



**To:** Public Works and Transportation Committee

**Date:** November 7, 2011

**From:** John Irving, P.Eng. MPA  
Director, Engineering

**File:** 10-6060-04-01/2011-  
Vol 01

**Re:** Irrigation Water Salinity Update

**Staff Recommendation**

That the attached staff report on the impacts of Fraser River salinity on agricultural irrigation water be received for information.

John Irving, P.Eng. MPA  
Director, Engineering  
(604-276-4140)

Att. 4

FOR ORIGINATING DEPARTMENT USE ONLY					
<b>ROUTED TO:</b>		<b>CONCURRENCE</b>		<b>CONCURRENCE OF GENERAL MANAGER</b>	
Sustainability		Y	<input checked="" type="checkbox"/>	N	<input type="checkbox"/>
Sewerage and Drainage		Y	<input checked="" type="checkbox"/>	N	<input type="checkbox"/>
<b>REVIEWED BY TAG</b>		YES	<input checked="" type="checkbox"/>	NO	<input type="checkbox"/>
<b>REVIEWED BY CAO</b>			YES	<input checked="" type="checkbox"/>	NO

## Staff Report

### Origin

This is an update to the Salinity Intrusion in the Fraser River staff report presented at the Public Works and Transportation meeting on July 21, 2010 (*Attachment 1*). The July 2010 report discussed factors that influence salt wedge penetration in the Fraser River and the potential impact of the salt wedge on irrigation water taken from the river. The report concluded that the No. 7 Rd. North and the No. 8 Rd. North Pump Stations are unlikely to be impacted by the salt wedge. The report also concluded that the No. 6 Rd South Pump Station is likely impacted by the salt wedge and recommended further monitoring of salt water intrusion at this station. Staff were asked to report back as further information became available.

### Analysis

Farmers in the Agricultural Land Reserve utilize water from City drainage watercourses for irrigation purposes and flooding cranberry fields. Water is abstracted from the Fraser River at three City drainage pump stations to support this activity. Brackish or saline water can cause damage to crops grown in Richmond and care must be taken to insure that irrigation water abstracted from the Fraser has salt content below damaging levels. Saline content is measured in terms of conductivity and water below 700 micro-siemens per centimetre ( $\mu\text{S}/\text{cm}$ ) is generally considered safe.

As noted above, irrigation water from the No. 7 Rd. North and No. 8 Rd. North Pump Stations is unlikely to be impacted by saline intrusion. However, water abstracted from the South Arm of the Fraser River at the No. 6 Rd. South Pump Station is periodically impacted by salt wedge penetration. To keep salt water out of the watercourse system, the No. 6 Rd. South Pump Station has a salinity sensor controlled valve that closes when it detects water that contains too much salt, keeping high salinity water away from farmer's crops.

Public Works operations staff and farmers use handheld salinity meters to spot check water quality in City watercourses to confirm that the No. 6 Rd. intake valve is adequately protecting the agricultural community from salt water. Staff reports that there have been no salinity issues within the watercourses served by the No. 6 Rd. South Pump Station to date in 2011.

Salinity data from the No. 6 Rd. sensor is presented in *Attachment 2* (August 3 to August 8, 2011) and *Attachment 3* (September 16 to September 21, 2011). These figures show that river salinity levels were safe for agriculture level 70% of the time in August but only 25% of the time in September. Additionally, maximum salinity was measured to be up to 10 times higher in September than in August. *Attachment 4* shows Fraser River discharge levels at Hope for 2011. Low river flows allow increased salt wedge penetration and discharge levels were lower in September than in August in 2011. The lower flows are likely responsible for the higher peak salinity levels and reduced irrigation water availability in September.

The City is generally meeting the irrigation needs of the farmers served by the No. 6 Rd. South Pump Station. However, irrigation water quantity could be limited during Fraser River low flow years or during the fall months. Staff will work with farmers during these periods to identify solutions should the need arise.

