

# **Kananaskis River Work - April & August 2008**

## **Synopsis of Project**

I am pleased to announce the completion of the in-river work on the Kananaskis River at Canoe Meadows for 2008. This project was the culmination of 2 years of planning, fundraising, study and onsite work. Special thanks has to be given to the following people and organizations for their contributions:

Ian and Lynn Jobe – Fundraising and Budget

Tom Jacklin – Permits and Government Approvals

Keith Morrison – Fundraising and supervision for Santa Claus

Dan Groenveld – Slalom Post bases, skidsteer donation

Rich Johnson – Trail Boss

Mark Taylor – In-river hydraulic planning, supervision and testing

UMA Engineering – Donation of Site Plan

Downer Contracting – Rock transport and Trackhoe placement of Rock

Standard General Contracting – Trackhoe placement of rock

Lafarge Canada – Donation of Rock

TransAlta – Water scheduling

Alberta Recreation, Parks, and Wildlife Foundation – Matching Grant to fund project

Alberta Whitewater Association

Lower Kananaskis River Users Association

Alberta Recreational Canoe Association

Alberta River Surfers Association

Calgary Kayak Club

Bow Valley Kayak Club

Bow Waters Canoe Club

Waterwerks Kayak Club

Chuck Lee

Director of Facilities and Environment

Alberta Whitewater Association

The primary purpose of the 2008 Kananaskis River project was to work on upgrading the Kananaskis River at Canoe Meadows to improve the river features from the Put-In Eddy to the Take-out eddy. Over time the river has slowed down due to erosion of features, sedimentation of eddies and gradual slumping of berms and rock piles. After 25 years of steady operation it was time to tune up the slalom course and to improve the trails and gate hanging system.

The proponent of this project is the Alberta Whitewater Association with support from LKRUA and the paddling clubs and the Alberta Sport Recreation and Parks Foundation. The total value of the work being done including donations in kind and volunteer labour is \$198,000.

The Alberta Whitewater Association is the sport governing body for whitewater kayaking, including recreational paddlers, freestyle kayaking and slalom racing. The AWA provided the initial funding and

the direction to create a whitewater playpark and slalom site at Canoe Meadows in the mid 1980's and the teaching site below the race course in the late 1980's. This work spawned the establishment of a major river rafting industry on the Kananaskis and the further development of other park and play sites further upstream on the river. The Kananaskis River currently handles over 100,000 river guests each year and is one of the most utilized rivers in Canada for whitewater activities.

The AWA was requested to amend the 2008 race course project to include an upgrade to the Smitty's wave by the Alberta River Surfers Association and to do an upgrade to the Santa Claus hole by a group of recreational playboaters. These extra projects were included in the grant application and the overall project with the understanding that the Canoe Meadows upgrade was the 1<sup>st</sup> priority. The Alberta River Surfers Association contributed \$1,000 to have their project included. The recreational playboaters pledged \$5,000 to help the Santa Claus project.

A major problem arose with the project when TransAlta announced that the Barrier Dam generators would be shutdown for servicing from April 15<sup>th</sup> to May 4<sup>th</sup>. This is the same time frame as the fish window that allows for construction in the river. The AWA was able to get an extension to the fish window period till May 15<sup>th</sup>, but the opportunity to work with the river on and off over a period of 2 weeks would not be afforded to us later in May, because of TAU's need to empty the reservoir before the spring flush. A work schedule was drafted using the 1<sup>st</sup> 5 full days from April 21-25 to do the major work and then having two cycles of seeing the river on and off and revising the work as needed.

There was some discussion about delaying the project till August so there would be more opportunities to review the river off work when the river was on. However so much of the work being planned such as the river trails, new eddies and embankments could be done with the river off without jeopardizing the river features. Large scale enhancement of major working features such as Santa Claus, Smitty's, Green Tongue, Cartwheel Corner, Miami or others would not be advisable during the spring work due to the inability to rework any of the changes given the time frame available. Minor tweaks of these features could be allowed with the understanding that the tweaks could be quickly reversed if they didn't work out on the 1<sup>st</sup> shot. Major reworks would have to wait until the fall fish window.

Downer Contracting began work in late April to deliver the 1500 tonnes of limestone rock that were donated by Lafarge Canada from their mine in Exshaw. This volume of rock was sufficient to cover the entire front parking lot at Canoe Meadows 8' high. At times it seemed that we had ordered too much rock as a landslide of boulders kept coming down to the river. However past experience has taught us that stockpiling rock for future use is never bad and that we will be able to use it at some time to reinforce berms and embankments or to create new features. These extra stocks were positioned on top of berms or in larger eddies where they would be out of the way until needed. Unfortunately the rock that was delivered was mostly Class 3 size and we should have asked for oversize Class 4 rock. This made the construction work more time consuming and difficult throughout the project.

Downer then worked for 4 days with 2 rock truck hauling the rock down to the river, dumping it at key points for future placement. At the same time, Standard General's trackhoe worked on placing the rock along the new Kananaskis Riverwalk, building a trail from the Put-In to the Take-out along the race track. This included building retaining walls to create beaches and embankments for viewing and gathering points.

With the river off all the time it was impossible to see the effects of the work being done, so it wasn't until the end of the week that some minor quick tweaks were done to the Green Tongue and Santa Claus. There was a lot of work done on the wave called Smitty's, upstream of the Put-In for the river surfers. After the river came on, there were two more chances to work on the major features and to upgrade the minor ones. There was great concern that the changes at the Green Tongue had destroyed the surfing wave there and so one more day was scheduled to attempt to fix it. Unfortunately this last chance before the fish window closed and TransAlta began full-on operations to flush the reservoir failed to rebuild the Green Tongue wave to its former self.

Three weeks later heavy rainfall combined with snowmelt created flood conditions on the Kananaskis River. Except for the berm at Smitty's which washed out on river left, all the riverwork done in the spring survived in tact without much problem. However flooding from Lusk Creek brought down tonnes of gravel into the Kananaskis choking off one of the main channels and filling eddies with sediments. It also destroyed the Point Break surfing feature, when the highway divider broke loose from its moorings.

