Invasive Non-Native Plant Species Control Project 2010-2014

Impact of INNPS Control for the Nith Catchment Fishery Trust

1. Purpose:

The purpose of this report is to present and describe the extent and impact of work undertaken for the control and eradication of riparian invasive non-native plant species (INNPS) in the Nith Catchment Fishery Trust (NCFT) area. The Dumfries and Galloway Invasive Non-native Plant Species project commenced in 2010 and has run for 5 years. The Nith Catchment Fishery Trust has led the project within the area of the Nith catchment. The project has been part funded by the Scottish Environment Protection Agency, LEADER and Landfill Communities Fund and supported by the Nith District Salmon Fishery Board.

2. The Initial Situation:

The catchment of the River Nith is long and narrow in shape, and spans an area of approximately 1,200 km^2. The catchment originates from the upland, industrialised landscape around New Cumnock, noted for its traditional local industry of coal mining. The catchment extends from the industrialised upper catchment in East Ayrshire, south through Dumfries & Galloway to the estuary in the Solway Firth. The land use through the majority of the catchment is dedicated to agriculture and many of the watercourses are foliated by deciduous trees. The river then traverses an urbanised area through the town of Dumfries, the largest town in South West Scotland. The tidal limit of the River Nith is at Dumfries but the river actually enters the sea at Glencaple village, located approximately 7 km to the south of Dumfries. To the west, the catchment includes the area around the village of Moniaive and eastwards to the Lowther Hills. Within the Nith catchment there are number of sub-catchments, namely the Cargen Water, Cluden/Cairn Water, Scaur Water, Shinnel Water, Kello Water, Euchan Water and Afton Water to the east of the main stem River Nith and the Cample Water, Mennock Water and Crawick Water to the west of the main stem River Nith. There are also a number of small coastal catchments; the Crooks Pow/Burn, the New Abbey Pow/Burn, Carsethorn Pow/Burn, Southwick Burn and Kirk Pow/Burn. See Appendix 1.

The invasive non-native riparian plant species present in the Nith Catchment before treatment were Japanese knotweed, Himalayan balsam, Giant hogweed and American skunk cabbage. See Table 1. The stands of Japanese knotweed were dense and ran from the top of the catchment north of New Cumnock, down the length of the main stem Nith, the waters of Cairn, Scaur and Crawick, and also a number of minor tributaries. Japanese

knotweed is also found on some of the coastal burns however full surveys were not conducted on these burns during the original survey in 2007 as efforts were concentrated on the main stem of the River Nith and its tributaries. Following a survey carried out in 2007, a total of 124 stands were identified, including those on the coastal burns, which were noted. During the course of the project an additional 96 stands were found or reported due to the increased awareness of INNPS resulting from the project. Giant hogweed was present in large numbers along a 67km stretch of the river from Penpont on the Scaur Water and down the Nith to Kingholm Quay. Himalayan balsam is present on the main stem of the Nith from Drumlanrig Castle down to Glencaple, and on the Cairn Water down to its confluence with the Nith and on the Cample Water. It is also present along a number of the small tributaries and on roadsides. See Appendices 2a, b, c & d.

Table 1: Distribution of invasive non-native plant species (INNPS) within the Nith catchment

Japanese knotweed					
Water body ID	**River/Water body Name**	**Length of area surveyed (km)**	**No. stands**	**Area colonized (m^2)**	**Density along area surveyed (DAFOR)**
100329	Lochrutton Loch	1.20	3	1625	Occasional
10601	Lochfoot Burn	0.50	2	650	Occasional
10603	River Nith (Dumfries)	6.59	17	3084	Occasional
10604	Cairn/Cluden	50.5	48	6707	Occasional
10605	Dalwhat Water	1.62	1	175	Occasional
10606	Craigdarroch Water	5.31	4	224	Occasional
10607	Castlefairn Water	10.60	7	438	Occasional
10610	River Nith (Dumfries - Sanquhar)	38.90	41	3029	Occasional
10614	River Nith (New Cumnock)	0.51	3	180	Occasional
10618	Crawick Water	1.05	3	60	Occasional
10624	Scaur Water (River Nith to Shinnel Water)	4.89	9	1380	Occasional
10634	Pennyland Burn	5.11	3	2962	Occasional
200316	Nith Estuary	15.50	23	2636	Occasional
10598	New Abbey Pow	9.82	46	14621	Frequent
10595	Southwick Burn	5.80	4	1185	Occasional
10599	Crooks Pow	0.53	2	5	Occasional
150184	Carse Pow	2.02	4	757	Occasional
	Total	**160.45km**	**220**	**39718m^2**	

Giant hogweed					
Water body ID	**River/Water body Name**	**Length of area surveyed (km)**	**No. plants treated (2010-14)**	**Area colonized (m^2)**	**Density along area surveyed (DAFOR)**
10624	Scaur Water (River Nith to Shinnel Water)	15.9	6501	7801	Frequent
10610	River Nith (Dumfries - Sanquhar)	38.9	22552	27062	Frequent
10603	River Nith (Dumfries)	6.59	4225	5070	Occasional
200316	Nith Estuary	5.26	1601	1921	Occasional
10604	Cairn/Cluden	0.50	35	42	Rare
10614	Afton Water	0.50	49	59	Rare
	Total	**67.65km**	**34963**	**41955m^2**	
Himalayan balsam					
Water body ID	**River/Water body Name**	**Length of area surveyed (km)**	**No. plants treated (2010-14)**	**Length of river bank colonized (km)**	**Density along area surveyed (DAFOR)**
10603	River Nith (Dumfries)	6.59	n/a	6.59	Dominant
10604	Cairn/Cluden	9.65	n/a	9.65	Dominant
10609	Old Water of Cairn	7.02	n/a	7.02	Dominant
10610	River Nith (Dumfries - Sanquhar)	16.53	n/a	16.53	Dominant
10634	Pennyland Burn	6.84	n/a	6.84	Dominant
200316	Nith Estuary	11.95	n/a	11.95	Dominant
10599	Crooks Pow	5.35	n/a	5.35	Dominant
10629	Cample Water	6501	n/a	6501	Dominant
	Total	**70.43km**		**70.43km**	
Skunk cabbage					
Water body ID	**River/Water body Name**	**Length of area surveyed (km)**	**No. plants treated (2010-14)**	**Area colonized (m^2)**	**Density along area surveyed (DAFOR)**
10606	Craigdarroch Water	1.66	551	661.20	Dominant
10607	Castlefairn Water	0.56	225	270.00	Dominant
10604	Cairn/Cluden	2.81	50	60.00	Rare
	Total	**5.03km**	**826**	**991.20km**	

Densities are shown using the DAFOR scale: D = Dominant (>75%), A = Abundant (75-51%), F = Frequent (50-26%), O = Occasional (25-11%), R = Rare (10-1%)

In 2007, SEPA provided funding to the Nith District Salmon Fishery Board (NDSFB) in order to conduct a comprehensive survey of invasive non-native plant species within the Nith catchment. The majority of the data was collected at that time and was collated to assess the scale of the problem. Additional information on the location of INNPS sites has been obtained from ongoing monitoring undertaken by staff from the NCFT and the NDSFB, particularly on the coastal burns which had not been surveyed fully as part of the initial project. Publicity and awareness raising campaigns resulted in local sightings, which were also incorporated, following confirmation of location and species by NCFT personnel.

Records from both the public and fisheries staff continue to be incorporated into the database.

