Westfields Wetlands Management Plan Appendices

JBA consulting

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Limerick City & County Council

ATLANTIC EDGE
LIMERICK
EUROPEAN EMBRACE

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Appendix 2.0 Stakeholder Engagement

Appendix 2.1 Stakeholder feedback

This section offers an overview of priorities as judged by the number of comments received in the MyPoint survey. The actions selected from stakeholder feedback have been incorporated into the different relevant chapters throughout the plan. The following table shows a summary of the main categories which were highlighted during the stakeholder feedback process:

Fig. A2.1 Overview of Stakeholder Input.

General categories of feedback	
Bulrush/Open water	65
Access to water/viewing	29
Water quality and flow dynamics	21
Pathways, access and interconnectivity	54
Wildlife	44
Antisocial behaviour	34
Other social aspects	8
Signage	30
Education	17
Seating	27
(Avoid new seating – 3)	
Bins	26
(Reduce bin numbers for rodent control – 1)	
Other infrastructure	11
(Do nothing. Perfect as it is – 4)	
How to get the work done	20

Note; the indented entries contradict the main category headings, and are counted separately.

Thus clearing of excessive bulrush encroachment and creation of open water is a priority for most respondents. This is followed by upgrade of pathways, access issues and interconnectivity between Westfields and wider walkways around Limerick. Protection and enhancement of wildlife follows as a concern for many. Antisocial behaviour reported in the area ranges from speeding on the Condell road to vandalism. Access to water and viewing opportunities are similar to creation of open water, but are listed as a distinct entry due to the different focus requiring different solutions. Seating, bins and other infrastructure are lower down the list, but important considerations nonetheless. Providing opportunities and resources for

education may be lower on the list, but is nonetheless an important element of what Westfields can offer.

The following tables give a breakdown of the feedback generated in the engagement process, showing the number of comments received in each case:

Fig. A2.2 Feedback on bulrush/open water and access to water/viewing

Bulrush/Open water	**65**
Increase area of open water/clear bulrush (some comments mentioning around platform, some along path)	59
Management of algae	4
Find balance between open water and cover for wildlife	2

Access to water/viewing	**29**
Raised observation areas/platforms	4
More observation areas/platforms	3
Clear Cleeve's Embankment at regular intervals for viewing the river	3
Add bird hide (many birdwatchers don't favour a hide, see relevant section)	3
Platform should be removed or moved	2
Improve platform area	2
Compliment on existing platform upgrade	2
Better access to water	1
Create open views for school groups to see birds	1
Viewing platform further out into lake	1
viewing platform on other side of walkway	1
Water-edge platforms (education, twitching, wellness, yoga etc.)	1
Wooden tower as viewing platform from a height	1
clean platform more	1
Extended platforms out into River Shannon	1
access to nature more important than ever with Covid	1
Telescope for children to watch wildlife	1

Fig A2.3 Feedback on water quality and flow dynamics

Water quality and flow dynamics	**21**
Increase water exchange/flow/scour	8
Monitor water quality (physical, chemical, sediments, estuary inputs etc.)	4
Identify pollution sources (and quality of spring)	3
address road runoff	1
Pollution observed from Dock Road discharge flowing up-river on high tide	1
Examine hydromorphology of the river basin and maintain better	1
Interconnect water between the four main sections of wetland	1
Keep channels between lake and Shannon clear (if appropriate)	1
Deepen channels close to shore	1

Fig. A2.4 Feedback on pathways, access and interconnectivity

Pathways, access and interconnectivity	**54**
Improve path surface/increased maintenance/maintain edging	8
More walking paths/trails/looped walks	7
Full perimeter pathway/lake perimeter pathway for viewing wildlife	7
Integrate with longer walks (e.g. to Coonagh with loop back to city)	5
Boardwalk over/near open water	4
Improve access between Wetland and River Shannon / Barrington's Pier	4
Widen river path (and trim bushes)	3
Cycleways (to improve both cycling and walking in the area)	3
Improve accessibility / clearing at entrance (general comment)	2
Swans take over path, particularly when dogs are present	1
Erect gate/barrier between causeway and Condell Road for safety	1
Safety for children at inlet/outlet streams to wetland	1
Raise path between lake and Condell road to prevent flooding	1
Improve buggy access along bath between Condell Road and wetland	1
Open up path along Condell Road for safety	1
Extend the flood bund walkway	1
Add a GreenPee along the Condell Road path. https://greenpee.nl/en/	1
Remove security fencing from old flood-bund works	1
Provide river access for leisure and other uses	1
Tarmac path for rollerblading	1