At the end of August we were able to re-enter the river for 11 days to finish the work started in April. With the water turning off each evening and back on the next morning, the crew was able to work on a number of features and then paddle it the next day before reworking the feature to optimize its characteristics.

Most features required at least 5-6 different configurations before we were satisfied with our work. One of the problems we encountered in working on our features was the breaking of large foundation stones as we moved and re-positioned them. Natural fissures in the rock made it difficult to work and therefore once our foundations rocks were positioned, we were reluctant to move them because of the limited supply of large rock.

*The Kananaskis River is quite unique in that the flow regime is quite stable throughout the year and year after year. The fact that most of the features are man-altered and remain stable for long periods, give people a feeling of permanency. However flood cycles, erosion, sedimentation and natural river processes alter the river either gradually over time or dramatically in a week. Rebuilding the river to its previous state is not usually possible because of the use of natural materials and lack of control mechanisms. This is part of the natural evolution of most rivers and river users must recognize this is true of the Kananaskis River as well.*

A synopsis of the work on each feature is detailed below, starting at the upstream end and finishing at the downstream end:

## **A. Lusk Creek**

### **Synopsis of Work**

**Before:** Spring flood brought down a huge amount of sediments into river that destroyed river right channel and forced the main current into the river left channel. This stranded the eddies and play features in the now mostly dry river right channel.

**Action Taken:** A quick dash was made to this site at the end of the work in August. The trackhoe removed some of the larger cobbles at the top of the river right channel to open a better flow into the old route.

**Effect on River After:** the River Right Channel was larger and wider and helps to bring water down into the eddies and play features in this channel.

**Further Work Required/Suggested:** Removal of the Lusk Creek sediments might be possible. It would require 1 trackhoe and 2 rock trucks at least 1 day of time. The natural place to take this gravel will be the new commercial parking lot at the Widowmaker. It is likely that this type of flooding will reoccur several times over the next 5-10 years until the Lusk Creek drainage becomes revegetated after being extensively clearcut last year.

## **B. Minor Features Lusk Creek to Point Break**

### **Synopsis of Work**

**Before:** Spring flood in Lusk Creek brought down sediments into river that filled eddies. It also moved several keystone boulders in the berms and underwater ledges

**Action Taken:** A quick dash was made to this site at the end of the work in August. The trackhoe scooped out some eddies and replaced keystone boulders back into berms and underwater ledges.

**Effect on River After:** Smaller features were returned to pre-flood conditions.

**Further Work Required/Suggested:** There is substantial gradient in this section of the river that is not being fully utilized at this time. Squeezing the river with additional rock will create increased speed and add new surfing spots and play features.

## **C. Point Break**

### **Synopsis of Work**

**Before:** After our work in April, spring flood waters ripped out anchor points that secured the highway divider in this structure. Failure point was the bedrock which delaminated. This was not a planned part of the Canoe Meadows project but was requested by many paddlers if it was possible because Point Break was one of their favourite play spots.

**Action Taken:** A quick fix was made to this site at the end of the work in August. The highway divider was repositioned on the bedrock ledge. A large stone was positioned behind the divider along with a stone on either side to block the divider from floating away again. New holes were drilled into the bedrock upstream and the divider was re-anchored with chains to the bolts inserted.

**Effect on River After:** A significant wave and hole feature was re-established, but it is not the same hole feature that Point Break was famous for. The wave formed is greener and less retentive than the pre-flood,

there is also a substantial mid-stream flush point where the water surges through and makes it difficult to stay on the wave.

**Further Work Required/Suggested:** The flush point in this wave is on the river left side of the divider where a low spot exists between the divider and the natural ledge. It might be possible to place a rock in this gap to prevent the water flushing through.

The lack of retention in the wave could be offset by scooping out the rock behind the divider/rock that forms the wave and creating a line of rock 2-3 m downstream that blocks the flow and lifts the water up to form a 2ndary wave and generate more recirculation on the 1<sup>st</sup> wave. Alternatively the area downstream of the divider/rock could be filled with rock to create more speed and form less hole and more wave.

The other option is that this is a new type of feature that will not have the same appeal as the old Point Break but it will have an appeal to different users with different skill sets. With this option the feature would be left as it exists now and not re-worked until it fails sometime in the future.

## **D. Santa Claus**

### **Synopsis of Work**

**Before:** Hole was stable on river right but fluctuating and instable on river left. Likely cause was due to difference in the plunge pool below the drop.

#### **Actions Taken - April:**

1. Align rocks in plunge pool to create uniform upslope downstream of drop in natural slot.
2. Squeeze river on river left to drop straight into plunge pool
3. Raise level of head by squeezing river on river left

**Effect on River After:** Hole was larger and wider, more uniform and more stable afterwards. Flow off the river left berm is slower than that coming off the deflecting shoulder of the river right berm. Lower river right eddy berms are duplicated and could be minimized.

#### **Next Action Taken - May:**

1. Move existing lower berm on river right upstream
2. Build deflecting shoulder above drop on river left
3. Remove large rock in midstream above drop to reinforce groynes
4. Remove rock from eddies and store extra pieces on berms and on river benches.

**Effect on River After:** Hole size stayed the same but was even more stable afterwards. Flow off the river left shoulder matches the speed of the flow coming off the deflecting shoulder of the river right berm. *Of concern is the lower right eddy berm which projects out into fast downstream current – several boats broached on this obstruction during the summer.* Water flowing on shoreline side could make this an easy fish ladder system with a little work.

High water floods did not affect feature but did move the three large boulders in the deep water water out of blocking position. Unlikely that these boulders will lock into place as desired as they tend to roll around when enough force is applied during high water events.

#### **Next Action - August:**

1. Put 3 large boulders back into midstream slot to complete underwater natural ledge.
2. Remove rocks projecting into river from river right berm just downstream of wave. Smooth and contour berm to create upstream ramp face to lessen broaching problem
3. Scoop out fish ladder around river right berm to allow for attainment upstream on river right.
4. Remove fallen tree from eddy above drop on river left

**Effect on River After:** Hole remained stable with minimal change. Increase of flow velocity downstream from reduction of river right berm. Safety has been improved by reducing broaching threat. Fish ladder is working well.