Staff will install additional monitoring in and around the No. 6 Rd. South Pump Station as part of the City's ongoing East Richmond drainage improvement program, with funding from existing budgets. The additional monitoring will provide improved Fraser River salt content information that will support enhanced operations and planning.

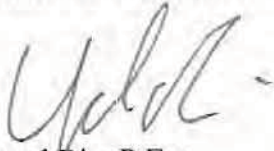
**Financial Impact**

None at this time.

**Conclusion**

The No. 6 Rd. South Pump Station's capacity to provide irrigation water is impacted by saline intrusion periodically. Salt water is kept out of the watercourse system at the No. 6 Rd. Pump Station by a valve controlled by a salinity meter. This system is working well and no operational issues have been reported so far in 2011.

The quantity of water that can be abstracted from the South Arm of the Fraser River by gravity is impacted by the flow in the river. Should this become problematic, City staff will work with the farmers to identify solutions.



Lloyd Bie, P.Eng.  
Manager, Engineering Planning  
(604-276-4075)

LLB:llb



**City of  
Richmond**

**Report to Committee**

**To:** Public Works and Transportation Committee

**Date:** July 5, 2010

**From:** John Irving, P.Eng. MPA  
Director, Engineering

**File:** 10-6060-00/Vol 01

**Re:** Salinity Intrusion in the Fraser River

**Staff Recommendation**

That the attached staff report be received for information.

*John Irving*  
John Irving, P.Eng. MPA  
Director, Engineering  
(604-276-4140)

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<b>ROUTED TO:</b>	<b>CONCURRENCE</b>		<b>CONCURRENCE OF GENERAL MANAGER</b>
Sewerage & Drainage	Y <input checked="" type="checkbox"/> N <input type="checkbox"/>		<i>[Signature]</i>
<b>REVIEWED BY TAG</b>	YES <input checked="" type="checkbox"/>	NO <input type="checkbox"/>	<b>REVIEWED BY CAO</b>
	<i>[Signature]</i>		YES <input checked="" type="checkbox"/> NO <input type="checkbox"/>

## Staff Report

### Origin

This staff report is intended to address concerns raised at previous Public Works and Transportation Committee meetings regarding the salinity of Fraser River water. Water from the river is important for agricultural irrigation and there is concern in the agricultural community that the Fraser River may be becoming increasingly brackish.

This staff report also reviews the use of drinking water for agriculture in three neighbouring municipalities that have significant levels of agriculture.

### Analysis

Salt water from the Strait of Georgia flows up the Fraser River during periods of average or low flow in the river. The salt water intrusion is generally in the shape of a wedge extending from the river bed to the surface of the river and can penetrate as far as 16 km up the river's main channel (Figure 1).

### Factors that Influence Salt Wedge Penetration

A thesis paper by Donald Ormond Hodgins titled "Salinity Intrusion in the Fraser River, British Columbia", dated August 1974, indicates that salt wedge intrusion is primarily influenced by:

- Flow rate of the Fraser River;
- Tidal fluctuations; and
- Channel depth.

Environment Canada maintains long term flow monitoring records for the Fraser River. Records from the flow monitor at Hope reveal a high degree of variability in Fraser River flows (Figure 2).

The tidal fluctuations at the mouth of the Fraser River are considered large and have significant influence on the salt wedge intrusion, particularly during low flow periods in the Fraser River. Periods of extreme tides that occur during low river flows produce the greatest salt wedge penetrations of the Fraser River.

Lastly, the depth of the channel influences salt water intrusion in the Fraser River. Deeper channels promote longer salt wedge penetrations of the river. The main channel of the Fraser River is dredged by Port Metro Vancouver to meet minimum depths for cargo vessels.

Rising sea levels may impact penetration of the salt wedge, however, the change in mean sea level to date is small when compared to the variability in tidal fluctuation. However, long term (2100) projections of sea level rise between 0.35 m and 1.20 m will have significant impacts on salt wedge penetration.

