of the irrigation cycle programmed to run actually was watered. Fortunately, we were able to obtain service that morning and diagnose the situation. Upon relaying the information of the failure to the board of directors of the club, the decision was made to make the pump-station replacement an immediate priority. We commissioned the drafting of plans for the construction and contacted a contractor.

For Tim Davis at Shoreacres, the road to a new pump station began 19 years ago. During this time period, he documented repairs and adjustments that were made to the system. The swing joints on all of the snap valves and sprinklers were galvanized and had been developing pinhole leaks, as was the pump station tank. Shoreacres commissioned the service of A.S. Altum and Associates to design a new pump station and irrigation system.

Obtaining building permits presented quite a challenge for Tim. Half of Shoreacres is located in unincorporated Lake County and the other half is in the Village of Lake Bluff. Lake Bluff classified the building as commercial, requiring a permit fee of 3% of the total project cost. Also mandated by the village was a central fire-detection system.

Selecting a Pump Station

Many factors come under consideration when selecting any product. Service, reliability and peer recommendations are always very important. The designer builds the size and specifications into the station. Shoreacres required a station that would work with the present system and be able to meet the needs of the new system. Water quality was also an issue at Shoreacres. Water drawn from Lake Michigan will contain zebra mussels that clog pipes and pumps. Silt is also an issue. The cleaner the water source, the less wear there will be on the pumps. To assist in cleaning the water, a secondary wet well was installed in the pond.

Shoreacres' secondary wet well.

The pump station is equipped with an amiad filter, one 5-hp pump and three 60-hp pumps; although rated for 1,800 gpm, they have the capability of providing 2,200 gpm. The new irrigation system will be able to provide water coverage throughout the entire golf course.

Chicago Golf Club is in a different situation. As our irrigation system is 10 years old, it has approximately another 10 to 12 years of life in the pipes, heads and control system. We needed a pump system that would meet the requirements of the existing system and also be able to supply a sufficient amount of water to a new system in the next decade. One 5-hp pressure maintenance pump and two 60-hp pumps are able to provide 1,200 gpm. The water source is a pond fed by two wells. Upon inspection, we found very little silt in the flume and none within the wet well, so water quality was very high, eliminating the need for additional filtering systems.

Cleaning out the wet well at CGC.

Selecting a Contractor

Shoreacres looked at the qualifications and work of three contractors. All had impressive track records and were very capable of accomplishing the task. Tim and the green chairman from the club visited job sites to inspect the work of the companies being interviewed. The green chairman, following a list of questions, made the final decision with Tim's input. Liebold Irrigation was not the lowest bid, but the club felt comfortable with their work and the timeline set to complete the task.

Having had this same company perform some work to complete mainline looping of the irrigation system at Chicago Golf Club, we hired Liebold Irrigation of East Dubuque, IL, to be the general contractor for the project. We were comfortable upon seeing the quality installation and clean-up they performed with the pipe installation. Two aspects that came under review for us were the company's ability to complete the job, and service following installation.

Warm-Winter Challenges

Construction of the pump facility was to begin at the end of the 2001 season for Shoreacres; however, the weather in November, December and into January was very uncooperative for mobilizing heavy equipment across the golf course. Construction began January 29 in conjunction with

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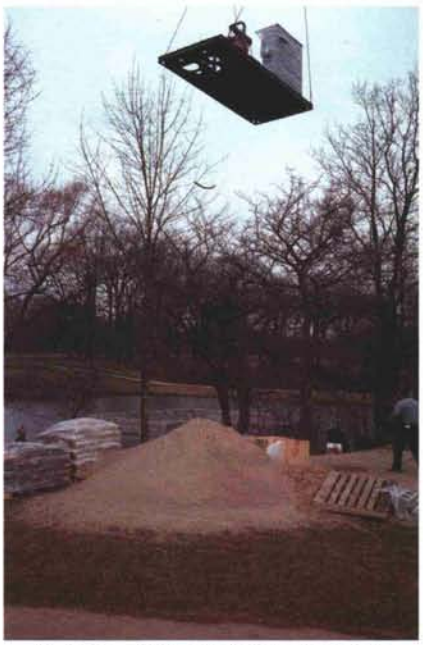
a pond-dredging project. The pump house is approximately 500 feet from the nearest paved area.

A flagged pathway was set in the rough for trucks to follow, creating a haul road to the construction site. The road area incurred very little damage; most of it could be repaired with a roller. The exception was at the area surrounding the pump house, where most of the turning occurred with equipment. Plywood came into use in some areas when necessary; for example, a crane sitting on no. 18 tee lifted the pumps off the truck down a ravine and into the building.