Fig. A2.5 Feedback on wildlife

Wildlife	**44**
Manage Westfields for wildlife	10
Encourage more native wildlife	6
Short grass at paths, wildflower lawns beside that, and taller wildflowers/meadows further away	5
Manage invasive species	4
More protection for wildlife	3
Bee hotels and/or bee friendly planting	3
Prioritise nature over amenities for people	2
Benefit birds	2
Add/leave islands for nesting	2
Rewilding / let it be wild / use water buffalo to control bulrush	2
Take cognisance of SAC during any works	1
Encourage diversity of wetland plants	1
Remove grass when mowing to favour wildflower growth	1
Have a variety of successional stages across the wetland areas	1
Publish ecological survey findings, to measure improvements year on year	1

Fig. A2.6 Feedback on antisocial behaviour and other social aspects

Antisocial behaviour	**34**
Discourage antisocial behaviour (e.g. litter, graffiti, alcohol, drugs, yelling at visitors, noisy music, parties in woods, congregating between platform and housing, lighting fires, vandalism)	14
CCTV (particularly on path below Condell Rd)	5
More police presence with a regular patrol and/or site security	3
Lighting for safety	3
Create safe feeling in area	3
Cyclists go too fast and pose a safety threat	2
Have dogs on leads at all times	2
More activity to reduce anti-social behaviour during day and early mornings	1
Enforcement of poop and scoop	1

Other social aspects	**8**
Cease new development encroachment from Clonmacken area	1
Extend habitat protections into undeveloped lands beyond Barrington's pier	1
Traffic calming on Condell Road	2
Advertise it more, for walking in particular, linked with wider city walks	3
Organise more community events	1

Fig. A2.7 Feedback on signage

Signage	**30**
Improved maintenance/cleaning of signage	7
Add more information and signage	6
More focus in signage on native flora and fauna (incl. Aquatic species)	5
Signs about feeding birds, avoiding mouldy food or leaving excess food etc.	5
Improved infographics for birds, flowers, trees	1
Highlight the fact that this a protected area	1
Better info on birds	1
Signs showing the extent of the wetlands	1
Existing newer wooden signs are good and fit in well with surroundings	1
Recipe suggestions for foraging such as nettle soup	1
Signage on Condell Rd to raise awareness of Westfields	1

Fig. A2.8 Feedback on education

Education	**17**
Host educational events (adult and children)	3
expert-led walks at various times of the year.	3
Interactive displays to show species present and why they're important	2
Promote more to community and schools	2
Host bat walks	1
Bio blitz for children to get actively involved with nature	1
Nature walks as part of Earth Day, water day, etc. For all ages	1
Engage people more with quizzes, competitions, QR codes	1
Add a nature table	1
Build little wooden cabin for education space	1
Increase educational services for schools	1

Fig. A2.9 Feedback on seating

Seating	**27**
More seating	19
Interesting, eco-appropriate seating with views of wildlife/peaceful space	2
Picnic area / benches	2
More seating on flood bund side	1
Seating for teens so they don't need to move to the trees/bushes	1
Grouped bench seating spread out over greens and paths	1
Picnic and barbecue areas on the lawn	1
Avoid any new seating to limit antisocial behaviour	**3**

Fig. A2.10 Feedback on bins and litter

Bins	**26**
Add extra bins	9
More dog waste bins	5
Keep the area litter free	5
Pick up litter in lake/bulrush	3
regular emptying of bins	2
Provide places for litter pickers to put litter	1
stop illegal dumping (compost, litter, fly-tipping?)	1
Remove bin to reduce rodents	**1**

Fig. A2.11 Feedback on other infrastructure

Other infrastructure	**11**
Playground (wild/nature playground)	3
make more child friendly	1
Hardstanding area for ice cream van etc. to encourage more use	1
Food truck	1
remove old rusted ESB box on path	1
General complaint about inaction and lack of maintenance	1
A tree stump that could be turned into a money collection point for wildlife	1
More trees, flowers in the grass area	1
Enclosed dog area so they can be left off their leash.	1
Do nothing. Perfect as it is	**4**

Fig. A2.12 Feedback on required actions to achieve the outcomes required

How to get the work done	**20**
Planned and properly funded programme for regular bulrush removal	8
Investigate national and EU funding sources / SAC may be possible source	2
Annual meeting or working group to meet regularly (include a decision maker with access to funds)	2
Organise/facilitate volunteer maintenance and clean-ups	2
Aerial photography to monitor reed growth changes	2
Get public more involved; more open LCCC communication about process	1
Volunteers to provide nature education	1
Employ an ecologist	1
Provide better ongoing maintenance	1

Appendix 3.0 Water Quality

Appendix 3.1 Parameters selected for analysis

Water samples were taken on a 3-weekly basis and sent to a lab for physical and chemical analysis. Parameters selected included the following:

Oxygen, Carbon and Suspended Solids:

- Biochemical Oxygen Demand (as mg/l O_2)
- Dissolved Oxygen (as mg/l and %)
- Total Suspended Solids (mg/l)
- Dissolved Organic Carbon (mg/l)
- Total Organic Carbon (mg/l)

BOD is essentially a measure of the food value for microbes in the water. The higher the BOD levels, the more the microbes can multiply and strip oxygen from the water. Thus for very polluted waters fish can drown for want of oxygen in the water.

