Creighton Creek Streamflow Recovery Project – Phase II

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Prepared for:
Whitevalley Community Resource Centre Society

Prepared with Financial Support of:
The Pacific Salmon Commission Southern Fund

Executive Summary

The Creighton Creek Streamflow Recovery Project – Phase 2 is the second and final year of a project begun by Whitevalley Community Resource Centre (WCRC) in 2004. The purpose of the project was to collect information on the available water in the Bessette system creek, in particularly, Creighton Creek, to encourage water conservation and work to prevent future stranding and dewatering of juvenile salmonids.

The second year objectives were to:

- Continue monitoring creek flows and withdrawals,
- Encourage and assist in establishing a water users group on Creighton Creek,
- Set up and work with at least two pilots farms that use tensiometers as the basis for irrigation scheduling and,
- Promote alternate and/or supplementary sources of water for irrigation.

The collection of flow data was concentrated on the 3.5 km deposition zone on Bessette Creek between Horner and Whitevale Roads. Measurements taken a 500 m intervals indicated that approximately 5 ft^3/s or 50% of the summer flow is lost to groundwater. Shifting the release dates of water at the Nicklen Dam ahead several weeks may prevent much of the stranding of juvenile salmonids that occurs in this section.

WCRC held three public meetings in an effort to organize licensees of Creighton Creek and promote a water use plan (WUP). There was enough interest that Phil Epp, regional hydrologist for the province, was asked to give a presentation on WUPs at the third meeting. After this meeting, the five principal irrigators began to meet on their own and decided that they would develop an informal plan on their own.

Tensiometer data was collected from two pilot farms. The results were limited. Rain in July kept farmers and ranchers from irrigating until mid-July. One potential pilot never irrigated at all in 2005.

The feasibility study that was looking at storage in the upper watershed of Creighton Creek was completed. While there were no locations within the watershed, a survey showed that Bonneau Lake had the potential to store 500 AF. However, the cost of the environmental impact studies and construction of two dams (one on Bonneau Creek and one on a Creighton Creek tributary) made the cost prohibitive. Once the cost of storage in the upper watershed became known, some of the irrigators reconsidered other alternate sources. WCRC helped one licensee to fill out a CBCWSEP application for funding a well for irrigation. Another is considering on-site storage.

Recommendations resulting from this project include:

1. Make the tensiometers that were used at Dolmans' and Schunter's available to Vale Farms. They show a genuine interest in reducing water usage and the additional tensiometers will give them more data on which to base their scheduling and make comparisons between the new K Line system and the traveling gun.
2. Water Management and DFO should work with the Real Estate Board to issue warnings with the sale of properties on agricultural land in water- stressed areas.

3. Pressure transducers should be placed upstream and downstream of the diversion points in Creighton Creek by DFO. This would serve to both collect continuous flow data on the creek for future use and be a remind the irrigators that conservation flows must be maintained.
4. DFO should seek funding to develop channel depth and stabilize gravel bars in the deposition zone on Bessette Creek.
5. Nicklen Lake release times should be monitored by MWLAP so they are better coordinated with the low flow periods in Bessette Creek.

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Introduction

The Creighton Creek Stream Flow Recovery Project began in May 2004. The main goal of the project was to reduce or eliminate the threat of dewatering and fish kills in the Bessette watershed and in particular in Creighton Creek. Several dry years in the southern interior of British Columbia had reduced stream flows and increased agricultural water use. In the first year of this project, Whitevalley Community Resource Centre (WCRC) assessed the water available in Creighton Creek and other Bessette Streams, the licensed and unlicensed withdrawals and promoted water conservation. A major focus of the project was to make the public and, in particular, the irrigators aware of the need to conserve water.

WCRC also worked to:

- Help establish a water users group for Creighton Creek to ensure that all water users were aware of the need to conserve water, were operating within their licenses and abiding by their priority status,
- Ensure that enough water be allowed to pass to meet fish requirements,
- Promote alternate water supplies including wells, on-site storage and storage in the upper watershed
- Improve creek morphology and riparian cover on the worst section of creek to improve fry survival in low water situations.

Phase II of the project continued with the work begun in 2004.

Goals and Objectives

The objectives of Phase II of the project are:

1. Continue to monitoring creek flows and withdrawals:
    - Establish a minimum flow in Creighton Creek that will be adequate for the rearing of juvenile coho and chinook salmon and rainbow trout.
    - Measure the flow at gauge sites and adjust the flow curves if necessary,
    - Determine the flow and withdrawals of the major tributaries to Creighton and t Bessette Creeks including Churchill, Harris, Nicklen and Vance Creeks and set up gauges and flow curves at the major tributaries.

      Of particular interest was the section of Bessette where there is no surface flow during the peak irrigation season. The flow measurements taken at Harris and Nicklen Creeks would provide information on the available flow while the measurements taken at Horner and Whitevale roads will help determine where the water losses are occurring.

2. Encourage and assist in establishing a water users group on Creighton Creek that will reduce conflicts between the licensees and insure that the minimum conservation flow is met.

3. Set up and work with at least two pilots farms that use tensiometers as the basis for irrigation scheduling,

4. Continue to promote alternate and /or supplementary sources of water for irrigation.

Methods

Monitoring Creek Flows and Withdrawals

A Marsh-McBirney Flo-Mate 2000 was used to measure stream velocity. Flow measurements in the creek were made according to RIC standards.

An Oxyguard beta oxygen meter was used for measuring dissolved oxygen levels and temperature.

Flow measurements were taken at the gauges placed in Creighton, Bessette and Duteau Creeks the previous year at various stages of flow and adjustments made to the flow curves as described in Newbury's Stream Analysis.

A Wild model T1A-127304 theodolite was used for measuring cross sections of Bessette Creek and for the preliminary surveying in the upper watershed.

Flow Gauges were set up on Bessette Creek at the Whitevale Bridge *(UTM 11, Easting 359.151, Northing 5565.719 or 118°58'28.7"W, 50°13'32.3"N)*, on Harris Creek at the Forestry Bridge on the Nicklen Forestry Road *(UTM 11, Easting 358.585, Northing 5562.614 or 118° 58' 53.1" W, 50° 11' 55.6" N)*. Flow in Nicklen Creek was measured at a road crossing *(UTM11 356.382, 5561.225, 119°0'42W, 50°11'9"N)* 880 m upstream of the highest point of diversion and 2 km upstream of the Bessette Creek confluence *(UTM11 357.014, 5562.997, 119°0'13"W, 50°12'7"N)*. Flows were measured at various levels to establish flow curves.

The flow in Harris Creek was measured at the same times (within an hour of each other) as the flow in Nicklen to determine the total amount of water available in Bessette Creek[1]. The flow in Bessette Creek was also checked at Horner Road and at Whitevale Road on the same days to determine how much water was being lost in the 3 km deposition zone between the two bridges. When it was found that the losses in this section were larger than the amounts licensed for irrigation, flow measurements were made at 500 m intervals between the two roads to determine where the losses were occurring. The results were plotted in Excel.

Water Users Group

Al Dolman, the farmer with third irrigation rights and the farthest downstream active irrigator on Creighton Creek, has asked that a bailiff be appointed and had been in contact with Water Management about appointing one. WCRC met with the principle irrigators and suggested the use of the water technician that had been collecting stream flow and irrigation data for this project as she was already familiar with the creek and irrigation systems and there would be a savings to the water users if she were required.

[1] The stream that is now called Bessette Creek above the Harris Creek confluence is actually a small intermittent tributary to the main creek. Until a few years ago, Harris and Bessette were two names for the same creek. The creek was called Harris from the headwaters to the confluence with Duteau Creek in Lumby. From the confluence of Harris and Duteau to the Shuswap River, the creek was called Bessette. It is not the usual practice to change the name of a stream partway so the new configuration was adopted.

Letters were sent to all the irrigators informing them that a bailiff had been selected and what their responsibilities would be in that regard. The letter also invited everyone to a public meeting where they would be updated on this project and where they could have any of their questions answered.

Three public meetings were held to promote a water use plan for Creighton Creek. All the water licensees on Creighton creek were invited by letter, followed by phone calls, to the commercial irrigators to ensure a representative turnout. The meeting dates were changed to accommodate as many people as possible if it appeared attendance would be poor. At the third public meeting the Provincial regional hydrologist, Phil Epp, gave a presentation on water use plans and how it would benefit the licensees.

Pilots

In Phase I of the project, WCRC had promoted the use of tensiometers as a means to conserve water by basing irrigation schedules on the soil moisture. Two irrigators on Creighton Creek, one on Duteau Creek and one on the Shuswap River asked to participate in these pilots. Kevin Murphy, the Resource Stewardship Agrologist from the BC Ministry of Agriculture and Lands in Vernon, demonstrated the installation and maintenance of the tensiometers at one of the pilot farms.

Two tensiometers, a 12" and 24", were placed at each farm except at Vale Farms where three sets were installed. The tensiometers were placed in a 40-acre potato field on Dolmans' farm, in a 20-acre cornfield at Schunter's ranch and in a 40-acre canola field at Silver Hills Ranch. Both Dolmans' and Schunter's fields were watered with traveling guns. Silver Hills Ranch uses a wheel line. The tensiometers at Vale Farms were all placed in pastures, two sets on hillside pastures and one set on the valley bottom. One of the hillside pastures was being converted to a K Line system of irrigation from a traveling gun while the other hillside pasture was still being watered with a traveling gun. [K Line is a flexible hose line sprinkler irrigation system designed to distribute water on a slow absorption method and reduce run-off and pooling]. The bottom field at Vale Farms was watered with a stationary gun. The tensiometers were maintained and readings recorded by a water technician from WCRC.

Alternate Water Source

Several areas were looked at as potential sites for water storage including several wet meadows in the upper Creighton Creek watershed, Clier Lake and Bonneau Lake. During Phase I of this project an application was made to the Canada British Columbia Water Supply Expansion Program (CBCWSEP) to conduct a detailed survey of any sites that showed potential. The criteria used when looking for possible storage areas was primarily basin morphology and flow. A walk into many of the areas was enough to determine whether there was a site that could be dammed - if there was sufficient area behind the potential dam site to store water and if there appeared to be adequate flow for potential storage. If these criteria were met, a cross section at the possible dam site and a level circuit of the area behind the dam site were done using a Wild model T1A-127304 theodolite to confirm the possibility of sufficient storage. If an area still showed promise, professional surveyors were contracted to do a detailed survey to determine the storage capacity.

Results

Monitoring Creek Flows and Withdrawals

Flow measurements were done at all the existing gauge sites on Creighton, Bessette and Duteau Creeks at different flow stages to check that the flow curves established the previous year were still accurate and the gauges could be used to measure flow. The gauge at the third bridge on Creighton Creek had to be adjusted because aggradation. The gauge at site 1 was gone. A new gauge placed about a 100 m downstream at a more stable site *(UTM 11, 368.519, 5563.880)* and a new flow curve was made.

During the previous season, flows in Creighton Creek were low enough to cause stranding (0.08 ft^3/s). When the flow dropped below 3 - 4 ft^3/s in the lower kilometer of the creek, salmon fry were observed to concentrate in the reduced pool areas and the water temperature rose above 19°C. WCRC had proposed to monitor this section of creek during the low flow period in 2005 to further refine at what stage the loss of the riffle areas occurred in the lower section. However, the flow in the lower section of Creighton never dropped below 6 ft^3/s during the summer of 2005. At this stage, there is enough water that the fry were distributed throughout the riffle areas as well as the pools.

Creighton Creek Tributaries

Neither Churchill nor Higgins Creeks contribute any surface flow to Creighton Creek during the irrigation season. According to the only landowner who has water rights on Churchill Creek, the creek has only flowed briefly in the spring for the past decade. Churchill Creek flows from a steep box canyon so the runoff is intense and short. The irrigation system has not been used in years and is in disrepair. Higgins Creek also has an intermittent flow. All the water is captured behind a dam located 1100 m upstream its confluence with Creighton Creek *(UTM11: 363.392, 5564.360)* and used for irrigation (license C060408). There is some seepage during the summer months, but no overland flow. No gauges were placed.

Bessette Creek Tributaries
Harris Creek

A gauge was placed on the eastern abutment of the forestry bridge *(118°58"53.4W, 50°11"55.6N, UTN11, Easting 358.581, Northing 5562.613)* over Harris Creek in July and flow measurements made in July and August (Figure 1). An attempt was made to place the gauge and take flow measurements in June, but because of the depth of the water, steep gradient and boulder substrate, it was considered too dangerous to work in the creek until the creek level was down.

