Seattle City Light

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March 30, 2016

U.S. Fish and Wildlife Office
Eastern Washington Field Office
11103 E. Montgomery Drive
Spokane, WA 99206

RE: SKAGIT RIVER PROJECT (FERC NO. 553) 2015 INCIDENTAL TAKE STATEMENT FOR BULL TROUT

Dear Sir or Madam:

On July 13, 2013, the Federal Energy Regulatory Commission (FERC) issued an Order Amending License and Revising Annual Charges for Seattle City Light's (City Light) Skagit River Hydroelectric Project (FERC No. 553). The Order states that the Skagit River Project (Project) is subject to the reasonable and prudent measures and terms and conditions of the Incidental Take Statement (ITC) in the Biological Opinion filed by the U.S. Fish and Wildlife Service (USFWS) on February 12, 2013 and included as Appendix B of the Order. Appendix B requires City Light to report annual incidental take of bull trout *(Salvelinus confluentus)* to the USFWS by March 31st.

City Light's third annual Take Statement for bull trout under the amended license for the Skagit River Hydroelectric Project is enclosed. It covers calendar year 2015, and is based on the results of monitoring conducted by City Light to estimate turbine entrainment and the calculations used to estimate spillway mortality. An emergency shutdown of the Skagit Hydroelectric Project was caused by a major wildfire, resulting in spills at all three dams for 10 consecutive days in late August. Otherwise, there were very few spill events the remainder of the year because of record dry conditions. There were no maintenance activities conducted in 2015 that required reservoir drawdowns that would have impacted bull trout. The total estimated incidental take from the Project for 2015 is **11** bull trout, all from spillway mortality.

If you have any questions about the information provided in this Take Statement please contact Ed Connor, Senior Skagit Fisheries Biologist, at (206) 615-1128 or ed.connor@seattle.gov.

Sincerely,

Colleen McShane
Manager, Natural Resource & Environmental Planning

CC: FERC Secretary
D. Johnson, FERC PRO
A. Rawhouser, North Cascades National Park Service Complex
T. Romananski
E. Connor

Annual Incidental Take Report for 2015 – Bull Trout
Skagit River Hydroelectric Project (FERC 553)
Seattle City Light

Prepared by: Ed Connor, Aquatic Ecologist

March 31, 2016

Introduction

The U.S. Fish and Wildlife Service (USFWS) issued a Biological Opinion (BO) and Incidental Take Statement (ITS) (Reference Number O1EWFW00-2012-F-0302) for the Skagit River Hydroelectric Project (FERC Project No. 553) on February 12, 2013. The ITS was issued under the terms of sections 7(b)(4) and 7(o)(2) of the Endangered Species Act (ESA), which provides that taking incidental to, and not intended as part of the agency action, is not considered prohibited, provided that such taking is in compliance with the terms and conditions of the ITS. The ITS requires that Seattle City Light (City Light) submit a take report for bull trout (*Salvelinus confluentus*) on an annual basis.

This Take Report for 2015 summarizes the monitoring methods used by City Light to estimate the annual incidental take of bull trout from the ongoing operations and maintenance of the Skagit River Hydroelectric Project (Project). The results of the monitoring are then used to provide an estimate of bull trout take from the following operational and maintenance activities and events:

- Turbine entrainment at Ross, Diablo, and Gorge dams
- Spillway entrainment at Ross, Diablo, and Gorge dams

Bull Trout Monitoring for Estimating Incidental Take

In 2015, City Light continued the acoustic monitoring program in the three Project reservoirs (Ross, Diablo, and Gorge) to estimate the number of bull trout entrained into the power tunnel intakes at the dams, and subsequently passing through the turbines of the power plants. This monitoring program was initiated in early 2013 following the issuance of the ITS by USFWS. Vemco VR2W acoustic receivers installed in all three reservoirs were used to monitor the movement of bull trout, to detect the entrainment of fish surgically implanted with acoustic transmitter tags into the power tunnel intakes, and to determine whether any entrained fish survived passing from the power tunnels through the turbines. City Light and their consultant, R2 Resource Consultants, maintained and periodically uploaded tag detection data from these receivers throughout the 2015 monitoring period.

A total of 18 acoustic receivers were active in Ross Lake for the 2015 monitoring period, with the majority of these receivers (14) placed in the forebay, the portion of the reservoir

immediately upstream of Ross Dam (Figure 1; Table 1). The monitoring effort was greatest in Ross Lake because it supports higher numbers of bull trout compared to the other two project reservoirs. The Ross Lake forebay acoustic receiver array was designed specifically to track the three-dimensional movement of tagged bull trout in the forebay over time. The configuration of forebay receivers allows for an accurate assessment of the vulnerability of bull trout in Ross Lake to entrainment into the hydroelectric project intakes. Two of the receivers (stations RFB11 and RFB 12) are located immediately in front of the Ross Dam intake structure to monitor the entrainment of bull trout into the power tunnel intakes. The power intake tunnel is located about 140 ft below the surface of the reservoir at full pool. These two receivers, along with receivers situated at the Ross Boat House (RFB10) and along the shore just north of the intake facility (RFB15), were used to monitor the area of the forebay where bull trout would be vulnerable to entrainment into the power intakes. The inner forebay of the Ross Dam, where fish would be vulnerable to entrainment into the spillways during spill events, was monitored by receivers RFB05, RFB06, RFB07, and RFB09, in addition to the four receivers that are located near the power intake facility located at the southern corner of the forebay (RFB10, RFB11, RFB12, and RFB 15). Four receivers were also used to monitor fish in the outer forebay of Ross Dam: RFB01, RFB02 (located at Ross Lake Resort), and RFB03 and RFB04 (both connected to outer log boom of forebay).

In addition to the forebay receiver array, four receivers were also stationed near the mouths of major tributaries to Ross Lake to detect the movement of tagged bull trout in these streams for spawning (Figure 2). Receivers were placed just outside of the mouth of Ruby Creek (RLK01), Big Beaver Creek (RLK02), and Lightning Creek (RLK04). A tributary receiver (RLK05) was stationed in the upper Skagit River, British Columbia, approximately 0.8 miles upstream of the reservoir. The Ross Lake receivers were downloaded in March and July 2015, and March 2016.

