December 22, 2015

Assessment and Abandoned Mines

Department of Energy, Mines, and Resources

Government of Yukon

Box 2703, K-419

Whitehorse, YT Y1A 2C6

Attention: Erik Pit, Project Manager

Re: Clinton Creek Environmental Monitoring and Fish Salvage

Introduction

During the late summer of 2015 the Government of Yukon, Assessment and Abandoned Mines (AAM) repaired drop structures at the Clinton Creek Site (herein referred to as the Site), an abandoned mine site located approximately 75 km northwest of Dawson, Yukon (100 km by road). At the Site, drop structures had been previously installed to stabilize Clinton Creek at the outlet of Hudgeon Lake, where gradual waste rock movement has created steep stream gradients and unstable slopes. A flood event in recent years damaged the lowermost (4th) drop structure, which was the focal point of repair works.

Ecological Logistics & Research Ltd. (ELR) was retained by AAM during the summer of 2015 to provide environmental monitoring and fish salvage services during the drop structure repairs. This letter report summarizes the activities performed by ELR and provides the data collected during the fish salvage and environmental monitoring process. The letter report does not provide an interpretation or analysis of the monitoring data.

Scope of Work

ELR’s scope of environmental monitoring and fish salvage services associated with Clinton Creek drop structure repairs included:

Attending meetings with AAM, AAM’s representatives, and the project contractor, as required.

Obtaining and providing closure data for a Scientific Collection Permit from Fisheries and Oceans Canada (DFO).

Working with AAM’s on-site environmental monitor to establish monitoring sites and review monitoring protocols.

Providing fish salvage services on site during construction works as required.

Performing environmental monitoring and providing related advice, as needed.

Fish salvage activities were performed according to the *Fish Salvage Plan For the Clinton Creek Drop Structure Repair*, prepared by Minnow Environmental Inc. (Minnow 2015a), and modified to site conditions as required. Environmental monitoring activities were performed according to the *Construction Monitoring Standard Operating Procedures For the Clinton Creek Drop Structure Repair,* prepared by Minnow Environmental Inc. (Minnow 2015b), and modified to site conditions as required.

Environmental Monitoring Activities and Results

ELR staff made three visits to the site to perform environmental monitoring and fish salvage activities, and also conducted other activities according to the scope of work during and after the completion of construction activities. A summary of environmental monitoring activities are provided below.

August 9-11 Site Visit

ELR staff (Chris Jastrebski and Michelle McKay) were at the Site from August 9-11, 2015 during the pre-construction period, when site access upgrades were being completed, including road upgrades/grading, the installation of a culvert crossing at the location of the lower access road crossing of Clinton Creek (generally a ford crossing), and general planning for the construction works. Leading up to and during this site visit, ELR:

Arranged for and provided to AAM all analytical laboratory sampling supplies for the weekly water quality sampling program.

Supplied a field turbidity meter to AAM which was to be used on site for the duration of the construction project.

Provided hard copies of field monitoring forms and laboratory chain of custody (COC) forms.

Worked with AAM staff (Luca Poloni and Patricia Randell) to ground-truth monitoring locations and to perform the first environmental monitoring events.

Discussed environmental monitoring, fish salvage, and mitigation strategies to be employed during the construction project.

September 2-3 Site Visit

ELR staff (Chris Jastrebski and Michelle McKay) were at the Site on September 2 and 3, 2015 during the implementation of the flow diversion and dewatering of the drop structures immediately prior to the drop structure repairs. At this time, all site access upgrades had been performed and the diversion pumping infrastructure had been installed (4 pumps and HDPE pipes leading from Hudgeon Lake to downstream of drop structure 4). During this site visit ELR:

Worked with AAM staff (Wayne Emery) to discuss the status of the environmental monitoring program, and to provide advice related to the rate at which the drop structure area should be dewatered (i.e., the rate of berm construction across the outlet of Hudgeon Lake).

Reviewed the turbidity measurement and water sampling processes with AAM staff to ensure compliance with monitoring protocols.

