Fortifying Against Future Floods…
Grand Forks Water Treatment Plant Leads the Way

At 6:30 a.m. Saturday April 19, 1997, the long, desperate fight to save the Grand Forks Water Treatment Plant was over. The plant was flooding beyond control. Operationally, it was failing. The Red River of the North had been too formidable an enemy.

That moment of defeat, however, marked a new beginning. Hazel Fetters-Sletten, water treatment plant superintendent, vowed that things would be different the next time the Red River came calling. She was going to find a way to better protect that critical facility in the future.

"My first thought was, 'Let's move it. I'm tired and I don't want this to ever happen again,'" said Fetters-Sletten. "But this isn't a facility that can just be picked up and plopped down in a short period of time. Building something of this magnitude would take four or five years."

So she did the next best thing. With the help of staff, engineers and contractors, she figured out how to restore the damaged plant so that it would be more disaster resistant, paying particular attention to the operation's most critical components.

What stands in the shadow of the river today is a water treatment facility that has undergone major changes to minimize the impact of future flooding and other disasters. In addition, there now is an extensive written flood contingency plan. And future building will no longer occur at the present site but far from the floodplain in which it currently sits.

Floodwaters inundated the Grand Forks Water Treatment Plant in April 1997. The city was without drinkable water for 23 days because of the damage to the facility. Photo courtesy of Advanced Engineering, Inc., Grand Forks.

Unlike other public and private facilities, water treatment plants were traditionally built near rivers on purpose. In Grand Forks, water is drawn from the Red River and the Red Lake River, both of which meet near the plant. The water then is treated in a three-phase process and sent through a citywide distribution system of water lines to homes, businesses and other end users. Average daily consumption for the city and the Grand Forks Air Force Base, located about seven miles away, is approximately eight million gallons.

The water treatment plant itself is a complex of three buildings, three large underground finished-water clearwells and a large aboveground water storage tank. Inside the main building, there are multiple levels of rooms with large equipment and thousands of feet of water-filled piping. When the river began invading all three buildings, the plant became a complicated nightmare. The buildings remained flooded for 10 days. As a result, the city was without drinkable water for 23 days.

Ken Vein, former Grand Forks city engineer, helped guide the changes that will enable the treatment plant to better withstand future flooding.

In deciding how to make the facility more disaster resistant, Fetters-Sletten and the engineers first targeted the three components that would be essential to keeping the plant operating, even if as much as a foot of water were to get inside.

Primary attention was focused on protecting the power supply, wiring and the massive amount of electrical equipment needed to run just about everything in the plant, Fetters-Sletten said. So electrical transformers and equipment such as motor control centers and electrical panels throughout the complex were elevated, some as much as 10 feet. The power "nerve center" for the plant now is located on a newly built earthen berm. Individual transformers and switchgear on the berm are elevated higher yet.

Next, two large air compressors were moved from the lowest level of the plant to a higher floor, greatly improving the chances that they would stay dry in the event of a future flood, Fetters-Sletten said. Losing the air compressors—as happened in the 1997 flood—presents a critical problem for the plant.

"We need compressed air to operate the valves," Fetters-Sletten said. "Without it, the valves fail in an open position and we can flood ourselves internally. So we moved them upstairs out of the boiler room. Now, in effect, they're about 30 feet higher than they were before."

The third key component involved disaster-proofing the water intake system, Fetters-Sletten said. Without the ability to draw raw water into the plant, there is no way to provide treated water to the rest of the city. So a concrete wall was built around one of three pumphouses and the electrical components inside were elevated. Additionally, a 250-kilowatt portable generator was purchased to provide a backup power source. This ensures that at least one raw water intake will work even if the city's power goes out.

In the main building, critical records such as blueprints, equipment information, and vendor lists have been relocated to a room on an upper floor of the plant. Safeguarding this kind of information is essential, Fetters-Sletten said, to reducing the amount of downtime that any facility or business could experience from a disaster.

For all three buildings, metal shields with rubber gaskets have been custom built to fit over 24 major doors and windows. In advance of a flood, the shields can be attached to special frames that are permanently affixed to the doors and windows to keep water from entering the plant.

When a flood is imminent, a clay dike can be built around the plant as a secondary means of protection. The use of the dike will be determined from the river crest forecast, Fetters-Sletten said. Although attaching the metal shields will work for most floods, a higher water level could exert too much pressure on the building walls, causing a collapse. The dike will help prevent those high levels from reaching the buildings.

With the ground-level measures in place, engineers and staff then looked at protecting the underground elements of the system because floodproofing this type of facility involves more than just stopping the spread of surface water, Fetters-Sletten noted. By the plant's very nature, there are several ways that water can get in below ground. So numerous shut-off gates and valves have been installed within the plant's underground utilities to block floodwaters from backing up into the facility from the city side.

To date, the disaster-resistant features have cost about $1.8 million, which is in addition to the nearly $4.3 million it cost just to repair the plant's flood damage. The funding came from the Federal Emergency Management Agency and the State of North Dakota through a disaster-recovery program that repairs or replaces disaster-damaged public facilities.

Given the almost yearly river flood risk and a continuing wet cycle, Fetters-Sletten wholeheartedly believes the cost for the extra protection measures has been worthwhile to protect a facility currently worth about $40 to $50 million.

A key electrical transformer (right) has a new home atop this concrete platform, built to keep the equipment high and dry in a future flood.

Multi-Hazard Protection

Besides floods, the plant now can operate in the face of other kinds of disasters as well, in large part because of a special 1500-kilowatt generator that can provide power at any time for any reason.

The $350,000 generator, installed just months prior to the 1997 flood, ran the plant during an ice storm that preceded the April flood when the rest of the city was without power. Although it succumbed to the flood just days later, the generator has since been rebuilt and reinstalled, the fuel line fill spout has been elevated 5 feet and contingencies have been added to protect the room in which the generator is housed so that the equipment can be kept dry.

The generator investment more than paid for itself just two years later when, during a nearly identical April ice storm, the plant remained operational after the power went out in the rest of the city. Now, plant operators often switch to generator power when the city is in the path of a severe thunderstorm as a precaution against surges that may occur in the regular power supply. That precaution virtually eliminates the risk of costly damage to equipment from those power surges.

With an eye to the future and mindful of the lessons learned from the record-setting 1997 flood, the city is determined not to take any more chances with one of its most critical facilities. So the entire water treatment complex gradually will be moved to a 40-acre site the city purchased for $540,000 located west of town, outside the floodplain and far from the floodwaters' edge.

The new location does mean abandoning the downtown site on which a treatment plant has stood since 1897. The current facility was built in 1956 and since then four additions have been made. But to build a new, technologically current facility would cost from $80 to $90 million. And it is just too big a risk to locate an expensive new facility like that close to a river with a long history of flooding, Fetters-Sletten said.

In addition to elevating electrical equipment (left), engineers also outfitted 24 major doors and windows (right) with special metal shields that can be attached ahead of time to keep out floodwaters.

The disaster-resistant measures and contingency actions now in place will enable the plant to operate in a future flood, even if it's totally surrounded by water, Fetters-Sletten said. Those changes probably would not have occurred if the plant hadn't been through the 1997 flood, she added.

"We're in a lot better shape now, definitely," Fetters-Sletten said. "We've relocated our critical components, we have our contingency plan in place and our staff is ready. We're not doing it on the fly."