Llanishen & Lisvane Reservoirs Crayfish Survey

Dŵr Cymru Welsh Water

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Revision and Amendment Register

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1	12/09/2018		19	First draft for DCWW review	PD
2	13/09/2018	3, 4, 5	22	Revised text re. Nant Fawr/ Glandulais watercourses and of recommendations	HW
3	14/09/2018	5	23	Final. Revision to anecdotal evidence text	HW

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1. Introduction

Dŵr Cymru Welsh Water (DCWW) is evaluating refilling and water transfer options between Lisvane and Llanishen reservoirs in Cardiff. Natural Resources Wales (NRW) has raised concerns regarding the potential spread of North Atlantic signal crayfish (NASC) which have been recorded near the source of the reservoir intake on the Nant Glandulais.

APEM was commissioned by DCWW to undertake a survey to ascertain the extent of any NASC population already present in the Lisvane and Llanishen reservoirs and the surrounding watercourses (the Nant Fawr, both upstream and downstream of Llanishen reservoir). This helps to inform the feasibility of future water transfer between the waterbodies and offers prospective operators of reservoirs with contemporary biosecurity risk information. This also allows DCWW to implement mitigation measures/ strategies to control the spread of NASC, and other invasive non-native species (INNS) at the site. DCWW has a statutory obligation in this regard to control all INNS in the water bodies that they manage, to reduce the probability of their establishment and, where they are present offer mitigation options to control their spread.

Therefore, the objectives of this survey were:

- To undertake manual search and trapping for crayfish in the marginal and deep refuges, targeting areas of optimal habitat in both reservoirs;
- Conduct manual search for crayfish upstream and downstream of the reservoirs, in the Nant Fawr watercourse;

  To understand population densities of INNS prior to refilling and water transfers between Lisvane and Llanishen reservoirs.

2. Locations & Sampling Dates

2.1 Site descriptions

Llanishen and Lisvane reservoirs are located in the north of Cardiff, with a central grid reference at approximately ST 187818 (see Figure 1). They lie within a suburban residential area, but the site itself is mostly bordered by undeveloped land, including the Nant Fawr Community Woodland to the south and east, Rhydypenau Park to the south-west, allotments to the north-west, and fields and woodland to the north.

Lisvane Reservoir is located to the north of the site, and Llanishen Reservoir to the south. Lisvane Reservoir supports an open water area of approximately 8 hectares. Llanishen Reservoir is currently mostly empty, facilitating engineering works by DCWW, but would normally have a water area covering approximately 23 hectares. Both reservoirs are bordered by grassy embankments which are mown several times per year.

The site includes two Sites of Special Scientific Interest (SSSI). Lisvane Reservoir SSSI is designated for its wildfowl, and Llanishen and Lisvane Reservoir Embankments SSSI are of special interest for their diverse assemblage of grassland fungi.

To the north of the reservoirs, DCWW operate an intake whereby water from the southwards flowing Nant Fawr watercourse is diverted into both Lisvane Reservoir and Llanishen Reservoir. From that point the Nant Fawr stream flows around the western side of Llanishen reservoir, and is culverted in some parts. Where it flows in a stone-lined channel it is known as the reservoir bywash channel.

The outflow/ spill from Llanishen Reservoir re-joins this bypass channel/ Nant Fawr just south of the reservoir. DCWW supply water, by pipeline, from Llanishen Reservoir to meet the demands of an industrial customer.