Provided training on turbidity meter calibration for AAM, and confirmed the correct operation of the field turbidity meter being used on site.

September 23 Construction Discussion

ELR staff (Chris Jastrebski) were contacted by Patricia Randell of AAM on September 23, 2015 to discuss a diversion pumping blockage on September 22, 2015 that had temporarily reduced flows below the required minimum for the stream. ELR was asked to provide advice on whether follow-up monitoring and reporting were relevant or required. ELR staff confirmed with Minnow Environmental staff that no follow up monitoring (for conditions or potential fish mortality) were relevant as flows had been re-established, and confirmed that a summary of the event should be provided to DFO for the purposes of maintaining a transparent reporting process. No further discussions or requests of ELR occurred.

September 30 Water Sample Collection

ELR staff (Aaron Nicholson and Chris Harwood [Hemmera]) on site for a water quality and hydrology sampling program were asked to collect a final (post construction) set of water quality samples from the five on-site locations. These samples were collected between September 30 and October 2, 2015, and delivered to the analytical laboratory in Whitehorse.

Analytical Water Sample Handling and Analysis

Throughout the construction project, ELR received weekly laboratory analytical samples from AAM staff either shipped via Air North or delivered directly to ELR by AAM staff. For each sample shipment, ELR reviewed the COC, submitted the samples to the laboratory (ALS Global), and conducted ongoing liaison with the laboratory through to the receipt of data. Throughout the duration of construction, ELR received and submitted for analysis eight shipments of samples (Table 1).

Table 1: Summary of Laboratory Analytical Samples Collected During the Drop Structure Repair Project

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Date | Event | Laboratory Analytical Parameters Requested | | | |
| pH | Total Suspended Solids (TSS) | Total Metals | Asbestos  (Sites HL, CCI, CC2 only) |
| August 10 | Pre-Construction | • | • | • | • |
| August 16 | Weekly Sample During Construction | • | • | • |  |
| August 26 | Weekly Sample During Construction | • | • | • |  |
| August 31 | Weekly Sample During Construction | • | • | • |  |
| September 8 | Weekly Sample During Construction | • | • | • |  |
| September 15 | Weekly Sample During Construction | • | • | • |  |
| September 22 | Weekly Sample During Construction | • | • | • |  |
| September 30 | Post-Construction | • | • | • | • |

After receipt of laboratory data, the results were reviewed and entered into ELR’s EQWin water quality database along with field *in-situ* parameter data (pH in pH units; conductivity in µs/cm) that was collected and provided by AAM. The database was used to flag exceedences of Canadian Council of Ministers on the Environment (CCME) *Water Quality Guidelines for Protection of Aquatic Life* (CCME-FAL), where applicable (CCME 2014). A summary of the monitoring data including flagged exceedences of CCME-FAL guidelines is provided in Appendix 1, while the laboratory certificates of analysis are provided in Appendix 2.

ELR was also provided the results of turbidity monitoring from the project, which were combined and are included as Appendix 3 of this memo. A review of the data was completed to identify exceedences of the project monitoring threshold of 50 NTU, to summarize where additional follow-up monitoring was completed in relation exceedences of more than 4 hours (Minnow 2015b). Throughout the construction period of August 10, 2015 to September 26, 2015, a single exceedance was noted (CC1, August 27, 2015 at 09:18; 60.1 NTU), which dropped to within limits within 10 minutes (CC1, August 27, 2015 at 09:28; 12.9 NTU). Based on these *in-situ* results, no additional monitoring as defined by Minnow (2105b) was required.

Fish Salvage Activities and Results

ELR staff conducted two fish salvage events at the Site in conjunction with instream works. All salvage activities were conducted under scientific collection permit XR 249 2015 (Appendix 4).

Culvert Installation August 9-10, 2015

ELR staff visited the Site on August 9 and 10, 2015 to perform fish salvage for the installation of culverts at the downstream ford crossing location. ELR installed block nets upstream and downstream of the work area to isolate an instream work area to be salvaged; the upstream and downstream limits were established by AAM and the construction contractor (P S Sidhu Trucking). ELR prepared nets and supporting posts on August 9, 2015 in order to start salvage work early on August 10, 2015.