There have been isolated cases where the further spread of INNPS has been traced to a specific activity, or event. For example, Japanese knotweed was discovered at one site where the source of infestation was an area where compost clippings had been deposited. Himalayan balsam was found on the Penpont Burn after works carried out by Scottish Water. It is believed to have been brought in on the machinery used to construct the last water treatment works. An isolated group of Giant hogweed plants was discovered near a Scottish Water facility at the top of the Afton Water.

In most cases, the source of riparian INNPS has been traced back to large country estates and houses where these species had been introduced in the 19th century as ornamental garden plants. At the time, the ability for these plants to rapidly colonize and escape was not appreciated.

3. Treatment:

The control strategy adopted a catchment-based approach. Since Giant hogweed is one of the earliest of the target plants to germinate and set seeds, it was the first plant scheduled for treatment during the season. Treatment began at the top of the catchment, continuing in a downstream direction towards the Estuary. This method was adopted for all species as the most common means of riparian INNPS seed dispersal is downstream via watercourses. This means that areas previously treated are not susceptible to re-infestation from untreated upstream colonies.

Work was undertaken by full time members of staff, seasonal staff members and volunteers. All members of staff and volunteers undertook training which included the identification and life histories of invasive species, different control methods, safe use of pesticide (PA1 & PA6AW), recording procedures and NCFT H&S procedures. Staff members and long-term volunteers who had undergone the official pesticide training course (PA1 and PA6) carried out stem injection of Japanese knotweed and Giant hogweed whilst other volunteers carried out hand pulling of Himalayan balsam.

Work commenced in 2010 and continued on an annual basis using the following procedures:

Japanese knotweed – Stem injection was the primary method used to treat Japanese knotweed and over the course of this project it has been observed that over 80% of the Japanese knotweed is affected during initial treatment. See Table 5. The initial treatment using stem injection systems took longer but thereafter, the treatment took less time and could be carried out using a sprayer.

The injecting of Japanese knotweed was more labour intensive but was our preferred method. This decision was based on the fact that we considered injecting glyphosate directly into the stem of a plant more environmentally friendly than spraying onto the leaves. There was less risk of the spray drifting onto surrounding plants and coming into contact with insects. The use of stem injection also meant that treatment was not restricted to dry days with low wind conditions, unlike spraying which could only take place when wind conditions were correct and when rain wasn't forecast. Spraying was effective when treating plants that were too small to inject and at locations where access was difficult or dangerous e.g. by using a long lance.

Japanese knotweed control started in June and continued through until the first frosts, normally in September/October. Initial treatments of Japanese knotweed stands were followed by a return visit two weeks later. Due to the number of stems normally found in a dense stand of Japanese knotweed, it was common for some stems to be missed, or for it to be very difficult to reach some stems without damaging treated stems. Therefore a strategy was developed where by the outer stems were treated first and then the stand revisited two to three weeks later and re-treated until the whole stand had been completed. Each stand was then monitored on an annual basis thereafter, and if required, newly emerging stems were re-treated. Some stands have now been treated/monitored for four consecutive years and in many cases most stands only have a couple of stems every year that require treatment.

Giant hogweed – Physical removal of giant hogweed, by cutting through the crown of the plant whilst it was small, was used for the first round of control in 2010, whilst we were awaiting permission from SEPA to use pesticides along the banks of the river. This method was very labor intensive, posed higher risks to the operator, and did not appear to be very effective with regrowth occurring later in the season. Since then a combination of stem injection using neat Roundup Pro Bioactive on larger plants and spraying of small plants has been carried out.

Treatment of Giant hogweed took place between April and June, before the plant flowered. Each plant received one dose of glyphosate and was revisited approximately two weeks after treatment to ensure the treatment had been successful and to check for newly emerging plants. Occasionally, some of the larger plants required a second treatment two to three weeks later.

Himalayan balsam – A variety of methods were used to tackle Himalayan balsam including strimming, hand pulling and spraying. No method was found to deal effectively with the large quantities of Himalayan balsam present within the catchment. Himalayan balsam must be treated before it seeds at the end of July/August. This leaves a very short window for treatment post any control work being carried out on Giant hogweed. The majority of the Himalayan balsam can be pulled/strimmed/sprayed in the first year but the area must be re-treated in years 2 and 3 to ensure no flowering plants are allowed to set seed. We have

worked with community groups from Glencaple, New Abbey, Islesteps, Irongray, Gatelawbridge, Wallaceton and Dumfries to encourage local communities to tackle Himalayan balsam within their areas. We visit with the group, discuss the problem, give a talk to the community and assist with organising control days.

Skunk cabbage – Skunk cabbage was treated for the first time in 2013. Plants were sprayed using the recommended solution of glyphosate.

Post-treatment monitoring

Pre- and post- treatment monitoring of all sites recording levels of INNPS coverage (number of stems/plants) was carried out to determine the success of control. Additionally, photographs were taken of each stand before and after treatment (see Appendix 6).

Awareness raising

The Nith Catchment Fishery Trust implements the Nith Catchment Biosecurity Plan, which identifies biosecurity issues within the River Nith catchment and presents actions that have been agreed with stakeholders for the prevention, early detection, control and mitigation of the introduction and spread of selected invasive non-native species (INNS) and fish diseases. Information leaflets with advice on biosecurity issues involving invasive species were made available for anglers and members of the public (see Table 2). All contractors were advised of the biosecurity risks associated with working cross catchments, of the biosecurity measures required to prevent the spread of invasive species and of their responsibility to carry out work within these guidelines.

Table 2: Distribution of promotional material during project

Type of promotion material	Number distributed
D&G Riparian INNS leaflet	1000's
Metal Angling signage	7
Metal Boating signage	5
Check Clean Dry laminated signs	50+
Species ID cards	100+
Presentations given to groups and communities	15

Recording and Data collection

Data is collated in the field post treatment and from regular monitoring visits. Data is recorded onto data sheets, which are then entered into a spreadsheet. Regular monitoring of all INNPS sites is undertaken. The following measurements are recorded:

- Stand no.
- Water body
- Water body ID Code
- Species
- River bank
- Estate/ Landowner
- Location
- Start Easting (upstream)
- Start Northing (upstream)
- Finish Easting
- Finish Northing (downstream) (downstream)
- Date recorded
- Length (m)
- Width (m)
- Area (m2)
- Starting number of stems (2010 – 2014)
- Area treated
- Stems treated
- Stems monitored
- Photograph
- Status (active/no regrowth)
- % decrease

The following procedural requirements were attached to the INNPS treatment work undertaken:

- Any work undertaken must comply with the Water Framework Directive
- Licenses to use pesticide within 10m of watercourses were obtained from Scottish Environmental Protection Agency (SEPA) on an annual basis. These were on a sub-catchment basis.
- Any members of staff or volunteers carrying out treatments had to be qualified in the safe use of pesticides (PA1) and the use of hand held applicators near water (PA6AW)
- Suitable Personal Protective Equipment (PPE) is mandatory for staff and volunteers to wear. Any damaged PPE or equipment must be reported and replaced.
- A health and safety risk assessment is issued and signed by staff and volunteers. All concerns relating to health and safety must be reported to line manager immediately.
- Procurement of equipment and chemicals must be authorised by the Operations manager and be within the annual budget.
- Accurate recording of all treatments carried out.
- Management staff carried out post treatment quality control checks to ensure that:

  A) Work was being carried out on the ground to a satisfactory level.

  B) Treatments were effective and the project was being completed satisfactorily.

4. Outputs and Outcomes and Impacts:

a) Outputs:

Volunteers were trained to assist with control work. In total seven volunteers have been trained in the use of pesticides and have delivered over 715 hours of their time to the project. Primarily the control of INNS during this project has been delivered by dedicated seasonal staff and Board/Trust staff with them putting a total of 10154 hours into the project. Of these, 6844 hours were delivered by seasonal staff and 3310 hours by existing Board/Trust staff.