The flow measured in Harris Creek combined with the flow measured in Nicklen Creek gives the available flow in Bessette Creek during the peak irrigation season. Bessette Creek upstream of the Harris confluence and Beetle Creek are intermittent, only flowing in the spring and after heavy rainfalls (Figure 1). The lowest flow measured at the Harris gauge was on August 17 at 5.90 ft^3/s.

In the third week of August 2004, the flow in Harris Creek dropped from 20.82 ft^3/s to 6.81 ft^3/s while the flow in the other unregulated creeks in the watershed remain

relatively unchanged during that time period. A search of water rights in the upper watershed showed that Greater Vernon Water (GVW) holds a license (CO17839) for 8000 AF on McAuley Creek, a tributary to Harris Creek. GVW diverts the water to the Duteau Creek system and then to Vernon. They typically divert the water in the spring but it can be done anytime on a demand basis (Kim Tvergyak, 2005). DFO was informed about the sudden drop in flow and was looking into to GVW's ramping rates for McAuley Creek.

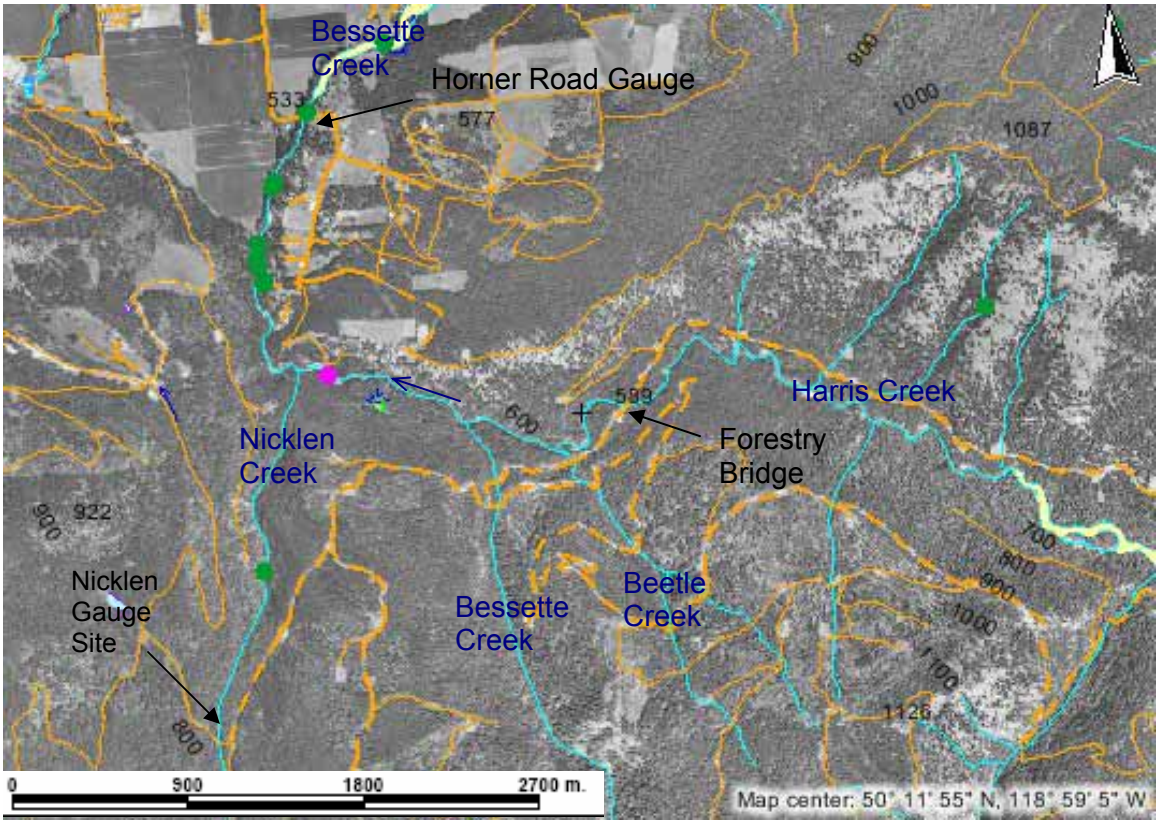


Figure 1: During the peak irrigation season Harris and Nicklen are the only source of water for Bessette Creek. The combined flow of these two creeks measured at the gauge sites shown above is the water available in Bessette Creek before any withdrawals.

A gauge was also set up on Bessette Creek at the Whitevale Road Bridge (Figure 2). The 3 km section in between the two bridges is a deposition area that often lacks a continuous surface flow in July and August. Measurements taken at the upstream gauging site indicated that there was substantially more water loss than could be accounted for by the licensed withdrawals. For example, on August 17, 2005, the combined flows of Harris and Nicklen Creek were 10.53 ft^3/s. The flow measured at Whitevale Road was 4.77 ft^3/s. The total licensed withdrawals upstream of Whitevale Road (based on 100 days of irrigation) is 2.66 ft^3/s. Not all the irrigation systems were in use that day so there was over 3.10 ft^3/s unaccounted for.

When WCRC examined the systems of the agricultural irrigators along this section of creek during the 2004 season, none of them were exceeding their licenses. To confirm that the losses in this section were natural, flow measurements were taken at 500 m intervals between the two bridges. The results are shown in Figure 3.

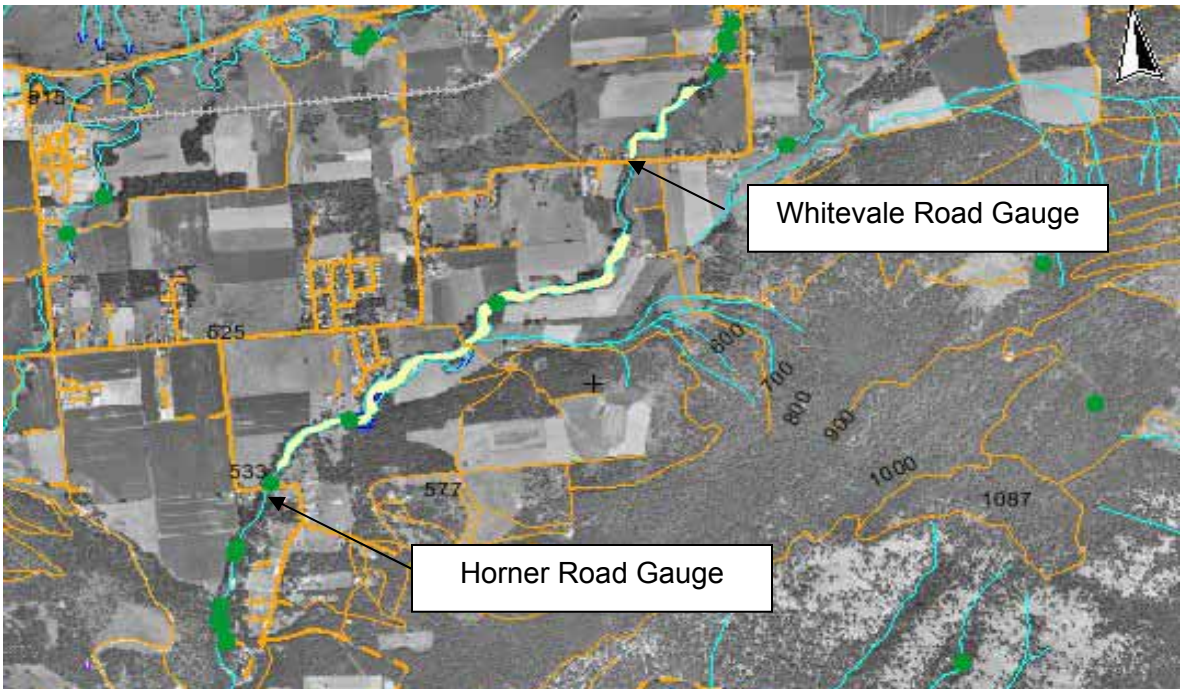


Figure 2: A gauge was placed on Bessette Creek at Whitevale Road. There were greater water losses measured between this gauge and the one at Horner Road than could be accounted for by licensed withdrawals. The green dots mark irrigation withdrawal points.

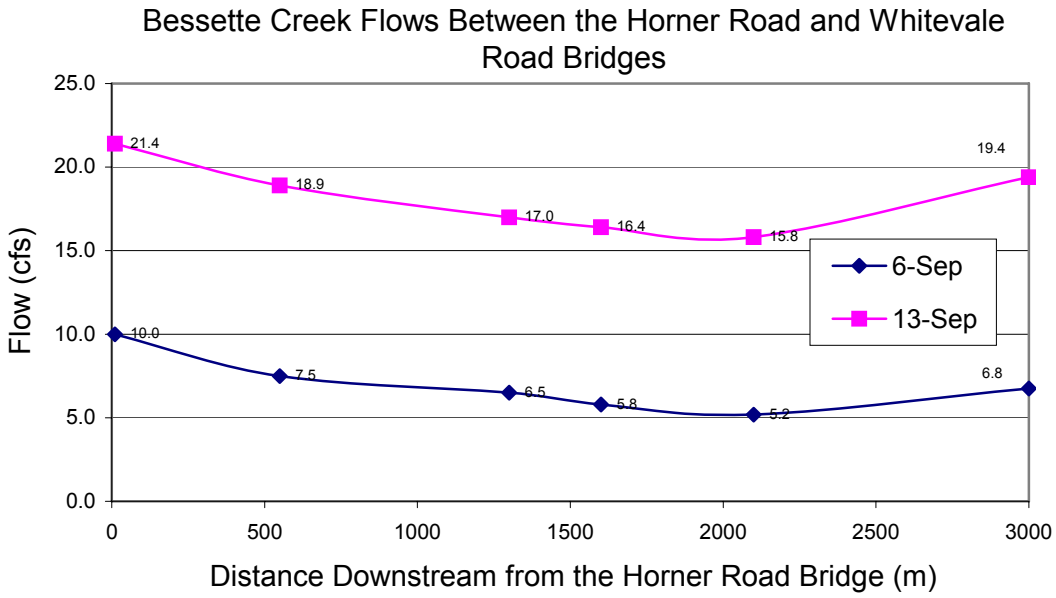


Figure 3: Flow measurements made at 500 m intervals show natural losses occurring in Bessette Creek between Horner Road and Whitevale Road. When the flow was measured on September 6, 4.8 ft^3/s or approximately half the flow was lost to groundwater in the 2.5 km below Horner Road. Juvenile salmonids get trapped in pools that become isolated as the water level drops. There were no irrigations in use on either day the measurements were taken.

The flow was measured at 500-meter intervals between Horner Road and Whitevale Road on two occasions in September when none of the irrigation systems were in operation. On both occasions there were natural losses through the 2500 m of deposition area. There was partial recover in the 1000m upstream of the Whitevale Road Bridge. The 3.2 ft^3/s overall loss on September 6th is similar to the 3.10 ft^3/s loss measured in August. The measurements done on September 13th followed a period of rain that would account for both the higher creek flows and the smaller loss to groundwater.

The landowner who owns the property where the creek often dries up has been in contact with WCRC on previous occasions about the amount of deposition in the creek along his property. He had cattle access points to the creek were his livestock watered but these had filled with gravel and were dry during July and August. He was also concerned that the heavy deposition would cause the creek to avulse if there was a larger than normal spring flood event. Four cross sections of the creek were taken on his property. The results are shown in Figures 4 to 12.