Dissolved Oxygen (DO) is a measure of the amount of oxygen in the water at the time of sampling, measured both in mg/litre of water and as a % of the total saturation that is possible at a given temperature. In general terms, the higher the DO, the healthier the water for fish and insects.

Total suspended solids is the total amount of fine solid material suspended within the water. At high concentrations it can settle out in rivers to clog spawning beds or freshwater pearl mussel beds, or can make it difficult for fish or insects to find and catch prey. It may also be indicative of other factors in the water such as algae or elevated nutrients from lake sediments, for example.

Total and Dissolved Organic Carbon are complimentary to BOD, but more specific to the carbon content rather than the general “food value” *per se*. May be indicative of high humic content in water, and thus an indicator of flood erosion or agitation of sediments.

Nutrients:

- Ammonia, (ionised NH_4, as N, mg/l)
- Nitrate (NO_3, as N, mg/l)
- Nitrite (NO_2, as N, mg/l)
- Total Phosphorus (as P, mg/l)
- Orthophosphate (mg/l P)

Ammonia, Nitrate and Nitrite are all commonly sampled nitrogen compounds in water pollution assessments. Nitrogen and Phosphorus compounds are important because above a relatively small baseline level they lead to proliferation of plant growth, and algal growth in particular. They are commonly applied as a fertiliser on farmland and have a great potential to flow off into watercourses where they can cause pollution. They are also the main nutrient pollutants in sewage, so municipal discharges or septic tank effluents can also lead to pollution by leading to nutrient enrichment of receiving watercourses. Ammonia and nitrite can also be toxic to aquatic organisms such as fish, and as such are important factors in assessing the health of a watercourse for wildlife.

Other physical and chemical parameters:

- pH (pH units)
- Alkalinity (mg/l CaCO3)
- Hardness (mg/l CaCO3)
- Conductivity (µS/cm @20°C)
- Salinity (ppt)
- Sulphate (mg/l SO_4)

pH is a measure of how acid or alkaline a water sample is, specifically measured as a function of the hydrogen ion concentration in the water. On a scale from 0 to 14, whereby 0 is very acidic and 14 is very alkaline, with 7 being neutral. The scale is logarithmic, so each whole number on the scale is ten times more acid or alkaline than the next. Fish can generally thrive close to neutral, in the pH range of 5.0 to 9.0, and prefer 6.5 to 8.5.

Alkalinity is a measure of the calcium carbonate in the water sample, and is a reflection of the capacity to buffer pH changes. Thus the more alkalinity present in the water the greater the capacity of that waterbody to resist the influence of a drop in pH.

Hardness is also expressed in terms of calcium carbonate, and was originally “taken to be the capacity of a water to destroy the lather of soap” [EPA, 2001 Water Quality Parameters]. The scale from soft water and hard water are often correlated with the flavour of a water source and the ease of making a lather, as well as the potential for causing limescale on boilers or domestic hot water cylinders. From a water quality perspective, hardness measures the calcium and magnesium concentration in a water sample and also has a bearing on the toxicity of some metals such as copper.

Conductivity (or electrical conductivity) is a measure of the water's ability to conduct an electrical current. The greater the conductivity, the higher the concentration of

dissolved (ionisable) solids in the water.

Salinity is related to conductivity and the latter may be used to estimate salinity levels. It is used to assess ingress of salt water into freshwater habitats or water supplies in coastal or estuarine environments.

Sulphates are often derived from sulphides of heavy metals such as iron, nickel, copper and lead and are present in nearly all natural waters. High concentrations of sulphite will impact on the suitability of a water body as a drinking water source. Excess sulphates will corrode concrete sewer pipes. In anoxic conditions sulphites are reduced to odorous sulphides, such as the rotten egg smell of hydrogen sulphide in estuary muds or anoxic sediments underlying water that suffers from chronic low levels of dissolved oxygen (such as those found near sewage pollution sources with insufficient dilution in the receiving waters).