A total of seven acoustic receivers were deployed in Diablo Lake for bull trout monitoring purposes in 2015 (Table 1; Figure 3). The most downstream of these receivers (DLK01) was stationed at Diablo Dam immediately in front of the power intake structure. Three were stationed around the main body of Diablo Lake receivers (DLK02, DLK03, and DLK05) to monitor the movement of bull trout within the reservoir. A receiver was also deployed in Thunder Arm of the reservoir near the outlet of Thunder Creek (DLK05) to monitor the movement of bull trout into this major tributary for spawning. An additional receiver was deployed near the mouth of Thunder Creek in 2015 (DLK07), which was used to improve the tracking of bull trout moving into this stream to spawn. The most upstream receiver (DLK06) was located in the tailrace of Ross Powerhouse. This receiver was used to detect any tags implanted in Ross Lake bull trout that were later entrained into the Ross Dam power tunnel intakes, then passed through the Ross powerhouse turbines, and finally released into Diablo Lake. The Diablo Lake receivers were downloaded in February and June 2015, and in January 2016.

A total of six receivers were maintained in Gorge Lake during the 2015 bull trout monitoring period (Table 1; Figure 4). The most downstream of these receivers (GLK01) was located in the forebay of Gorge Dam. This receiver was located just upstream of the Gorge Dam intake structure, and was used to detect the entrainment of tagged bull trout into the power intake tunnel. Any bull trout passing into this area of the reservoir would also be vulnerable to spillway entrainment during spill periods at Gorge Dam. Four receivers were situated throughout Gorge Lake (GLK02, GLK03, GLK04, and GLK05) to monitor the movement and habitat use of tagged bull trout in this reservoir. The uppermost of these receivers (GLK05) was positioned near the mouth of Stetattle Creek, and was used to monitor the movement of bull trout into this spawning stream. The most upstream receiver in the reservoir (GLK06) was located at the tailrace of Diablo Powerhouse, and was used to detect any bull trout tagged in Diablo or Ross lakes that were entrained through into the Diablo Dam power intakes or spillways and released into Gorge Lake. Finally, a seventh receiver (SKG01) was placed in the Skagit River immediately downstream of the Gorge Powerhouse tailrace (Table 1) to detect any tagged bull that were entrained into the power tunnel intake or spillway of Gorge Dam and passed downstream into the Skagit River. The Gorge Lake receivers were downloaded in February and June 2015, and in January 2016.

Beginning in 2011 adult bull trout from all three reservoirs have been captured using hook-and-line and surgically implanted with Vemco V13 acoustic tags. Fish are captured and tagged each year to replace those with expired tags. The collection and handling of fish, and surgical implantation of tags is conducted following the methods described in City Light's USFWS scientific collection permit for an ESA-listed species (Permit TE 005885-4). City Light is also issued a scientific research permit annually by the National Park Service (NPS) for project work, which is conducted within the Ross Lake National Recreational Area.

The acoustic tags implanted in bull trout at the Project reservoirs have a lifespan ranging from 193 to 1583 days. The lifespan of an acoustic tag is dependent upon the power output (low or high), the transmission interval (30 to 180 second intervals are common), and sensor capability (temperature and depth sensors can be added to tag). The short lifespan tags (193 days) were high power tags that transmitted at relatively short intervals (30 seconds). These tags were found to be problematic, since bull trout often congregate in the same areas and the overlapping transmissions caused interference problems during monitoring conducted in 2013. Range testing studies conducted by City Light in Ross Lake found that the low power tags could be detected by a receiver at distances ranging between 0.5 and 2.0 km, depending upon the local topography of the reservoir. Based upon these results, only low power tags are now being used to minimize tag transmission interference problems, and to extend the useful life of a tag implanted in bull trout. This has resulted in a substantial reduction in the number of bull trout that need to be captured and tagged each to replace fish with expired tags.

In Ross Lake, a total of 50 tags were active during the 2015 monitoring period (Table 2). The majority of these tags were implanted in bull trout from 2012 through 2014. A total of 20 bull trout were captured and implanted with new acoustic tags in Ross Lake during 2015. These additional tags were required to replace 20 tags that were due to expire during the year. The majority of bull trout in Ross Lake (42 fish) have been implanted with acoustic tags outfitted with temperature and pressure (TP) sensors. The pressure sensors provide the ability to track the depths used by bull trout in the reservoir. This is especially useful for detecting and monitoring fish that swim close to the Ross Dam power tunnel intakes, which are located near the bottom of the reservoir. The remaining fish were implanted with non-sensor "pinger" tags that transmit a unique identification code for each fish.

In Diablo Lake, a total of 11 tags were active during the 2015 monitoring period (Table 3). Six of these tags were implanted in 2012 and 2013. Bull trout remain difficult to capture in this reservoir, and a number of attempts were made to capture fish throughout the year. Five additional bull trout in the reservoir were successfully captured and implanted with tags in 2015. All the tags used in Diablo Lake were "pinger" tags. The results of recent genetic analysis conducted by the Washington Department of Fish and Wildlife's (WDFW) genetics lab suggest that the majority of native char in Diablo Lake are Dolly Varden, which are substantially smaller in size than bull trout. The WDFW genetics lab confirmed that all the fish used in the acoustic tracking study were bull trout.

A total of 14 tags were active in Gorge Lake during the 2015 monitoring period (Table 4). Eight of these tags were implanted in bull trout captured during the two prior years (2013 and 2014). Six additional bull trout in this reservoir were captured and tagged during 2015. Two of the active tags were sensor tags which transmitted temperature and depth data, and the remaining tags used in this reservoir were non-sensor "pinger" tags.