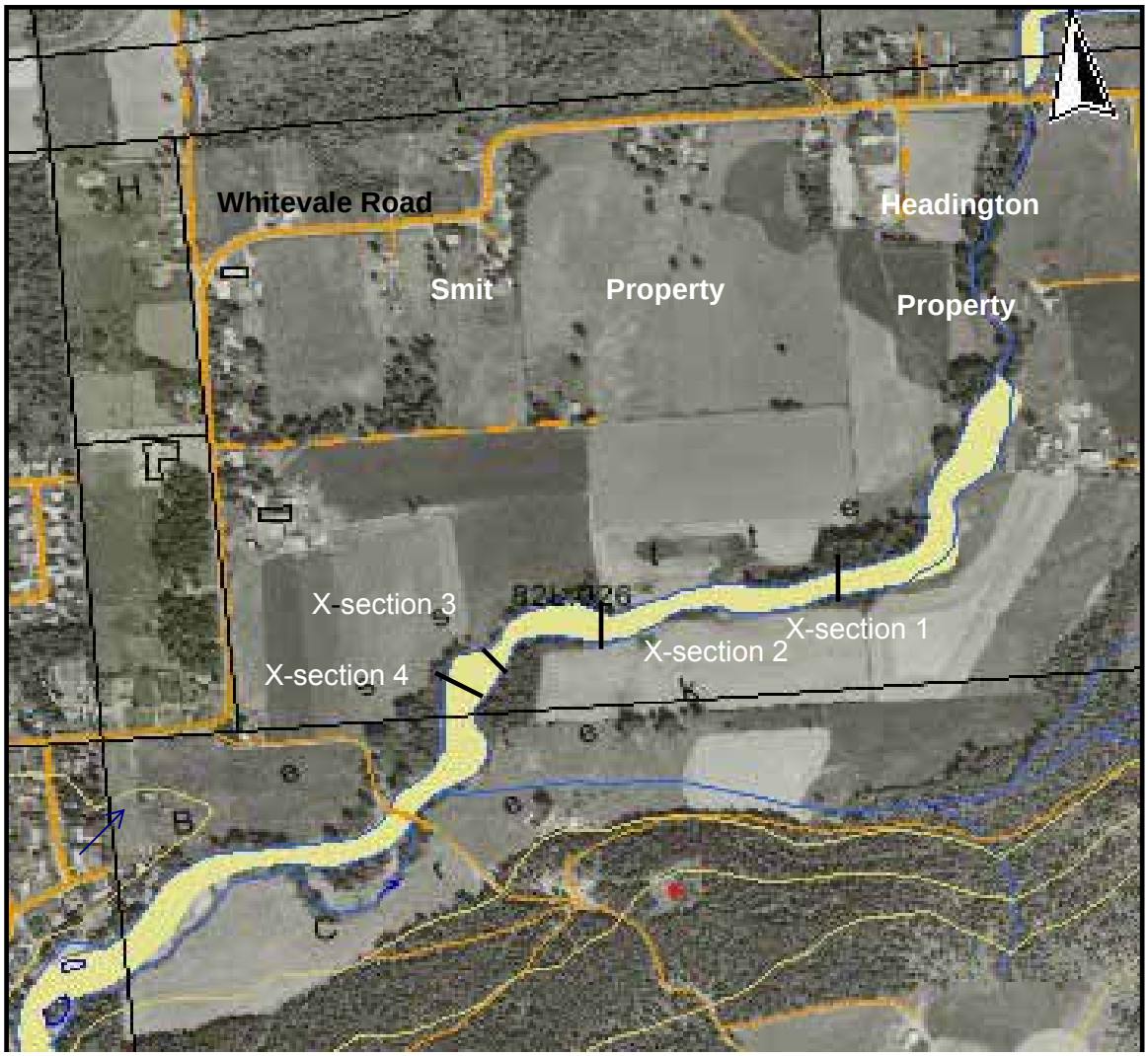
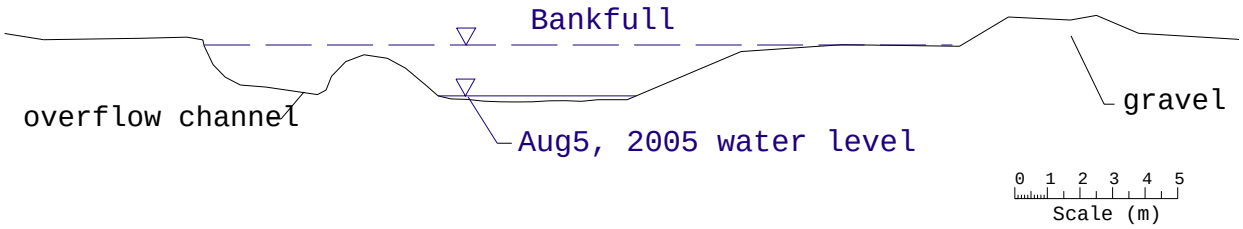


Figure 4: Map of Bessette Creek at the end of the deposition zone between Horner Road and Whitevale Road. Four cross sections were measured to determine the stream capacity.

Cross section #1 on Bessette Creek near the Smit – Headington Property Line (UTM 11, 358.827, 5565.091)



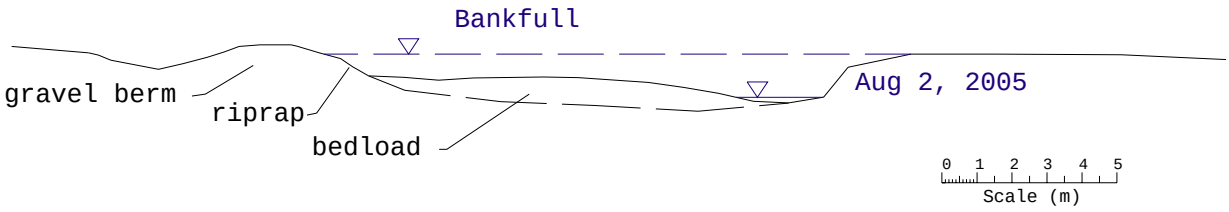
bankfull x-sectional area = 23.55 sq m

Figure 5: Cross section # 1 at the downstream end of the heavy deposition area.

Figure 6: an upstream view of Bessette Creek at Cross section #1 near the Smit/Headington Property line. This is the downstream limit of the severe deposition.

Cross section #2 on Bessette Creek

(UTM 11, 358.339, 5564.950)



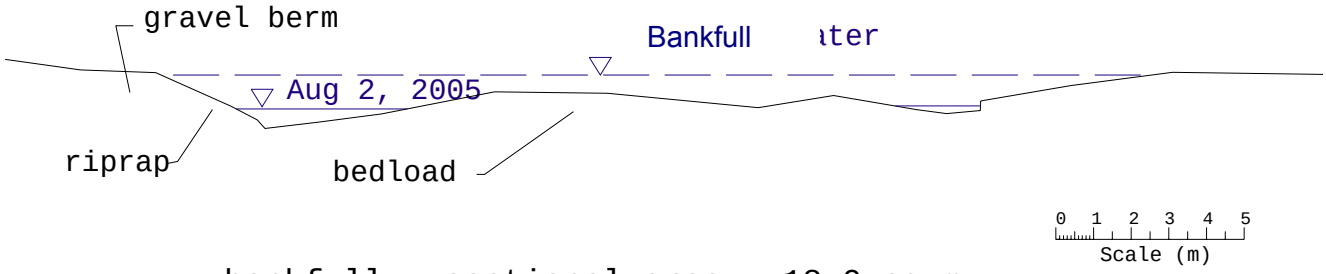
bankfull x-sectional area = 12.99 sq m

Figure 7: Cross section # 2. This site had the smallest cross sectional area due to the narrow width (16 m) and bedload. Since the slope and roughness are similar at all four sites, this site would have the smallest capacity and be the most likely to break over the berm. The dashed line below the creek indicates where the bottom would have to be to obtain a cross sectional area of 18 m^2, the next smallest cross section measured.

Figure 8: Cross section #2 and a downstream view at the second cross section on Bessette Creek. This cross section had the smallest area, about half the area of the first cross section at the end of the deposition zone.

Cross section #3 on Bessette Creek

(UTM 11, 358.512, 5565.061)



bankfull x-sectional area = 18.0 sq m

Figure 9: Cross section # 3. The cross sectional area at this site is greater than the second site due to the greater distance between the berm and the left bank. This section is 7 m wider than the first site and 10 m wider than the second site. Deposition here is at least as great as at site # 2.

Figure 10: Cross section # 3 and an upstream view of Bessette Creek at the third cross section.

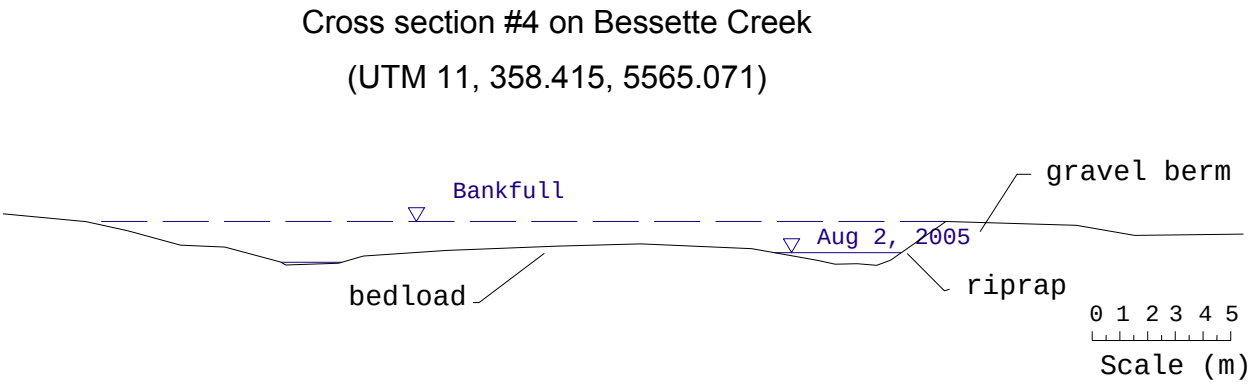


Figure 11: Cross section # 4. This site has the greatest distance between berms: 32 m.

Figure 12: Upstream view of Bessette Creek at the fourth cross-section. During July and August there is often no continuous flow through the cobble substrate between cross-sections three and four.

Nicklen Lake/Nicklen Creek

Nicklen Lake *(UTM 11 356.225 5555.338)* is a 79 ha lake on the Aberdeen plateau at an elevation of 1350 m. The outlet of the lake has a controlled dam owned by the Andrews Ranch in Lumby. There are 11 water licenses held on the lake totaling 1920.45 AF. MWLAP holds a license for 1200 AF.

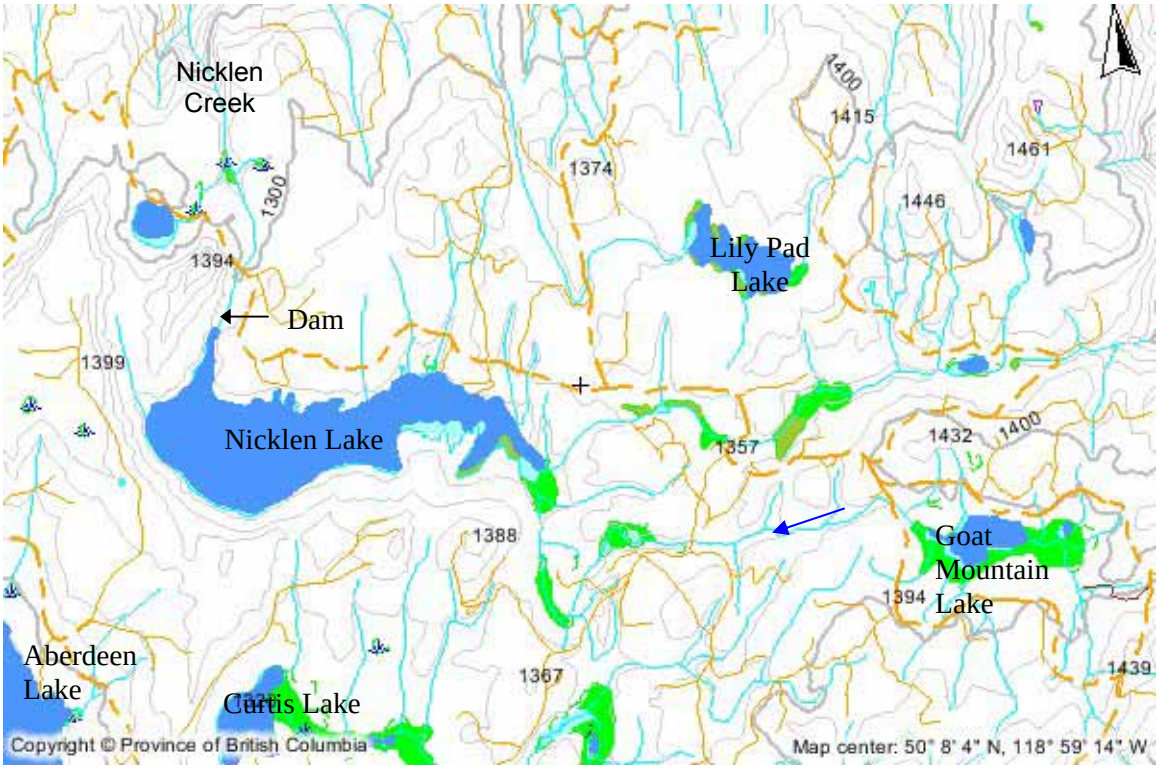


Figure 13: The only surface flow into Nicklen Lake in June 05 was the creek from Goat Mountain Lake. This creek was dry by August.