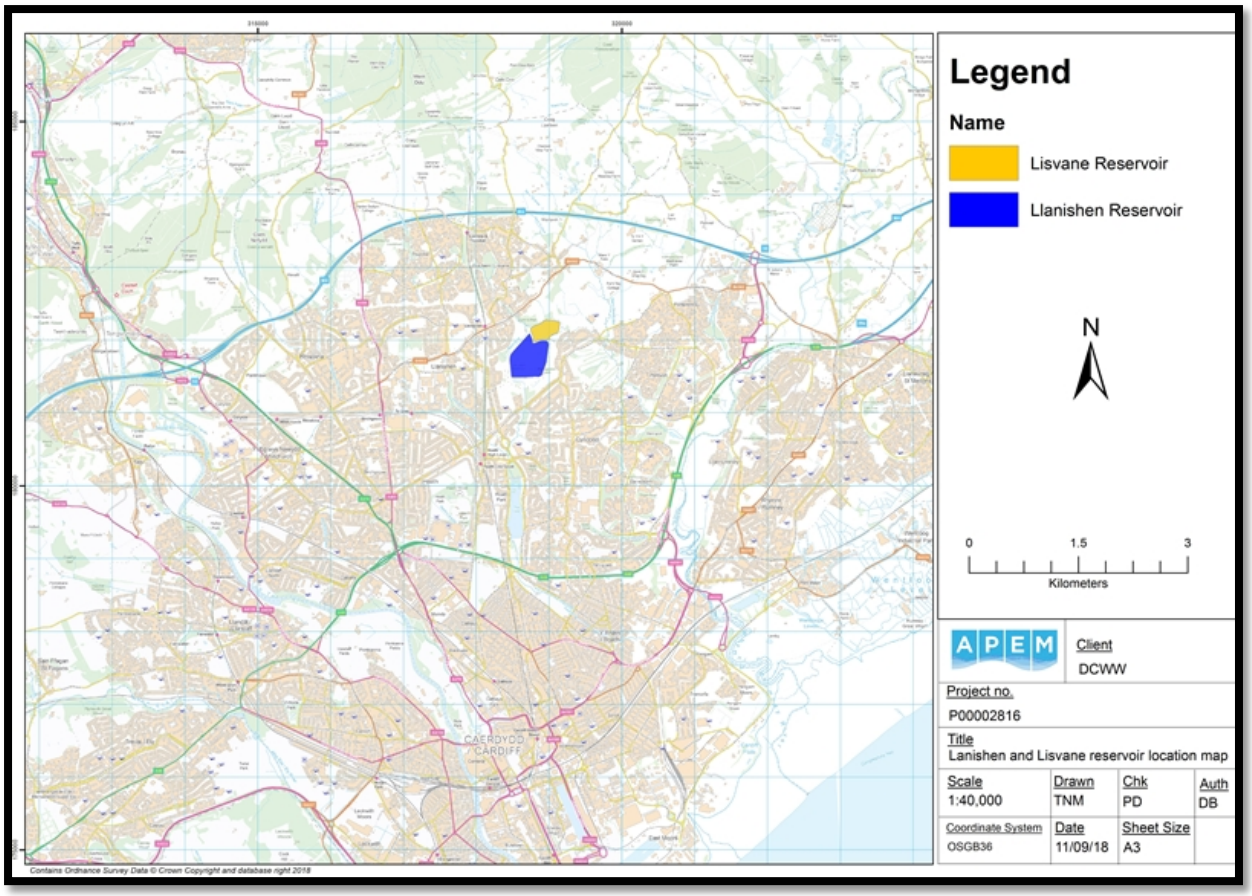


Figure 1 Location of Lisvane and Llanishen reservoirs

2.1.1 Lisvane Reservoir

At the time of survey Lisvane Reservoir was considerably drawn down by approximately 2.5 m, following extremely dry antecedent conditions, resulting in exposure of steep walls and soft banks on the reservoir margins. Reservoir crayfish habit was generally poor with large silted areas blanketing most areas; however pockets of boulder and large cobble margins remained (Figure 2). Water depth was variable throughout the reservoir.

Figure 2 Lisvane Reservoir, looking east. Steep & walls and boulder on margins of reservoir

2.1.2 Llanishen Reservoir

As a result of ongoing engineering works, Llanishen Reservoir was fully drawn down at the time of survey, the only wetted areas remaining were a small channel of maximum depth 0.5 m in (Figure 3, left) and some extremely shallow pools (Figure 3, right). Soft substrate blanketed the wetted area and margins, providing little suitable crayfish habitat.

Figure 3 Llanishen Reservoir, almost completely dry. Steep walls and soft sediment.

2.1.3 Nant Fawr

The Nant Fawr upstream of the reservoirs is a sinuous stretch of river running through deciduous woodland and the Lisvane Housing Estate. The watercourse follows a generally unmodified footprint with active erosion reported throughout the survey reach which was shrouded by overgrowth in places.

During the crayfish survey the wetted channel was reduced following extremely dry antecedent weather conditions and the previously wetted banks extended across half of the channel. The survey reach consisted mostly of shallow run with some shallow glide and riffle. Crayfish refuges were present, including boulders and cobbles, fine and large roots, undercut banks and accumulations of woody debris (Figure 4). The condition of the aquatic habitat in the reach was good with minimal sedimentation recorded.

Figure 4 Nant Fawr upstream of the reservoirs. Suitable crayfish habitat included fine roots (left) and large cobbles and woody debris (right).

Downstream of Llanishen Reservoir, the Nant Fawr flows through open parkland and deciduous woodland, with fluvial features similar to that seen upstream: a sinuous reach with fine and large roots, undercut banks and large cobbles were among the crayfish refuges searched (Figure 5). The Nant Fawr survey reaches were however affected by urban discharges from surface water drains which became active during the survey. The sediment load of the substrate in the lower survey reach was high, often smothering crayfish habitat.

Figure 5 Tree roots and undercut banks at Nant Fawr, downstream of Llanishen Reservoir

3. Methods

3.1 Crayfish surveys

A combination of manual searches and trapping surveys were undertaken across the site. Marginal manual searches were conducted in both Llanishen (where possible) and Lisvane reservoirs and more comprehensive surveys undertaken on the Nant Fawr (both upstream and downstream of the reservoirs) on 9th and 10th August 2018.

In deeper reservoir water, where manual surveys were not feasible, crayfish traps were baited with oily fish and set at depths ranging from 1 to 3.5m (Figure 6). Traps were set with otter-proofing to prevent entrapment of otters foraging in and around the reservoirs. Traps were marked with a fluorescent orange buoy to aid in retrieval and deployed by a small inflatable boat at suitable locations within the reservoir (Figure 7). Traps were left for 24 hours and retrieved the following day.

Figure 6 Example of a baited crayfish trap.