Figure 1: Extent of Salt Wedge During Fraser River Low Flow Periods

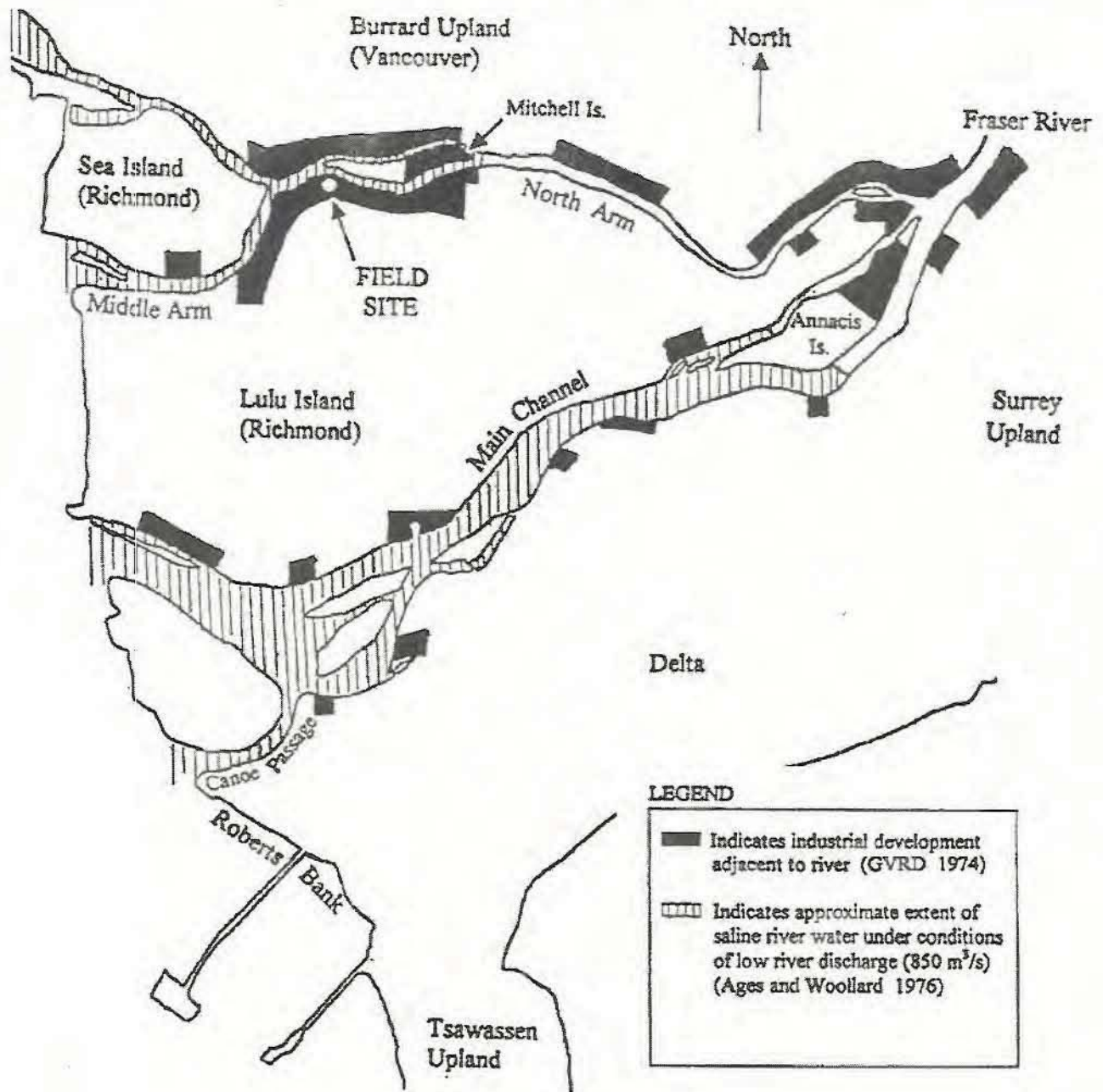
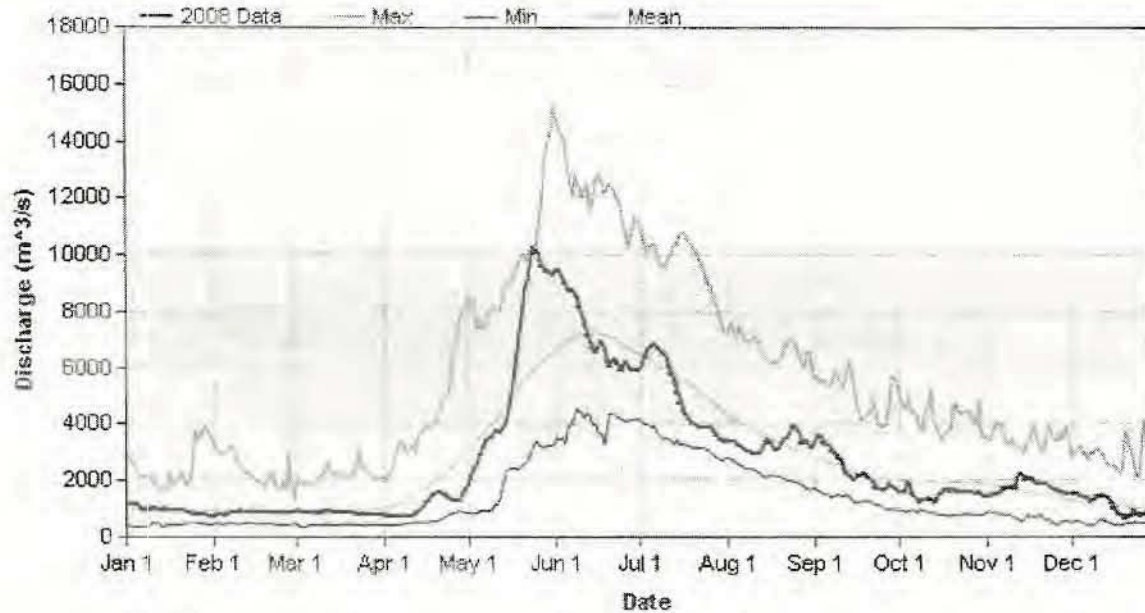