On June 23, 2005, the only surface flow found into Nicklen Lake was from Goat Lake. It was measured at 1.68 ft^3/s in June 05. The Goat Lake creek was dry by July 30. The dam on Nicklen Lake remains closed from October through to mid-August so there is no outflow from the lake. In 2005, the lake level continued to rise after spring melt with the inflow from Goat Lake and rainfall. The water level in Nicklen Lake was to the top of the spillway when the outlet was opened in mid-August.

While there is no outflow from Nicklen Lake into Nicklen Creek, Nicklen Creek picks up a small amount of flow from Lily Pad Lake and from groundwater seepage as it descends the plateau. The flow in Nicklen Creek was measured at a road crossing *(UTM11 356.382, 5561.225, 119°0'42W, 50°11'9"N)* 880 m upstream of the highest point of diversion and 2 km upstream of the Bessette Creek confluence *(UTM11 357.014, 5562.997, 119°0'13"W, 50°12'7"N)*. Nicklen Creek had a flow ranging between 2.54 ft^3/s and 3.06 ft^3/s in June decreasing to 0.40 ft^3/s in August without contribution from Nicklen Lake. Approximately 4 ft^3/s (1491 Imp. gal/min) was allowed to flow out of Nicklen from mid-August until October. The dam has been managed to reduce the need for maintenance of the dam and spillway. The lake level is drawn down to the extent that the lake will refill again by August without overflowing into the spillway.

Discussions were held with the owner of the dam. He felt that he had been releasing water early enough to prevent dewatering downstream as much as possible. However, it is not easy to judge the condition of the creek at the lower end of the deposition zone from his intake above Horner Road. He also said that he had been asked by provincial fisheries to keep discharging from Nicklen Lake throughout the fall spawning period. An email was sent to Brian Jantz of MWLAP with the data that had been collected on Nicklen Lake and Creek and Bessette Creek recommending that water be released from Nicklen Lake earlier. In the first week of August 2005, for example, the flow from Harris Creek was 11.17 ft^3/s and Nicklen Creek was 0.40 ft^3/s (no water was being released from the lake yet). Beetle Creek and Bessette Creek above the Harris confluence were dry. Licensed withdrawals before the deposition zone total 3.13 ft^3/s and natural looses at that flow are about 5 ft^3/s. That leaves 3.4 ft^3/s of flow to filter through the lower section of the deposition zone. Even if there is a continuous flow, this section of creek is often wide and exposed to the sun. The shallow water moving through the rocky substrate can reach lethal temperatures (Figures 5-12). In the 2004 season, the flow in Harris Creek was measured as low as 4.37 ft^3/s. The threat of dewatering is compounded by the possibility of GVW diverting the water in McAuley Creek (~2 ft^3/s).

Vance Creek

There is a Water Survey of Canada gauge on Vance Creek below Deafies Creek *(50°17'5" N, 118°56'48" W)* that has been recording flows since 1978. Information for historical data (up to 2004) is available through their website, http://www.wsc.ec.gc.ca/hydat/H2O/.

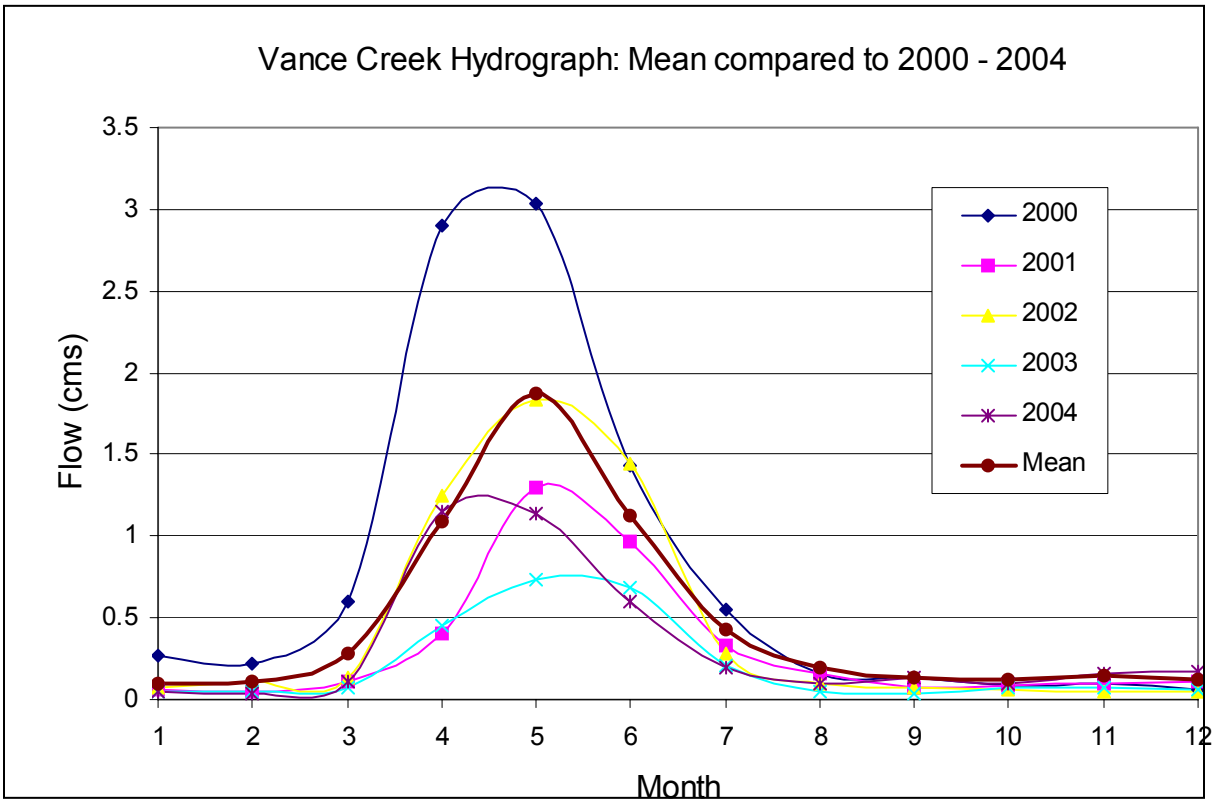


Figure 14: The Vance Creek Hydrograph shows that 2001, 2003 and 2004 had less flow than average. The biggest difference is in the runoff months from April through June.

With the rainfall in June, there was no opportunity to measure low flows in the lower section of Vance Creek below the withdrawal points. The wetter 2005 weather however, did call attention to other concerns with Vance Creek. Vance Creek headwaters are in Silver Star ski resort. Silver Star has been expanding for the past decade with growth in both the residential area and the development of new ski runs. The exposed ground, especially the steep ski runs, can lead to sedimentation of the creek. Rain in early October, for example, led to extremely turbid creek conditions in Vance Creek and consequentially in Bessette Creek during salmon spawning season. Figure 15 shows Vance Creek at Mabel Lake Road on October 7, 2005, the day after a 38.2 mm rain was measured at Silver Star Mountain Resort (Environment Canada, 2005).

Figure 15: Vance Creek at Mabel Lake Road 560 m upstream of Bessette Creek on October 7, 2005.

Water Users Group on Creighton Creek

In the first year of this project, it was concluded that a bailiff would be necessary to monitor withdrawals and to enforce the priority system if creek levels dropped below the stage where there was sufficient water to meet all the requirements of the active irrigators. Al Dolman, who has third rights on the creek and is the farthest downstream of all the active irrigators, had already been in contact with Water Management about the procedure for appointing a bailiff. He was told that if he had a qualified person for the position, Water Management could appoint that person within a day. Al agreed to WCRC's suggestion that WCRC's technician be selected for the position as she was already familiar with the project and many of the landowners and would be readily available if the need arose. On June 27, a letter was sent to all the Creighton licensees updating them on this year's project, the possible use and implications of a water bailiff and inviting them to a meeting to meet the prospective bailiff and have any questions

answered regarding the project or the bailiff. The meeting was held at the White Valley Community Hall on July 19th.

At the July 19th meeting, WCRC presented an overview of last year's project and the objectives of this year's project. WCRC's water technician was introduced as the prospective water bailiff. There was some discussion of alternatives to a bailiff including the use of water meters. Metering would give accurate information on water use by all users but did not address the problem of how users would know whether or not there was enough water available for them to irrigate. WCRC agreed to price meters for the next meeting.

There was 108.5 mm of rainfall in June (Marchant 2006, Environment Canada 2006), about five times as much as fell during the same period for the previous two years. This shortened the irrigation season and resulted in the highest creek flows in four years. With the relatively large supply and low demand for water, there was no need to use the water bailiff during the 2005 season.

A water use plan (WUP) was discussed as a method of outlining who is entitled to the available water in the creek at all the different flow stages. WCRC would look for some existing WUPs that might be used as a template.

The group felt that due to the low turnout, decisions on how the group would operate and what would trigger the use (and cost) of the bailiff would be deferred until more water users were in attendance. Those in attendance expressed that they were eager to continue discussions as a group and would speak with their neighbors to encourage them to attend the next meeting.

There was also an interest in the storage possibilities by several of the licensees. It had become apparent with the survey work to date that the best opportunity for storage was at Bonneau Lake. However, inquiries made by WCRC indicated that there would be objections to any inter-basin diversions by Fisheries and Oceans Canada (DFO). There would also be objections by the provincial fisheries that have been managing Bonneau Lake as a walk-in only lake. There also would be high costs associated with the environmental impact studies. In Phase I of the project, several of the landowners that held low priority or inadequate rights were urged to consider wells or on-site storage. These landowners were reminded that this was the last year that CBCWSEP grants would be available.

A letter was sent out on August 31st to all the Creighton licensees describing the first meeting and outlining the benefits of having a WUP. The letter included the minutes from the last meeting and a price list for water meters [the cost of a meter depends on the amount being pumped; the price would be more for a large water licensee than for a small one]. It also urged everyone to attend the next meeting scheduled for September 20th.

After the letter was sent, follow up calls were made to confirm the attendance of at least the principal irrigators. The meeting was postponed until November 10th after several of the irrigators said it would be impossible for them to attend during harvest.

At the November 10th meeting, the topics of discussion were WUPs, metering, storage in upper watershed and some methods for efficient use of the available water. The

purpose of a WUP was explained again - that it would clearly outline who could be watering at different stages of creek flow based on the priority system. There had been questions at the early meetings about including agreements about sharing water (if an irrigator were not using all their licensed amount of water, would it be possible for another irrigator to use the first unused portion).

The cost of a WUP was a concern:

- A facilitator would have to be paid
- There would be addition data to be collected
- WUPs can be time consuming and
- Provincial and Federal fisheries and First Nations would be involved.

WCRC pointed out that it was likely that funding would be available to carry out the WUP and that Phil Epp would make himself available to help. The licensees would probably just have to commit their time.

There was some discussion about whether Creighton Creek still needed a users group and WUP. The creek had dry periods for approximately three years, but this past year there had been a good flow throughout the summer. In addition, some of the problem with over-use has been solved when one of the farms was sold. This was countered with the opinion that it is better to come up with a solution now before the problem comes along again.

WCRC pointed out that while the problem of low flows might not seem urgent now, the licensees had the interest and the offers of help from federal and provincial fisheries, Agriculture BC and WCRC. If they were to delay developing a WUP until the next crisis, they might have to carry the financial burden themselves.

There was enough interest in creating a WUP that WCRC agreed to invite Phil Epp to do a presentation further explaining the WUP process and how the WUP in Summerland arrived at minimum fish flows. A meeting was scheduled for January 12th.

At the January 12th meeting, Phil Epp gave a PowerPoint presentation outlining the WUP process. He also explained how they determined the minimum flow required for conservation and how it could be done on Creighton Creek. There were more questions concerning time commitments and costs involved with a WUP.

Several attendees commented on the importance of having all the major irrigators willing to participate before further discussion on a WUP took place. As not all of the large irrigators were present, the two of that group that were present indicated that they would meet with the other major irrigators to see if they were willing to commit at least their time to participate in a WUP. They would also inform WCRC if they wished to continue.

After the five largest irrigators had met several times, they informed WCRC that they thought that they had enough information now and the level of co-operation was such that they could come to an informal agreement between themselves that would involve less time and money than a formal WUP. They felt confident that communication between them now was such that there would not draw the creek low enough to cause any concern to DFO or the provincial fisheries.