In Ross Lake, 39 of the 50 bull trout with active acoustic tags were detected in 2015 (Table 5). Ross Lake is very large in area in relation to the other two Skagit Hydro Project reservoirs, and detecting all the tagged fish in the large reservoir and expansive tributary drainage network is challenging. Nevertheless, the receiver array detected the majority of the fish (78 percent) with active tags. A total of 296,961 unique detections of tagged bull trout were recorded in Ross Lake during 2015, an average of 7,614 data points for each of 39 fish detected. This is a smaller number of detections per fish than observed in 2013 and 2014, a result of transitioning to tags with longer transmission intervals (120 seconds average) for the majority of tags implanted in bull trout in 2014 and 2015. The use of tags with longer transmission intervals effectively reduced the number of false tag detections caused by collisions of two or more tags transmitting at the same time. This reduction of false tag detections improved the time required for data analysis, and improved the accuracy of detections.

Of the 50 bull trout with active tags, 34 (68 percent) were found to have used the forebay of Ross Lake during the 2015. A total of 164,373 detections were recorded by the receivers deployed in the forebay (Table 5), accounting for 55 percent of all detections in the Ross Lake drainage during 2015. This high percentage of detections largely reflects the fact that the majority of the receivers in the Ross Lake (14 of 18) were deployed in the forebay area. Nevertheless, the acoustic data suggest that bull trout spent a substantial amount of time in the forebay during 2015. A total of 24 tagged bull trout were detected within the power intake zone of the forebay during 2015 (detected at receiver stations RFB10, RFB11, RFB 12, or RFB14; see Figure 1). However, detections in the intake area only accounted for 13.5 percent of all detections within the forebay (22,214 of 164,373 data points), confirming observations during the two prior years of monitoring that the intake zone is a low use area for bull trout.

In Diablo Lake, 8 of the 11 bull trout with active tags were detected in the reservoir during the 2015 monitoring period (Table 6). A total of 227,796 unique detections of tagged bull trout were collected during the year, with an average of 28,475 detections per fish with an active tag. Of the 11 tagged bull trout in Diablo Lake, 6 were detected at the Diablo forebay receiver (DLK01) in 2015. This is the region of the reservoir where fish are susceptible to entrainment into the power intakes or spillways. However, the 11,675 detections in the vicinity of the Diablo Dam forebay only amounted to 5.1 percent of all detections in this reservoir during 2015. Most detections of tagged bull trout in Diablo Lake were observed in the area of the reservoir immediately downstream of the Ross Powerhouse tailrace, and in the Thunder Arm area of the reservoir (see Figure 3). This suggests that the area of the reservoir where the Diablo Dam intakes and spillways are located is a low-use habitat for bull trout in the reservoir.

In Gorge Lake, 13 of the 14 bull trout with active acoustic tags were detected by the receivers in 2015 (Table 7). A total of 356,262 unique detections were recorded in this reservoir during this monitoring period, with an average 25,447 detections per fish with an active tag. Only two tagged bull trout was detected in the forebay area where the power intakes and spillways are located at Gorge Dam. Moreover, only 2,857 detections were recorded by the forebay receiver (GLK01), representing 0.1 percent of all bull trout detections in Gorge Lake during 2015. This indicates that the forebay area is a low-use habitat zone for bull trout in Gorge Lake. The majority of bull trout detections were recorded in the deep pool area of the reservoir immediately above the confluence of Stetattle Creek (GLK05), and upper area of the reservoir near the Diablo Powerhouse tailrace (GLK06). Together, these two monitoring sites accounted for over 90 percent of the detections in the reservoir.

Turbine Entrainment and Mortality

None of the acoustic tagged bull trout in Ross Lake were found to be entrained by the power tunnel intakes at Ross Dam and pass through the turbines during 2015. Of 39 bull trout detected in the reservoir, none were last detected at the two receivers (RFB11 and RFB12) located immediately adjacent to the Ross Dam power intakes, or at two other receivers (RFB10 and RFB 15) located in close proximity to the intake area (Table 5). Any bull trout that was last detected in the vicinity of the Ross Dam power intakes would be assumed to have been entrained into the power intakes and then passed through the turbines. All of the tagged bull trout were last detected at other locations, either at the outer areas of the forebay (when the fish were presumably leaving the area), or at receivers located near the mouths of Big Beaver Creek, Ruby Creek, Lightning Creek, upper Skagit River (British Columbia). Most importantly, none of the bull trout tagged in Ross Lake were later detected in Diablo or Gorge lakes (Table 4), indicating that no tagged fish had passed through the turbines in Ross Powerhouse into Diablo Lake. Any tag passing through the Ross Dam turbines, including the tag of a dead fish, would have been detected by a receiver (station DLK06) located immediately downstream of the Ross Powerhouse tailrace.

Likewise, none of the tagged bull trout in Diablo Lake were found to have been entrained into the Diablo Dam power tunnel intake during the 2015 monitoring period. Of the 11 active bull trout tags in the Diablo Lake, none were last detected at the receiver (DLK01) situated in the forebay adjacent to the power tunnel intake (Table 6). Most of the active bull trout tags were last detected in the Thunder Arm area of the reservoir (receivers DLK04 and DLK07), or in the vicinity of the Ross Powerhouse tailrace (receiver DLK06). Moreover, no bull trout tagged in Diablo Lake were detected later in Gorge Lake (Table 6). These findings indicate that none of the tagged bull trout were entrained into the power tunnel intakes at Diablo Dam.

Finally, none of the tagged bull trout in Gorge Lake was assumed to have been entrained into the power tunnel intakes and passed through the turbines of Gorge Powerhouse. Of 14 bull trout with active tags present in Gorge Lake during the 2015 monitoring period, only 1 (A69-1303-836) was last detected at the forebay receiver (GLK01) located adjacent to the Gorge Dam power tunnel intakes (Table 7). The last detection date of this tag (9/29/2010) coincided closely with the expiration date for the tag (10/10/2015). Consequently, we assumed that the last detection for this tag was related to the expiration of the battery, instead of the entrainment of this fish into the dam power intakes. All the other tagged bull trout were last detected in the upper half of Gorge Lake above the confluence of Stetattle Creek, with the majority of these fish last detected at the receiver located near the Diablo Powerhouse tailrace (site GLK06). Finally, no bull trout tags were detected at the receiver that was deployed just downstream of the Gorge Powerhouse tailrace in the Skagit River (SKG01).