**Further Work Required/Suggested:**

1. Experience here and at Green Tongue demonstrates that the hole created at this feature is almost entirely due to the steep drop from the upstream face into a deep pool of water. This forms a steep hole feature that is a classic for the Kananaskis. Blocking the channel therefore has little effect on the hole upstream but it does start a wave train downstream that could be enhanced given the speed of the water through this spot. Filling in the natural trench will likely create more of a wave and less of a hole.

## **E. Santa Claus Beach**

### **Synopsis of Work**

**Before:** Shoreline was a cobble strewn slope with water flowing from the berm making it difficult for pedestrian traffic to enjoy watching the freestyle competitions and activities, especially during larger events when there was insufficient space on the main berm.

**Action Taken - April:**

1. Build 2 retaining walls – one at river level and one 3 feet higher along the river right shoreline
2. Backfill and level gravel bed in behind retaining wall on top of snow/ice

**Effect After:** Melting of snow and ice under the gravel left uneven surface combined with continued flow of water under berm. Concern raised about gravels being flushed into the river during flood stage events. This was not a problem during the spring high water as gravel benches remained in tact. Lower retaining wall is at water surface and may require an additional layer of rock to the existing 2 layers to give adequate separation from river. River disembarkment along shoreline is more difficult and rocks may need to be adjusted to make it easier for playboaters to get off the river.

**Action Taken - August:**

1. Add another layer of retaining rocks to lower level and backfill behind it.
2. Reinforce river right berm and create flood way slot closer to river right shore for river to flow through during high water events.

**Effect After:**

1. Lower bench is now out of water.
2. Water is not leaking through berm as much as before.
3. A flood water channel closer to the river right bank could be enhanced to carry water away from the main drop and the riverside benches.

**Further Work Required/Suggested:**

1. The upper bench could be raised by lifting lower rock layer out and putting on top of top layer and then backfilling behind this. This would be a great way to utilize any gravel sedimentation that occurs in future years.
2. Establishing a grass cover on the gravel benches would help to minimize erosion of the riverside bench.
3. Stones can be positioned to give playboaters easier access to the shore.

**F. Minor Features between Santa's Little Helper and Smitty's****Synopsis of Work**

**Before:** River runs straight with minimal features after the Santa's Little Helper feature until it reaches the head of water stored upstream of Smitty's wave. River drops at a consistent rate over a flat bedrock substrate through this section and the river is broad, wide and shallow. The river right banks runs along a treed sloped, while the river left bank is marked by a steep cliff slope with noticeable rock outcroppings.

**Action Taken - April:**

1. Several truckloads of rock were stockpiled in this section for future placement.
2. Rocks were used to form berms on left and right

**Effect After:** A number of easy eddies were formed from the rock piles

**Action Taken - August:**

1. Berms were moved to squeeze the river and create some more speed .
2. A small underwater ledge was brought out from river left from a berm to create a beginner surfing wave.

**Effect After:** The river speed increased where the berms squeezed the river slightly and a great beginner surfing wave was established.

**Further Work Required/Suggested:** This stretch of river could have 2 or 3 good features on it and create a continuous rapid environment if more rock was brought in to squeeze the river and create some diversity to its riverbed surface.

**G. Smitty's****Synopsis of Work**

**Before:** The Smitty's wave was originally built by LKRUA in 2005 using small materials that created a nice intermediate surfing wave for both paddlers and surfboarders. Subsequently the surfboard community had adopted this feature as their own and spent considerable amount of time and energy trying to improve the surfing character of this wave. High water in 2007 had knocked out several key rocks and the wave had deteriorated considerably since then. The wave/hole was small, river wide but inconsistent and instable. Likely cause was due to different heights and angles in the rock ledge and lack of kicker below hole. Drop into wave/hole was only 2'. The lack of constriction in drop structure and water flowing over river left berm did not allow a large head of water to be created.

### **Action Taken April & May:**

1. Remove existing small rock ledge.
2. Rebuild double wide rock ledge with a sloping angle and align larger rocks to create uniform downslope.
3. Build larger berm on river right to force river away from cliff wall.
4. Build larger berm on river left to prevent river from flowing over retaining wall.
5. Place highway divider in river bed 3 m below the drop structure and anchor in place with rock to provide kicker to primary wave.

**Effect on River After:** Rock ledge stayed in place after several modifications. River stayed within confines of channel provided and did not overflow berms initially. However spring flood event washed out a hole in the berm on river left. This gap was partially handfilled by surfers to bring the head of water back. Head of water behind the ledge increased to 4'. Wave/Hole formed with a strong green tongue in the middle without any recirculation in the centre, making this wave difficult to catch except for very fast boats/boards. Steep entry holes on either side make it difficult to launch surfboards from the eddy below. No eddies on lower river left makes it difficult for boaters to recirculate but surfboarders can walk upstream.

An unanticipated surprise was that the highway divider, which was supposed to form a kicker for the primary wave, created a secondary wave/hole that is useable by surfboards.

***Of concern was the increase in river speed and force into the Headwall immediately downstream of this feature. This is a safety concern with many intermediate river users being slammed into this undercut headwall.***

### **Action Taken - August:**

1. The safety issue and the need for a surfboard wave was of considerable debate at the final LKRUA meeting prior to August construction. There was consensus that river user safety had to be the priority consideration. If Smitty's was to be allowed to remain in its current location the Headwall safety had to be resolved. The Alberta River Surfers Association wanted to insure that Smitty's would remain intact until a suitable surfing wave was created. Many of the other user groups wanted to completely remove this feature. The AWA proposed a plan to try to save Smitty's by backing up water at the Headwall to soften the pressure from Smitty's into the wall. The LKRUA group decided that:
  - a. The AWA would 1<sup>st</sup> attempt to build a constriction at the Headwall to lessen the force of the water being created by the Smitty ledge against the Headwall.
  - b. Should the Headwall plan not work to eliminate the safety issue, then the force directed by Smitty's into the Headwall would have to be mitigated.
  - c. Decommisioning Smitty's (ie complete removal) would not be done initially or until another surfing wave was created on the Kananaskis
  - d. Smitty's could be retained in some form if sufficient materials were available to build the new wave berm structure at the Headwall.
2. Construction of a better wave at the Green Tongue and a new wave at the Headwall was the 1<sup>st</sup> priority of the August construction. Rock stockpiled in the spring from the Green Tongue upstream to the Headwall were used extensively to build a river left berm at the Headwall. This created a 2.5' head of water upstream on the Headwall and created a great new wave/hole feature at the Headwall. However this structure was not sufficient to soften the