Figure 2: Fraser River Discharge at Hope

Daily Discharge for FRASER RIVER AT HOPE (08MF005)



### Fraser River Water Intakes

Water from the Fraser River is utilized by local farmers for irrigation purposes. There are a number of pump stations that allow river water to flow into the City's drainage ditches.

The No. 6 Road South Pump Station is within the area of the river impacted by the salt wedge. The 1974 "Salinity Intrusion in the Fraser River, British Columbia" study included a salinity monitoring station approximately 1.2 km down river from the No. 6 Road South Pump Station. Data recorded at this station indicates that the salt wedge extends to the surface of the Fraser River during average February flows at this location. It is unknown what the exact profile of the salt wedge is at the No. 6 Road South Pump Station, however, this evidence suggests that the salt wedge could be at or near the surface during Fraser River low flows that coincide with high tides in the Strait of Georgia.

The No. 6 Road South Pump Station allows water to flow by gravity from the Fraser River into the City's ditches at medium to high tide. Given that the maximum salt wedge penetrations occur during the high tide period, there is a reasonable probability that salt water could be admitted to the ditch system during Fraser River low flows. In response to concerns regarding the salinity of irrigation water, the City installed a salinity meter at the pump station that shuts off flow from the Fraser River when the salt content becomes too high.

The No. 7 Road North Pump Station includes an electrically controlled valve that allows water to flow by gravity from the Fraser River into the City's ditch system at high tide. The salt wedge extends as far as the east tip of Mitchell Island in the North Arm of the Fraser River and the No. 7 Road North Pump Station is not impacted by the salt wedge.

The No. 8 Road North Pump Station is considered the main source of irrigation water from the Fraser River. This station includes a purpose built irrigation pump station that was constructed in the early 1990's under the Agricultural and Rural Development Subsidiary Agreement program. The salt wedge does not extend as far as the No. 8 Road North Pump Station in the North Arm of the Fraser River and is therefore not a factor at this pump station.

