

Inlet Control Structure (at centre of photograph) on the floodway east of Winnipeg.

# Inlet Control Structure Trunnion Anchoring Replacement

**A team of engineers and construction firms had a complicated job to replace hinge anchors on the Red River Floodway Inlet Control Structure near Winnipeg.**

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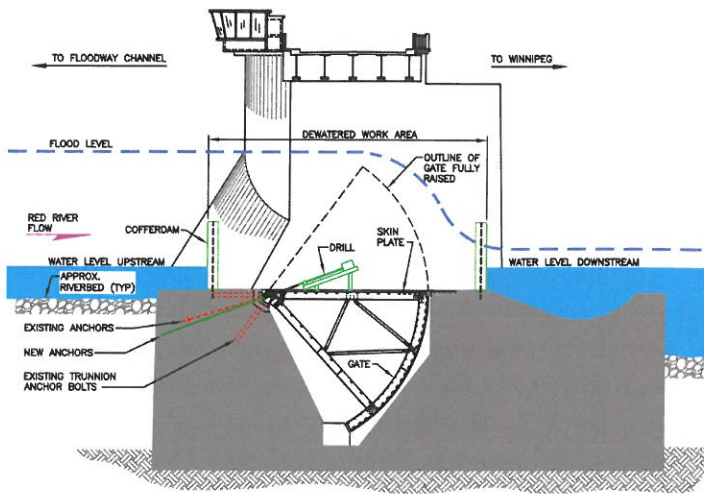
The Red River Floodway was constructed between 1962 and 1968 to protect the City of Winnipeg, East St. Paul, and West St. Paul from flooding by diverting flows from the Red River around the city. The original floodway, constructed at a cost of \$63 million, has prevented more than \$32 billion in potential flood damage to Manitoba.

A critical component of the floodway is the Inlet Control Structure (ICS), which controls the flows and water levels within the city and the amount of flow directed through the floodway channel during flood events. The ICS consists of a concrete structure with two 34-metre wide by 12-metre high submersible gates. The two gates are normally lowered, but in flood conditions they are raised to restrict flows into the Red River through Winnipeg.

In 2003, the Government of Manitoba established the Manitoba Floodway Authority, a provincial crown agency responsible for increasing the flood capacity of the floodway. KGS Group and sub-consultants SNC-Lavalin and Hatch designed the floodway capacity upgrades and life extension measures. The total cost of this program, which was jointly funded by the governments of Canada and Manitoba, was estimated at \$665 million.

While the major capacity changes to the floodway were completed in 2010, upgrades to some components are still being carried out. One of these is the Trunnion Anchoring Replacement Project. This project involved the careful detensioning and then replacement of existing post-tensioned strand anchors that provided in excess of 49,000 KN (11 million lbs.) of tension to secure the hinges (trunnions) of the floodway inlet gates to the concrete crest.

The trunnions allow for transferring the large hydrostatic wa-



Section of Floodway Inlet Control Structure showing orientation and location of the existing and new trunnion anchors, as well as required location for drill and tensioning jack on top of gate during construction.



Tensioning jack on top of gate applying 250,000 lbs. of tension to the new grouted DCP post-tensioned trunnion anchors which are located about 8 ft. below.

ter forces on the gate (as it holds the upstream water back) to the concrete structure. Site investigations performed by KGS in 2010 confirmed that the anchors were corroding and required replacement to ensure the continued reliable operation of the ICS gates.

The anchor installation system collaboratively developed by the design and construction team (Geo-Foundations Contractors and The Pritchard Group) advanced the state-of-the-art for anchoring in small confined spaces. The design required using various numerical models, including finite element method analysis (using ANSYS) and visualization tools to define the complex 3D spatial orientations.

Since there is very little room inside the gate, the drilling of the anchor holes and the tensioning of the anchors could only be done by cutting access holes in the gate and then performing the work from outside on the top of the lowered gate. The new strand anchors had to be drilled and located to precise coordinates, using a custom designed lightweight track-mounted drill rig and a downhole hammer to minimize the potential for the drill hole to wander as it passed through the concrete and reinforcing. The new anchors required precise in situ machining of the existing beams to allow the new anchor base plates to then be welded into position in the correct 3D orientation. The tensioning of the anchors required the development of pipe jack stands to allow the anchors to be jacked from outside the gate while the jack loaded the concrete within the gate.

Among the many challenges of the project was the fact that the Inlet Control Structure was required to be “flood ready” every spring, meaning that construction could only occur during the winter months between November and March. As a result, all the construction works had to be staged to ensure the Inlet’s flood readiness each and every year that construction was undertaken.

Cooperation and an efficient means of design updates and com-

munication was ensured throughout the design and construction phases by having KGS Group staff on site or available 24 hours per day to assist in the resolving construction and design issues as they occurred. Their availability proved of key importance in maintaining the challenging schedule.

Despite the many site constraints and challenges, along with the numerous design modifications required throughout the course of construction, the project was completed in the spring of 2013, one year ahead of the originally planned date, and under budget.

This was a rewarding project that presented KGS Group and its sub-consultants with new challenges, a high level of complexity, and an opportunity to develop and implement leading-edge engineering technology. The collaborative relationship and close communication used between MFA and the design and field staff proved critical to the project’s schedule and budget success. The benefits from the life extension of these components will assure continued good performance of the trunnions and the gates for the next 50 years and more.

The KGS Group design team was presented with an Association of Consulting Engineers of Canada-Manitoba Award of Excellence in Engineering in 2013. ■

**PROJECT:** Inlet Control Structure Trunnion Anchoring Replacement, Red River Floodway

**CLIENT:** Manitoba Floodway Authority

**PRIME CONSULTANT:** KGS Group (Dave MacMillan, P.Eng., Gord McPhail, P.Eng., Scott Larson, P.Eng.)

**SUB-CONSULTANTS/CONTRACTORS:** SNC-Lavalin, Hatch, The Pritchard Group, Geo-Foundations Contractors