- pressure of downstream current being generated by the larger Smitty's drop. Later work over the next 4 days increasing the head to 3.5' at this feature did not improve this problem and made the wave/hole turn into a hole.
3. Given the safety mandate that was entrusted to the AWA on this project, the onsite manager looked to reduce the pressure against the Headwall by reducing the head of water from 4' to 3', backed up at the Smitty's drop by widening the drop structure. This was done by removing rocks from both the river left and river right berms. The double wide rock ledge was extended with an angled slope to generate a better primary wave. This helped to alleviate the pressure against the Headwall but the primary wave formed did not achieve its goal of forming a surfable wave and instead became more of a riverwide hole.
  4. In consultation with Neil Egsgard from ARSA, a plan was formulated to create a smooth uniform drop structure by removing the core centre of the rocks and inserting the highway divider that rested in the bottom of the rapid into the middle at the top of the drop. This created a ramp down the face to speed up the water. A riverwide hole was generated from this effort but the critical vertical height on the primary upswell wave to make it a surfable feature was not found.
  5. The next attempt to find a solution was jointly determined by AWA and ARSA to add subsurface material to the river bed directly below the drop to create a kicker to the primary wave. There was no substantial change to the hole's character which remained too steep to surf.
  6. On the advice of ARSA and with concurrence from the AWA project manager it was decided to take out the rock ledge structure and replace it with a V-drop slide that would gradually constrict the flow and speed up the water before hitting a plunge pool. The intent would be to have a smooth faced ramp underwater that would generate enough force to kick up a standing wave at the bottom of the drop. Technically this was accomplished and at the bottom of the drop the hole was transformed into a very fast V-shaped wave but it lacked sufficient size on the surfing face for surfboards or kayaks. Compounding this problem was the re-creation of a dangerous current into the Headwall again.
  7. To resolve the Headwall safety issue and to assist the formation of a wave, a new ledge was built downstream between Smitty's and the Headwall to absorb the energy from the V-slide and to deepen the pool of slower moving water upstream of the new ledge. Initially this was built 50 m downstream of the drop and had the desired effect in negating the current into the Headwall and eliminating the danger at this location and in deepening the pool of water upstream into the V-slide plunged into. Unfortunately there was minimal effect on the V-wave at the bottom of the slide.  
A large stockpile of rock was brought on site from the stockpile upstream to augment the regular daily transfer of 2 rocks from downstream and 2 rocks from the upstream side.
  8. Given the success of mitigating the current into the wall, the height of the V-slide drop was increased from 3' to 4' by adding additional material into the top of the slide slope and to the base. This increased the speed of the water and added more force to the downstream current but the wave at the base resulting from this remained unchanged, fast and green but without sufficient height on the surfing face to be useable.

9. The new ledge below Smitty's was then moved upstream another 20 m to deepen the pool of water and increase the surf wave height. Again this met with minimal improvement but still not sufficient to declare success.
10. Finally, the highway divider was inserted at the base of the V-slide structure to generate a kicker to the wave. But again it was a marginal improvement without real tangible results for surfboarders or kayakers.

**Effect on River After:** A good surfable wave was not able to be recreated at this location.

However the safety issue on the Headwall was resolved by the two new drop structures one above the Headwall that absorbs all the energy coming into it and by the other below the Headwall that backs water up and slows its progress into the Headwall.

**Further Work Required/Suggested:**

1. The formation of river waves generally occurs when water is channeled and accelerated to supercritical speeds and then hits slower moving deeper water. The resulting fluid dynamics generate a series of standing waves to relieve the pressure that is created. The plunge pool cannot be too deep however because the water will either recirculate in a steep faced hole feature (ie. Santa Claus) or boil to the surface (ie. Notch)  
To generate the force required to make this possible the height of the drop at Smitty's could be increased. This can probably be done without affecting the pressure into the Headwall. This might be sufficient to generate enough force to throw up a wave, however it is doubtful without some type of significant type of obstruction that will force the wave to form. This could take the form of either a deeper slotted pool of slow water or an upslope ramp.
2. The other alternative is to abandon this site as not having the right critical elements and find a better site for a surfboard feature. Ideally we would find a downstream ramp that is set on bedrock to minimize the bottom drag. Alternatively we could use a site that is running over smooth gravels.

By narrowing the river and maintaining a continuous ramp down, enough force could be generated to have the speed required to create a great rolling type wave. The river should be narrowed using gentle sloping banks to minimize the effect of waves coming off the sidewalls. The upslope of the river should be built to create a gentle slope up and a gentle slope down the backside. The height of the upslope would not have to be more than 2' high to create a 4' high wave. This could be repeated 2 or 3 times to create several surfing waves once the initial downriver speed is built. The upslope feature could be created using 2 highway dividers set on their side butt to butt. We would want to maintain a wide width by setting 2 highway dividers end to end across the current. Therefore we would need 4 highway dividers for this project for each wave and 8 in total.

Brace Lee had a great suggestion for a location between the Widowmaker and Hollywood Hole where the river has a natural ramp downstream and it is not occupied by any other feature at this time.

**H. Headwall Hole and Headwall Wave (Thing 1 and Thing 2)**

**Synopsis of Work**

**Before:** Several small recirculating 4" waves running on bedrock existed just below Headwall. Otherwise there was nothing at this location. The river ran broad and shallow at this location. The plan is to constrict

the river against the existing Headwall on river right with a new berm to create a head of water that will soften the current against the Headwall coming down from Smitty's. There is a deep hole under the Headwall and the feature has slight undercut to it that makes it dangerous when the river has any force on the Headwall.