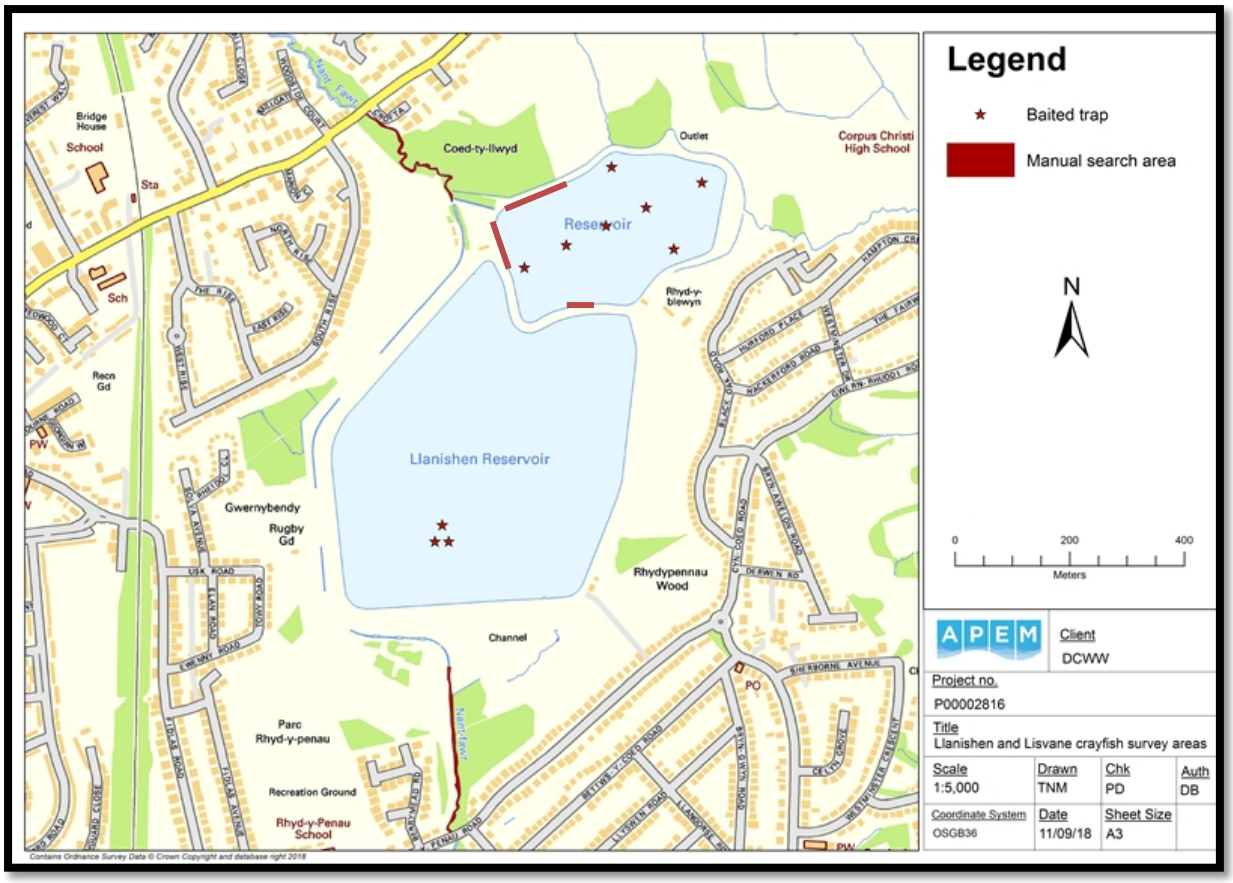


Figure 7 Location of crayfish traps and manual searches.

3.1.1 Nant Fawr

A continual manual search using the Standard Method (Peay, 2003) was undertaken throughout the survey reach of Nant Fawr, upstream of Llanishen reservoir. Where access allowed timed searches of suitable crayfish habitat were performed with five habitat patches assessed within each 200 m survey reach. The number of stones turned or refuges searched was recorded to provide an indication of search effort (Appendix 1).

In addition to the manual search performed throughout the survey reach a fine meshed hand net was also used to sweep areas of undercut banks and where tree roots protruded into the watercourse. The net sweeps were timed to establish a semi- quantitative evaluation of the catch if encountered. Crayfish traps were not set in the Nant Fawr as suitable trapping habitat was not located and manual searches in the target reaches satisfied the requirements of the objectives.

As the survey was performed an appraisal of the suitability of the instream habitat was compiled and the perceived influences affecting the quality of the habitat reported, such as extent of sedimentation (undesirable for crayfish) and other pollution sources.

3.1.2 Lisvane Reservoir

A manual search of the margins of Lisvane Reservoir (where water present) was conducted, with particular attention to suitable crayfish habitat, such as marginal boulder/ cobble pockets and exposed wall structure. In addition to the manual search, seven baited traps were deployed overnight in deep water (Figure 8).

