TURNER VALLEY AND BLACK DIAMOND WATER SUPPLY SYSTEM

CANADIAN CONSULTING ENGINEERING AWARDS

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FLOOD OF THE CENTURY

In the days leading up to June 19, 2013, southern Alberta experienced extremely heavy rainfall that triggered catastrophic flooding (described by the provincial government as the worst in the Province’s history). Areas along the Bow, Elbow, Highwood, Red Deer, Sheep, Little Bow and South Saskatchewan Rivers and their tributaries were particularly affected. By the morning of June 20, major flooding affected several communities including the Towns of Turner Valley and Black Diamond (located approximately 1.5 km apart). Each Town, with a combined population of 4,500, had declared a state of emergency. Emergency conditions included:

- Washed out highways and local roads,
- Washed out bridges,
- Flooded residences and businesses in low lying areas,
- Power outages,
- Complete loss of the Black Diamond Campground,
- Damage to Oil & Gas facilities,
- Unstable banks along the Sheep River,
- Flooding of the Turner Valley main sewage lift station,
- Complete decimation of the water supply systems in both communities.
Due to the flood, **there was no raw water supply to the raw water storage reservoir in Turner Valley and no raw water supply, storage or treatment in Black Diamond.** Noted below were the flooding effects on the primary wells, pipeline and water treatment plant:

**Turner Valley**
- Well No. 5 – Decimated
- Well No. 8 – Decimated
- Well No. 7 – Power Supply and Pipeline Decimated

**Black Diamond**
- Well No. 1 – Decimated
- Well No. 2 – Decimated
- Water Treatment Plant – Decimated

Black Diamond was left with a three-day potable water supply, with no means of generating additional water. The only water available was from Turner Valley’s full raw water reservoir which was relatively untouched by the flood. (This reservoir was commissioned in 2008 to provide Turner Valley with a reliable source of water that is less dependent on the Sheep River during times of low flow or poor quality.) Both communities significantly benefitted from the available water in the reservoir as new sources were investigated and secured.
THE RESPONSE

Natural disasters dictate immediate response. An emergency response plan combining the efforts of both municipalities, emergency workers and the Consultant Team consisting of MPE Engineering Ltd. (MPE) and Urban Systems Ltd. (USL) was developed. This emergency response plan was implemented through a priority list. Public safety issues were of prime importance and focus on restoring essential services began. Emergency measures commenced immediately with round-the-clock support during the flood event by several MPE/USL staff, and extensive support beyond to assist the communities with the required work.

From a communications perspective, the Towns each appointed an emergency response coordinator. The Consultant Team worked closely with the coordinators, advising on priority tasks, assisted in retaining and directing contractors, and provided field staff including surveyors. The emergency command centre remained open during the “State of Local Emergency” (SOLE), and the engineering consultants remained a key component, sitting alongside fire and rescue, town councillors, regulators, and public health officials.

Developing a temporary water supply that would meet safe drinking water criteria was paramount. This meant sanitizing all the materials utilized for the supply system and ensuring continual monitoring of the works to maintain the potable water standards. Implementation of these temporary emergency measures would be followed by the development of an upgraded temporary and then a permanent water system solution. It was essential that the permanent plan of the regional water system originally mapped out in 2008 by the municipalities was fast-tracked.

**Priority 1 – Potable Water Supply to Black Diamond**

The first priority was to connect the water distribution systems between the communities as the only available water was located in a raw water reservoir in Turner Valley. This raw water was sufficient to meet short-term demand.

MPE assisted the Towns to analyze potential tie-in locations and the impacts of their different water pressure zones. MPE assisted emergency crews to quickly carry out hydraulic calculations and create a design to connect 100mm dia. fire hoses to a fire hydrant in Turner Valley, extend it 1.3 kilometres away to Black Diamond, then reconnect to a hydrant there. This resourceful endeavor enabled Black Diamond’s residents, businesses and a Regional Hospital to have access to clean drinking water within two days post-flood (and one day before the reserve supply was to be depleted).