Pilot Farms

Tensiometers were installed at the Dolman and Schunter farms at Creighton Creek, at Vale Farm on Duteau Creek and at Silver Hills Ranch on the Shuswap River during the last week of May. Kevin Murphy, the Resource Stewardship Agrologist from the BC Ministry of Agriculture and Lands in Vernon, demonstrated the installation and maintenance of the tensiometers at Vale Farms. The owners of the other farms that planned on using tensiometers were invited to participate.

The results from the tensiometer readings on Vale Farms are shown in Figures 16 to 19. The results from the Dolman farm are shown in Figure 20. There was no data from the either the Schunter farm or Silver Hills Ranch. The owner of the Schunter farm had asked to participate because he has irrigation licenses that are not adequate for his property. He had hoped that the tensiometers might help to optimize the use of what water he had. However, the owner was contracting much of the work on his fields (seeding, cultivating, harvesting) out. There was a disagreement between the owner and the contractor about placing the tensiometers in the field and they had to be removed.

The tensiometers at Silver Hills ranch were placed in an 18 ha field planted in canola. This field is usually irrigated by a wheel line system. However, the irrigation system was never used during the summer of 2005 because of the rain during the early half of the summer.

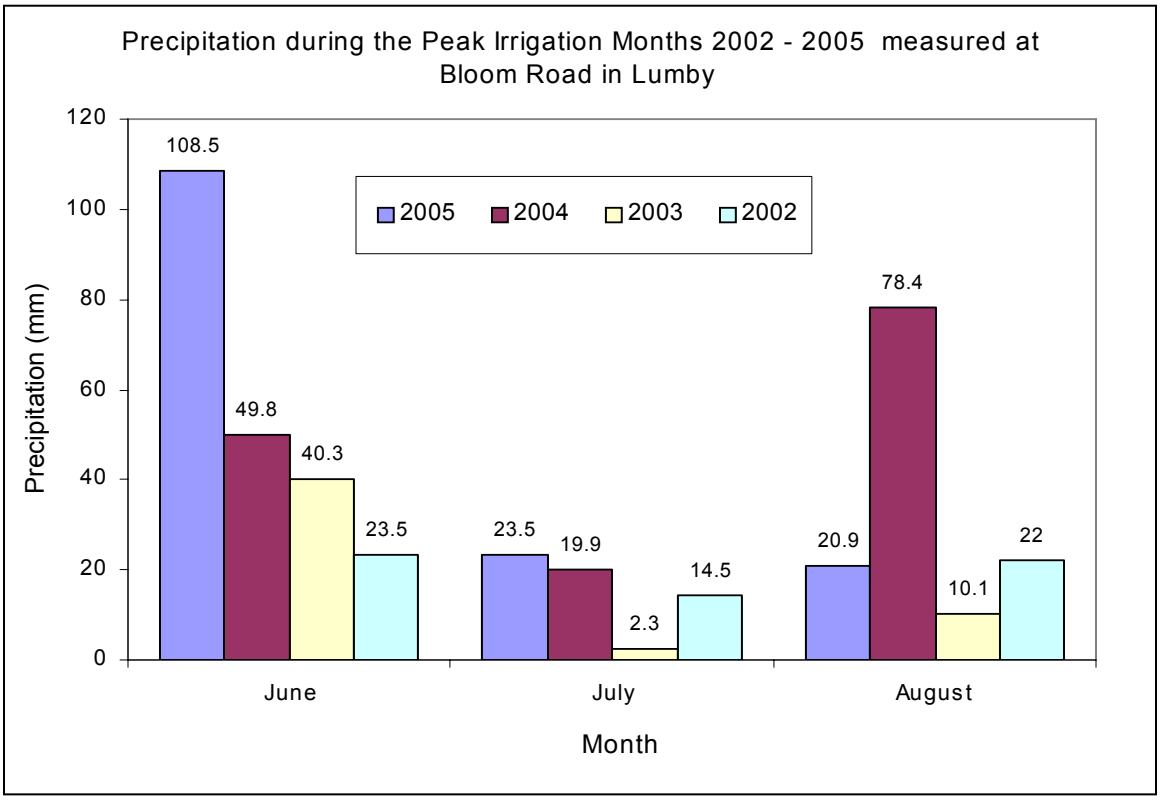


Figure 16: The summer precipitation increased during the two years that this project took place. Both 2004 and 2005 had almost three times the amount of rain (152.9 mm and 148.1 mm respectively) during the irrigation season as 2002 and 2001 (52.7 mm and 60.0 mm). Most of the rain in 2004 fell during the later half of August, while in 2005 most

the rain fell in June. The June rain of 2005 dissuaded most farmers from irrigating well into July. The June rain also charged the Bessette watershed so that the summer creek levels were the highest in four years.

Tensiometers were installed on three separate pilot fields located on Vale Farms (Figure 16). The three locations are the west side of J1, the southwest corner of VMT, and the north side of the V3 field.

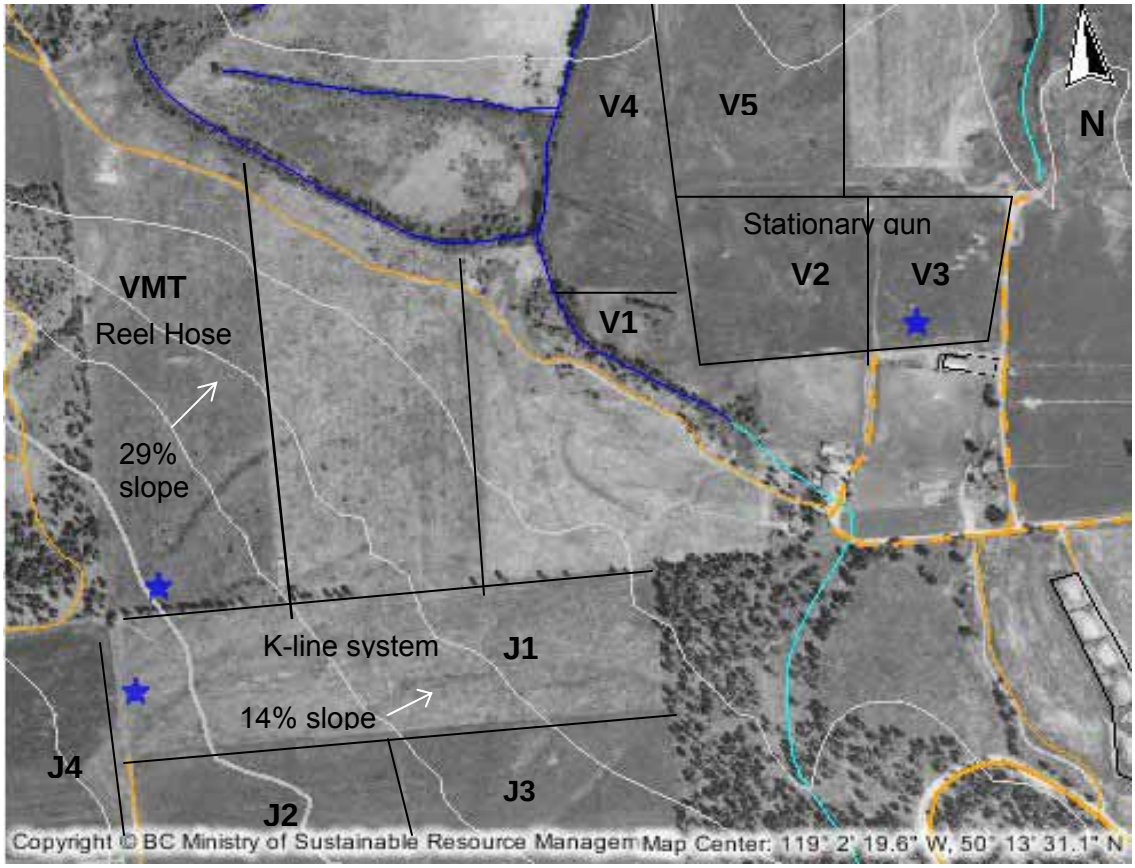


Figure 17: The blue stars in this orthophoto show the locations of the tensiometers place at Vale Farms

At the start of the season, Vale Farms was installing a new K Line system in fields J1, J2, J3, and J4. They were concerned about high water losses due to evaporation and erosion caused by the high delivery rate of the guns on the hillside. The hillside contains large amounts of gravel that erodes easily and has a limited capacity for holding water. The k-line system delivers water at a slower rate and are easier to rotate than the traveling guns. Due to weather and other circumstances, the system was not completely installed and running until mid-August. The delay in applying irrigation resulted in the tensiometers to crash frequently at this site. The data collected from the tensiometers will be used to establish a rotation schedule for the 2006 season.

The second set of tensiometers were installed in the pasture designated V3. V3 along with adjacent pastures V2, V4 and V5, are on a stationary gun system with a 13-day rotation schedule. This system includes two guns with ¾" nozzles that are supplied with

water by above ground aluminum pipes, with 7 pulls and 8 hydrants. These four fields are in an intensive grazing program where the livestock are quickly rotated through the four fields. The length of time spent in each field varies to some degree but is usually no longer than two days. The pasture rotation has priority over the irrigation schedule. If the livestock were in the pasture that is due to be watered, that stationary gun would be moved to the next field in line to be watered. Irrigation began the third week of June and finished the first week of September.

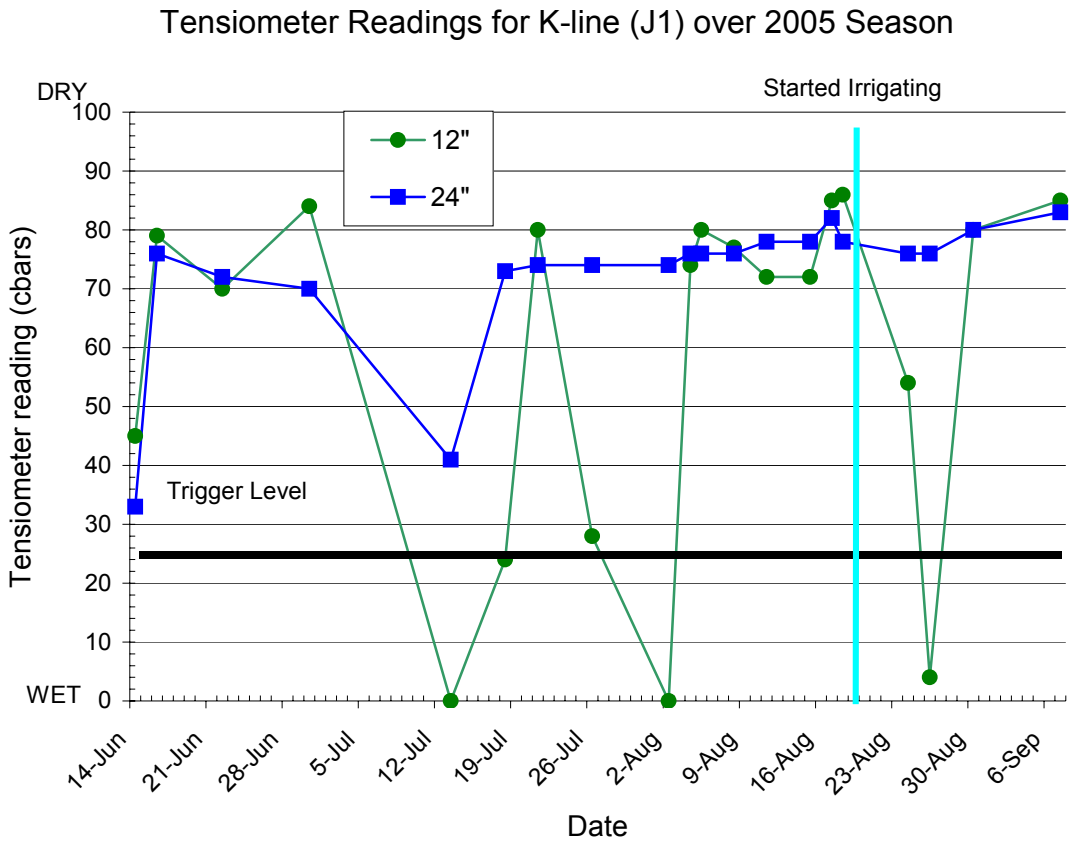


Figure 18: Both tensiometers in the J1 field were continually crashing despite the rain in June. After water was applied in late August the 24" did not respond. The lack of response to the applied water and earlier rains suggested that the deeper probe may have been in a gravel pocket incapable of holding water and not representative of the field. If water had been applied earlier in the season with no still response, the tensiometers would have been moved to more representative location.