**Action Taken - August:**

1. All the extra materials above the Green Tongue were scavenged to create a berm on river left side including excess riverwalk rocks, Put-In eddy rocks, berm and midstream piles left from the spring work. This was augmented by some of the natural rock found in the vicinity. The quantity of rock was not sufficient to completely build the necessary structure but it provided a good opportunity to see the effects of this project. The rock gathered was piled opposite the Headwall on a diagonal angle to mimic the Headwall. This narrowing of the river created a 2.5' high head of water. This reduced the flow into the undercut, but not substantially.
2. The downstream edge of the trench underneath the Headwall was partially filled to block the channel and lift the water to over a natural ledge that was present on river right. The natural wave that was formed over the small ledge had a shallow ramp down into a shallow wave before it curled. The wave was perfect, especially on river right. But there was some thought that it could be better with a larger head, the river left side needed to be improved and that the berm on river left needed to be moved farther downstream.
3. The berm was moved downstream and the berm extended another 5' into the river. Excess material from Smitty's was brought down to the site to reinforce the berm. The river right side against the Headwall was reinforced with more rock to eliminate the undercut nature of this wall. The net effect of this work was to raise the head of water by 1' which changed the wave/hole into a hole.
4. The berm was reduced in size by 5' to drop the head of water created by the berm back to 2.5'. There was no effect on the nature of the hole and it did not revert back to a wave/hole. (it was later discovered that relieving the pressure of water on the Headwall was the key to getting this feature to revert back to a nice wave/hole away from a sticky hole)
5. Additional rock was added in beside and behind the 1<sup>st</sup> row of bedrock to extend the cross river line of the 1<sup>st</sup> row and 2<sup>nd</sup> rows of bedrock that creates the "ledge drop" and the wave uplifting blocking ledge.
6. Fine tuning of the river left and river right edges of the berms to create solid immovable anchors to the structures.
7. The berm was filled with smaller stones, cobbles and gravels on both front and back slopes to minimize water penetration and erosion.
8. The beach at the Put-In eddy was rebuilt because the Green Tongue flooded the old Put-In Beach. A line of stones was buried in the sediments and then backfilled to hold the new beach in place.

**Effect on River After:** A very good intermediate level surfable wave was created at the Wave in the Wall location. Both paddlers and surfboarders were immediately attracted to this new wave. It is a shallow wave so vertical moves are not recommended but front surfing and flat spins are very easy. The location of this drop structure also reduced the risk associated with the Headwall by reducing the force of water on this undercut wall.

The head created by the Green Tongue allows easy access up to this wave from the Put-In Eddy.

### **Further Work Required/Suggested:**

1. The river left berm will need additional reinforcement in the future and will benefit from creating a larger armored front and back with gravel fills in the middle.
2. A beach for landing below the river left berm will give better access for paddlers/surfers to paddle across the river from the Put-In and walk over the berm to gain access to Smitty's.
3. A name is needed for this feature. LKRUA should post a naming competition to assist with this.

### **Thing 2**

1. To resolve the Headwall safety issue and to assist the formation of a wave at Smitty's, a new ledge was built between Smitty's and the Headwall to absorb the energy from the V-slide and to deepen the pool of slower moving water. Initially this was built 50 m downstream of the drop and had the desired effect in negating the current into the Headwall and eliminating the danger at this location and in deepening the pool of water upstream into the V-slide plunged into. Unfortunately there was minimal effect on the V-wave at the bottom of the slide. But it did create a new river wide hole that is good for paddlers.
2. The new ledge below Smitty's was then moved upstream another 20 m to deepen the pool of water in Smitty's and increase the surf wave height of Smitty's. Again this met with minimal improvement to Smitty's but still not sufficient to declare success. This site gave a bigger river wide hole that was still acceptable for kayakers.

## **I. Green Tongue**

### **Synopsis of Work**

**Before:** The wave/hole at Green Tongue has become smaller with each passing year, lacks stability and tended to surge and break. Drop into wave/hole was less than 2'. Likely cause was due to lack of vertical drop and the kicker provided by the highway divider is not river wide. To fix this would be a major undertaking and may be difficult to accomplish in the spring work. Therefore only a minimal attempt was planned for the Green Tongue during the spring upgrades at Canoe Meadows and a full blown change planned for the fall work.

### **Action Taken - April:**

1. Build riverwalk trail on river right up to Green Tongue from Cartwheel Corner
2. Bring two large rocks to site and position beside large boulder that braces highway divider in the deep water channel below drop.
3. Reposition large boulder on river left berm edge out 1' to square off the river left berm and squeeze the drop more to raise some more head.

**Effect on River After:** The vertical walls created by the riverwalk trail sped up the current in the eddy and the river. The work on reducing the entrance into the Tongue had little or no effect in creating a larger head of water at the entrance of the drop. The wave created in the drop was wider, but more prone to surging and less consistent.

### **Action Taken May:**

1. Move extra rock below Green Tongue eddies out of way to lessen the drowning effect from downstream side.
2. Scoop out rock debris in front of highway divider. Other than large slab rock not much else is found in the deep water channel.

**Effect on River After:** The wave/hole was smaller than before, it seemed to be drowned out by the water backed up from the rapid below and the wave surges more than before. There does not appear to be enough force against the highway divider to sustain a consistent wave.