Staff will continue to monitor salt levels on an ongoing basis at No. 6 Rd Pump Station.

### Agricultural Use of Drinking Water

Drinking water may be considered as an alternative to Fraser River water for irrigation purposes. Currently the City of Richmond allows agricultural use of drinking water but does not offer a discounted water rate to farmers.

Staff contacted three neighbouring municipalities that have significant levels of agriculture to determine their policies regarding agricultural use of drinking water. Table 1 is a summary of staff's finding and includes the City of Richmond's current position.

Table 1: Agricultural Use of Municipal Drinking Water

Municipality	Agricultural Use of Drinking Water	Residential Water Rates	Agricultural Water Rate	Meter Rental Charge
City of Surrey	Not permitted	\$0.745 / m <sup>3</sup>	n/a	\$20 to \$213 depending on meter size per 4 month period
Corporation of Delta	Permitted	\$0.71 / m <sup>3</sup> up to 125 m <sup>3</sup> each quarter	\$0.61 / m <sup>3</sup> up to 8,000 m <sup>3</sup> each quarter	n/a
		\$0.98 / m <sup>3</sup> over 125 m <sup>3</sup> each quarter	\$0.98 / m <sup>3</sup> over 8,000 m <sup>3</sup> each quarter	
		\$25.00 minimum Quarterly Charge	\$25.00 minimum Quarterly Charge	
Township of Langley	Subject to approval from General Manager of Engineering	\$174.09 flat rate for up to 100 m <sup>3</sup> each six month period	\$174.09 flat rate for up to 100 m <sup>3</sup> each six month period	\$25 to \$146 depending on size per 6 month period
		\$0.503 / m <sup>3</sup> over 100 m <sup>3</sup> each 6 month period	\$0.503 / m <sup>3</sup> over 100 m <sup>3</sup> each 6 month period	
City of Richmond	Permitted	\$0.9277 / m <sup>3</sup> with a \$20 minimum charge each 3 month period	\$0.9277 / m <sup>3</sup> with a \$95 minimum charge each 3 month period	\$10 to \$662 depending on size per 3 month period

The policies regarding agricultural use of drinking water in Richmond's neighbouring municipalities is not consistent. The City of Surrey does not permit agricultural use of drinking water. The Corporation of Delta is the only municipality contacted that discounts drinking water rates for agricultural use.



The City of Richmond's current water rate structure is built on the values of equity and conservation.

**Financial Impact**

No financial impact.

**Conclusion**

The extent of salt wedge intrusions into the Fraser River are largely governed by:

- Fraser River flow;
- Tidal fluctuation; and
- Channel depth.

Water from the Fraser River is allowed to flow into the City's ditches for irrigation purposes at:


- No. 6 Road South Pump Station;
- No. 7 Road North Pump Station; and
- No. 8 Road North Pump Station.

Salinity of the water is an important factor and evidence suggests that the salt wedge can impact water quality at No. 6 Road during periods of Fraser River low flows that coincide with high tides. Water quality at the No. 7 Road North and No. 8 Road North Pump Stations is not impacted by the salt wedge.

It is likely that current concerns regarding increasing Fraser River salinity at the No. 6 Road Pump Station are largely due to the high degree of variability in Fraser River flow. However, in the long run, sea level rise will play a role, increasing salt wedge penetrations of the Fraser.