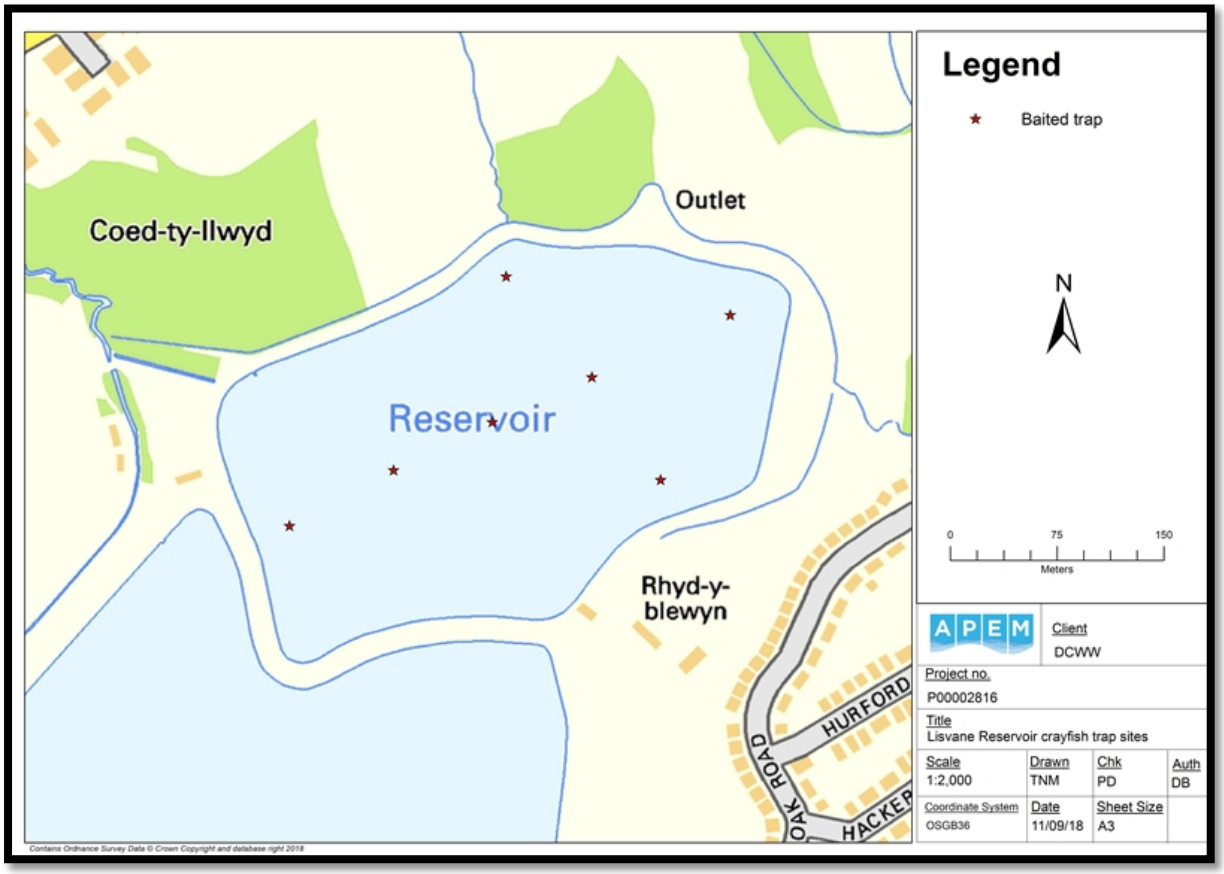


Figure 8 Locations where baited traps were set across Lisvane Reservoir

3.1.3 Llanishen Reservoir

A manual search of the marginal extent of the vastly drained down Llanishen Reservoir was conducted. However due to the soft substrate there was little suitable habitat to search, with hazardous sediment pockets precluding wading into the deeper water. Therefore, three baited traps were deployed overnight in the shallow marginal water of the remaining waterbody (Figure 9).

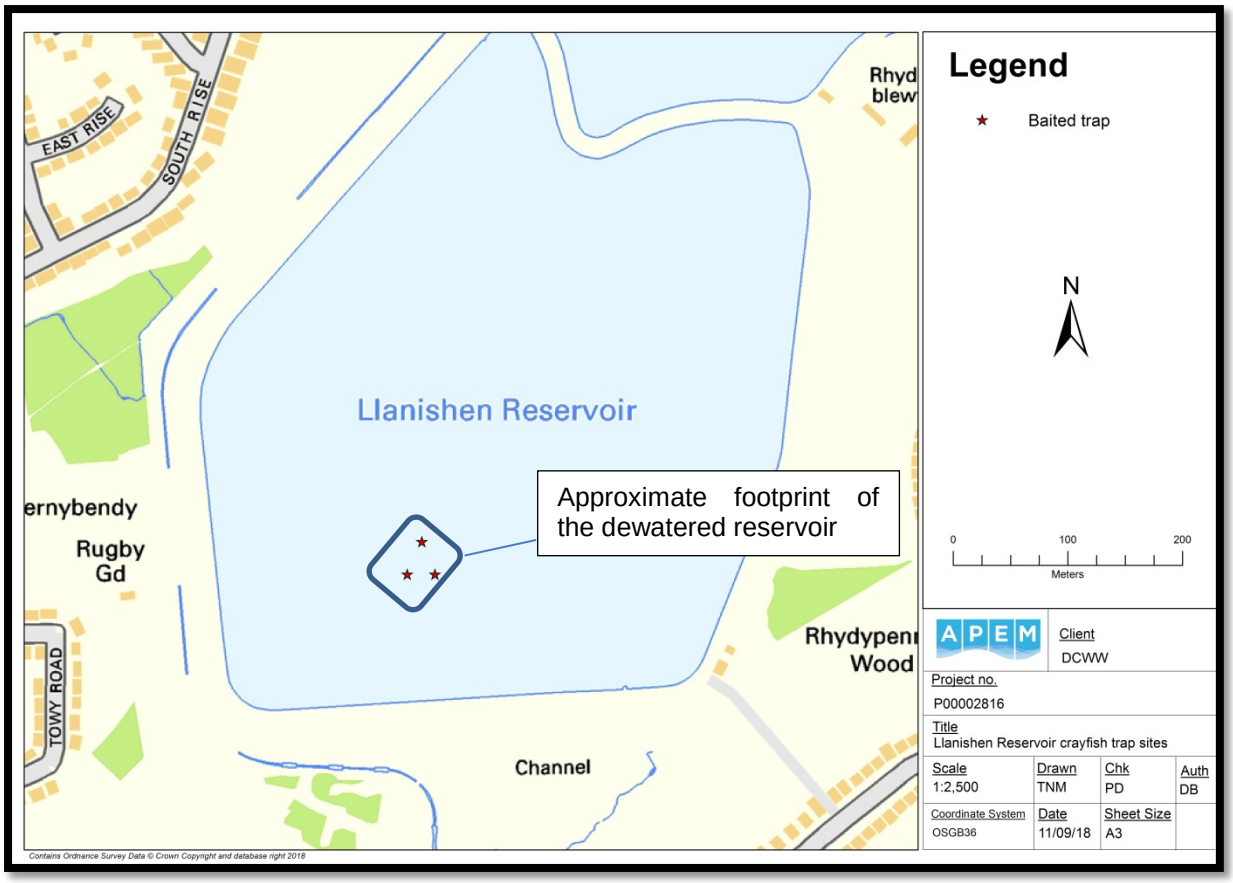


Figure 9 Locations where baited traps were set on the mostly dewatered Llanishen Reservoir