The points on the graph are centibars of pressure registered by the tensiometer. As the soil dries, it pulls water out of the tensiometer through the porcelain tip at the end of the probe creating a vacuum that registers as pressure on the gauge at the top of the tensiometer. In the spring when the soil is saturated, there should be a reading of zero on the tensiometer. As the soil dries, more pressure is exerted. Irrigation should begin when the pressure reaches the trigger level, in this case, 25 centibars. The trigger level is the pressure at which water should be applied and is determined by the type of soil and the crop. If the soil receives no water, the pressure will continue to climb until the tensiometer "crashes" or all

the water is pulled from the column of the tensiometer. When this happens, the tensiometer must be re-primed.

By monitoring the two tensiometers at different depths, the moisture at the different levels can be determined as well as the rate at which the water penetrates the soil. After observing several cycles, the irrigation schedule can be adjusted to correspond to the rate at which the soil dries.

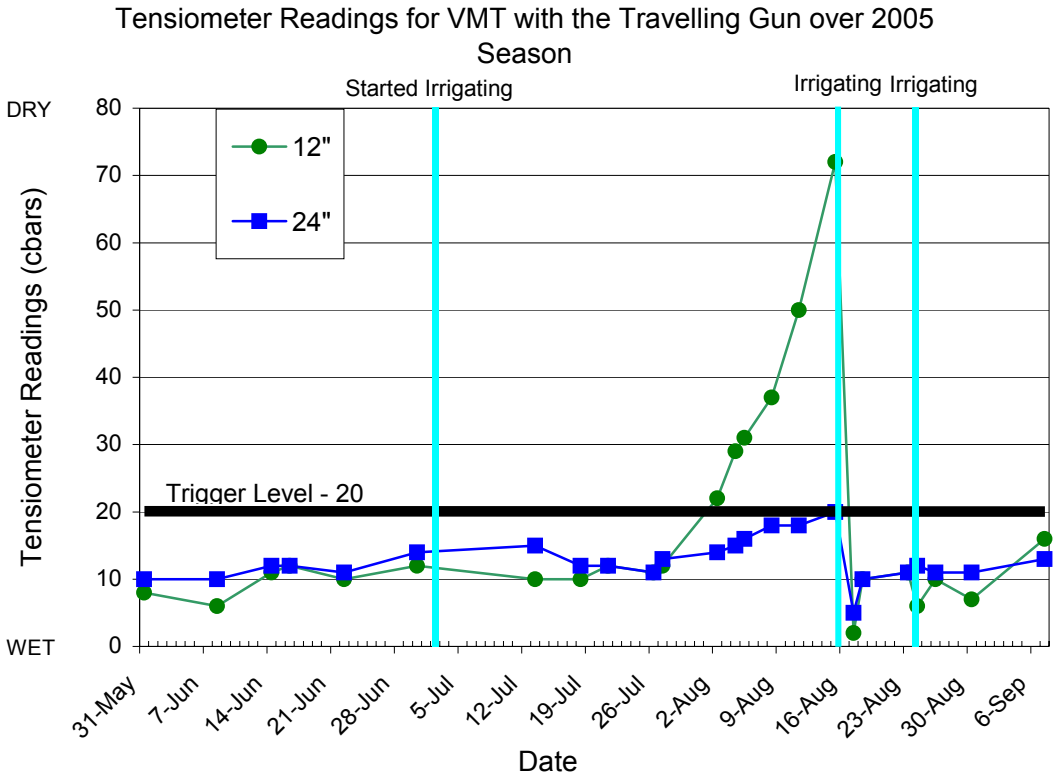


Figure 19: The tensiometer readings in the VTM field where the traveling gun was used indicate that the first pass in early July was not necessary yet. The trigger level for this field is 20 centibars and was hit in the end of July though the gun did not pass again until the 16th of August.

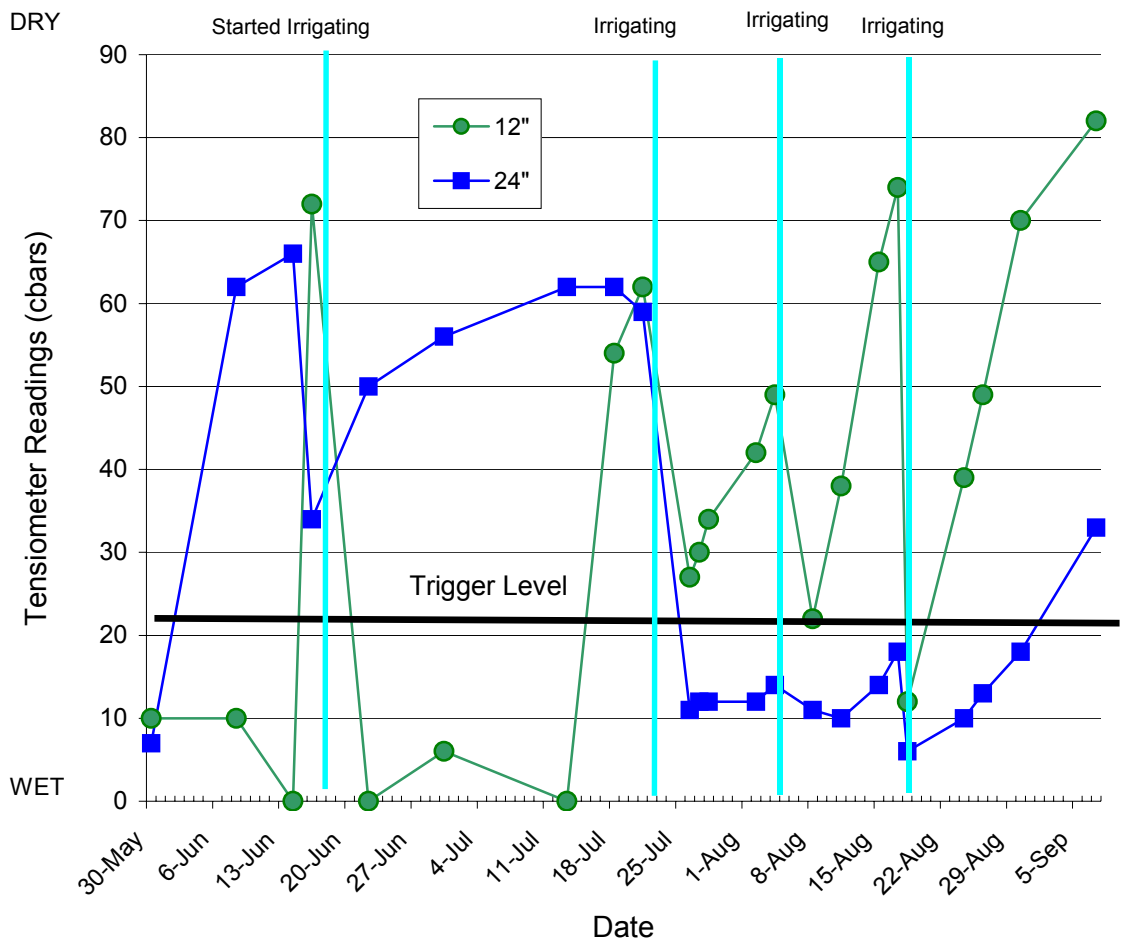


Figure 20: Tensiometer readings for the V3 field. This field is on the valley bottom and closer to the water table than the upper fields. The fields were used for pasture with a high percentage of alfalfa. The topsoil was a sandy loam with silty gravel from 11 – 14“. The trigger level was 20 cbars. The tensiometers at this site continuously crashed and had to be reinstalled twice in the first two months. Only after July 26th 2005 did the tensiometers provide consistent readings.

Tensiometers were also installed May 30th in a forty-acre potato field on Dolman’s property (Figure 21). The soil profile at this location was silty loam for the depth of the test pit (0.8 m). It was only water twice during the summer. The 24” tensiometer never reached the trigger level of 30 centibars. The farmer waited for the upper 12” of soil to dry thoroughly from the June rain before applying irrigation.

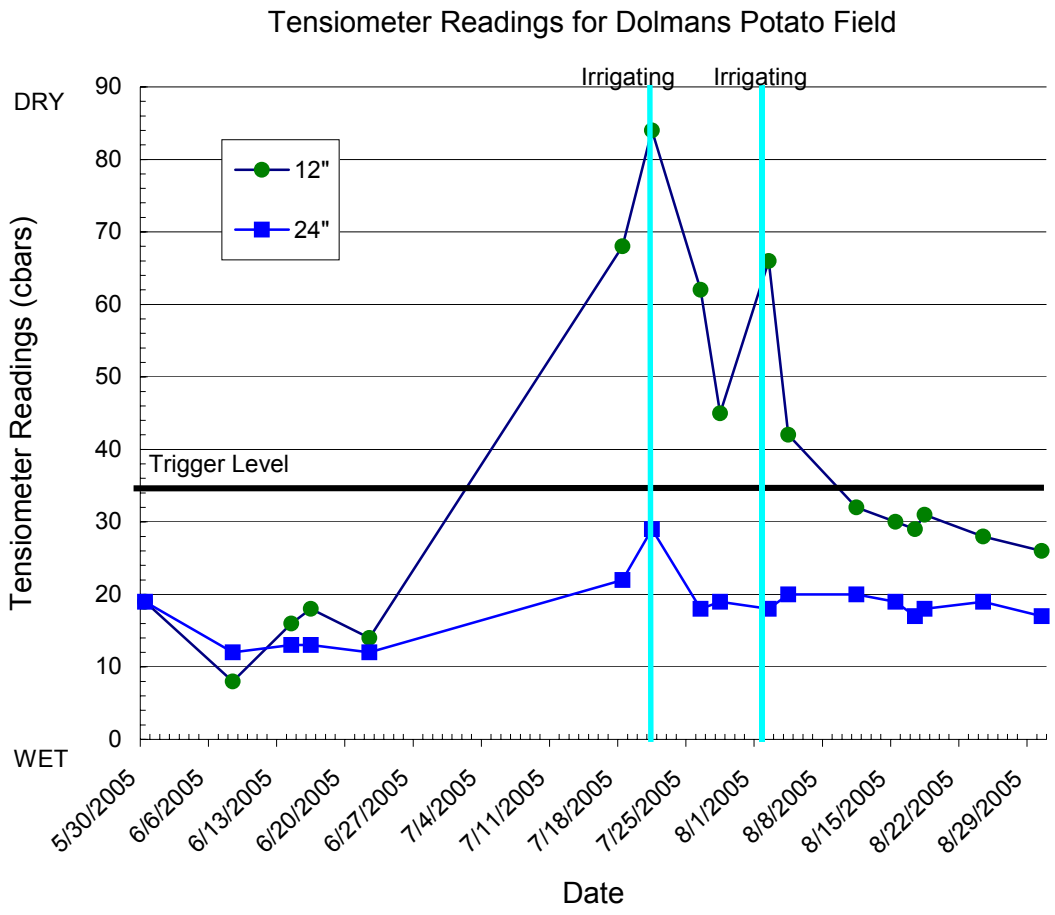


Figure 21: Tensiometer readings on Dolman's field. This water table is seldom more than a meter below the Dolman property. The Dolmans grow mostly root crops and are just as concerned about over-watering as under-watering.

A pair of tensiometers was installed in a 40-acre canola field on the Silver Hills Ranch at the request of the landowner. Silver Hills Ranch is a 40-minute drive from Lumby and draws its irrigation water from the Shuswap River. It was too far for WCRC's technician to drive on a regular basis for maintenance checks and recording the readings so the rancher was instructed on the maintenance procedures in May when the tensiometers were installed. As it turned out, the rancher never applied irrigation to the canola because of the rain in June and early July.

Storage and other Alternative Sources

After site visits to all the areas suggested by licensees at various meetings and areas picked out from orthophotos, two sites were thought to have enough potential to merit further investigation: the meadows in the northeastern corner of the upper watershed and Bonneau Lake. A cross section of the potential dam site at the east meadows and a level circuit of the area upstream of the dam site were conducted (Figures 22- 23).

No sites in the upper watershed were suitable for storage.

Figure 22: The east meadows in September 2004. The standing water is a result of a wet fall.