In conclusion, the results of acoustic monitoring conducted in 2015 provided no evidence that tagged bull trout from the three Skagit Hydroelectric Project reservoirs were entrained into the power tunnel intakes and passed through the powerhouse turbines. *Therefore, the total Incidental Take for bull trout turbine mortality at the Skagit Hydroelectric Project for 2015 was determined to be* ***zero***.

Spillway Mortality

Based upon the acoustic monitoring data collected in 2015, none of the bull trout implanted with acoustic tags in Ross, Diablo, and Gorge lakes were later detected downstream of the dam above which they were captured and tagged. Any bull trout passing over the Ross and Diablo dam spillways would likely be killed, and the tags of these fish subsequently detected in either Diablo or Gorge Lake. Tagged fish passing over the Gorge Dam spillways would be more difficult to detect downstream, since these fish would then pass through the 2.4 mile long Gorge bypass reach before passing by the Gorge Powerhouse tailrace where the most downstream receiver is located (SKG01). Nevertheless, all bull trout in Gorge Lake that had active tags during the last receiver data download in January 2016 were detected in the reservoir (Table 7), which means that these fish were still present and accounted for in the reservoir.

During 2015, there were 10 days of spill observed at Ross Dam, 14 days of spill at observed at Diablo Dam, and 11 days of spill observed at Gorge Dam (see Figure 5). The number of spills occurring at Diablo and Gorge dams were very low compared to that observed in 2014, a result of a record dry year in 2015. Only three days of spill were observed at Diablo Dam during the spring snowmelt period, and no spill events were observed at Ross and Gorge dams during this period (Figure 5). The only significant spill event at all three dams occurred over a period of 10 consecutive days during the last week of August (Figure 5). These spills were caused by the emergency shutdown of all three facilities at the Skagit Hydroelectric Project, the result of a major wildfire that occurred within the project area. The fire damaged the dedicated project transmission lines, requiring City Light to stop power generation until the liens could be safely repaired. Spills were required at all three dams during this shutdown period to meet the fish flow requirements in the Skagit River downstream of the hydroelectric project.

The BiOP for the Skagit Hydroelectric project (USFWS 2013) describes the method for calculating spillway mortality of bull trout based upon the percent of time that spill occurs during the year at each of the three dams. For Ross Dam, this method estimates an annual take of 1 bull trout (fish entrained by the spillways and subsequently killed) assuming that the dam spilled, on average, 0.6 percent of the time on an annual basis. Adjusting for the spills observed at Ross Dam in 2015 (2.7 percent of the days during the year), the annual take estimate for spill at this dam would be **5** bull trout. For Diablo Dam, this method estimates an annual take of 6 bull trout (fish entrained by the spillways and subsequently killed) assuming that the dam spilled, on

average, 6.2 percent of the time on an annual basis. Adjusting for the spills observed at Diablo Dam in 2015 (3.8 percent of the days during the year), the annual take estimate for spill at this dam would be **4** bull trout. Finally for Gorge Dam, this method estimates an annual take of 3 bull trout (spillway entrainment and mortality) given that spill occurs on average 5.5 percent of the time on an annual basis. Based on the observed spill rate at Gorge Dam in 2015 (3.0 percent of the days during the year), the annual estimated take would be **2** bull trout. *The total estimated Incidental Take for spillway mortality at the Skagit Hydroelectric Project for 2015 is therefore **11** bull trout.*

Total Incidental Take Estimate for 2015

The total estimated Incidental Take of bull trout attributed to the ongoing operation of the Skagit Hydroelectric Project (including the Ross, Diablo, and Gorge power facilities) for 2015 can be summarized as follows:

- Turbine mortality – zero
- Spillway mortality – 11 fish (assumed to be adults)

The total annual Incidental Take at the Skagit Hydro Project is therefore estimated to be **11** bull trout.

Figure 1. Acoustic receiver array in Ross Lake forebay for 2015.

Figure 2. Acoustic receiver array in Ross Lake outside the forebay for 2015.

Figure 3. Acoustic receiver array in Diablo Lake for 2015.

Figure 4. Acoustic receiver array in Gorge Lake for 2015.