3.2 Sampling order, biosecurity and licensing

Given the potential for signal crayfish in the catchment (and the plague often carried by signal crayfish), strict biosecurity measures were employed. The sites were surveyed by a single instream surveyor in a downstream direction to prevent potential crayfish plague movement up the catchment. All ancillary equipment (nets, waders, buckets, callipers) was disinfected prior to starting the survey with Virkon disinfectant sprayed liberally in a controlled area. A brush was used to thoroughly scrub waders whilst stood in the disinfectant tank. Once the survey had been completed this process was repeated.

4. Results

4.1 Crayfish survey

4.1.1 Nant Fawr

Although suitable crayfish habitat was widespread in the surveyed reaches of the Nant Fawr no evidence of crayfish of any species was recorded. In addition, no evidence of carapaces, claws or other body parts were observed within the water course and the surrounding riparian habitat throughout the survey reaches. This suggests that crayfish are not only absent from the area surveyed but from the local vicinity as a whole.

Whilst crayfish habitat was general good in the reaches surveyed it is thought that the very low water levels experienced in 2018 and ephemeral nature of the flows at these sites is not suitable to support a viable crayfish population at the time of the survey. However, if remnant crayfish populations were to exist in deeper water further up the catchment it may be possible for individuals in future to colonise the watercourse close to the reservoirs.

4.1.2 Lisvane Reservoir

Despite thorough manual searches of suitable refuges in the margins of Lisvane Reservoir and deployment of baited traps in a variety of locations and water depths across the waterbody, no crayfish of any species were captured.

With its very low water levels at the time of the survey, the generally poor quality of the habitat observed at Lisvane Reservoir is thought to be a contributory factor to the apparent lack of crayfish at the site. Deep, fine-grained, unconsolidated sediment accumulations were the principal constituent of the substrate in most locations. This is known to be undesirable for all crayfish species and would greatly reduce the potential carrying capacity of the reservoir in its drawn down condition (Peay 2003). The marginal boulder constituents of the reservoir walls would however constitute good habitat with ample refuge between the structures. This habitat was however, generally exposed during the survey. Whilst the manual searches of these refuges at a variety of locations returned no crayfish catch there is potential for these areas to offer ideal habitat for crayfish, notably when water levels are higher in the reservoir.

4.1.3 Llanishen Reservoir

Manual searches of the vastly reduced footprint of Llanishen Reservoir were somewhat curtailed by health and safety constraints with deep, unstable sediment reported in places. However marginal sweeps were undertaken where feasible and baited traps were set in a variety of locations. In general the crayfish habitat was very poor and unsurprisingly no crayfish of any species were captured. As with Lisvane Reservoir however, there is potential for the reservoir walls to offer ideal habitat for crayfish, when water levels are higher upon rewatering.

5. Discussion & Recommendations

Despite thorough inspection of the target watercourses no crayfish or evidence of their inhabitation was reported during the survey. A comprehensive survey was undertaken in the intake system and in the most likely habitats available in and around the reservoirs at the site with no catch or salient observations of previous crayfish colonies reported.

Although crayfish habitat is good in the Nant Fawr and the connective watercourses, with suitable instream and marginal refuge reported throughout the survey reaches, it is thought that the very dry antecedent weather conditions prior to the survey may have caused the surrounding watercourses to dry up. Although flow was reported during the surveys, evidence of very low flow conditions were present and DCWW staff suggested that the flow had become ephemeral during the summer of 2018. As such, the conditions prior to the survey may have caused any remnant crayfish to become isolated to wetted/ pooled reaches of the watercourse away from the survey areas.

Whilst these results suggest with a high degree of certainty that crayfish are absent at the locations surveyed, this may not unequivocally mean that NASC are absent from the reservoirs as a whole as low water levels, in Llanishen Reservoir especially, may have caused crayfish to seek refuge and thus could remain undetected. It is therefore recommended that ongoing surveys may be required at the site in future years until the presence/ absence of a resident crayfish population can be indisputably determined.

If a remnant crayfish population were to be identified in the upper catchment, the potential for the reservoir complex to support a population of signal crayfish is considerable, given the availability of suitable habitat on site (boulders, cobbles and soft marginal substrate suitable for burrowing) as well as the abundance of natural food present (e.g. macroinvertebrates, small fish and filamentous algae) (Bean et al., 2004). The most suitable habitat was located around the margins, where large boulders and abundant food source provides an ideal refuge.

NASC have been recorded in the nearby Nant Glandulais catchment (by NRW). As DCWW are able to abstract water from four intakes in the nearby Nant Glandulais catchment into Lisvane Reservoir, it is reasonable to assume that NASC population transfer into the Nant Fawr/ reservoirs catchment could have occurred historically. However, as the results of this survey indicate, no evidence of NASC in the reservoirs catchment has been found (accepting the caveats stated above).