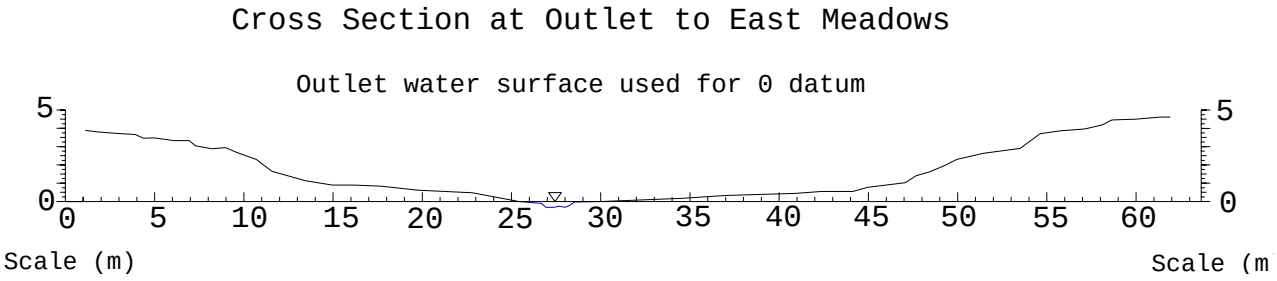


Figure 23: A cross section at the outlet of the east meadows indicated that a dam 4 m in height and 60 m long could be built to hold back 3 m of water. However, a circuit level showed that despite the standing water in the meadow, there was too much of a gradient for a 4 m high dam to store more than a 10 AF.

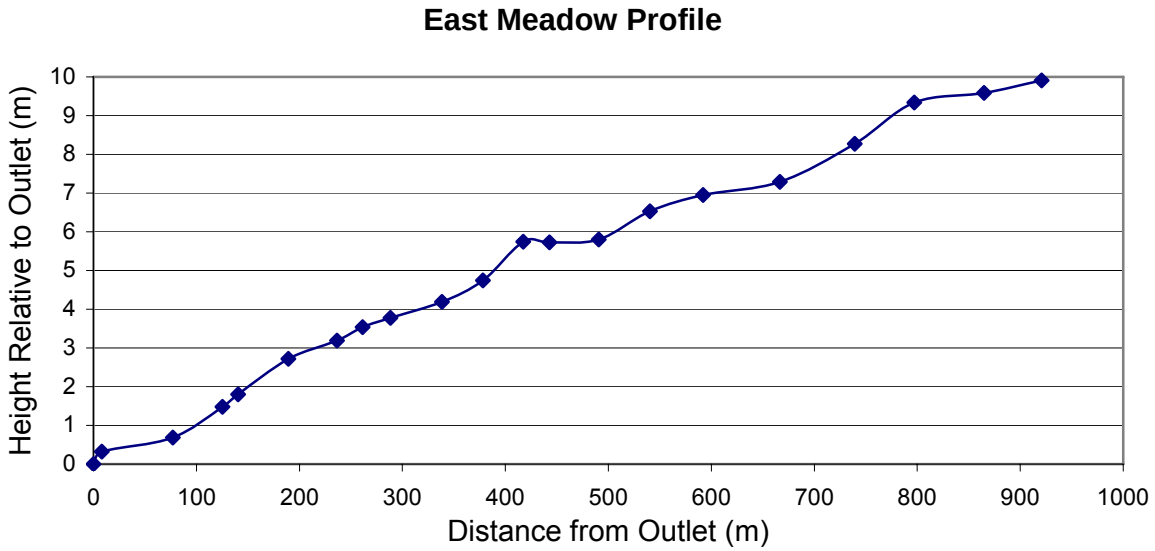


Figure 24: A profile of the east meadows (# 8) with the outlet water surface used as 0 elevation. A dam 4 m in height holding back 3 m of water would only back the water up to about 230 m behind the dam.

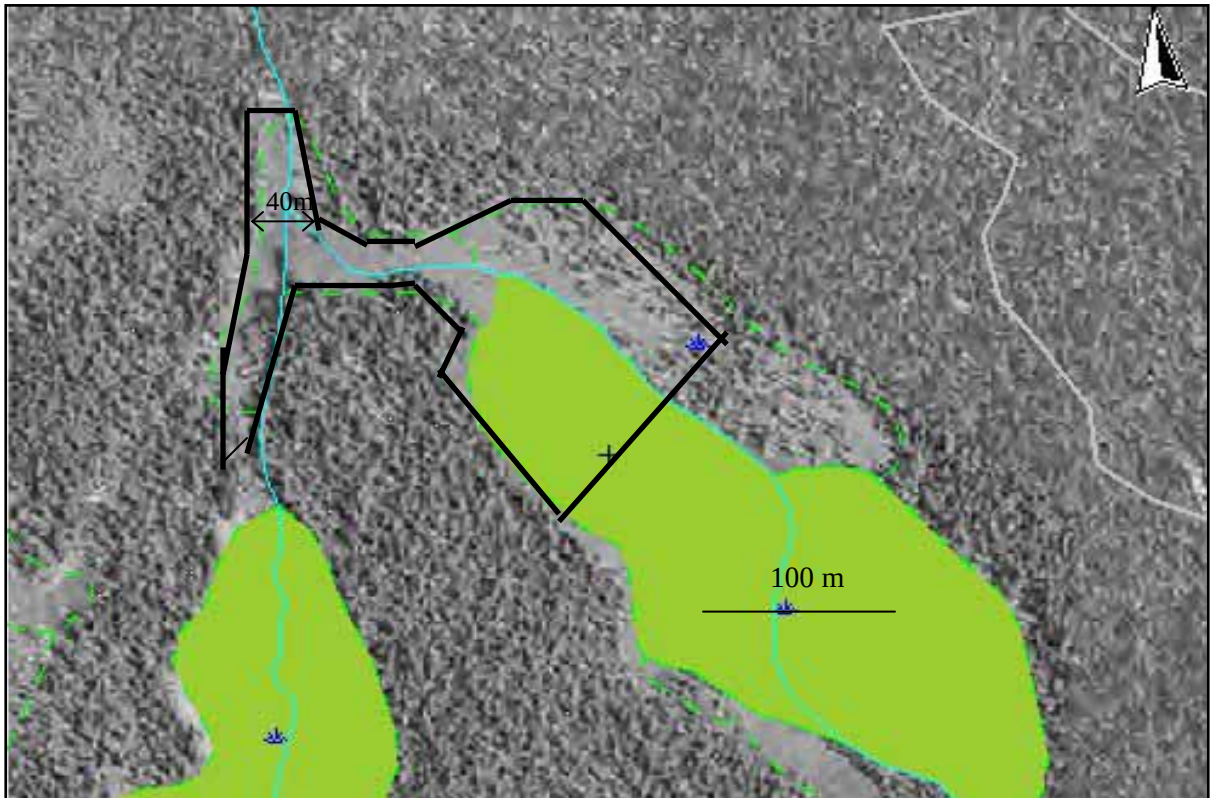


Figure 25: The area that would be flooded if a 4 m high dam were built at the outlet would back up water for approximately 230 m and flood an area of about 2.5 ha.

A level circuit was also conducted at Bonneau Lake to see if there was the potential to divert the water to Creighton Creek. After it was found to be possible, to both store

additional water at Bonneau Lake and to divert the stored water into Creighton Creek. WCRC contacted the members of the BC Ministry of Agriculture and Lands that were overseeing the CBCWSEP grant. The option of doing a detailed survey of Bonneau Lake was discussed. Initially, the intent behind the storage feasibility study was to look for any areas that had the physical potential for storing enough water to augment Creighton Creek flows during the six weeks when irrigation demands are high and creek flows are low. However, after conversations with representatives of the various government agencies that would be involved in the approval of such storage, it became apparent that even if the physical capability existed, the approval process would be difficult and expensive, possibly increasing the cost of creating storage to the point that it was no longer feasible.

The concerns with the high costs of environmental impact studies were discussed with the grant manager. It was decided to continue with the investigation of the physical possibilities of water storage. If such possibilities exist, the benefits of improving habitat for an endangered species (coho) might outweigh any negative environmental aspects. There might also be funding available to help landowners with the costs of additional studies.

Surveyors were contracted to conduct a detailed survey of Bonneau Lake to determine the storage capacity. Storage at Bonneau Lake would involve constructing two dams, one on Bonneau Creek and one on a Creighton Creek tributary. Bonneau Creek is currently the only outlet to Bonneau Lake. However, if the lake level were raised 2 m, the water would begin to flow into Creighton Creek. In order for all the stored water to be diverted to Creighton Creek, 420 m of pipe would have to be placed from the lake to below the Creighton Creek tributary dam site.

The cost of the dams would include an environmental impact study under the *Canadian Environmental Assessment Act* (CEAA) and *Fisheries Act*, engineered designs and construction. Estimates for the environmental impact study ranged from $30,000 to $80,000. Engineering costs were estimated to be between $5,000 and $15,000 per dam providing there is access for a small excavator to dig test pits. Construction costs would depend on what the test pits showed and if suitable material were found at any of the nearby borrow pits but would likely be in the neighbourhood of $100,000.

Before an interested party could consider such an investment, there are other obstacles to overcome. Provincial fisheries have been managing Bonneau Lake as a walk-in trophy lake. Federal fisheries have been working to prevent inter-basin water diversions. Both agencies would have to be convinced of a net benefit to fish before they would grant approvals to proceed.

The complete results of the survey can be found in Appendix B.

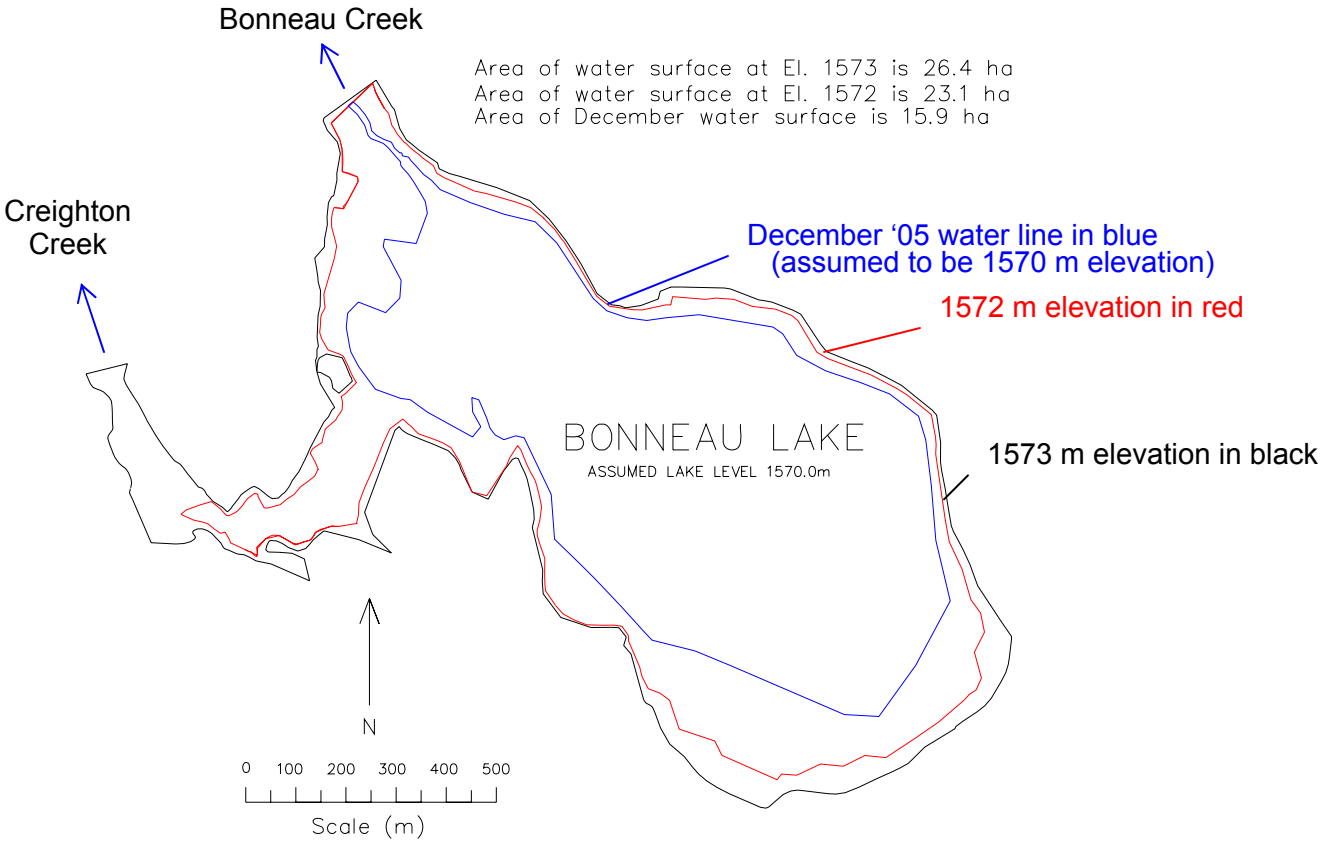


Figure 26: The survey results show the areas that would be flooded if the water was raised 2 m from the 1570 m elevation to the 1572 m elevation and 3 m to the 1573 m elevation. If the lake level were raised 3 m, the lake surface would increase from 16 ha (39 acres) to 26 ha (65 acres) and have a storage capacity of approximately 500 AF.