During the course of this project, members of staff, volunteers and seasonal workers were trained in the use of pesticides, identification and recording of INNPS and best practice for the control of INNPS. See Table3.

Table 3: Training courses attended by staff and volunteers

Training category	FT Staff	Seasonal	Volunteers
Safe use of pesticides (PA1)	5	6	7
Hand held application near water (PA6AW)	5	6	7
Identification of INNPS	5	6	7
Control of INNPS	5	6	7
Recording of INNPS	5	6	7
Conferences/events attended	12	5	4

Equipment, chemical and PPE was supplied to all of the volunteers and they work alongside and independently of the Trust members of staff. Volunteer training days were carried out to ensure that volunteers kept up to date with health and safety policies and requirements and strategic control plans.

Untrained volunteers have also assisted with INNPS control by pulling Himalayan balsam, assisting with days out spraying Skunk cabbage and Japanese knotweed and monitoring INNPS species. In 2010, the Criminal Justice Service also assisted with strimming of Himalayan balsam. We have been assisted by approximately 75 untrained volunteers during the course of this project.

Trained volunteers have been hand selected as people who have a long term interest in the river, who enjoy working in the countryside and want to improve their local beat/river. Volunteers include anglers from Dumfries and Galloway Angling Association, a ghillie from Friars Carse Hotel, an angler from New Cumnock Angling Association, an estate worker from Drumlanrig Estate and other regular Trust volunteers. Teams of untrained volunteers are recruited from local community groups, anglers and other Trust volunteers.

Equipment

All of the equipment purchased for the project is kept centrally and distributed amongst trained staff members and untrained volunteers. The equipment is serviced regularly and kept in good condition by staff members. Trained volunteers have been issued their own equipment. There have been some issues with the stem injection guns (purchased from Stem Injection Systems). They breakdown frequently and become jammed very easily. We have spoken to the manufactures about this numerous times but other than servicing the guns very little can be done. In an effort to prevent the guns becoming blocked, glyphosate is now diluted 50:50 and rate of application has been increased to compensate for this. Since doing this, the reliability of the guns has improved. Needle breakages are fairly common, especially for Japanese knotweed and needles need to be replaced frequently. The large Cooper Pegler spraying knapsacks function well and none have had to be replaced so far. The smaller handheld sprayers are more prone to failure but are relatively inexpensive and can be replaced easily.

Table 4: Costs of the project for the years 2010 - 2014. Costs include in kind contributions.

	Year				
Costings (£)	2010	2011	2012	2013	2014
Staff costs	13048.56	7703.54	11806.65	11811.38	12373.50
Equipment	773.56	2922.58	731.58	685.71	865.28
Chemical	870.69	1852.80	1574.16	1551.36	1338.50
Staff time (inc. in kind)	12555.83	14771.88	18012.50	22987.00	17616.74
Training	1145.00	3600.00	980.00	735.00	540.80
Mileage	2838.36	3399.06	4273.86	2849.78	3200.00
Total:	**£31,232.00**	**£33,812.36**	**£37378.75**	**£40,620.23**	**£35934.82**

b) Outcomes and Impacts:

Japanese knotweed

The distribution and abundance of Japanese knotweed has decreased significantly since 2010. Overall there has been a 99.54% decrease in the number of Japanese knotweed stems present within the catchment. See Table 5. This is based on the initial number of stems treated and the final number of stems counted when all stands were treated in September 2014. See Appendix 2a for an illustration of treated stands.

Table 5: Treatment of Japanese knotweed within the Nith catchment show as pre/post treatment stem counts.

Water body ID	River/Water body Name	Species	Initial treatment stem count	Final stem count Sept 2014	% decrease
100329	Lochrutton Loch	Japanese Knotweed	1802	2	-99.89%
10601	Lochfoot Burn	Japanese Knotweed	2387	3	-99.87%
10603	River Nith (Dumfries)	Japanese Knotweed	7167	299	-95.83%
10604	Cairn/Cluden	Japanese Knotweed	87744	177	-99.80%
10605	Dalwhat Water	Japanese Knotweed	300	16	-94.67%
10606	Craigdarroch Water	Japanese Knotweed	2476	13	-99.47%
10607	Castlefairn Water	Japanese Knotweed	4383	1	-99.98%
10610	River Nith (Dumfries - Sanquhar)	Japanese Knotweed	16853	96	-99.43%
10614	River Nith (New Cumnock)	Japanese Knotweed	1233	12	-99.03%
10618	Crawick Water	Japanese Knotweed	329	1	-99.70%
10624	Scaur Water (River Nith to Shinnel Water)	Japanese Knotweed	7200	8	-99.89%
10634	Pennyland Burn	Japanese Knotweed	12187	10	-99.92%
200316	Nith Estuary	Japanese Knotweed	8209	57	-99.31%
			152270	**695**	**-99.54%**

New stands are found or reported on an annual basis and these have been added into the database. See Table 6.

Table 6: Japanese knotweed stands recorded between 2007 and 2014

	2007	2010	2011	2012	2013	2014	Total
No. Stands	124	0	9	24	19	44	220

The Cairn Water and the New Abbey Pow were the last watercourses to be treated, as completing treatment on the main stem River Nith and its tributaries was given priority over smaller coastal burns. When treatment commenced on these watercourses it became apparent that the amount of Japanese knotweed present was far in excess of that initially surveyed. On the New Abbey Burn it is likely that these stands have spread as it has been discovered that cutting of Japanese knotweed has been carried out by local residents. This will have facilitated its spread. In 2014, posters and leaflets were distributed around New Abbey to try and inform the locals of the issues associated with Japanese knotweed and the correct ways to treat it. The community council and local land owners have been approached and the Trust will be giving a presentation on INNS in February 2015.

Giant hogweed

The number of large flowering Giant hogweed has decreased since control began but there are still new plants germinating every year (see Table 7). By the end of each season of treatment (July/August) all Giant hogweed plants over the 67 kilometers of river bank that they colonize have been treated. Particular attention was given to flowering hogweed to prevent them seeding. The seeds from Giant hogweed can stay dormant for up to 20 years

(C. Nielsen, 2005) and therefore we would not anticipate seeing a significant decrease in the number of Giant hogweed plants emerging until at least 2021. Provided that treatment of Giant hogweed is continued on an annual basis and no plants are allowed to flower, the control of Giant hogweed within 20 years should be possible.

Table 7: Treatment of Giant hogweed within the Nith catchment shown as number of plants treated each year.

Water body ID	River/Water body Name	Species	2007 survey	2010	2011	2012	2013	2014
10614	River Nith (u/s of New Cumnock)	Giant hogweed	9	40	0	0	0	0
10603	River Nith (Dumfries)	Giant hogweed	561	38	1262	823	307	1234
10610	River Nith (Dumfries - Sanquhar)	Giant hogweed	3959	1004	4606	5113	3341	4529
10604	Cairn/Cluden	Giant hogweed	0	0	0	0	10	25
10624	Scaur Water (River Nith to Shinnel Water)	Giant hogweed	111	157	907	396	2480	1440
200316	Nith Estuary	Giant hogweed	160	78	0	60	0	1303
			4800	**1317**	**6775**	**6392**	**6138**	**8531**

Himalayan balsam

This project has had little positive impact on the distribution and abundance of Himalayan balsam due the size of the task required to make any major progress. The timing of treatment has also made this task more difficult as it was agreed at the start of this project that the removal of Giant hogweed should take precedence due to the risk to human health that it poses.