*Temporary Fire Hose Connecting Both Towns*
**Priority 2 – Raw Water Supply**

The next priority required establishment of a raw water supply as both communities had lost their source of water. Re-establishing a raw water supply within the Turner Valley aquifer became the next focus.

As a result of the flood, access to Well No. 7 was destroyed and the pipeline and power supply were severed; however, the well itself was relatively untouched. MPE began to fast-track a design to run a new supply pipeline and re-establish power service. This work was completed, and Well No. 7 was supplying water to the raw water reservoir by July 31.

Turner Valley’s Wells No. 5 and 8 were completely obliterated during the flood, and the surrounding area was significantly altered. The river had changed location and the status of the water aquifer was unknown. As a result, exploration to replace the wells began immediately after the flood receded.

New well locations were tested and a permanent infiltration gallery was required to re-establish water supply. However, this investigation would take time, and levels in the raw water reservoir continued to drop as Well No. 7 could not keep up to the new demand imposed by both communities.
Two-Pronged Solution

As a result, a two-pronged approach was taken during the exploration. Firstly, a temporary solution was explored to supplement Well No. 7, in what was still an emergency situation.

Significant effort was made to locate, test and implement temporary infiltration pits. Working with Alberta Environment and Sustainable Resource Development relative to water quality testing and temporary diversions, additional raw water supply from the infiltration pits was commissioned in late July 2013. As a result, water levels in the Turner Valley raw water reservoir began to rebound and by November 2013, the reservoir was once again full and able to provide water to both communities over the winter months. The infiltration pits were decommissioned immediately after due to winter conditions.

Despite vast efforts by residents to conserve water, the raw water reservoir was reduced to 40% capacity and levels continued to drop in June 2014. As a result, the infiltration pits were again commissioned while a permanent solution continued to be designed, approved and constructed.
Permanent Source of Groundwater

Once the immediate temporary raw water supply (infiltration pits) was complete, focus shifted to secure the new groundwater source in Turner Valley. As part of the exploratory work, three locations proved promising as a new source. Those locations were in the same vicinity as the original Turner Valley Water Wells (No. 5 and 8). Ultimately, these three locations were selected and a new supply was secured:

- Well 5A: Commissioned January 21, 2014
- Well VW5: Commissioned July 22, 2014
- Well CW8: Commissioned July 23, 2014

Environmental Sensitivities

Given the sensitivities and realities of working within an area of intense oil and gas development, and the unknowns of a potentially changed aquifer as a result of the flood, significant attention was paid to raw water quality. The raw water that entered the reservoir was tested and continually monitored. All sources of water including the temporary infiltration pits and the permanent shallow wells were tested for a variety of parameters to ensure compliance with ESRD approvals and ongoing monitoring requirements.
**Priority 3 – Establish a Permanent Transmission Main**

The moment the emergency (fire hose) transmission main between Turner Valley and Black Diamond became operational, work continued on a more robust temporary solution, which would reduce the risk of the overland placement. The Towns began searching for HDPE pipe that would be suitable for this more durable temporary installation. Once the pipe was procured, it was fused and then placed in a similar location as the emergency fire hose supply line. The HDPE pipeline was laid above ground, but buried at road crossings to provide further protection. Installation was completed by July 2013.

Concurrently, USL began fast-tracking the design of the permanent potable water transmission main, which involved significant alignment and landowner challenges. By November 2013, the Towns were connected with a permanent transmission main that bridges the two communities together as part of the regional initiative.
Priority 4 – Protection of the Water System

There was significant pressure to re-establish the river channel and construct berms to protect the communities. Not only was the new water supply infrastructure at risk, but also the newly repaired bridges, reconstructed campground, as well as residences and local businesses needed protection. Several challenges included:

- **A Changed Environment:** Due to significant scouring and erosion, the Sheep River channel had been altered. Detailed modelling was required to capture the new characteristics of the channel and how it would behave in future high flow events.