### **Action Taken – August**

1. The river left groyne was moved downstream to be aligned opposite of the river right groyne. It was also brought out an additional 5' to squeeze the river and generate a bigger head of water and more energy at the drop. Observation the next day showed that no substantial change occurred and that the wave remained prone to surging and lacked enough energy to form properly.
2. To get the head of water desired, the highway divider was positioned standing vertically at the top of the drop and supported by two large boulders behind it and wedged on the corners. The effect of this was to create a 4' head of water that pooled water back to the Put-In eddy, this was the desired effect that we were seeking to build a head of water and create a lot of energy downstream. Below the highway divider and boulders the river formed a steeply sloping drop into a steeply faced hole below it. There was also a significant amount of waves and very fast water downstream from the drop down to the middle of the 2<sup>nd</sup> eddy.
3. To create a better sloping wave in the drop and a less steep hole, another highway divider was brought in and positioned downstream from the drop where the foam pile was forming that morning. This highway divider was also stood upright on its base and braced behind it by three big boulders. The theory behind this was that this divider would force the river up and over it to create a green wave. The reality was that the trench the divider sat in was too deep and the hole continued to exist just as it had the previous day, deep and steep.
4. Boils and turbulence at the river left side of the current had become quite obvious and substantially different from the river right side. The only explanation for this was that the river right side of the current has a defined edge that drops into the trench, whereas the river left side gradually slopes upward on a cobble lined slope. To focus the energy of the current a number of rocks were dug into the river left side of the trench to assist the river in staying in a defined slot and lessen the boils and turbulence. This was successful and should be continued in other spots where the river's energy is being wasted on the eddy line.
5. The mid stream boulder at the bottom of the Green Tongue runout was removed to improve safety for swimmers and paddlers.
6. The next step was to raise the lower highway divider up so that it would be more effective in creating a kicker for the wave. We did this by adding a considerable amount of rock into the trench to bring the level of the trench up and reduce the depth of water in this section. The highway divider was then repositioned in the trench and braced front and back with several large boulders.  
This worked perfectly in creating a much better wave in the hole and squaring up the feature. Paddlers were very excited about how much better Green Tongue was now. Mark Taylor and I congratulated ourselves in solving this puzzle and how the lower divider was so successful in generating a great wave/hole.

When the water turned off that evening we found our highway divider, laying on its side **behind** the boulders that had been supporting it. The pressure of the water was too much and the divider had floated up and over the boulders during the day and had no effect on the character of our new wave/hole. Raising the bottom of the trench has instead changed the plunge into deep water into a plunge into shallower water which forced the wave to appear and minimized the hole aspect.

7. Given this new twist, we added some more material to the trench to build a better wave/hole. Then we moved the highway divider 20' downstream to create a secondary wave behind the primary drop. Again it was placed upright and braced with two large boulders. The wave/hole remained intact and was judged to be sufficiently good to leave it in this state while we worked with other aspects of the course. However the secondary hole created by the highway divider was deemed to be too close to the primary wave/hole and would be a safety liability if it remained in this position. Of considerable interest was the downstream speed that continued to be generated even with the highway divider impeding the current's flow.
8. The lower highway divider was subsequently moved another 30' downstream and placed upright in the centre of the channel blocking the flow downstream. The base was dug out so it fit as low as possible, but it still rests about 3" above the surface when the river is turned off. Again it was braced by two large boulders behind it and several medium sized boulders in front. The result was a high and wide green fast wave that is excellent for fast front surfing. There remains a very fast current with a number of standing waves before and after this feature.

#### **Further Work Required/Suggested:**

1. No further work is needed at this site. The Green Tongue wave/drop is in good condition and provides a similar but different type of feature to Santa Claus. The Green Gullet wave is also a welcome new addition and seems to create a great wave train downstream.

## **J. Upper Race Course**

### **Synopsis of Work**

**Before:** The upper race course had become flat and slow over the past 15 years, a smooth laminar flow characterized this section. There was a lack of speed caused from the decline in the Green Tongue, boulders sliding off the berms and erosion of eddies. The plan is to rebuild the vertical walls on the berms and along the shore, gain more power from the Green Tongue drop and add additional boulders to the bottom to add bounce and waves to this section. Slalom gate post anchors will be installed on the berms and in the eddies on the river left bank. A Cliffside trapeze will be anchored into the wall along the river right side.

### **Action Taken – April:**

1. Build riverwalk trail on river right up to Green Tongue from Cartwheel Corner
2. Build diagonal ledges leading to and away from the central midstream boulder to create the infamous 'X' and provide a jetferry opportunity.
3. Clean up edges of berms, front, side and back to stack rock in vertical form to increase speed of the current and improve crispness of eddylines.
4. Add new rock piles and large boulders in last section above Cartwheel Corner to improve wave action and increase bump in the river.

5. Two rock piles were built on the river left eddy line just above Cartwheel Corner to keep the river running downstream and to give slalom racers alternative locations for upstream gates.
6. Rebuild old ledges coming off berms to provide additional small surf waves and improve slalom racing.
7. Empty eddies of gravels and deposits.
8. Stack rock on Cartwheel Corner berm to create a more level walking surface.

**Effect on River After:** The vertical walls created by the riverwalk trail sped up the current in the eddy and the river. The 'X' did not work and was taken out. The vertical surfaces on the berms increased the speed of the eddies and the main current. The new rockpiles improved the "whitewater" character of the river. The rebuilt ledges brought back some of the old surf waves and slalom moves.

**Action Taken - August:**

1. A line of boulders were layed underwater along the eddy line of the 2<sup>nd</sup> big eddy on river left to reduce the flow of water into this eddy and keep the volume of the river in the main channel.
2. The placement and configuration of the underwater rock piles and boulders were fine tuned to give maximum wave action.
3. Additional underwater ledges were built beside the main berms.

**Effect on River After:** The speed of the river below the Green Tongue is quite impressive with a substantial wave train, highlighted by the Green Gullet, that will swallow up the unsuspecting boater. There are a number of small surfing waves coming off most of the berms at a variety of different angles. The eddies are crisp and deep with good upstream velocity. The flow through and out of the 2<sup>nd</sup> river left eddy has been minimized. There is a considerable amount of wave and bump action in the last section above the Cartwheel Corner drop.

**Further Work Required/Suggested:**

1. The downstream speed generated by the Green Tongue could be utilized to create more wave action between the 2<sup>nd</sup> berm and the 4<sup>th</sup> berm. Rock for this is currently on top of the 3<sup>rd</sup> berm.
2. Lining the river left 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> eddies with a vertical wall and backfilling with sediments behind would create faster upstream eddies on the far shore. Future plans to allow pedestrian access to the far shore would then have better trails.
3. A significant amount of sediments accumulated after the spring flood in the 2<sup>nd</sup> and 3<sup>rd</sup> river left eddies and will need to be emptied in the future. This could be placed in the beach areas described in point 2 above.
4. The eddy line from Green Tongue to the 2<sup>nd</sup> berm on river left and river right should be lined with underwater rock to keep the current moving downstream and minimize friction with the water in the eddy.