It is widely accepted that NASC are likely to spread to all parts of almost all river systems in England and Wales within the next few decades. There are no present practical methods to prevent the population expansion. In some cases, very large weirs, waterfalls, locks, or limited habitat availability may act as a temporary barrier to NASC movement. Nonetheless all the evidence points to the inexorable spread of NASC upstream and downstream in every catchment into which they are introduced or self populate. Typical detectable rates of spread are around 1 km per year in each direction. Even wholly enclosed ponds are only a temporary barrier to the NASC movement as the signal crayfish can walk over land and are increasingly likely to do so when the population reaches high density. Given the close proximity of the Nant Glandulais catchment to the Nant Fawr catchment (and the reservoirs) it is likely that were NASC not transferred through direct transfer into Lisvane Reservoir, that over land self population would (or has) occur.

There is no available method for eradicating or controlling the spread of NASC populations once they become established in watercourses. The best prospect for any eradication is the combined use of biocides and habitat destruction. However, these methods have high environmental impacts, as they are not specific to crayfish. Therefore it is not recommended that these methods are employed in the Nant Glandulais or Nant Fawr catchments.

Screening, or other such preventive measures, are not considered necessary or practical on the DCWW Nant Glandulais intakes (into Lisvane Reservoir) as the mesh spacing required to prevent NASC juvenile transfer would need to be so small that the screens would require constant maintenance/ cleaning to prevent blockages.

Overall, to minimise the risk of further INNS colonisation (in general, for example Japanese knotweed) at the reservoirs it is recommended that a strict biosecurity procedure is adhered to as engineering work (including re-watering) progresses at the site. This should include the use of disinfectant when vehicles or ancillary equipment are used which have been deployed previously in high risk areas. Biosecurity considerations should constituent a general component of site inductions and tool box talks at the site and it is recommended that biosecurity information should be promoted around the site. This is of notable importance in areas which may be used by water sport users and anglers.

DCWW may wish to complete spot checks in the wider Nant Fawr catchment in the future to ascertain the risk of colonisation of the watercourse close to the reservoirs once flows become more established following higher rainfall quantities.

6. References

Peay S. (2003) *Monitoring the white clawed crayfish (Austropotamobius pallipes).* Conserving Natura 2000, Rivers Monitoring Series No 1, English Nature, Peterborough.

Bean C, Maitland P & Collen P. (2004). *Crayfish in Scotland: a review of current status and legislative control*, Freshwater Crayfish. 15. 220-228.

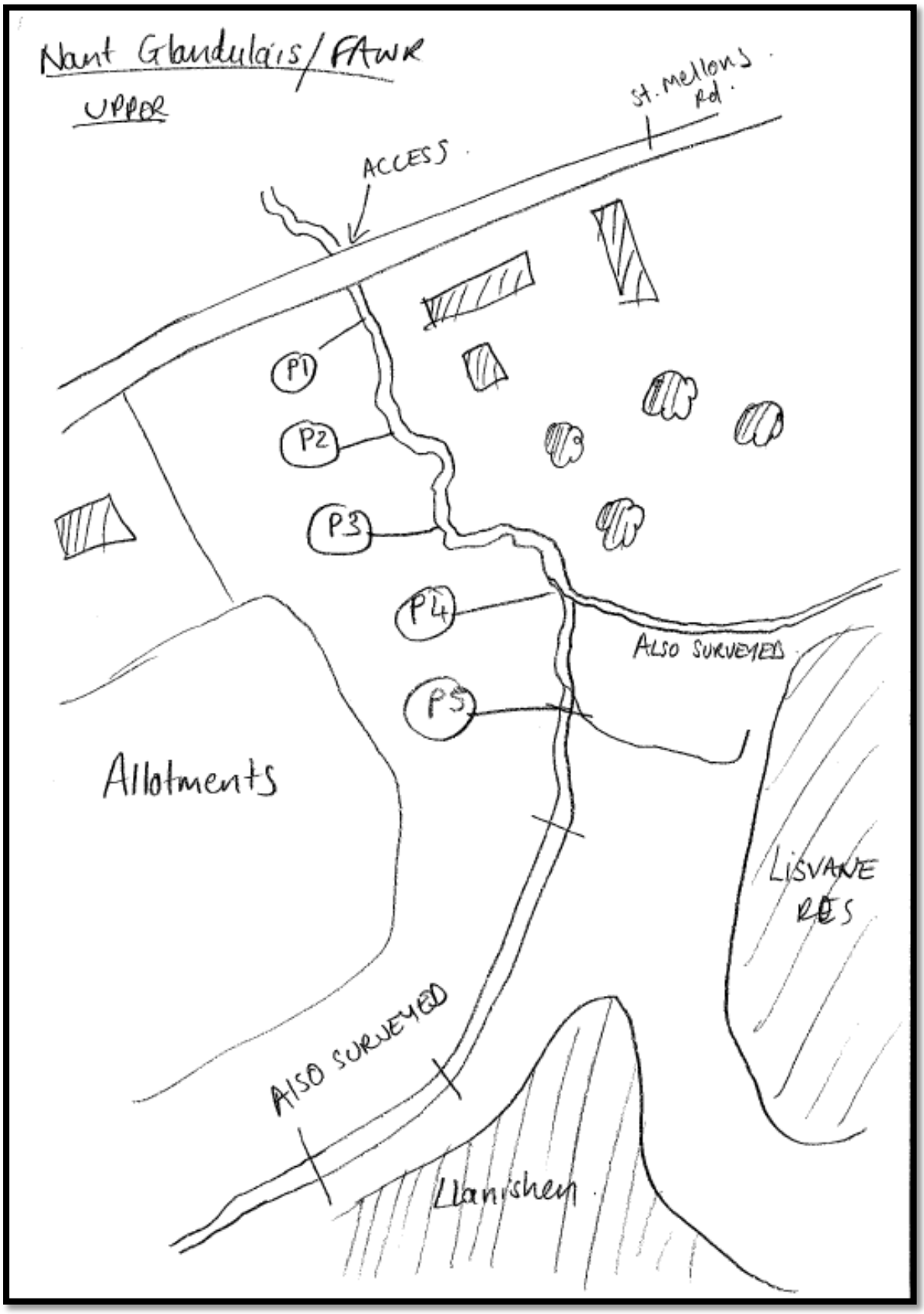
7. Appendix – field survey sheets populated during the surveys