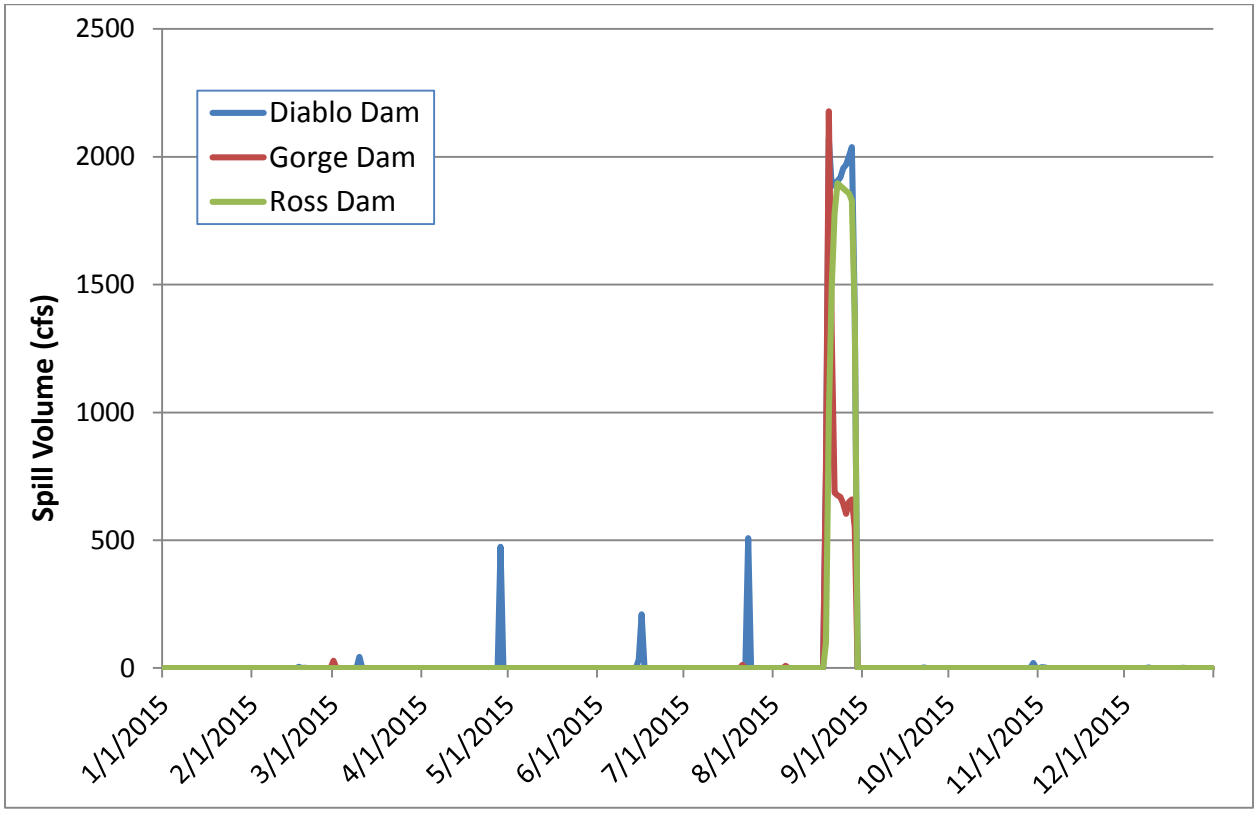

Figure 5. Spill volumes at Ross, Diablo, and Gorge dams in 2015.

Table 1. Acoustic receivers deployed in Ross, Diablo, and Gorge lakes for 2015 monitoring period.

Receiver	Location	Reservoir	Station	Deployment Date	Latitude	Longitude
VR2W-105049	Resort Boom West	Ross	RFB01	2/23/12	48.73759	-121.06577
VR2W-105034	Resort Boom East	Ross	RFB02	2/23/12	48.73890	-121.06072
VR2W-122250	Outer Boom North	Ross	RFB03	2/23/12	48.73764	-121.05405
VR2W-122843	Outer Boom South	Ross	RFB04	2/23/12	48.73670	-121.05563
VR2W-105035	Inner Boom South	Ross	RFB05	2/23/12	48.73449	-121.06480
VR2W-105037	Inner Boom Middle	Ross	RFB06	2/23/12	48.73470	-121.06595
VR2W-122846	Inner Boom North	Ross	RFB07	2/23/12	48.73419	-121.06817
VR2W-102681	Dam Boom North	Ross	RFB08	2/23/12	48.73283	-121.06866
VR2W-105671	Boathouse NPS	Ross	RFB09	2/23/12	48.73254	-121.06784
VR2W-105048	Boat House	Ross	RFB10	10/20/11	48.73236	-121.06760
VR2W-101961	Intake North	Ross	RFB11	2/23/12	48.73168	-121.06695
VR2W-105046	Intake South	Ross	RFB12	2/23/12	48.73180	-121.06638
VR2W-102788	Resort Shoreline	Ross	RFB14	3/19/13	48.73420	-121.06863
VR2W-104662	Intake Shoreline	Ross	RFB15	3/19/13	48.73276	-121.06527
VR2W-104295	Ruby Creek	Ross	RLK01	2/7/13	48.73004	-121.02532
VR2W-104779	Big Beaver South	Ross	RLK02	2/7/13	48.76682	-121.04427
VR2W-101602	Lightning Creek Mouth	Ross	RLK04	2/7/13	48.87482	-121.01878
VR2W-101960	Canada Swing Bridge	Ross	RLK05	10/10/12	49.01927	-121.06065
VR2W-105039	Diablo Dam	Diablo	DLK01	3/2/12	48.71449	-121.13139
VR2W-102789	Diablo Buoy	Diablo	DLK02	3/2/12	48.71796	-121.12206
VR2W-103973	Diablo Thunder Point	Diablo	DLK03	11/14/13	48.70838	-121.10800
VR2W-102780	Diablo Thunder Arm	Diablo	DLK04	10/17/12	48.70175	-121.09940
VR2W-105043	Diablo Canyon	Diablo	DLK05	3/2/12	48.71205	-121.09097
VR2W-105042	Ross Powerhouse Tailrace	Diablo	DLK06	3/2/12	48.72983	-121.07255
VR2W-105036	Diablo Highway 20 Bridge	Diablo	DLK07	3/19/15	48.69110	-121.09548
VR2W-105047	Gorge Logboom	Gorge	GLK01	12/7/11	48.69951	-121.20055
VR2W-103974	Gorge Right	Gorge	GLK02	12/7/11	48.70361	-121.18240
VR2W-105041	Gorge Left	Gorge	GLK03	12/7/11	48.70845	-121.16502
VR2W-104300	Gorge Launch	Gorge	GLK04	12/5/13	48.71327	-121.15244
VR2W-102680	Gorge Narrows	Gorge	GLK05	12/7/11	48.71625	-121.14826
VR2W-102682	Diablo Powerhouse Tailrace	Gorge	GLK06	12/7/11	48.71518	-121.14468
VR2W-104294	Skagit River Newhalem	Gorge	SKG01	12/7/11	48.67210	-121.24653

Table 2. Active acoustic tags in Ross Lake during 2015 monitoring period (TP = temperature/pressure sensor tag; PING = pinger tag).