The hand pulling of Himalayan balsam is extremely labour intensive but has been found to be successful in isolated outbreaks. However, in large areas this method is impractical due to the large numbers of people required. See Table 8.

Table 8: Treatment of Himalayan balsam within the Nith catchment shown as m2 treated

Water body ID	River/Water body Name	Species	2010	2011	2012	2013	2014
10603	River Nith (Dumfries)	Himalayan balsam	0	3087	0	0	2297
10610	River Nith (Dumfries - Sanquhar)	Himalayan balsam	19000	2068	200	0	0
10634	Pennyland Burn	Himalayan balsam	0	0	2200	200	0
10629	Cample Water	Himalayan balsam	0	0	0	16200	0
			19000	**5155**	**2400**	**16400**	**2297**

Skunk cabbage

Skunk Cabbage was reported for the first time in the Nith catchment in 2012 in the Craigdarroch Water, the Castlefairn Water and the Cairn Water. It was subsequently treated in 2013 when all plants were sprayed with glyphosate. Treatment was repeated in 2014 but it is too early to tell what effect this is having. Plants will be monitored and re-treated.

Table 9: Treatment of Skunk cabbage within the Nith catchment shown as m2 treated.

Water body ID	River/Water body Name	Species	2010 - 2014 m^2
10606	Craigdarroch Water	American Skunk Cabbage	661.20
10607	Castlefairn Water	American Skunk Cabbage	270.00
10604	Cairn/Cluden Water	American Skunk Cabbage	60.00
			991.2m^2

Re-establishment of native plants

Although no official surveying was carried out to monitor the re-establishment of native plants in areas that had been treated, it has been observed that post treatment, both by spraying and injecting, the ground is often left bare, with no regenerating vegetation for a number of years. The first plants to become established are often tall, broadleaf species such as nettles, brambles, comfrey and dockens. Himalayan balsam has often become established in areas previously colonized by Japanese knotweed. It has been suggested that future projects should include the re-seeding of treated areas using wildflower and grass seeds and that these areas should be monitored.

5. Conclusions:

The treatment of Japanese knotweed using the stem injection method proved to be successful and stands along the main stem River Nith and its tributaries were significantly reduced. Following an initial treatment using stem injection, small stemmed plants are spot sprayed using a dilute solution of glyphosate and water. If was felt that the technique of carrying out the initial treatments using stem injection systems and then treating any subsequent growth by spraying worked well.

Giant hogweed was treated either by injecting or by spraying, depending on the weather conditions. Both methods proved to be effective but due to the dormant seed banks present along the river banks it could be a further 5 years before we start to see significant decreases in the number of plants germinating. It is vital that the treatment of hogweed is continued to have any chance of eradicating it from the Nith system.

Skunk cabbage continues to be treated following an initial treatment in 2013.

Himalayan balsam has been treated either by hand pulling, spraying or strimming. All of these methods have been effective on small areas but have not had much impact given the scale of the issue in the Nith catchment.

6. Lessons Learnt:

The benefits and limitations of each method are detailed below:

- Stem injection of Japanese knotweed and Giant hogweed is very effective but can be time consuming. Equipment can stop working and stems may be missed. Plants need to be re-visited at least once to ensure all stems are treated.

- Spraying is a quicker method but plants need to be re-visited 2-4 times to ensure that treatment has been effective. The number of days it is possible to treat INNPS by spraying can be limited due to weather conditions.

- Spraying of Giant hogweed is effective. Plants need to be re-visited at least once, preferably twice, to ensure all stems are treated.

- Physical removal of Giant hogweed was not successful and was not repeated.

- There was an increase in the number of Giant hogweed found along the river banks in 2014. It has been theorized that the large flood episodes experienced over the winter of 2013/14 appear to have exposed dormant seed banks of hogweed, stimulating its germination.

- The removal of Himalayan balsam has not been as effective as originally hoped due to the scale of the problem. Strimming, hand pulling and spraying all worked well but were not suitable for large areas as the NCFT does not have the resources in place to be able to deal with it.

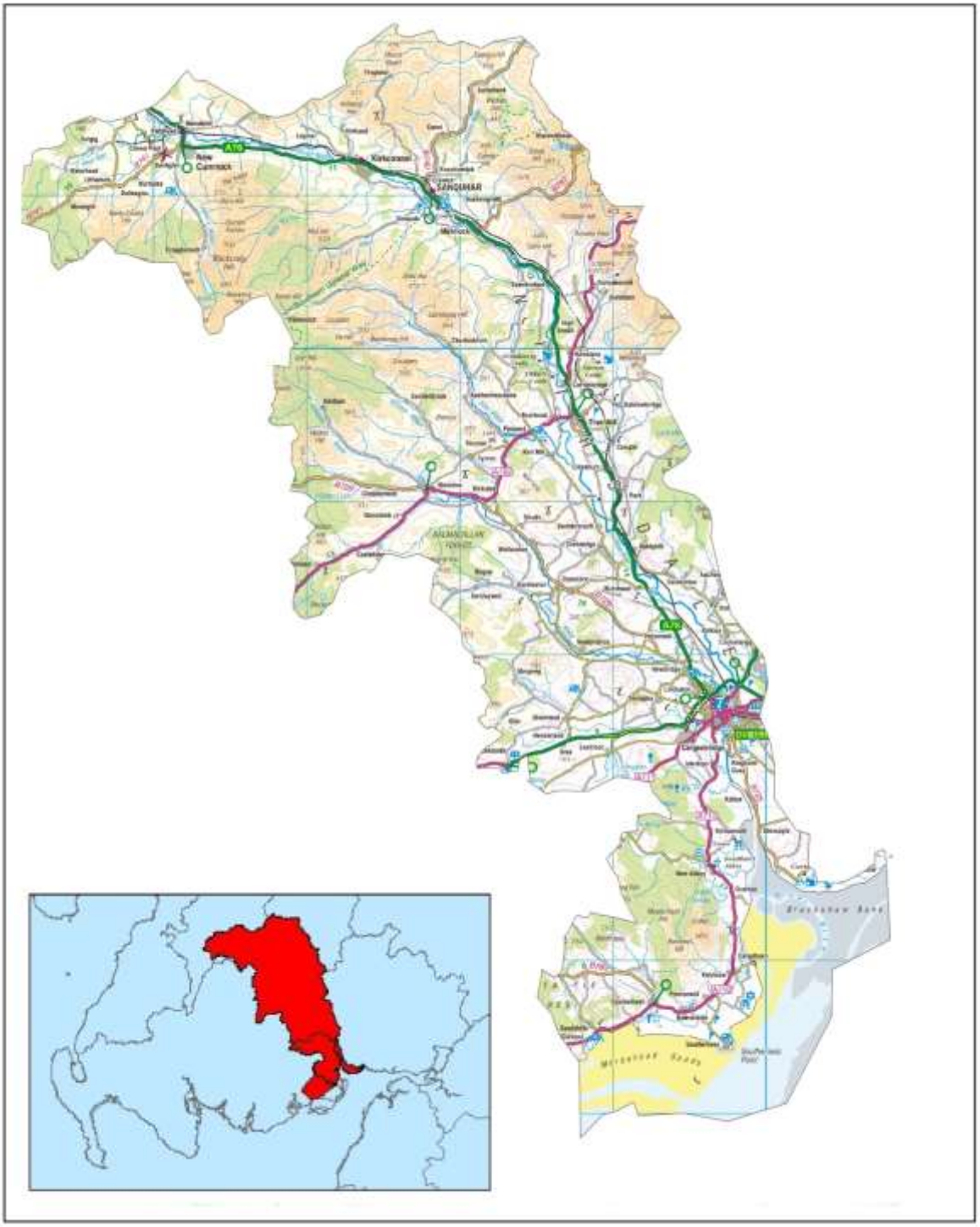
- Using teams of volunteers can be successful but is also unreliable as numbers of volunteers can fluctuate. The practical aspect of using volunteers for skilled tasks such as application of pesticides has to be considered. Every volunteer must work to the same health and safety standards as employees, they must be insured, trained to a standard to be able to operate machinery/equipment and be provided with PPE and equipment that is in good condition. These are all fully justifiable costs provided that the time given by the volunteer in return is sufficient. Unfortunately, volunteers are often transient in nature and there is a risk that the project may not get back the capital put in to training and equipping a volunteer. The coordination of volunteers also requires large inputs of time. However, their involvement can benefit the project and engage the local community in the work of the project and Trust.