Crayfish habitat survey card

Catchment: GLANDFORD	River: FANY R		Site (no., name): (1)
Date (dd/mm/yy): 10/08/2018	Surveyors: PD		Grid ref. (d/s end):
Weather, good 1,	Flow norm 1, low 2, mod. 2, poor 3	Water temp. (°C) fall 3, rise 4	Clarity, good 1, (1) mod. 2, poor 3
Photo ref. & location	Width channel (m) 2	Start/finish time	10·40 – 12·40
Site length (m) 200m	Description (channel features, land use)	Natural Sinuous	

Sample	Patch 1	Patch 2	Patch 3	Patch 4	Patch 5
Survey method, std 1, quad 2, net/kick 3, trap 4, view 5	1/3	1/3	1/3	1/3	1/3
Details (if not standard)					
Extent (l x w patch)	5MX2	5 X 1·5	5x0·9	7x0·9	5X2
Channel (1 margins, 2 mid, 3 both, other specify)	3	3	2	3	3
Depth (metres)	0·2	0·3	0·3	0·1	0·2
Feature (1 marg. d'water, 2 pool, 3 glide, 4 run, 5 riffle)	1/5	1/5	1/2/5	1/5	1/2
Refuges in channel (tick all present in patch, ring main type(s) searched)					
Cobble (6.5–15cm)	✓	✓	✓	✓	✓
Cobble (15–25.6 cm)	✓	✓	✓	✓	
Boulder (25.6-40 cm)			✓	✓	
Boulder (>40cm)				✓	
Rubble (give size)	✓	✓	✓	✓	✓
Woody debris	✓	✓	✓	✓	✓
Other urban debris	✓	✓	✓	✓	✓
Tree roots, fine	✓	✓	✓	✓	
Moss					
Filamentous algae	✓	✓			
Other submerged vegetation					
Emergents					
Main substrate beneath					
Bedrock					
Cobble (6.5-15 cm)					
Pebble (<6.5 cm)					
Gravel (<1.6cm)	✓	✓		✓	✓
Sand (<2mm)	✓	✓	✓	✓	
Clay					✓
Silt					
Siltation					
None					
Low	✓	✓	✓	✓	✓
Moderate					
High			✓		
Refuges in bank					
None	✓				✓
Cobble/boulder				✓	✓
Tree roots, large		✓			
Vertical or undercut bank					
Dry stone wall					
Other reinforced					
Crayfish burrows					
Shading above	70%	50%	80%	80%	70%
Crayfish from 10 refuges Search time	0	0	0	0	0
Bullhead present?	✓				

Evaluation crayfish habitat for whole site (0 none, 1 pres., 2 freq., 3 abund.)	Score	Notes (survey conditions, patches, etc.)
In margins	2	
In mid-channel	2	
In banks	2	
Surveyability	2	
Problems pollution 1, erosion 2, (E if >33% affected), aliens 3,	2	Some erosion / low water
Total crayfish (by 1 method, note total(s) by other methods in notes if applicable)	0	No evidence of any historical colonisation