Tag Number	Tagging Site	Sensor	Tagging Date	Tag End Date	Sex	Length (mm)	Weight (g)
A69-1105-20/21	Big Beaver Cr	TP	8/28/2013	4/2/2016	m	595	2150
A69-1105-22/23	Ruby Cr	TP	8/28/2013	4/2/2016	m	510	1380
A69-1105-24/25	Big Beaver Cr	TP	10/24/2012	5/30/2015	f	465	1150
A69-1105-26/27	Big Beaver Cr	TP	10/24/2012	5/30/2015	f	585	2000
A69-1105-28/29	Big Beaver Cr	TP	10/24/2012	5/30/2015	m	600	2050
A69-1105-30/31	Big Beaver Cr	TP	8/28/2013	4/2/2016	f	395	820
A69-1105-32/33	Big Beaver Cr	TP	8/28/2013	4/2/2016	m	559	1950
A69-1105-34/35	Ruby Cr	TP	8/28/2013	4/2/2016	f	452	1150
A69-1105-36/37	Big Beaver Cr	TP	10/24/2012	5/30/2015	m	538	1445
A69-1105-38/39	Big Beaver Cr	TP	10/24/2012	5/30/2015	m	580	2100
A69-1105-40/41	Ruby Cr	TP	8/28/2013	4/2/2016	m	550	1700
A69-1105-44/45	Big Beaver Cr	TP	10/24/2012	5/30/2015	f	535	1770
A69-1105-46/47	Big Beaver Cr	TP	10/24/2012	5/30/2015	m	465	1045
A69-1105-48/49	Big Beaver Cr	TP	10/24/2012	5/30/2015	m	565	1750
A69-1105-50/51	Ruby Cr	TP	8/28/2013	4/2/2016	m	521	1480
A69-1105-52/53	Big Beaver Cr	TP	10/24/2012	5/30/2015	m	545	1600
A69-1105-54/55	Big Beaver Cr	TP	10/24/2012	5/30/2015	m	575	1750
A69-1105-56/57	Big Beaver Cr	TP	10/24/2012	5/30/2015	m	565	1800
A69-1105-58/59	Big Beaver Cr	TP	10/24/2012	5/30/2015	f	590	1895
A69-1105-60/61	Big Beaver	TP	11/5/2014	3/30/2017	m	530	1650
A69-1105-62/63	Ruby Cr	TP	6/25/2015	11/17/2017	m	503	1450
A69-1105-64/65	Ruby Cr	TP	6/25/2015	11/17/2017	f	500	1600
A69-1105-66/67	Big Beaver	TP	11/5/2014	3/30/2017	m	585	1900
A69-1105-68/69	Big Beaver	TP	11/5/2014	3/30/2017	m	610	2100
A69-1105-70/71	Big Beaver Cr	TP	6/24/2015	11/16/2017	m	600	1850
A69-1105-72/73	Big Beaver Cr	TP	6/24/2015	11/16/2017	m	510	1450
A69-1105-74/75	Big Beaver Cr	TP	6/24/2015	11/16/2017	f	473	1100
A69-1105-76/77	Big Beaver Cr	TP	6/24/2015	11/16/2017	f	620	2100
A69-1105-78/79	Big Beaver Cr	TP	6/24/2015	11/16/2017	m	490	1250
A69-1105-80/81	Big Beaver Cr	TP	6/24/2015	11/16/2017	m	610	1750
A69-1105-82/83	Big Beaver Cr	TP	6/24/2015	11/16/2017	f	430	1000
A69-1105-84/85	Big Beaver Cr	TP	6/24/2015	11/16/2017	m	418	850
A69-1105-86/87	Ruby	TP	6/12/2015	11/4/2017	f	530	1350
A69-1105-88/89	Ruby	TP	6/12/2015	11/4/2017	f	505	1400
A69-1105-90/91	Ruby	TP	6/12/2015	11/4/2017	m	550	1800

Table 2. (continued)

Tag Number	Tagging Site	Sensor	Tagging Date	Tag End Date	Sex	Length (mm)	Weight (g)
A69-1105-92/93	Big Beaver Cr	TP	6/24/2015	11/16/2017	m	531	1550
A69-1105-94/95	Big Beaver	TP	6/11/2015	11/3/2017	m	435	1200
A69-1105-96/97	Ruby	TP	6/12/2015	11/4/2017	m	520	1650
A69-1105-98/99	Ruby	TP	6/12/2015	11/4/2017	m	495	1350
A69-1303-2250	Big Beaver Cr	PING	10/25/2013	7/9/2015	m	560	1850
A69-1303-2251	Big Beaver Cr	PING	10/25/2013	7/9/2015	m	390	750
A69-1303-2252	Big Beaver Cr	PING	10/25/2013	7/9/2015	m	555	1450
A69-1303-2255	Big Beaver Cr	PING	10/25/2013	7/9/2015	m	495	1170
A69-1303-2256	Big Beaver Cr	PING	10/25/2013	7/9/2015	f	410	860
A69-1601-58455	Big Beaver Cr	PING	11/12/2015	3/13/2020	m	570	1800
A69-1601-58456	Big Beaver Cr	PING	11/12/2015	3/13/2020	m	473	1050
A69-1601-58457	Big Beaver Cr	PING	11/12/2015	3/13/2020	m	448	950
A69-9002-3509/3510	Ruby Cr	TP	8/28/2013	3/27/2015	f	475	1450
A69-9002-3519/3520	Ruby Cr	TP	8/28/2013	3/27/2015	m	485	1500
A69-9002-3529/3530	Ruby Cr	TP	8/28/2013	3/27/2015	m	430	1010
A69-1105-90/91	Ruby	TP	6/12/2015	11/4/2017	m	550	1800
A69-1105-92/93	Big Beaver Cr	TP	6/24/2015	11/16/2017	m	531	1550
A69-1105-94/95	Big Beaver	TP	6/11/2015	11/3/2017	m	435	1200
A69-1105-96/97	Ruby	TP	6/12/2015	11/4/2017	m	520	1650
A69-1105-98/99	Ruby	TP	6/12/2015	11/4/2017	m	495	1350
A69-1303-2250	Big Beaver Cr	PING	10/25/2013	7/9/2015	m	560	1850
A69-1303-2251	Big Beaver Cr	PING	10/25/2013	7/9/2015	m	390	750
A69-1303-2252	Big Beaver Cr	PING	10/25/2013	7/9/2015	m	555	1450
A69-1303-2255	Big Beaver Cr	PING	10/25/2013	7/9/2015	m	495	1170
A69-1303-2256	Big Beaver Cr	PING	10/25/2013	7/9/2015	f	410	860
A69-1601-58455	Big Beaver Cr	PING	11/12/2015	3/13/2020	m	570	1800
A69-1601-58456	Big Beaver Cr	PING	11/12/2015	3/13/2020	m	473	1050
A69-1601-58457	Big Beaver Cr	PING	11/12/2015	3/13/2020	m	448	950

Table 3. Active acoustic tags in Diablo Lake during 2015 monitoring period (PING = pinger tag).