- The use of seasonal staff was ideal for on the ground treatment of INNS as it was possible to put large numbers of staff on the ground at the times when treatment was required. This had the additional benefit of motivating staff as it can be de-motivating to tackle a large stand of Japanese knotweed on their own.
- It would have been beneficial to have had a single national database where all data required could be reported. This would have allowed data to have been compiled on a national level and standardized. It has become more apparent as the project has progressed that data has been recorded in different ways in different areas and that a standardized method is required for future projects.
- It is important that the treatment of INNPS is continued to prevent their re-emergence beyond the life of this project. Further funding will be sought.

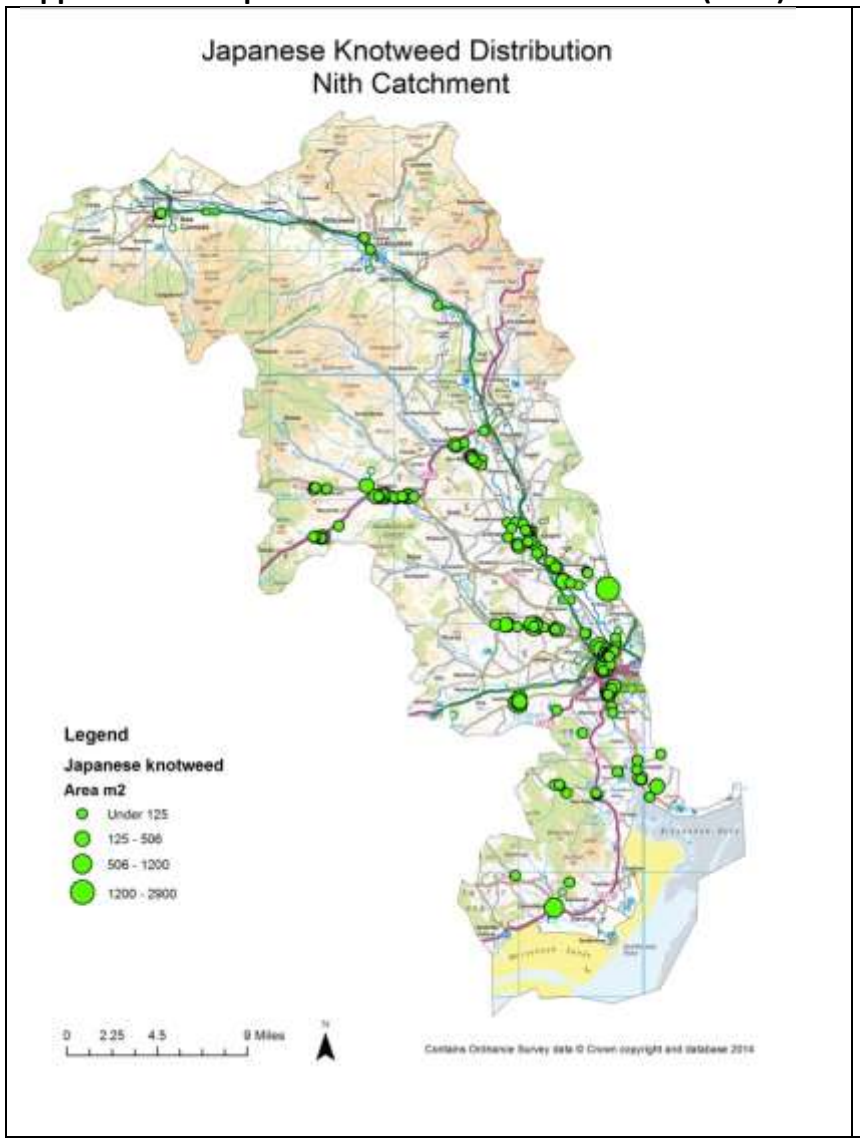
Bibliography

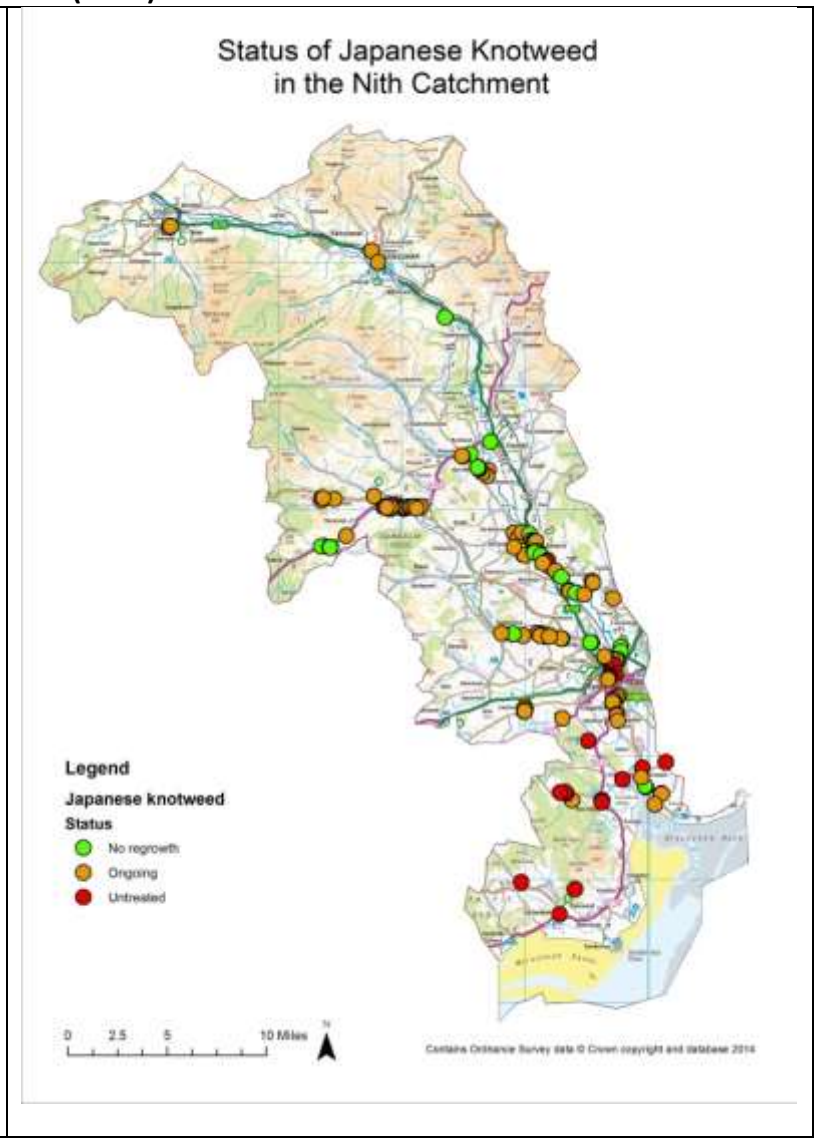
C. Nielsen, H. R. (2005). *The Giant Hogweed Best Practice Manual: Guidelines for the management and control of an invasive weed in Europe.* Denmark: Published by Forest & Landscape.