ELR conducted salvage using a backpack electrofisher (Smith Root LR-24) starting at 8:40 on August 10, 2015. Seven electrofishing passes of the isolated area were conducted between 8:40 and 13:00, totaling 4,204 seconds of electrofishing effort, during which time fish continued to be consistently captured at a low rate. Although block nets had been securely installed (no fish entering), the isolation area included a deep run and deep pool area where fish were concentrated and where the backpack electrofisher was less effective, therefore the fishing effectiveness was low. After further discussion with AAM and the contractor, it was agreed that the isolated area was to be reduced to only the area needed for culvert installation. Following the installation of an additional block net to reduce the isolation area, six passes totaling 2,027 seconds of effort were required to clear fish from the area. Salvage of the culvert area was completed at approximately 14:00 on August 10, 2015. A summary of the electofishing efforts employed fish catches from this salvage event is provided in Table 2. In total, 37 fish were removed from the instream work area.

Table 2: Backpack Electrofishing Effort Summary for Culvert Installation at Clinton Creek

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Watercourse** | **Date** | **Electrofisher Effort and Settings** | | | | | **Catch** | | | |
| **Effort (seconds)** | **Voltage (V)** | **Duty Cycle** | **Frequency (Hz)** | **Power (w)** | **Arctic Grayling** | **Slimy Sculpin** | **Longnose Sucker** | **Juvenile Chinook Salmon** |
| Clinton Creek | 10-Aug-15 | 723 | 250 | 12 | 45 | 45-50 |  | 4 |  |  |
| 10-Aug-15 | 984 | 250 | 12 | 45 | 45-50 | 1 | 3 |  |  |
| 10-Aug-15 | 799 | 275 | 12 | 75 | 40-60 | 4 | 3 | 3 | 1 |
| 10-Aug-15 | 672 | 275 | 12 | 75 | 40-60 | 1 | 1 | 1 |  |
| 10-Aug-15 | 603 | 275 | 12 | 75 | 40-60 | 2 | 1 |  |  |
| 10-Aug-15 | 423 | 275 | 12 | 75 | 40-60 | 2 | 1 |  |  |
| 10-Aug-15 | 546 | 275 | 12 | 75 | 40-60 | 3 |  |  |  |
| 10-Aug-15 | 468 | 275 | 12 | 75 | 40-60 | 4 |  |  |  |
| 10-Aug-15 | 180 | 275 | 12 | 75 | 40-60 | 2 |  |  |  |
| 10-Aug-15 | 367 | 275 | 12 | 75 | 40-60 |  |  |  |  |
| 10-Aug-15 | 210 | 275 | 12 | 75 | 40-60 |  |  |  |  |
| 10-Aug-15 | 256 | 275 | 12 | 75 | 40-60 |  |  |  |  |
| **Total Effort** | | **6,231** |  |  |  |  | **19** | **13** | **4** | **1** |

Diversion Implementation September 2-3, 2015

ELR staff visited the Site on September 2 and 3, 2015 to perform fish salvage during the implementation of the diversion (and dewatering of the drop structures). On the morning of September 2, ELR assessed the instream work area, which extended from the base of the 4th drop structure to roughly 10 m downstream of the extent of construction. Prior to the implementation of the pumping diversion, it was determined that flows were too high through the work area to conduct salvage safely and effectively, and that flow to the drop structure area should be reduced prior to salvage work. Accordingly, AAM initiated the contractor to begin closing off the outlet to Hudgeon Lake, and a berm closure was completed between 8:30 and 13:00 of that day. Due to the amount of water stored in the upper three drop structures, water levels at drop structure 4 were very slow to respond (be reduced), and it wasn’t until the early afternoon of September 2 that fish salvage could begin.