Tag Number	Tagging Site	Sensor	Tagging Date	Tag End Date	Sex	Length (mm)	Weight (g)
A69-1303-828	Thunder Arm	PING	3/19/2015	9/28/2015	m	625	2250
A69-1303-833	Thunder Arm	PING	3/19/2015	9/28/2015	f	620	2100
A69-1303-834	Thunder Arm	PING	3/19/2015	9/28/2015	m	485	900
A69-1303-835	Thunder Arm	PING	3/19/2015	9/28/2015	f	680	2300
A69-1303-2253	Diablo Res.	PING	10/17/2013	7/1/2015	m	720	3700
A69-1303-2257	Diablo Res.	PING	10/29/2013	7/13/2015	m	405	800
A69-1303-2261	Diablo Res.	PING	11/21/2013	8/5/2015	m	770	3800
A69-1303-2262	Diablo Res.	PING	11/14/2013	7/29/2015	m	550	1600
A69-1303-2264	Diablo Res.	PING	11/7/2013	7/22/2015	m	480	1380
A69-1303-17756	Diablo Res.	PING	10/18/2012	11/26/2016	m	525	2100
A69-1601-22793	Thunder Arm	PING	2/19/2015	6/21/2019	m	555	1650

Table 4. Active acoustic tags in Gorge Lake during 2015 monitoring period (TP = temperature/pressure sensor tag; PING = pinger tag).

Tag Number	Tagging Site	Sensor	Tagging Date	Tag End Date	Sex	Length (mm)	Weight (g)
A69-1105-42/43	Gorge Res.	TP	8/15/2013	3/20/2016	m	485	1130
A69-1303-836	Diablo Powerhouse	PING	3/20/2015	9/29/2015	m	580	1400
A69-1303-2254	Gorge Res.	PING	10/11/2013	6/25/2015	m	485	1450
A69-1303-2258	Gorge Res.	PING	10/29/2013	7/13/2015	m	573	2100
A69-1303-2259	Gorge Res.	PING	10/29/2013	7/13/2015	f	490	1200
A69-1303-2263	Gorge Res.	PING	11/7/2013	7/22/2015	f	620	2850
A69-1601-22788	Diablo Powerhouse	PING	11/4/2014	3/6/2019	m	750	3250
A69-1601-22789	Diablo Powerhouse	PING	11/4/2014	3/6/2019	f	535	1900
A69-1601-22791	Diablo Powerhouse	PING	2/19/2015	6/21/2019	m	558	1675
A69-1601-22794	Diablo Powerhouse	PING	2/19/2015	6/21/2019	f	480	1150
A69-1601-58454	Diablo Powerhouse	PING	11/13/2015	3/14/2020	m	755	3250
A69-1601-58458	Diablo Powerhouse	PING	11/6/2015	3/7/2020	f	760	4400
A69-1601-58459	Diablo Powerhouse	PING	11/13/2015	3/14/2020	f	563	2400
A69-9002-3499/3500	Gorge Res.	TP	8/15/2013	3/14/2015	m	355	520

Table 5. Acoustic tag detection summary for bull trout tagged in Ross Lake during 2015 monitoring period (ND = no detections).

Tag Number	Tagging Date	Last Detection Date	Last Detection Site	Ross Lake	Ross Dam Forebay	Ross Dam Intake	Diablo Lake	Gorge Lake
A69-1105-20/21	8/28/2013	4/19/2015	RLK02	10	1	1	0	0
A69-1105-22/23	8/28/2013	ND	ND	0	0	0	0	0
A69-1105-24/25	10/24/2012	3/1/2015	RLK01	13	0	0	0	0
A69-1105-26/27	10/24/2012	2/19/2015	RLK01	469	183	1	0	0
A69-1105-28/29	10/24/2012	4/29/2015	RLK02	825	772	300	0	0
A69-1105-30/31	8/28/2013	ND	ND	0	0	0	0	0
A69-1105-32/33	8/28/2013	ND	ND	0	0	0	0	0
A69-1105-34/35	8/28/2013	2/27/2016	RLK01	7,090	125	29	0	0
A69-1105-36/37	10/24/2012	ND	ND	0	0	0	0	0
A69-1105-38/39	10/24/2012	ND	ND	0	0	0	0	0
A69-1105-40/41	8/28/2013	3/8/2016	RLK01	50,406	32	0	0	0
A69-1105-44/45	10/24/2012	5/29/2015	RLK01	4,876	3	1	0	0
A69-1105-46/47	10/24/2012	5/15/2015	RLK02	3,759	1,009	136	0	0
A69-1105-48/49	10/24/2012	6/9/2015	RLK02	11	1	0	0	0
A69-1105-50/51	8/28/2013	2/16/2015	RLK01	4	1	0	0	0
A69-1105-52/53	10/24/2012	ND	ND	0	0	0	0	0
A69-1105-54/55	10/24/2012	4/24/2015	RLK01	7	2	0	0	0
A69-1105-56/57	10/24/2012	3/11/2015	RLK01	14	1	1	0	0
A69-1105-58/59	10/24/2012	ND	ND	0	0	0	0	0
A69-1105-60/61	11/5/2014	3/8/2016	RLK02	27,022	2,256	398	0	0
A69-1105-62/63	6/25/2015	10/6/2015	RLK01	1,583	948	1	0	0
A69-1105-64/65	6/25/2015	1/5/2016	RLK02	4,052	3,638	847	0	0
A69-1105-66/67	11/5/2014	10/23/2016	RFB03	3,651	1,187	258	0	0
A69-1105-68/69	11/5/2014	7/9/2015	RFB05	69	24	6	0	0
A69-1105-70/71	6/24/2015	3/10/2016	RFB04	10,087	8,675	1,021	0	0
A69-1105-72/73	6/24/2015	11/26/2016	RLK04	1,553	0	0	0	0
A69-1105-74/75	6/24/2015	3/8/2016	RLK02	35,306	34,917	7,196	0	0
A69-1105-76/77	6/24/2015	3/8/2016	RLK02	49	2	0	0	0
A69-1105-78/79	6/24/2015	9/28/2015	RLK04	56	2	1	0	0
A69-1105-80/81	6/24/2015	12/27/2015	RLK02	6,831	6,614	0	0	0
A69-1105-82/83	6/24/2015	ND	ND	0	0	0	0	0
A69-1105-84/85	6/24/2015	2/24/2016	RLK01	26,671	25,578	10,552	0	0