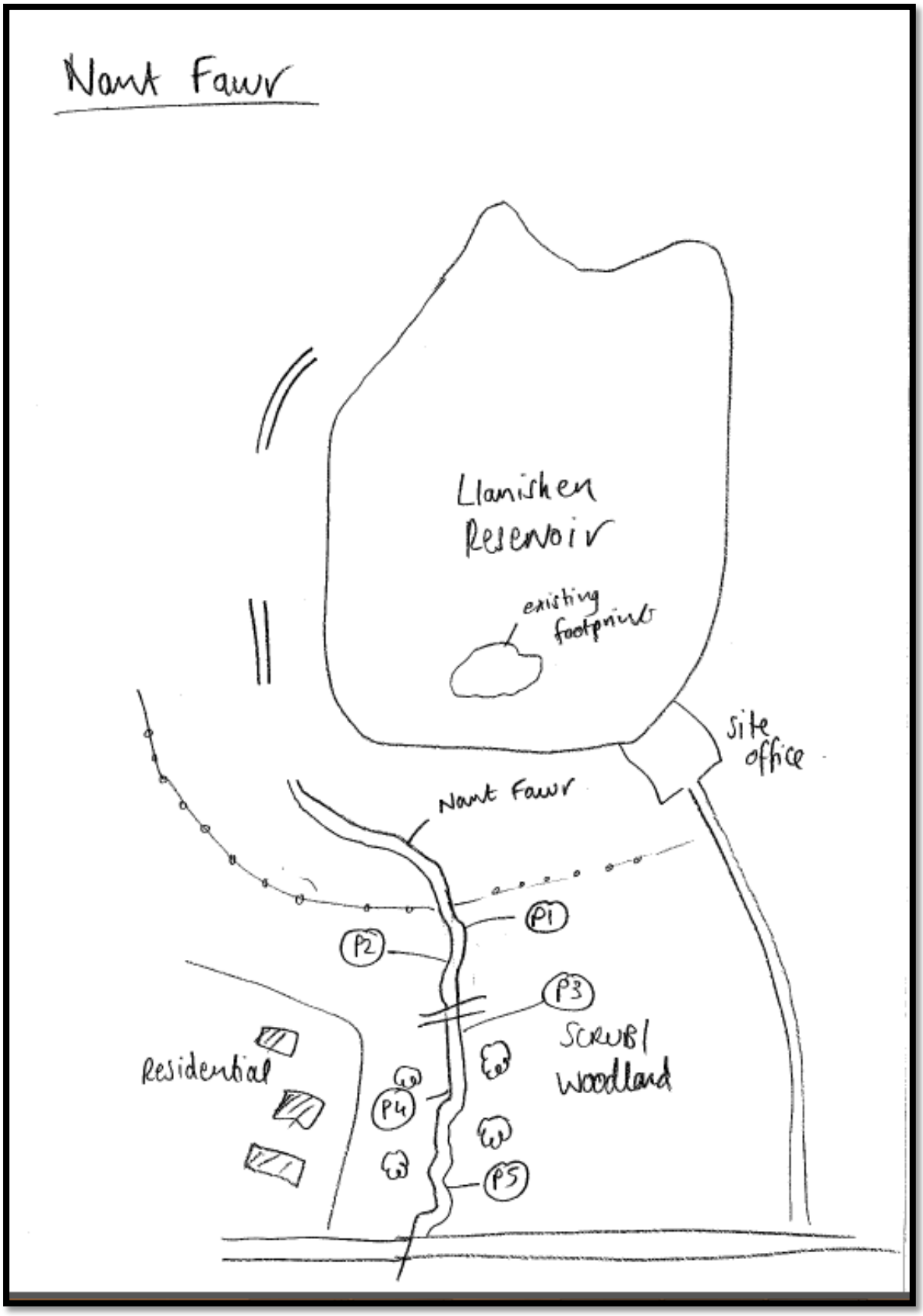

Nant Glandulais/ FAWR
UPPER
St. Mellons Rd.
ACCESS
P1
P2
P3
P4
P5
ALSO SURVEYED
Allotments
LISVANE RES
ALSO SURVEYED
Llanishen

Crayfish habitat survey card

Catchment PAWK	River PAWK	Site (no., name) (2)
Date (dd/mm/yy) 10/08/2018	Surveyors PD	Grid ref. (d/s end)
Weather, good 1, mod. 2, poor 3 — Flow norm 1, low (2)	Water temp. (°C) fall 3, rise 4	Clarity, good 1, mod. 2, poor 3 (1)
Photo ref. & location	Width channel (m)	Start/finish time
Site length (m)	Description (channel features, land use) 200M	

Sample	Patch 1	Patch 2	Patch 3	Patch 4	Patch 5
Survey method, std 1, quad 2, net/kick 3, trap 4, view 5	1/3	1/3	3	1/3	1/3
Details (if not standard)					
Extent (l x w patch)	4x3	6x2	7x1	5x2	5x2
Channel (1 margins, 2 mid, 3 both, other specify)	3	3	3	3	3
Depth (metres)	0.2	0.2	0.3	0.1	0.2
Feature (1 marg. d'water, 2 pool, 3 glide, 4 run, 5 riffle)	1/2/5	5	3/5	5	1/3
Refuges in channel (tick all present in patch, ring main type(s) searched)					
Cobble (6.5–15cm)	✓	✓	✓	✓	✓
Cobble (15–25.6 cm)					
Boulder (25.6-40 cm)					
Boulder (>40cm)					
Rubble (give size)	✓	✓	✓	✓	✓
Woody debris	✓		✓	✓	
Other urban debris					
Tree roots, fine	✓			✓	
Moss	✓			✓	
Filamentous algae					
Other submerged vegetation					
Emergents					
Main substrate beneath					
Bedrock					
Cobble (6.5-15 cm)					
Pebble (<6.5 cm)					
Gravel (<1.6cm)	✓	✓	✓	✓	
Sand (<2mm)	✓	✓	✓	✓	✓
Clay					
Silt					
Siltation					
None					
Low	✓	✓	✓	✓	✓
Moderate					
High					
Refuges in bank					
None	✓				
Cobble/boulder		✓	✓	✓	✓
Tree roots, large		✓			
Vertical or undercut bank					
Dry stone wall			✓		
Other reinforced	✓				
Crayfish burrows					
Shading above	30%	40%	15%	30%	30%
Crayfish from 10 refuges	0	0	0	0	0
Search time	✓				
Bullhead present?					

Evaluation crayfish habitat for whole site (0 none, 1 pres., 2 freq., 3 abund.)	Score	Notes (survey conditions, patches, etc.)
In margins	1	
In mid-channel	1	
In banks	1	
Surveyability		
Problems pollution 1, erosion 2, (E if >33% affected), aliens 3,	1	Sedimentation / runoff
Total crayfish (by 1 method, note total(s) by other methods in notes if applicable)	0	No evidence.


Nant Fawr
Llanishen Reservoir
existing footprint
site office
Nant Fawr
P1
P2
P3
P4
P5
Residential
Scrub/ Woodland