ELR installed a block net at the downstream extent of the fish salvage area below drop structure 4, and began salvage activities at roughly 13:30 on September 2 using a combination of electrofishing and seine netting. After an initial electrofishing pass, it was apparent that there was an extremely high concentration of fish in the upper pool area immediately below the drop structure. Accordingly, ELR employed a seine net to remove large numbers of easily catchable fish from the pool area, then resumed electrofishing. In total, 11 seine net pulls and 10 electrofishing passes (totaling 3,557 seconds) were conducted on September 2, with work ending at 19:00. Water levels were relatively stable overnight and ELR resumed fish salvage at 8:00 on September 3, performing another 9 passes totaling 4,469 seconds of effort. During salvage work on the second day, the contractor installed an instream berm to help isolate flow from the work area, and also installed a small pump to directly dewater the work area and concentrate any remaining fish, assisting in the progress of the salvage. The salvage was completed at approximately 12:30 on September 3, 2015, with a total of 500 fish having been removed from the work area. A summary of the electofishing efforts employed and fish catches from this salvage event is provided in Table 3, and a summary of seine netting efforts and catches is provided in Table 4.

Table 3: Backpack Electrofishing Effort Summary for Drop Structure 4 Dewatering

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Watercourse** | **Date** | **Electrofisher Effort and Settings** | | | | | **Catch** | | | |
| **Effort (seconds)** | **Voltage (V)** | **Duty Cycle** | **Frequency (Hz)** | **Power (w)** | **Arctic Grayling** | **Slimy Sculpin** | **Longnose Sucker** | **Juvenile Chinook Salmon** |
| Clinton Creek | 2-Sep-15 | 129 | 275 | 12 | 75 | 40-60 | 6 | 1 |  | 1 |
| 2-Sep-15 | 356 |  |  |  |  | 8 | 13 | 1 |  |
| 2-Sep-15 | 432 |  |  |  |  | 17 | 15 | 3 | 4 |
| 2-Sep-15 | 148 |  |  |  |  | 3 | 3 | 2 | 1 |
| 2-Sep-15 | 140 |  |  |  |  | 1 | 1 |  |  |
| 2-Sep-15 | 110 |  |  |  |  |  |  |  |  |
| 2-Sep-15 | 295 |  |  |  |  | 13 | 9 |  | 1 |
| 2-Sep-15 | 301 |  |  |  |  | 16 | 22 |  |  |
| 2-Sep-15 | 760 |  |  |  |  | 18 | 23 | 2 | 2 |
| 2-Sep-15 | 886 |  |  |  |  | 12 | 25 | 2 |  |
| 3-Sep-15 | 1265 |  |  |  |  | 16 | 11 |  |  |
| 3-Sep-15 | 956 |  |  |  |  | 1 | 5 |  |  |
| 3-Sep-15 | 276 |  |  |  |  | 1 | 2 |  |  |
| 3-Sep-15 | 601 |  |  |  |  |  | 6 | 2 |  |
| 3-Sep-15 | 397 |  |  |  |  |  | 5 |  |  |
| 3-Sep-15 | 182 |  |  |  |  |  | 2 | 1 |  |
| 3-Sep-15 | 363 |  |  |  |  | 2 | 11 |  | 1 |
| 3-Sep-15 | 277 |  |  |  |  |  | 1 |  |  |
| 3-Sep-15 | 152 |  |  |  |  |  | 1 |  |  |
| **Total Effort** | | **8,026** |  |  |  |  | **114** | **156** | **13** | **10** |

Table 4: Seine Netting Effort Summary During Salvage for Drop Structure 4 Dewatering

| Watercourse | Date | Seine Pull Number | Catch | | | |
| --- | --- | --- | --- | --- | --- | --- |
| Arctic Grayling | Slimy Sculpin | Longnose Sucker | Juvenile Chinook Salmon |
| Clinton Creek | 2-Sep-15 | 1 | 17 |  |  |  |
| 2-Sep-15 | 2-3 | 21 |  |  | 1 |
| 2-Sep-15 | 3-4 | 30 | 1 |  | 2 |
| 2-Sep-15 | 6 | 59 |  |  |  |
| 2-Sep-15 | 7-8 | 6 | 1 |  |  |
| 2-Sep-15 | 9 | 45 |  |  |  |
| 2-Sep-15 | 10-11 | 24 |  |  |  |
| **Total Effort** |  |  | **202** | **2** |  | **3** |