Appendix 1 – Map of the River Nith catchment



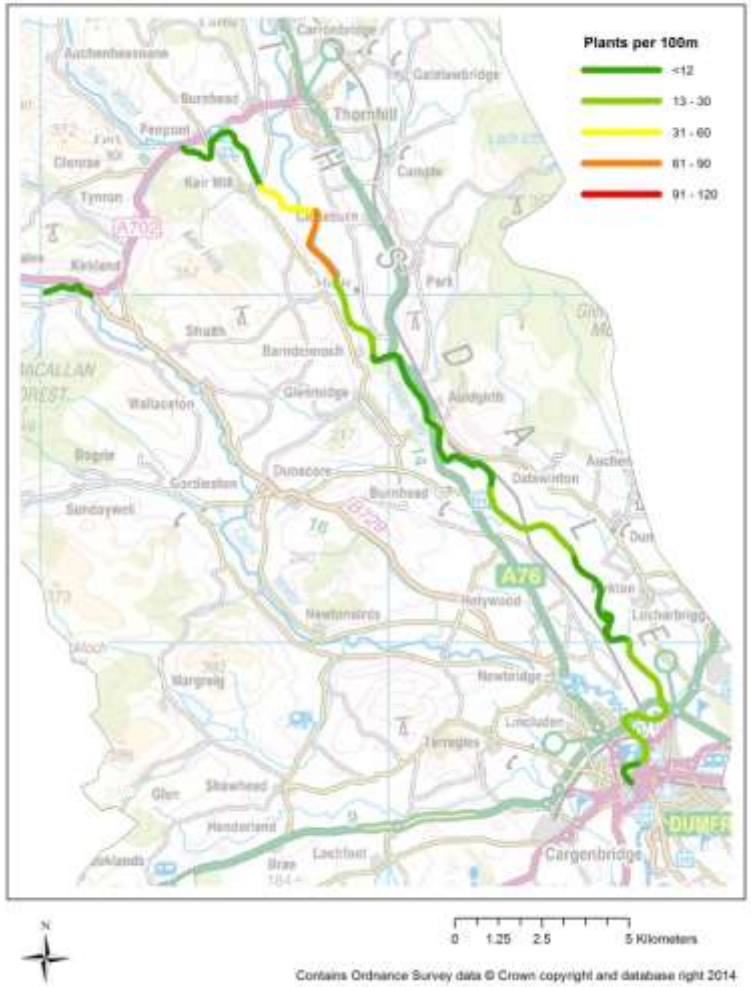
Appendix 1a – Japanese knotweed distribution Pre (2007) and Post (2014)