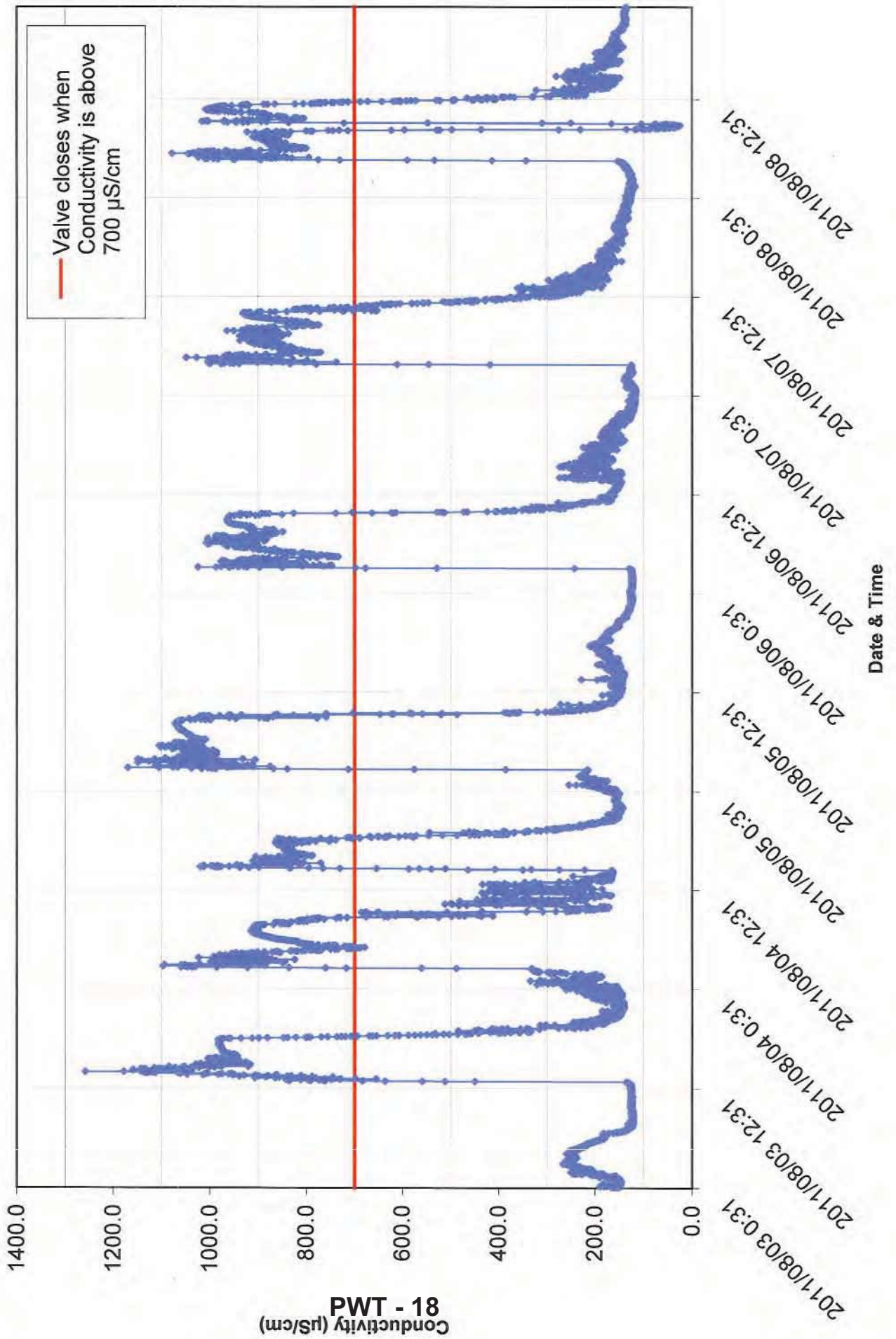
To guard against salt water entering the City's ditch system, a salinity meter has been installed at the No. 6 Road South Pump Station that stops flow from the Fraser when the water becomes too salty. Staff will continue to monitor salt levels at this location.

Richmond permits drinking water to be used for agricultural purposes but does not offer a discounted water rate for this use. Of local agricultural municipalities polled, only the Corporation of Delta offered a discounted water rate for agricultural use.