Closure

Ecological Logistics & Research Ltd. (ELR) has prepared this memo to summarize environmental monitoring and fish salvage activities performed at the Clinton Creek Site in conjunction with drop structure repairs. This memo is intended for use by the Government of Yukon, Assessment and Abandoned Mines and its agents, and is not to be used or relied upon for other purposes.

We trust this this memo meets the project needs at this time, and we welcome any further inquiries related to the project that you may have.

Sincerely,

|  |
| --- |
| S:\ELR Documents\Admin\Digital Signatures\C J.jpeg |
| Chris Jastrebski, M.Sc., R.P.Bio.  Biologist, Lead Consultant  867.668.6386  chris@elr.ca |

References

Canadian Council of Ministers of the Environment (CCME). 2014. Canadian Water Quality Guidelines for the Protection of Aquatic Life. Accessed online at http://st-ts.ccme.ca/, March 2014.

Minnow Environmental Inc. (Minnow). 2015a. Fish Salvage Plan for the Clinton Creek Drop Structure Repair. Prepared for Yukon Government, Assessment and Abandoned Mines.

Minnow Environmental Inc. (Minnow). 2015b. Construction Monitoring Standard Operating Procedures for the Clinton Creek Drop Structure Repair. Prepared for Yukon Government, Assessment and Abandoned Mines.