**K. Cartwheel Corner and Area**

**Synopsis of Work**

**Before:** The Cartwheel Corner feature is one of the few spots on the Kananaskis where a natural ledge creates a drop into a hole. This 3' drop creates a lot of speed down to the Miami Beach area but the river here is generally flat with a smooth laminar flow characterized this section. The drop was enhanced in

2000 when a highway divider was placed on top of the river left side of the ledge. This created a larger hole on the river left side with a slide/wave on the right.

The plan is to add additional wave action and obstacles in this section below Cartwheel Corner to create more diversity for paddlers and racers. The Miami Bench will be extended upstream to the Cartwheel Corner pocket eddy which will create more pedestrian capacity and improve water in the eddy.

**Action Taken – April:**

1. The Miami Bench was extended upstream with 2 rows of boulders which were backfilled with the sediments from the eddies. A trail into the river was left for the machines to enter the river for future improvements.
2. New midstream underwater boulders were strategically placed to create offsetting waves and holes.
3. One rock pile was built on the river left eddy line below Cartwheel Corner to keep the river running downstream and to give slalom racers alternative locations for upstream gates.
4. Empty eddies of gravels and deposits.
5. Stack rock on Cartwheel Corner berm to create a more level walking surface.

**Effect on River After:** The vertical walls created by the riverwalk trail sped up the current in the eddy and the river. The new rockpiles improved the “whitewater” character of the river and really enhanced the speed and opportunity for offset gate placements in rough water.

**Action Taken - August:**

1. The placement and configuration of the underwater rock piles and boulders were fine tuned to give maximum wave action and allow easy raft passage.
2. There was a request by the BowWaters Canoe Club to make Cartwheel Corner a friendlier drop for open boaters. The highway divider on the Cartwheel Corner was moved from river right to river left. But it did not stay in place when the water came on despite two attempts to position it on this side to see what effect it would have.
3. The highway divider was needed upstream at the Green Tongue and a large boulder was dug out of the CC berm to replace it. This large boulder was positioned on top of the ledge in several different places but it would not stay in place when the water came on. Subsequently it was taken up to Smitty’s for use on that feature.
4. There was an incident the week prior to our work when a river swimmer wedged a knee in between rock in the CC berm. This reinforced our plans to make sure that the holes in berms and obstructions are filled as carefully and as fully as possible. Consequently we worked on the CC berm to landscape the upstream edge to make it more swimmer friendly.

**Effect on River After:** The pourover character of the Cartwheel Corner drop was eliminated and for those paddlers and rafters that used this feature it will be a loss. The speed of the river here was increased however and additional wave and hole action can be found throughout this section.

The opportunity for injury will hopefully be reduced with the work that we did, however it cannot be stressed enough for swimmers to keep their feet up and avoid touching the bottom until they swim into the eddies.

**Further Work Required/Suggested:**

1. The downstream speed generated by Cartwheel Corner could be utilized to create more wave action downstream with the addition of more underwater rocks.

2. The ledge and/or the plunge pool at Cartwheel Corner could be experimented with to get a site that has a more interesting character.
3. The long eddy below Cartwheel Corner should be cut into 2-3 sections with new rock islands/berms that would keep the river flowing downstream at a faster rate of speed.

## **L. Miami Beach and Area**

### **Synopsis of Work**

**Before:** The Miami Beach feature was significantly changed in 2007 when the highway divider that was used to create this hole was removed and replaced by a natural rock. This was done because the rafts were finding the hole stickier and having problems flipping rafts at this feature.

The river right eddy was working well to recirculate racers. The fish ladder on river right needed to be cleaned up. The large Miami Bench was an exceptional viewing and pedestrian friendly location.

The diagonal underwater ledge on river left beside Big Bertha is not working.

The river through this section was relatively flat and this made it good for novice and intermediate race training but not a very good race site for intermediates and advanced slalom paddlers.

The plan is to rework the rock in the Miami Hole to create a better hole. Other underwater rock will be added to create additional wave action and obstacles in this section. The fish ladder and eddies will be cleaned out and rock in the berms restacked to make vertical surfaces to increase the river speed. The long eddy on river left beside Miami will be cut into 2 by a new berm. The long eddy on river right above the Notch will be cut into 2-4 sections to increase river speed and eddy options. The Riverwalk Trail will be used to create vertical walls that will accelerate the upstream current. Just above the river right channel at the Notch a small rockpile will be established to assist paddlers to attain this section from below the Notch.

### **Action Taken – April:**

1. Another rock was added to Miami Hole and reworked to form a better hole.
2. Below Miami a new eddy was built on river left and a large boulder was buried just off the berm to create a small hole.
3. Another similar sized boulder was buried on river right off the Miami Bench that formed a smaller wave.
4. More rock was added to the diagonal ledge beside Big Bertha to enhance this feature.
5. Empty eddies of gravels and deposits.
6. Stack rock on berms to form vertical walls.
7. The little ledge in the river right channel was re-built
8. The last eddy on river right was cut into 3 sections with the addition of 2 new berms that forced the river to stay in its channel before dropping through the Notch.
9. A small island was built above the river left channel at the Notch.

**Effect on River After:** The vertical walls created by the riverwalk trail sped up the current in the eddies and the river. The new rockpiles improved the “whitewater” character of the river and really enhanced the speed and opportunity for offset gate placements in rough water. The new eddies on river left and river right added a lot to the speed of the river and created some great upstream currents. The underwater boulder on river left made an exceptionally good hole that has seen a number of people doing loops and other freestyle moves. The river right boulder seemed to sink into the gravels and disappeared and was

not effective. There was no effect of the additional rock to the Big Bertha diagonal ledge. The spring flood deposited a tone of sediments in the eddy underneath the Miami Bench.

**Action Taken - August:**

1. The eddy underneath Miami Bench was emptied and a row of rocks were lined up downstream from the berm along the eddy line to keep the water flowing downstream and minimize future siltation and deposition in this eddy.
2. The placement and configuration of the underwater rock piles and boulders were fine tuned to give maximum wave action and allow easy raft passage.
3. The fish ladder was cleaned up.
4. The berms were reinforced and gravels added into the spaces to make them less prone to wash through and more pedestrian friendly.