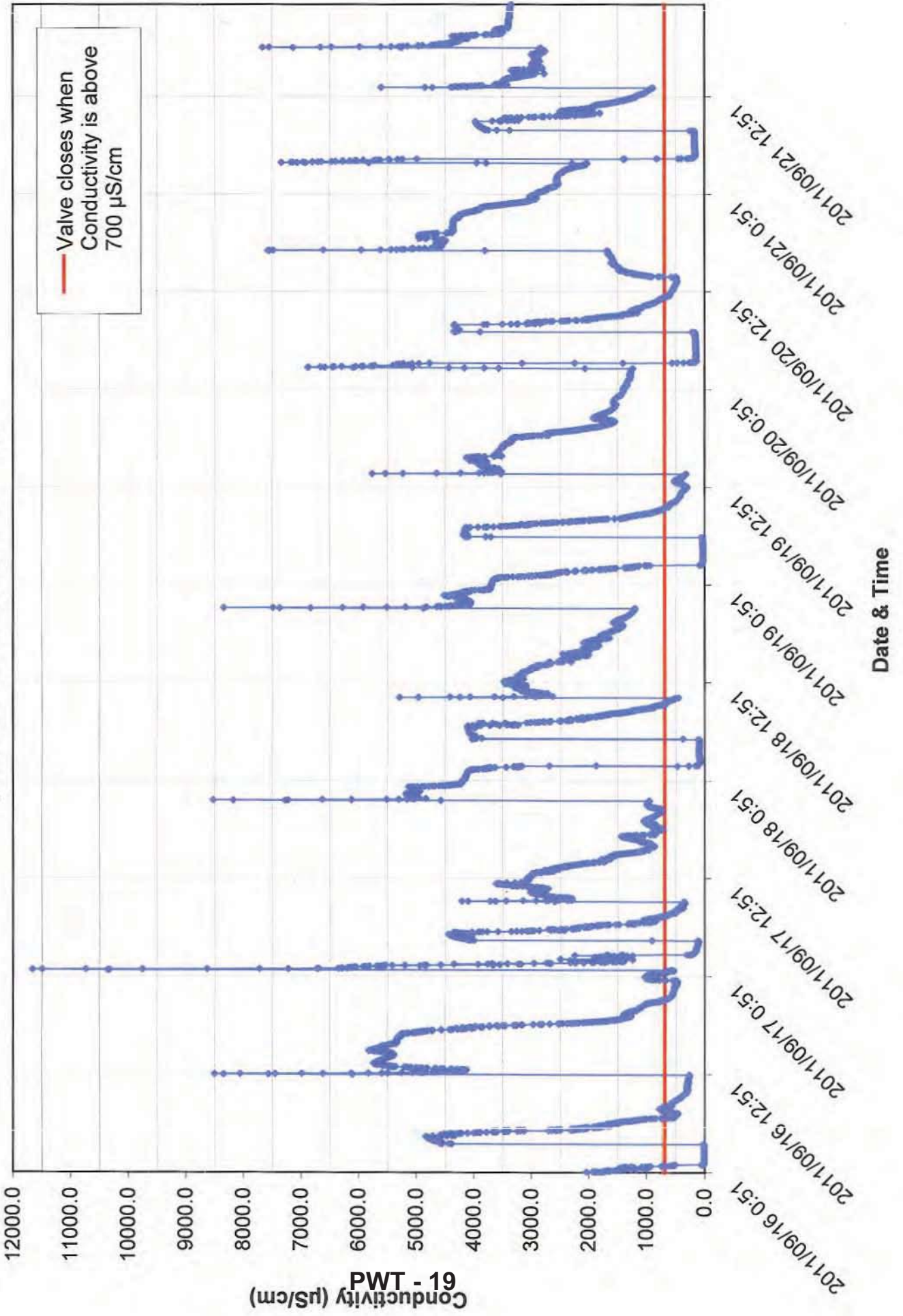
 PER:  
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**Attachment 2: Conductivity Readings At No 6 Road South**  
(August 3, 2011 to August 8, 2011)



**Attachment 3: Conductivity Readings At No 6 Road South**  
(September 16, 2011 to September 21, 2011)



**Attachment 4: Daily Discharge of Fraser River at Hope**  
(Source: Environment Canada, [www.wateroffice.ec.gc.ca](http://www.wateroffice.ec.gc.ca))