WCRC also assisted on irrigator to apply for a CBCWSEP grant to dig a well for irrigation purposes. The CBCWSEP program, originally scheduled to end March 31st, 2006 has been extended for two years.

Discussion

In general, the Creighton Creek Streamflow Recovery Project has made substantial steps towards both determining the cause and resolving the problem of the shortage of water in Creighton Creek and Bessette Creek but has not gone as far as hoped. As a result of this project, there is data on how much water is available in the system and where it is going. There is also a much greater awareness of the need to conserve, especially among the irrigators. The level of communication and co-operation has improved substantially on Creighton Creek. The irrigators have gone from blaming each other for over-watering and exceeding their licenses, to meeting with each other to determine how best to share a limited resource. However, the irrigators were not yet willing to commit to a formal and binding water use plan.

Progress has also been made on Bessette Creek as far as determining what water is available and where the losses are occurring. Discussions with key licensees and MWLAP have the potential to lead to better management of the Nicklen Dam that could prevent stranding in the deposition zone below Horner Road.

After the urgency created by the dry conditions in 2002 to 2004 had passed, it was harder to maintain interest or evoke commitment. WCRC's role in this project has been to gather information and to inform and assist the public in general and the local irrigators in particular. An effort was made to convince the irrigators that it was in their best interest to participate in a WUP, but not everyone was convinced.

Monitoring Creek Flows and withdrawals

Establish a minimum flow in Creighton Creek

WCRC had proposed to monitor this section of creek during the low flow period in 2005 to further refine at what stage the loss of the riffle areas occurred in the lower section. However, the flow in the lower section of Creighton never dropped below 6 ft^3/s during the summer of 2005. At this stage, there is enough water that the fry were distributed throughout the riffle areas as well as the pools. As a result, little time was spent on this aspect of the project. For the purposes of the group of principal irrigators on Creighton Creek that are working on an agreement on their own, the 4 ft^3/s arrived at last year will act as a guideline.

In a WUP process, a conservation flow would be established by provincial and federal fisheries. Conservation flows are based on a generalized model of habitat response to varying percentages of mean annual discharge for a wide range of streams in B.C. They integrate species life stage requirements with naturalized hydrograph changes to represent an ecosystem perspective, and are based on a combination of provincial standards and stream specific flow/habitat relationships. These flow address the fundamental ecosystem requirements of aquatic habitats including channel formation/maintenance, invertebrate production and fish production. They represent overall system requirements that support sustainable fish production. Any flows less than conservation flows would eventually result in reduction of available fish habitat and fish production (MWLAP, 2005). The conservation flow for any given month is usually based on a percentage of the mean annual discharge (MAD).

The required conservations flows based on a percentage of the MAD can be less than the actual base flow during a dry year. On Trout Creek in Summerland, for example, the conservation flows for July and August are 40% and 30% of the MAD or 1.08 m^3/s and 0.81 m^3/s respectively. On a low-flow year like 1969 the mean flow for the July was 0.22 m^3/s and August was 0.11 m^3/s.

To get a better understanding of how flow relates to habitat for the Trout Creek WUP, MWLAP calculated the optimum flows for fish habitat. The limiting habitat for rainbow trout and kokanee production were considered to be spawning/incubation habitat. Access to the available spawning areas was considered critical. Migration flows are based on the body depth of the fish. As riffles would be the limiting habitat type for migration, enough flow to provide a minimum average depth of 100% of the fish body depth is usually required through the riffle areas. Transects were set up in key areas. The weighted usable width (WUW) was calculated at each transect by applying habitat

suitability index (HSI) values for depth, mean velocity (at 0.4 of depth) and the dominant substrate at various flows. WUW is calculated using the formula:

$$WUW_{dvs} = \Sigma_i^n (W_i * D_i * V_i * S_i);$$

where W_i is the width of cell i on the transect,
D_i is the suitability of depth at cell i,
V_i is the suitability of velocity at cell i, and
S_i is the suitability of substrate at cell i.
Cover or another habitat parameter can be substituted for substrate in this model.

The optimum flows were used to determine the amount of habitat loss and the associated loss of fish production for specific flows.

There is no continuous flow data for Creighton Creek other than flows recorded during the spring and summer months for the six years from 1959 to 1965 at the Water Survey Canada station (08LC033). The MAD would have to be estimated using water balances, a watershed model of extrapolation from another watershed.

BC Hydro originally developed WUPs and most WUPs have been for systems that are at least in part controlled by dams that interrupt the natural flow. In these cases, all the life stages of the species using that stream including spawning, incubation, rearing and emigration must be considered and conservation flows established for the periods. Creighton Creek in not controlled and the only anthropomorphic influence on flow that would be considered is withdrawals for irrigation during the summer months. The life stages that coincide with this period include the rearing stage for coho and chinook salmon, migration of adult chinook and the incubation, and rearing stages for rainbow trout. Spring migration and spawning by rainbow trout and fall migration and spawning by coho occur before and after the irrigation season. Fall spawning by chinook would also occur after the irrigation season. Chinook generally tend to be mainstem spawners but they have been seen on occasion in Creighton Creek. They can enter the creek during the irrigation season prior to spawning.

While the licensees on Creighton Creek were still discussing the possibility of conducting a WUP, Phil Epp was taken to several sites on the Creek to check on their suitability for placing transducers for collecting continuous flow data that could be used in a WUP. The gauge sites that are farthest upstream and downstream both were suitable and would give flow data both above and below all points of diversion. These transducers cost about $1,500 each. Phil Epp suggested that even if the water users did not commit to a WUP, the placement of the transducers would provide continuous flow data that would be valuable for DFO in monitoring the creek. The continuous data would also serve to remind the irrigators of the need to maintain conservation flows.

Other flow measurements

Enough flow measurements were done to verify the flow curves on the gauges that were placed the previous year. Three more gauges were place and curves developed. For the most part, these gauges seemed to be in stable areas and can be used for future work if necessary.

Enough information was collected to fill in the gaps noted in last year's project. The main tributaries to Creighton do not contribute any surface flow during the peak irrigation months and do not have to be factored into the water balance for the creek. Churchill

Creek is intermittent and contributes no surface water to Creighton Creek during the irrigation season on most years. All the water available in Higgins Creek is being used by the licensee on Higgins Creek during low to moderate flow periods.

The information gathered on Bessette and Nicklen Creeks this year suggest that with slightly different management of the dam at Nicklen, it might be possible to maintain a continuous flow in the deposition zone in Bessette Creek between Horner Road and Whitevale Road by starting to release water earlier and possibly more at critical times. The licensee that owns the dam was cooperative and MWLAP owns substantial rights on Nicklen Lake. Brian Janz at MWLAP has been given the information that was collected as well as recommendations for changes in the operations.

There is still the problem of the bedload that is reducing stream capacity and creating significant loss of surface flow to groundwater in the deposition zone below Horner Road. In areas where the creek is wide, the gravel bars could be planted with willows. This is an inexpensive treatment that was done on several properties farther upstream on Bessette Creek. The willows stakes are planted in a series of rows that concentrate high flows in the channel while slowing flow across the bars. This causes the channel to deepen while finer sediment accumulates on the bars. As finer sediment collects on the bars, the bars become populated with first cottonwood then conifers volunteers.

Figure 27: Willows stakes were planted in this gravel bar during the winter of 1999 on Bessette Creek to help stabilize the bar and to eventually concentrate the high flow to the other (left) side of the creek.

Figure 28: A picture of the same site as above taken during the freshet of 2004 from a vantage point 30 m farther upstream. The willows have grown several meters. The bar has collected enough fine material that cottonwood volunteers are more numerous than the willows originally planted. The high flow has become concentrated to the right side of the creek. Some of the streamside edges of the bar have eroded as the stream became concentrated on the left side of the channel.

This method works only where the area between the berms is wide enough and where livestock don't have access to the creek and riparian area. In areas where the creek width is narrow, like the second cross section, there is only enough room to pass high flows and another method would have to be used.

While the bar stabilization is inexpensive, it alters the creek gradually and takes several years to notice a change. In areas were the distance between the berms is narrow and the channel capacity reduced to the point where even a moderate high water will overflow the berms, there is the chance of avulsion. The channel capacity should be increased and possibly pool habitat created.

Water Users Group/WUP

Some progress was made during the year in creating a water users group though not as much as hoped. It was difficult enough to persuade irrigators that they would have to make changes when there was a water shortage; it became more difficult when the crisis ended and there seemed to be more water available than was being used. Even for those that realized that low flow situations will happen again and that given the number of licenses on the creek a crisis could develop even in years of moderate flow if more landowners decided to use their licenses, the urgency to create a WUP was gone This resulted in poorly attended meetings. The urgency for a WUP was also reduced by the change of ownership of the property with second water rights. The new owner has

demonstrated a much greater willingness to work with the other licensees than the previous owner.

Sporadic meeting attendance made it necessary to spend time repeating information that had been covered in previous meetings. Attendance of residential licensees and hobby farmers tended to disrupt the discussions between the commercial irrigators. Time was spent explaining to the non-commercial water users why options like watering at night may work for home gardens and hobby farms, but not for commercial enterprises. Several of the commercial irrigators voiced their frustration with these diversions.

One of the problems faced by the irrigators on Creighton Creek is knowing how much water is available at any given time. Because the licenses with the highest priorities are located at the downstream end, the upstream users can only guess if there is enough water flowing by for them to begin pumping unless they were to phone Al Dolman to ask how much is going past his weir. This might work for the four or five commercial irrigators at the downstream end of the creek who can see each other's farms and are already working with one another but it is not as likely to happen with users farther upstream. Even if an upstream user were to try, being able to catch Al on the phone during irrigation season is not easy. This would be a problem whether a wup was developed or not.

Pilots

The tensiometers placed on the hillside at Vale Farms confirmed what they already suspected: they were applying more water than was need to the hillside pastures with the traveling guns. It was unfortunate that there was the delay in setting up the K Line system. They are planning on using the tensiometers again in 2006 to help with scheduling all three systems.

The tensiometers were not particularly useful for the Dolman farm. They were growing root crops and were concerned about problems from too much moisture as well as not enough, they preferred the digging test holes by hand in different locations throughout their fields to the tensiometer readings. The soil is not uniform throughout the fields and digging a number of test holes gives them a better idea of the overall conditions of the fields than relying on one pair or even several pair tensiometers. When the 12" tensiometer reading hit the trigger level they waited a week before watering based on their test holes. They suggested that they might find the tensiometers more useful in a field with more uniform soil or in a field not being cultivated such as a hay crop or pasture.

Alternate water supplies

After determining that there was no inexpensive storage in the upper watershed some of the landowners began to reconsider other alternatives. WCRC helped one of the main irrigators with a CBCWSEP application for a well. Another is considering developing on-site storage. These alternatives had been brought up the first year, but the landowners waited to make sure there were not any less expensive alternatives before proceeding.

Recommendations

Make the tensiometers that were used at Dolmans' and Schunter's available to Vale Farms. They show a genuine interest in reducing water usage and the additional tensiometers will give them more data on which to base their scheduling and make comparisons between the new K Line and the traveling gun.

Water Management and DFO should work with the Real Estate Board to issue warnings on agricultural land in water- stressed areas. Many landowners hold onto their irrigation water licenses even though they have no plans for using them because they add to the resale value of the property. These landowners might be more inclined to give up inactive licenses if they had to disclose the unlikelihood of ever using these licenses during the irrigation season.

Pressure transducers should be placed upstream and downstream of the diversion points in Creighton Creek by DFO. This would serve to both collect continuous flow data on the creek for future use and be a remind the irrigators that conservation flows must be maintained. If they aren't, there will be a record of it.

DFO should seek funding to stabilize gravel bars on Bessette Creek and develop channel depth in the deposition zone.

Nicklen Lake release times should be monitored by MWLAP so they are better coordinated with the low flow periods in Bessette Creek.

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