**Effect on River After:** The Miami Hole is working, but the large gap in the middle tends to make the hole surge and reduces the ability to use it for playing. The speed of the river in this section was increased and additional wave and hole action can be found throughout this section.

**Further Work Required/Suggested:**

1. This section is in good shape and no further work is anticipated at this time.

**M. Notch to Slide**

**Synopsis of Work**

**Before:** The Notch creates a unique spot on the Kananaskis where fast water drops into a deep pool with no obstructions for a 100' downstream. This creates a swirling boil downstream from the drop that is quite a challenge to get through without losing an edge or losing direction. Below the Notch pool there are a number of flatwater eddies and training spots built on river left with some 2 midstream boulders that allow for some great beginner learning. Access to this area is difficult and the eddies along the river right bank need to be better configured.

The plan is to maintain the great pool and swirling boils in the Notch pool. The Riverwalk embankment will improve the eddies and assist pedestrians. A new set of eddies and islands on river right will balance the current set of eddies and islands on river left. This will improve alternatives for training and become the new beginner site for slalom paddlers.

**Action Taken – April:**

1. The river right embankment was started but not completed.
2. A new midstream island was built on river right.
3. The berm on river right at the bottom of the Notch pool was extended 5'.
4. The eddies were emptied of gravels in this section.
5. Placement of new concrete slalom post anchors on river right.

**Effect on River After:** Not much change occurred in this section other than the new island balanced the teaching sites and the new berm created better recirculation on river right.

**Action Taken - August:**

1. A 2-4 stone high river right embankment from the Notch down to the Slide was completed and backfilled.

2. The new berm on river right was extended out 20' into the current with a 4 stone high armoring on front and back and filled with gravels to create a new viewpoint.
3. The new island on river right was rebuilt.
4. The eddies and the Notch Pool were emptied of gravels in this section.
5. Placement of new concrete slalom post anchors on river left.
6. The rock pile on river left below the Notch pool was pulled out into the current and reinforced. This opened a new channel over an existing bedrock ledge.

**Effect on River After:** The upstream currents in this section are very fast especially the Notch. The Notch pool remains full of boils. There are good teaching and slalom practice eddies now on river left and river right. The new ledge drop on river left does not have enough depth to make it an interesting feature. The spectator viewing and pedestrian trail along this stretch and over the Notch point makes this an easier place to utilize.

**Further Work Required/Suggested:**

1. The new ledge could be more effective by moving the pile of rocks on the river right side out further into the current.
2. Another smaller berm could be built on river right and river left before the water falls into the Slide.

## **N. The Slide**

### **Synopsis of Work**

**Before:** The Slide has the most continuous drop on the Kananaskis River and as such should be one of the best sites for whitewater slalom training given the speed, intense features and the variety of whitewater that is found here. Over the past 15 years little work has been done in this section to maintain the site other than cleaning out the eddies in 2005.

The plan is to clean up the berms and rockpiles to make the edges more vertical. Add retaining walls to speed up the upstream flow in the eddies, and fix any of the features that define the different drops in the two separate channels.

**Action Taken – April:**

1. The first river right eddy was lined with rock and backfilled to create a walking path, remove the sediments and speed up the current.
2. The Riverwalk trail was extended down from the top to the Takeout Eddy, increasing pedestrian accessibility and improving upstream eddy currents.
3. The upstream, downstream and outer edges of the berms and islands were restacked and smoothed to create vertical surfaces to increase river speed and crisp up the eddies.
4. The eddies were emptied of gravels and large rock removed to create clean deep water in the eddies.
5. The Last Dance Wave was straightened up and an additional boulder was aligned with the other 2 rocks to create a better wave.
6. The rocks in Random Hole were restacked on the bedrock ledge to bring this feature back.
7. Underwater rocks were set off the midstream islands to create diagonal waves to assist upstream fish ladder attainment from below.
8. The concrete bases for the slalom posts were installed on river left and river right.

**Effect on River After:** The vertical walls created by the Riverwalk trail sped up the current in the eddy and the river. The restacked berms also improved downstream river speeds. The eddies were deeper and had less debris in them. The rocks in Random Hole rolled off during the spring floods. The first big eddy on river right filled back up with sediments after the spring flood. The Last Dance Wave proved to be quite good but still needs some work.

**Action Taken - August:**

1. A line of underwater boulders was set along the eddy line on the first river right berm to keep the current flowing downstream and limit future deposition of sediments in this eddy.
2. The upstream, downstream and outer edges of the berms and islands were restacked and smoothed to create vertical surfaces to increase river speed and crisp up the eddies.
3. The eddies were emptied of gravels and large rock removed to create clean deep water in the eddies.
4. The Last Dance Wave was reconfigured several times to get the best possible wave.
5. The berm forming the last eddy on river right was moved upstream to allow easier access to the Last Dance wave.
6. The rocks in Random Hole were restacked on the bedrock ledge to bring this feature back.
7. The island rocks on the first ledge on river left were extended out to force more water over the ledge.
8. New large boulders were placed in the two key spots in the bottom river left fish ladder.
9. The underwater rocks were reset off the midstream islands to enhance the diagonal waves to assist upstream fish ladder attainment from below.
10. The Takeout eddy was rebuilt to form a beach that would stay in place, with a layer of rock that was backfilled with gravels and sloped up to the bank.
11. New boulders and rockpiles were set in the river bottom to create more waves and holes throughout this section.

**Effect on River After:** The river speed is exceptional in this section with lots of great wave and hole action from the top of the slide right to the TakeOut.

The eddies are very crisp and clean.

There are three great surfs, First Surf, Random Hole and Last Dance and several smaller surfs in this stretch. A number of surfboarders are using the Last Dance wave at the Takeout now.

The lower left fish ladder is more difficult to climb than previous and needs more work to make it easier to attain upstream.

**Further Work Required/Suggested:**

1. The fish ladder needs more work.
2. The long first eddy on river right should be cut into 2 sections with a new rock island/berm that would keep the river flowing downstream at a faster rate of speed.