- **Design Coordination:** Restoration efforts were being carried out on many fronts. It was critical to incorporate and overlap various concurrent designs being completed by multiple stakeholders and consultants.

- **Environmental Protection:** Several environmental assessments were completed leading to a mitigation strategy that included river isolation, dewatering and staging. MPE and USL worked with environmental consultants to monitor water quality, sediment control and coordination of fish salvage.

- **Construction Coordination and Timing:** Utilizing infiltration pits to supplement water supply was critical to ensure adequate water through the winter months. Timing of the berm installation was deferred to ensure water access and quality from the pits was not compromised. This consideration, along with the implementation of environmental approvals and mitigation, resulted in a narrow construction window.

- **Rock Supply:** Availability of rock armour was scarce throughout Alberta due to high demand as a result of the flood. Turner Valley and Black Diamond were no exception. Limited supply compounded the issue of a narrow construction window as the Towns, consultants and contractors pushed to have the work complete prior to the next high flow event. Ultimately, the berms were completed prior to the spring runoff in mid-June 2014.

- **Raw Water Capacity:** Performance of the newly established raw water supply continues today. The primary goal is to obtain pre-flood capacity that was previously provided by Black Diamond and Turner Valley wells, which allows for sustainable growth over the next 25 years. The new system continues to be monitored and tested to ensure a sustainable design is achieved providing a reliable source from the Sheep River with no negative impacts to the surrounding area.
The 2013 June flood ravaged the communities of both Turner Valley and Black Diamond. Community commitment between both municipalities had always been amicable; however this devastating event and the unified efforts of both communities has brought in a new realm of cooperation and a greater shared vision of common goals. The project team, including Town politicians, administration and public works staff, and the consultants (MPE and USL) focused on “What is best for the entire region?” throughout the project. The aftermath of this event brought many residents together to help one another and recover from the impacts of the flood. This unified, resilient and cooperative spirit among the Towns’ residents will continue to shape the communities with a strong commitment to the future.

When the Towns declared a local state of emergency, strict water conservation measures were implemented. This involved no outdoor watering, local car wash operators were shut down, a fire ban was instituted, and residents were urged to use water sparingly. At the time of the flood event, Turner Valley had the benefit of a full raw water reservoir which represented approximately six months of water supply for the Town only. However, by now adding the water demand for Black Diamond, the available water supply was cut in half, so these conservation efforts would greatly assist in conserving the reserve water supply.

The communities have demonstrated great cooperation and patience, and residents and business owners alike adopted these water conservation measures willingly which allowed sufficient time to implement new water sources. The reduced daily consumption ensured that the water storage reservoir never dropped below 40% storage. It is noted that the residents have maintained their water conservation efforts, even after the water restrictions were eased in September 2014.
A SUCCESS STORY

The June 2013 flood ravaged many areas in southern Alberta, including decimation of the entire water supply to Turner Valley and Black Diamond. After emergency measures restored basic services including water service to both communities, the municipalities reacted quickly and fast-tracked the regional solution, with funding assistance from the Southern Alberta Flood Recovery Task Force. Since the initial flood disaster, water supply to approximately 4,500 residents went from non-existent to fully-secured. The Towns’ residents, businesses and infrastructure are more flood-resistant than ever.

Without the vision provided by the municipal leaders years ago, or the Towns’ resiliency and spirit of cooperation, it is not clear how the individual communities would have endured the Flood of 2013. The Towns of Black Diamond and Turner Valley, along with their Consultant Team of MPE Engineering Ltd. and Urban Systems Ltd., partnered together to implement emergency measures and expedite long-term water supply system solutions. They can take great pride in what they have accomplished through exceptional cooperation, innovative designs and prompt decision-making, turning a dire situation into a true success story.