Photographs

Appendix 1 – Summary of Water Quality Monitoring Data

Appendix 2 – Laboratory

Certificates of Analysis

Appendix 3 – In-Situ Turbidity Monitoring Data

| **Date** | **Time** | **HL - Hudgeon Lake** | **HLB - Hudgeon Lake Alternate (While Diversion Active)** | **CC1 - Clinton Creek Compliance point Downstream of Construction** | **CC2 - Clinton Creek Upstream of Wolverine Creek** | **WC - Wolverine Creek Upstream of Clinton Creek** | **CC3 – Clinton Creek Downstream of Wolverine Creek** | **Clinton Creek Downstream of Construction – Alternate Sites** | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Centre of stream** | **North side of stream** |
| 10-Aug-15 | 8:10 | 0.5 |  | 0.2 | 0.09 | 2.43 | 1.01 |  |  |
| 10-Aug-15 | 14:30 |  |  | 5.36 |  |  |  |  | 23 |
| 10-Aug-15 | 14:45 |  |  | 13.26 |  |  |  | 11.3 | 11.35 |
| 10-Aug-15 | 15:00 |  |  | 14.7 |  |  |  |  | 24.7 |
| 10-Aug-15 | 15:25 |  |  | 0.93 |  |  |  | 0.97 | 0.79 |
| 10-Aug-15 | 16:10 |  |  | 0.82 |  |  |  |  |  |
| 11-Aug-15 | 7:40 | 1.88 |  | 0.33 | 1.06 | 12.9 | 6.03 |  |  |
| 12-Aug-15 | 8:22 | 0.62 |  | 0.48 | 0.65 | 12.05 | 3.74 |  |  |
| 13-Aug-15 | 9:56 | 0.99 |  | 0.78 | 0.6 | 7.54 | 1.59 |  |  |
| 14-Aug-15 | 9:37 | 0.52 |  | 0.43 | 0.63 | 9.01 | 1.87 |  |  |
| 15-Aug-15 | 8:04 | 0.49 |  | 0.47 | 0.43 | 6.33 | 2.68 |  |  |
| 16-Aug-15 | 8:15 | 0.66 |  | 0.23 | 0.33 | 5.01 | 2.13 |  |  |
| 16-Aug-15 | 9:56 |  |  | 10.2 |  |  |  |  | 7.34 |
| 16-Aug-15 | 10:00 |  |  | 1.21 |  |  |  |  | 1.21 |
| 16-Aug-15 | 10:15 |  |  | 33.7 |  |  |  |  | 23.1 |
| 16-Aug-15 | 10:30 |  |  | 1.48 |  |  |  |  | 1.04 |
| 16-Aug-15 | 10:45 |  |  | 0.93 |  |  |  |  | 0.75 |
| 17-Aug-15 | 7:47 | 1.68 |  | 0.67 | 2.03 | 20.4 | 12.52 |  |  |
| 18-Aug-15 | 7:35 | 0.36 |  | 0.43 | 0.71 | 27.7 | 14.8 |  |  |
| 19-Aug-15 | 7:40 | 0.42 |  | 2.57 | 2.34 | 23.3 | 11.19 |  |  |
| 19-Aug-15 | 8:20 |  |  | 14.9 |  |  |  |  |  |
| 19-Aug-15 | 8:30 |  |  | 21.2 |  |  |  |  |  |
| 19-Aug-15 | 8:43 |  |  | 17.1 |  |  |  |  |  |
| 19-Aug-15 | 8:56 |  |  | 23.5 |  |  |  |  |  |
| 19-Aug-15 | 9:10 |  |  | 1.69 |  |  |  |  |  |
| 20-Aug-15 | 10:55 | 1.72 |  | 2.81 | 3.11 | 19.3 | 7.88 |  |  |
| 20-Aug-15 | 7:55 |  |  | 2.28 |  |  |  |  |  |
| 20-Aug-15 | 8:20 |  |  | 22.3 |  |  |  |  |  |
| 20-Aug-15 | 8:51 |  |  | 17.1 |  |  |  |  |  |
| 20-Aug-15 | 9:30 |  |  | 33.8 |  |  |  |  |  |
| 20-Aug-15 | 10.04 |  |  | 8.65 |  |  |  |  |  |
| 20-Aug-15 | 10:41 |  |  | 3.87 |  |  |  |  |  |
| 21-Aug-15 | 9:30 | 16.2 |  | 3.92 | 8.05 | 11.2 | 7.98 |  |  |
| 21-Aug-15 | 9:30 | 2.89 |  |  |  |  |  |  |  |
| 22-Aug-15 | 8:35 | 2.42 |  | 2.23 | 1.99 | 9.33 | 2.6 |  |  |