Crane on no. 18 at Shoreacres.



Lifting pump station into pump building at Shoreacres.

The timeframe for construction at Chicago Golf Club was set for the colder winter months of January and February 2002. The irrigation pump station area has no road access, in fact, the nearest paved area is more than 1,800 feet away. Frozen ground was imperative for the heavy equipment to travel across the golf course without creating damaged areas. As luck would have it, January and February this past winter were exceptionally mild. For the concrete and stone trucks in particular, traveling across the golf course would cause a great deal of damage. Discussion took place with the green committee; the debate even entertained the consideration of postponing the project until the following winter. The advantage would be that the probability of the ground firming up and being able to accommodate traffic would increase. The disadvantage was hoping that the pump system might make it through another season. Upon expressing our concerns about the soft ground and uncooperative weather to John Liebold, he assured us that we could use lighter equipment to move material on and off the golf course. He also emphasized the possibility that the weather next season had the potential to be just as wet. We decided to proceed with the project.

The building permit came through on Friday, February 22, and we contacted ComEd to remove the old electric meter from the building. Demolition of the old building commenced on Monday, February 25, with the disconnection of the electrical service, removal of the electrical meter and dismantling of the electrical panels within the building.

Demolition of old pump station at CGC.

On Tuesday, February 26, tear-down of the building began. Footings for the new building were poured on Thursday, February 28. At this point, the ground had become soft. We set plywood across the fairways and utility vehicles were used to transport the cement for the footings from the trucks.

Utility vehicles used to transport cement at CGC.

The concrete block arrived on Friday, March 1, and was moved from the parking lot to the construction area. Fortunately, the nighttime temperature had dropped to 17 degrees, allowing the block to be transported to the site. A couple days prior to pouring the building's foundation on Tuesday, March 5, we received 10″ of snow and the high temperature for the day was only in the teens or low 20s. This allowed for driving the cement truck for the foundation walls right across the golf course. The snow and the cold weather combined to form a protective barrier, creating a platform on which the truck could travel.

The real fun began two days later. The forms for the foundation were dismantled and it was time to pour the floor. The temperature the day before had reached 50 degrees, so the snow was beginning to melt rapidly. The forecast called for warmer temperatures coupled with rain during the next seven days. In order to move the requisite amount of cement to the construction site, a large truck would need to get across the golf course, as it would take too long using utility vehicles. We purchased 100 sheets of 5/8″ plywood to move the cement trucks. When it was time to pour the floor early that afternoon, the temperature was already in the lower 50s with the sun shining. The first cement truck arrived at 1:30 p.m. We double-sheeted the plywood and set it up for the cement truck to travel upon. We opted for a direct path leading from the clubhouse to the construction site.

Plywood path for cement trucks to traverse to minimize golf course damage.

Truck traveling across plywood at CGC.

When the truck had traveled 200 feet, reaching the end of the plywood, we would go back and move the wood forward for the truck to travel another 200 feet. We performed this process eight times in order to reach the area; the trip included crossing the no. 18 and no. 1 fairways and the driving-range tee. The gross weight of the truck full of cement was 79,000 pounds. The result of our diligence was evident when the truck reached the pump-house area and exited the plywood to turn into position. The wheels immediately sank 8″ into the turf. The truck made all of its turns within a designated area of disturbance surrounding the pump house. After emptying the concrete, the truck was much lighter, making the return trip easier. We used single sheets of plywood in the rough and double-sheeted the driving-range tee and fairway crossings. The remaining section of the floor necessitated bringing out only a small amount of concrete. Again, we used utility vehicles. When all of the cement had been transferred from the truck to the pump house, the sun was setting and the temperature was dropping. The floor was completed at 8:30 p.m. using the lights of a skid steer and a pickup truck. The forms came off the foundation walls on Monday, March 11 and the concrete block walls started to go up Tuesday, March 12.

Do whatever possible (during pump-station replacement) to avoid equipment damage to the golf course. These areas will become very unsightly and take longer to recover than you anticipate.

The walls are constructed 8′ high and the new building measures 24′ x 24′ for a total of 576 square feet. The east and west sides of the building offer double doors for access. A section of the floor is recessed to accommodate a fertigation system in the future. This area

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measures 9′ wide, 22′9″ long and is 24″ below the primary floor and surface of the wet well. A sump hole sits in the corner of the floor to collect any water from the station or spillage from the future fertigation system.