Table 5 (continued).

Tag Number	Tagging Date	Last Detection Date	Last Detection Site	Ross Lake	Ross Dam Forebay	Ross Dam Intake	Diablo Lake	Gorge Lake
A69-1105-86/87	6/12/2015	8/9/2015	RFB02	930	928	0	0	0
A69-1105-88/89	6/12/2015	6/28/2015	RLK01	7	3	1	0	0
A69-1105-90/91	6/12/2015	12/20/2015	RLK02	1,367	326	4	0	0
A69-1105-92/93	6/24/2015	9/7/2015	RFB04	1,194	929	0	0	0
A69-1105-94/95	6/11/2015	2/24/2015	RLK02	2,377	1,791	318	0	0
A69-1105-96/97	6/12/2015	9/8/2015	RLK02	1,578	1,533	137	0	0
A69-1105-98/99	6/12/2015	3/8/2016	RLK02	44,002	16,267	5	0	0
A69-1303-2250	10/25/2013	4/28/2015	RLK05	572	0	0	0	0
A69-1303-2251	10/25/2013	6/30/2015	RLK02	439	272	31	0	0
A69-1303-2252	10/25/2013	7/3/2015	RLK02	113	0	0	0	0
A69-1303-2255	10/25/2013	ND	ND	0	0	0	0	0
A69-1303-2256	10/25/2013	7/19/2015	RFB03	23,377	23,377	0	0	0
A69-1601-58455	11/12/2015	3/6/2016	RLK02	587	0	0	0	0
A69-1601-58456	11/12/2015	2/29/2016	RLK01	19,122	17,101	174	0	0
A69-1601-58457	11/12/2015	3/8/2016	RLK02	16,124	15,647	523	0	0
A69-9002-3509/3510	8/28/2013	1/27/2015	RLK02	577	47	0	0	0
A69-9002-3519/3520	8/28/2013	ND	ND	0	0	0	0	0
A69-9002-3529/3530	8/28/2013	ND	ND	0	0	0	0	0
TOTAL DETECTIONS				296,961	164,373	22,214	0	0

Table 6. Acoustic tag detection summary for bull trout tagged in Diablo Lake during 2014 monitoring period (ND = no detections).

Tag Number	Tagging Date	Last Detection Date	Last Detection Site	Diablo Lake	Diablo Dam Forebay	Gorge Lake
A69-1303-828	3/19/2015	8/2/2015	DLK07	20,331	8,321	0
A69-1303-833	3/19/2015	5/3/2015	DLK07	8,268	0	0
A69-1303-834	3/19/2015	8/24/2015	DLK02	17,610	523	0
A69-1303-835	3/19/2015	9/28/2015	DLK04	19,330	2,452	0
A69-1303-2253	10/17/2013	ND	ND	0	0	0
A69-1303-2257	10/29/2013	7/22/2015	DLK02	9,365	42	0
A69-1303-2261	11/21/2013	8/15/2015	DLK06	46,011	276	0
A69-1303-2262	11/14/2013	ND	ND	0	0	0
A69-1303-2264	11/7/2013	8/1/2015	DLK06	88,362	61	0
A69-1303-17756	10/18/2012	ND	ND	0	0	0
A69-1601-22793	2/19/2015	1/27/2016	DLK07	18,519	0	0
TOTAL DETECTIONS				227,796	11,675	0

Table 7. Acoustic tag detection summary for bull trout tagged in Gorge Lake during 2014 monitoring period (ND = no detections).

Tag Number	Tagging Date	Last Detection Date	Last Detection Site	Gorge Lake	Gorge Dam Forebay	Gorge Powerhouse Tailrace
A69-1105-42/43	8/15/2013	1/13/2016	GLK06	3,522	0	0
A69-1303-836	3/20/2015	10/10/2015	GLK01	25,072	2776	0
A69-1303-2254	10/11/2013	7/3/2015	GLK06	2,047	0	0
A69-1303-2258	10/29/2013	ND	ND	0	0	0
A69-1303-2259	10/29/2013	5/24/2015	GLK06	13,865	0	0
A69-1303-2263	11/7/2013	7/20/2015	GLK05	68,984	0	0
A69-1601-22788	11/4/2014	1/13/2016	GLK05	43,229	0	0
A69-1601-22789	11/4/2014	1/13/2016	GLK06	63,979	0	0
A69-1601-22791	2/19/2015	1/6/2016	GLK04	53,076	81	0
A69-1601-22794	2/19/2015	1/13/2016	GLK06	47,007	0	0
A69-1601-58454	11/13/2015	1/12/2016	GLK06	13,488	0	0
A69-1601-58458	11/6/2015	1/13/2016	GLK06	11,467	0	0
A69-1601-58459	11/13/2015	1/13/2016	GLK05	7,927	0	0
A69-9002-3499/3500	8/15/2013	3/16/2015	GLK06	2,599	0	0
TOTAL DETECTIONS				356,262	2,857	0