| 23-Aug-15 | 8:08 | 1.29 |  | 1.27 | 1.24 | 6.68 | 1.67 |  |  |
| 24-Aug-15 | 8:08 | 2.03 |  | 2.47 | 2.39 | 12.45 | 3.23 |  |  |
| 25-Aug-15 | 7:50 | 1.8 |  | 2.24 | 1.76 | 9.68 | 1.97 |  |  |
| 26-Aug-15 | 8:29 | 2.76 |  | 3.36 | 3.37 | 20.4 | 9.92 |  |  |
| 27-Aug-15 | 7:57 | 1.97 |  | 4.89 | 4.8 | 33.6 | 12.5 |  |  |
| 27-Aug-15 | 9:08 |  |  | 4.45 |  |  |  |  |  |
| 27-Aug-15 | 9:18 |  |  | **60.1** |  |  |  |  |  |
| 27-Aug-15 | 9:28 |  |  | 12.9 |  |  |  |  |  |
| 27-Aug-15 | 9:38 |  |  | 9.24 |  |  |  |  |  |
| 27-Aug-15 | 9:48 |  |  | 23.8 |  |  |  |  |  |
| 27-Aug-15 | 9:54 |  |  | 65 |  |  |  |  |  |
| 27-Aug-15 | 10:05 |  |  | 27.2 |  |  |  |  |  |
| 27-Aug-15 | 10:20 |  |  | 11.1 |  |  |  |  |  |
| 27-Aug-15 | 11:15 |  |  | 6.39 |  |  |  |  |  |
| 28-Aug-15 | 7:50 | 4.29 |  | 4.7 | 5.75 | 24.4 | 9.99 |  |  |
| 29-Aug-15 | 7:42 | 3.83 |  | 4.9 | 4.88 | 15.1 | 6.13 |  |  |
| 30-Aug-15 | 9:32 | 11.63 |  | 5.54 | 5.87 | 11.31 | 6.3 |  |  |
| 31-Aug-15 | 8:55 |  | 4.83 | 5.36 | 4.71 | 7.58 | 4.74 |  |  |
| 01-Sep-15 | 7:51 |  | 6.23 | 3.93 | 3.66 | 7.37 | 4.38 |  |  |
| 02-Sep-15 | 10:06 |  | 3.7 | 4.93 | 4.52 | 6.8 | 4.06 |  |  |
| 03-Sep-15 | 7:59 |  | 3.68 | 3.63 | 3.05 | 5.08 | 3.41 |  |  |
| 04-Sep-15 | 11:01 |  | 2.99 | 3.79 | 3.01 | 5 | 3.61 |  |  |
| 05-Sep-15 | 8:12 |  | 3.05 | 2.97 | 3.1 | 5.66 | 2.96 |  |  |
| 06-Sep-15 | 7:58 |  | 2.51 | 2.94 | 2.24 | 4.64 | 2.82 |  |  |
| 07-Sep-15 | 7:59 |  | 2.58 | 2.71 | 2.35 | 4.83 | 2.88 |  |  |
| 08-Sep-15 | 8:28 |  | 2.28 | 2.43 | 2.65 | 3.78 | 2.3 |  |  |
| 09-Sep-15 | 11:13 |  | 2.05 | 1.63 | 2 | 3.51 | 1.96 |  |  |
| 10-Sep-15 | 8:39 |  | 2.04 | 1.82 | 1.15 | 3.43 | 1.45 |  |  |
| 11-Sep-15 | 8:19 |  | 1.46 | 1.6 | 1.24 | 3.73 | 1.82 |  |  |
| 12-Sep-15 | 8:54 |  | 1.32 | 2.06 | 1.92 | 4.19 | 2.08 |  |  |
| 13-Sep-15 | 7:48 |  | 1.11 | 2.26 | 0.86 | 3.78 | 1.25 |  |  |
| 14-Sep-15 | 11:37 |  | 0.95 | 0.93 | 0.65 | 4.36 | 1.89 |  |  |
| 15-Sep-15 | 13:54 |  | 1.01 | 1.38 | 0.96 | 6.74 | 2.89 |  |  |
| 16-Sep-15 | 15:20 |  | 1.1 | 0.97 | 0.88 | 6.52 | 2.42 |  |  |
| 17-Sep-15 | 8:24 |  | 1.22 | 0.7 | 0.63 | 6.21 | 1.46 |  |  |
| 18-Sep-15 | 8:09 |  | 2.81 | 0.97 | 0.62 | 4.5 | 1.42 |  |  |
| 19-Sep-15 | 8:46 |  | 0.59 | 0.53 | 0.68 | 4.11 | 1.6 |  |  |
| 20-Sep-15 | 8:19 |  | 0.55 | 0.48 | 1.39 | 2.88 | 0.84 |  |  |
| 21-Sep-15 | 11:56 | 0.8 |  | 0.91 | 0.69 | 3.41 | 1.81 |  |  |
| 22-Sep-15 | 9:54 | 0.79 |  | 0.78 | 0.62 | 3.32 | 1.1 |  |  |
| 23-Sep-15 | 17:05 | 0.86 |  | 0.98 | 0.56 | 3.34 | 1.51 |  |  |
| 24-Sep-15 | 9:04 | 2.11 |  | 2.83 | 0.76 | 3.04 | 1.85 |  |  |
| 25-Sep-15 | 8:27 | 0.46 |  | 0.75 | 0.53 | 3.23 | 1.07 |  |  |

Appendix 4 – Scientific

Collection Permit