Erecting building at CGC.

The building at Shoreacres, meanwhile, is very elaborate. Measuring 24′ x 24′ less an 8-½′ x 8-½′ section to accommodate the electrical transformer, the total area for the building is 504 square feet. The cost and difficulty of relocating the transformer called for the building to surround the existing transformer.

Shoreacres' building goes up around existing transformer.

The sides of the building are cedar shake and, in many ways, the building is modeled after the clubhouse in every detail down to the copper flashing. Inside, the ceiling is sheet-rocked and painted; all of the joints in the block walls, as well as the floor, are filled and painted. The same depressed section of floor exists for the possibility of a fertigation system in the future. Shoreacres has a very aesthetically pleasing building to house its pump station.

Budget vs. Actual

The two projects varied in their costs for completion. Shoreacres' building and pump station that consists of a 5-hp pressure maintenance pump, three 60-hp primary variable-frequency drive pumps with the capability of delivering 2,300 gpm, an amiad strainer, wet well, secondary wet well, and approximately 100′ of mainline to tie the pump station into the irrigation system, came in at approximately $238,000.

Originally budgeted for $150,000, the pump-station project at Chicago Golf Club ran over the intended amount due to some unforeseen electrical complications and an underestimation of the building cost (see Table 1).

Dos and Don'ts to Make the Project Run More Smoothly

The most important element of planning for a pump-station installation is making sure all of your permits are in order, well in advance. Contact the utility company and research your existing service and what will be required of the future station. If a transformer change-out or wire connection needs to be made, it may be up to 12 weeks before it will happen.

Working on the transformer at CGC.

Expect issues to arise and take care of them quickly so the project moves forward. You will need to be adaptable in order to make things work in a timely fashion.

Set a strict timeframe for your contractor. Pumps are critical and with the unpredictability of the weather, it can get hot quickly in the spring, resulting in a need for water for existing turf or sod. If a transformer is being installed, it can still be three days to three weeks before it is energized. If you have a shallow water source, do whatever possible to prevent contaminating debris from entering the pumps, as well as secondary wet wells and strainers; this will prolong their life. Do whatever possible to avoid equipment damage to the golf course. These areas will become very unsightly and take longer to recover than you anticipate. Have a power contingency. Find out about generators to run the pump system in case the utility company is unable to energize the pump station on time. Be sure you know exactly who owns the primary power cables into your prop-

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TABLE 1

Item	Budget	Actual
Pump	$65,000	$61,039.56
Building/Electrical/Demolition	$65,000	$86,730
Architect	$500	$400
Building Permit	$500	$438
Electrical Connections	$4,000	$2,603
Design	$5,000	$6,500
Contingency	$10,000	
Extra Stone		$186.92
Transformer		$1,607
Sod for Damaged Area Around Building		$2,400
Pump Communication Wire		$2,600
Electrical Extras		$2,490
Total	$150,000	$166,994.48

erty and who will be responsible for them. Things will go wrong during any project of this magnitude.

Even with the best planning, "things will go wrong," as this episode at Shoreacres testifies.

Expect issues to arise and take care of them quickly so the project moves forward. You will need to be adaptable in order to make things work in a timely fashion. Communicate with the general contractor immediately if you are not pleased with any aspect of what is occurring. Wax the pump station and skid at least once a year to keep standing water from rusting the metal.

Final Results

Tim Davis reports that the increased pressure and improvement in coverage is tremendous. He is able to run more heads and accomplish watering in a much faster timeframe than before. The only limiting factor is pipe size of the existing system. Shoreacres also expects a noted savings in energy. A 5-hp pressure maintenance pump, instead of the 60-hp pump that was previously in service, will now be able to supply water for syringing or run a couple of heads.

The same results have been evident at Chicago Golf Club. Integrated with pipe looping and nozzle change-outs, the coverage and performance of the irrigation system is much improved. The new pumps run very smoothly. The building offers an abundance of light and space, making work and access very easy. Evaluating the status of the system and diagnosing problems is very straightforward. Touch-screens provide an array of information to correct even the most complicated issues.

Data control pad for pump station.

Inside of new pump station at CGC.

We estimate that with proper care, the pump stations should last about 25 years and the building even longer. Water quality will have a large impact on how long a pump station will last without any problems. Do not forget to check your pump station frequently. Understand what it sounds like under load and follow the manufacturer's recommended maintenance sequences.

Proper planning and oversight will result in a new pump station that will provide many years of reliable service.

Chicago Golf Club's pump house: before and after.