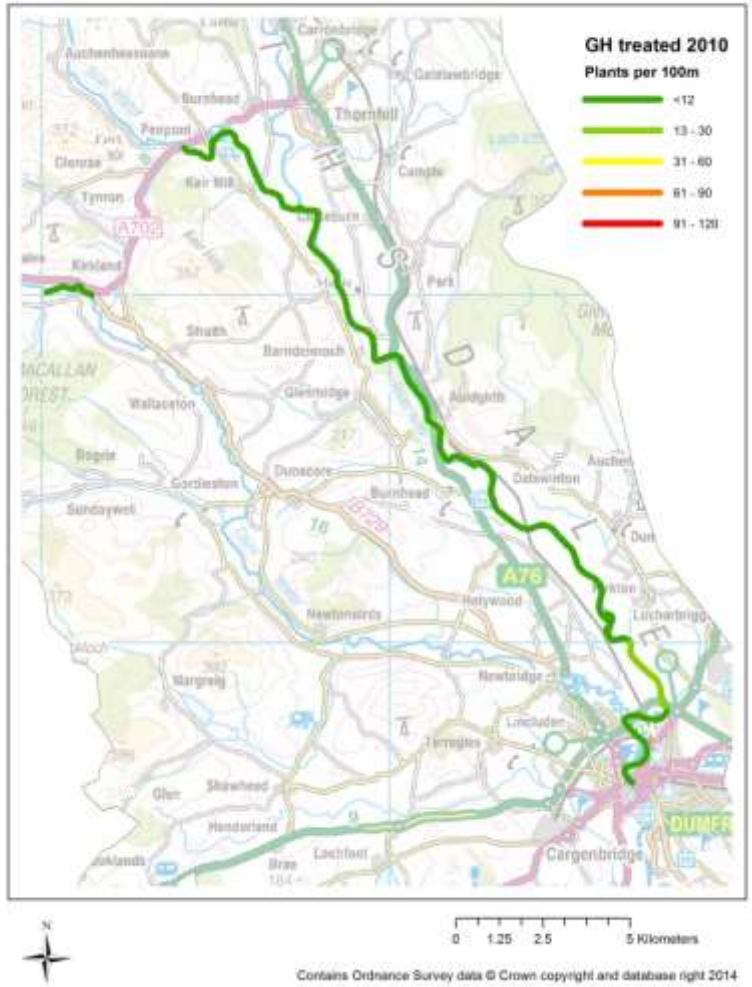


Appendix 2b – Giant hogweed distribution pre (2007) and during treatment

Giant hogweed surveyed within the Nith catchment 2007

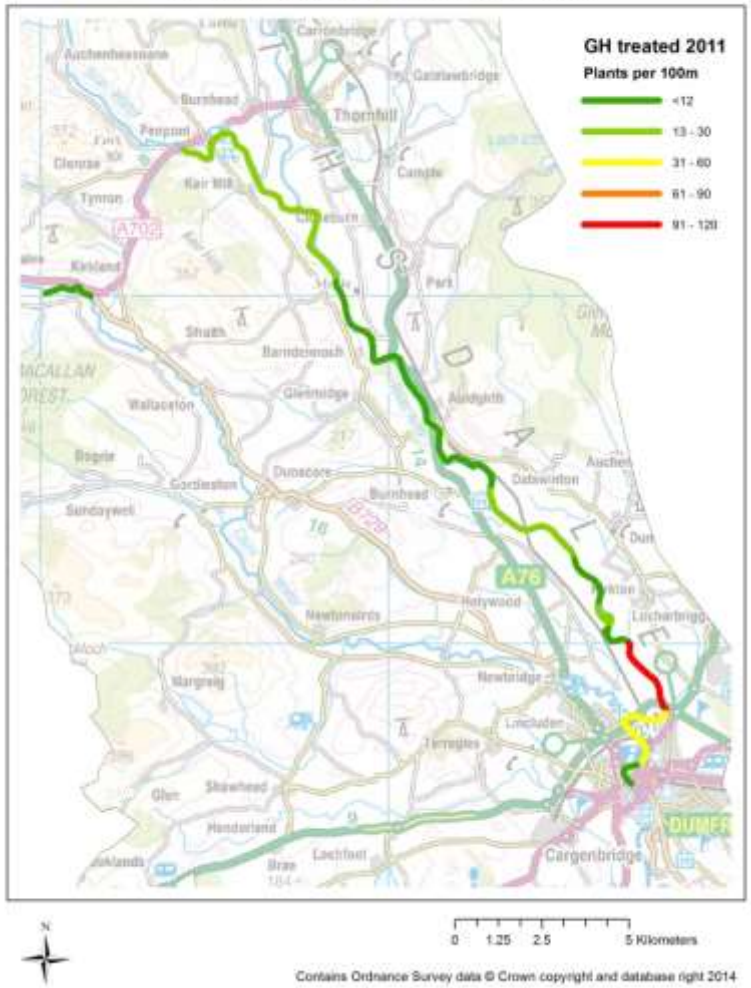


Giant hogweed treated within the Nith catchment 2010

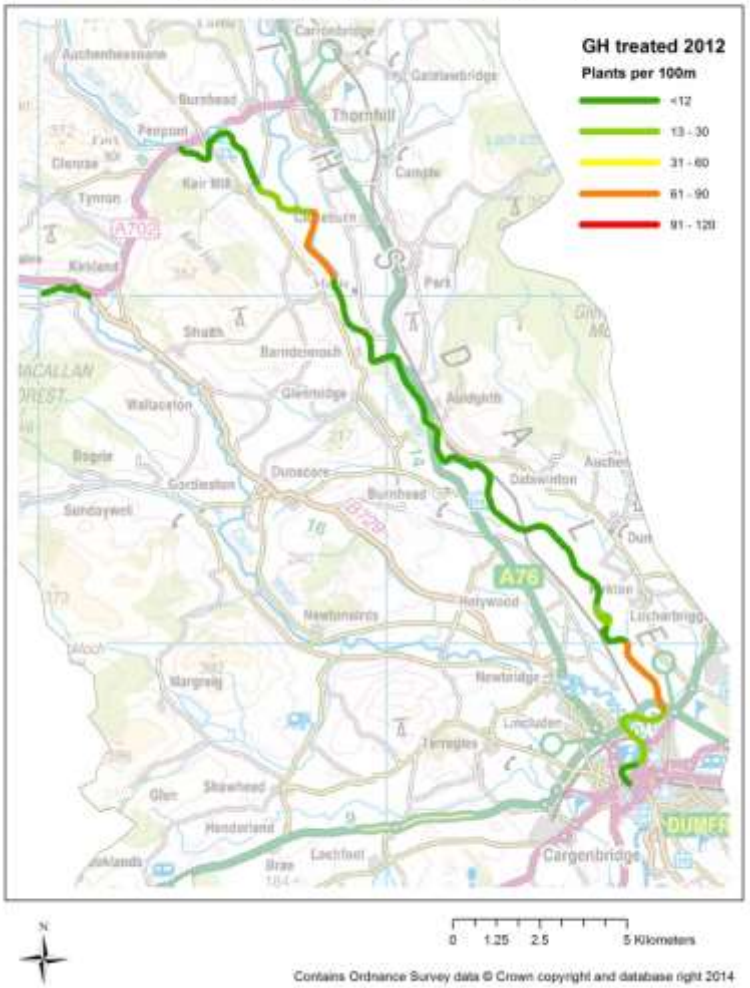


Appendix 3b – Giant hogweed distribution Pre (2007) and during treatment continued

Giant hogweed treated within the Nith catchment 2011

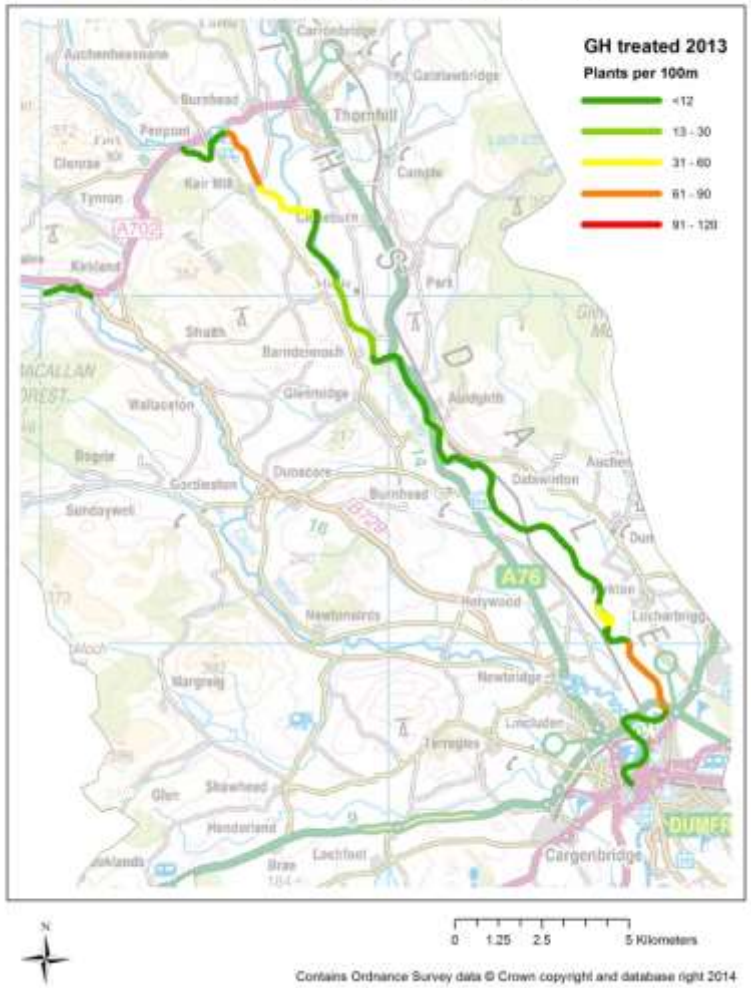


Giant hogweed treated within the Nith catchment 2012

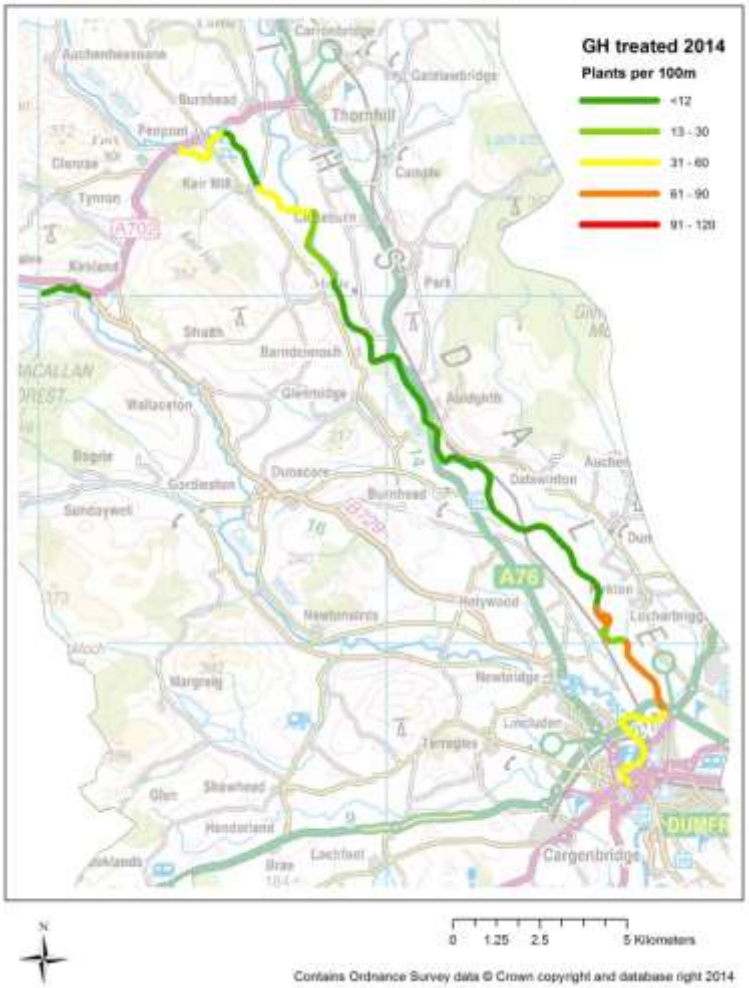


Appendix 4b – Giant hogweed distribution Pre (2007) and during treatment continued

Giant hogweed treated within the Nith catchment 2013



Giant hogweed treated within the Nith catchment 2014



Appendix 4c – Himalayan balsam and Skunk cabbage distribution

Distribution of Himalayan balsam
and Skunk cabbage within the Nith Catchment

Appendix 5 - Tables summarizing the coverage of INNPS infested sites prior to treatment and the impact of control.

All sites were originally surveyed in 2007.

Japanese knotweed											
Water body ID	**River/Water body Name**	**Length of area surveyed (km)**	**No. stands**	**Area colonized (m^2)**	**Density along area surveyed (DAFOR)**	**Number of stems treated each year**					
						2010	**2011**	**2012**	**2013**	**2014**	**Total**
100329	Lochrutton Loch	1.20	3	1625	Occasional	0	0	1505	356	54	**1915**
10601	Lochfoot Burn	0.50	2	650	Occasional	0	0	2387	6	38	**2431**
10603	River Nith (Dumfries)	6.59	17	3084	Occasional	0	0	5867	150	1477	**7494**
10604	Cairn/Cluden	50.5	48	6707	Occasional	30	20248	38149	39937	2756	**101120**
10605	Dalwhat Water	1.62	1	175	Occasional	0	0	250	300	80	**630**
10606	Craigdarroch Water	5.31	4	224	Occasional	0	0	300	2256	325	**2881**
10607	Castlefairn Water	10.60	7	438	Occasional	0	535	3466	600	82	**4683**
10610	River Nith (Dumfries - Sanquhar)	38.90	41	3029	Occasional	8886	3950	3225	2622	848	**19531**
10614	River Nith (New Cumnock)	0.51	3	180	Occasional	0	433	0	0	47	**480**
10618	Crawick Water	1.05	3	60	Occasional	197	112	73	70	0	**452**
10624	Scaur Water (River Nith to Shinnel Water)	4.89	9	1380	Occasional	4200	22	184	3067	145	**7618**
10634	Pennyland Burn	5.11	3	2962	Occasional	12087	0	3006	535	145	**15773**
200316	Nith Estuary	15.50	23	2636	Occasional	0	0	5776	1252	2371	**9399**
10598	New Abbey Pow	9.82	46	14621	Frequent	0	0	0	0	15038	**15038**
10595	Southwick Burn	5.80	4	1185	Occasional	0	0	0	0	120	**120**
10599	Crooks Pow	0.53	2	5	Occasional	0	40	0	0	8	**48**
150184	Carse Pow	2.02	4	757	Occasional	0	0	0	0	3290	**3290**
	Total	**160.45km**	**220**	**39718m^2**		**25,400**	**25,340**	**64,188**	**51,151**	**26,824**	**192,783**

Giant hogweed											
Water body ID	River/Water body Name	Length of area surveyed (km)	No. plants treated (2010-14)	Area colonized (m^2)	Density along area surveyed (DAFOR)	Meters squared treated each year (m^2)					
						2010	2011	2012	2013	2014	Total
10624	Scaur Water (River Nith to Shinnel Water)	15.9	6501	7801	Frequent	188.4	1088.4	475.2	2988.0	1728.0	**7801.2**
10610	River Nith (Dumfries - Sanquhar)	38.9	22552	27062	Frequent	1204.8	4606.0	6135.6	4009.2	5434.8	**27062.4**
10603	River Nith (Dumfries)	6.59	4225	5070	Occasional	45.6	5527.2	987.6	368.4	1480.8	**5070.0**
200316	Nith Estuary	5.26	1601	1921	Occasional	0.0	0.0	0.0	12.0	30.0	**42.0**
10604	Cairn/Cluden	0.50	35	42	Rare	93.6	0.0	72.0	0.0	1563.6	**1921.2**
10614	Afton Water	0.50	49	59	Rare	48.0	0.0	0.0	0.0	0.0	**58.8**
	Total	**67.65km**	**34963**	**41955m^2**		**1644.0**	**8130.0**	**7670.4**	**7377.6**	**10273.2**	**41955.6**

Himalayan balsam											
Water body ID	River/Water body Name	Length of area surveyed (km)	No. plants treated (2010-14)	Area colonized (km)	Density along area surveyed (DAFOR)	Meters squared treated each year (m^2)					
						2010	2011	2012	2013	2014	Total
10603	River Nith (Dumfries)	6.59	n/a	6.59	Dominant	0	3087	0	0	2297	**5384**
10604	Cairn/Cluden	9.65	n/a	9.65	Dominant	0	0	0	0	0	**0**
10609	Old Water of Cairn	7.02	n/a	7.02	Dominant	0	0	0	0	0	**0**
10610	River Nith (Dumfries - Sanquhar)	16.53	n/a	16.53	Dominant	19000	2068	200	0	0	**21268**
10634	Pennyland Burn	6.84	n/a	6.84	Dominant	0	0	2200	200	0	**2400**
200316	Nith Estuary	11.95	n/a	11.95	Dominant	0	0	0	0	0	**0**
10599	Crooks Pow	5.35	n/a	5.35	Dominant	0	0	0	0	0	**0**
10629	Cample Water	6501	n/a	6501	Dominant	0	0	0	16200	0	**16200**
	Total	**70.43km**		**70.43km**		**19000**	**5155**	**2400**	**16400**	**2297**	**45252**

Skunk Cabbage											
Water body ID	**River Name**	**Length of area surveyed (km)**	**No. plants treated (2010-14)**	**Area colonized (m^2)**	**Density along area surveyed (DAFOR)**	**Number of stems treated each year**					
						2010	**2011**	**2012**	**2013**	**2014**	**Total**
10606	Craigdarroch Water	1.66	551	661.2	Dominant	0	0	0	420	241.2	**661.2**
10607	Castlefairn Water	0.56	225	270	Dominant	0	0	0	198	72	**270**
10604	Cairn/Cluden	2.81	50	60	Rare	0	0	0	0	60	**60**
	Total	**5.03km**	**826**	**991.2**		**0**	**0**	**0**	**618**	**373.2**	**991.2**

Appendix 6 – Photographs of INNPS before and after treatment

Japanese knotweed stand JK36 on Burns walk, Nunholm	
	
Before – 25/06/2012	After 07/05/2013

Japanese knotweed stand JK22 Friars Carse Hotel	
	
Before 28/07/2010	After 11/07/2014

Japanese knotweed stand JK71 Six Mile Corner	
	
Before 02/08/2013	After12/06/2014

Japanese knotweed stand JK34 Burns Walk- Above bypass bridge	
	
Before 06/06/2013	After 07/07/2014

Giant hogweed Barjarg Fishing beat	
	
Before 12/05/2014	After 21/05/2014

Giant hogweed Whitesands Dumfries	
	
Before 06/06/2013	After 12/07/14

Himalayan balsam – Dalswinton	
	
Before spraying 25/07/2012	After spraying 09/08/2012

Himalayan balsam Whitesands	
	
Before 16/07/2014	After 16/07/2014

Skunk cabbage Craigdarroch Loch	
	
Before 08/07/2013	After 23/07/2014

Skunk cabbage Craigdarooch burn – follow-up treatment	
	
06/06/2014	23/07/2014