Microbiological:

- Total coliforms (MPN/100ml; most probable number/100ml)
- *E. coli* (MPN/100ml)
- Faecal coliforms (cfu/100ml; colony forming units/100ml)
- Total viable count (cfu/ml @22°C)

Microbial analysis of Total and Faecal Coliforms, and the indicator species *Escherichia coli* (*E. coli*), are common indicators of faecal pollution – typically from sewage or livestock in a water pollution context. Coliforms are not generally pathogenic in themselves, but act as a relatively safe indicator of the possible presence of pathogens in a watercourse. The greater the number of coliforms, the greater the potential for, and likely concentration of, pathogens in the water.

The total viable count (also known as a total bacterial count or colony counts) is a similar test, carried out to assess the overall concentration of bacteria in a water sample.

Appendix 3.2 Results of water quality analysis

Averaged results of analysis showing standard deviation in each case.

Fig. A3.1 Overview of oxygen levels, oxygen demand and suspended solids, by location

	BOD5		Dissolved Oxygen		Dissolved Oxygen		Total SS	
	mg/l O2	+/-	%	+/-	mg/l O2	+/-	mg/l	+/-
1 Western Wetland	5.43	4.87	72	26	5.7	2	95.1	217.3
2 Exit from Central Wetland	1.01	0.42	99	14	8.5	1	13.3	17.4
3 Exit from Eastern Wetland	0.88	0.91	99	10	8.6	1	4.3	3.5
4 Near viewing platform	1.14	1.01	86	24	8.3	1	14.0	19.0
5 E point of Eastern Wetland	1.63	1.12	87	24	6.2	2	3.3	2.4
6 W point of Southern Wetland	3.16	1.99	80	18	6.3	2	6.9	6.0
7 N side of Southern Wetland	2.45	1.00	75	20	7.0	1	3.1	3.3
8 Open drainage channels	2.65	1.47	87	17	7.5	2	98.3	205.3

Fig. A3.2 Overview of nutrient samples, averaged for each location

	Ammonia as NH4		Nitrate as N03		Nitrite as N02		Orthophosphate as P		Phosphorus, Total as P	
	mg/l	+/-	mg/l	+/-	mg/l	+/-	mg/l	+/-	mg/l	+/-
1 Western End	0.19	0.37	0.56	0.38	0.02	0.03	0.10	0.07	0.22	0.17
2 Exit from Central Wetland	0.10	0.23	2.10	1.24	0.02	0.03	0.02	0.02	0.06	0.03
3 Exit from Eastern Wetland	0.13	0.24	2.21	1.39	0.02	0.02	0.56	1.52	0.57	1.50
4 Near viewing platform	0.11	0.25	2.30	1.70	0.03	0.03	0.01	0.02	0.06	0.02
5 E point of Eastern Wetland	0.12	0.28	0.53	0.52	0.01	0.01	0.03	0.03	0.09	0.03
6 W point of Southern Wetland	0.15	0.30	0.92	0.97	0.01	0.02	0.04	0.03	0.09	0.06
7 N side of Southern Wetland	0.13	0.23	0.53	0.62	0.00	0.01	0.03	0.06	0.11	0.04
8 Open drainage channels	0.19	0.30	0.99	1.07	0.01	0.02	0.06	0.08	0.17	0.09

Fig. A3.3 Overview of nutrient samples, averaged for each location

	Alkalinity CaCO3		Conductivity @ 20°C		Dissolved Org C		Hardness, CaCO3		Salinity		Sulphate		Total Org C	
	mg/l	+/-	uS/cm @20°C	+/-	mg/l	+/-	mg/l	+/-	ppt	+/-	mg/l	+/-	mg/l	+/-
1 Western Wetland	228	38	689	291	14.4	3.4	267	43	0.34	0.15	26.2	8.9	63.6	83.2
2 Exit from Central Wetland	184	32	442	138	10.1	0.9	200	29	0.22	0.07	15.0	1.8	10.8	1.4
3 Exit from Eastern Wetland	182	22	422	79	9.2	1.2	197	33	0.21	0.04	19.7	7.1	9.7	1.6
4 Near viewing platform	180	8	404	45	9.5	0.7	197	9	0.20	0.02	15.0	1.0	10.3	1.0
5 E point of Eastern Wetland	180	10	526	299	8.8	0.7	202	31	0.26	0.15	18.4	10.9	9.1	0.6
6 W point of Southern Wetland	182	15	442	132	10.3	0.8	199	15	0.22	0.06	13.4	1.2	12.2	1.9
7 N side of Southern Wetland	184	16	486	205	10.2	1.5	204	20	0.24	0.10	13.7	2.9	11.1	1.1
8 Open drainage channels	179	35	473	208	10.4	1.3	206	50	0.24	0.10	14.6	2.9	16.0	3.9

Fig. A3.4 Overview of microbial analysis, averaged for each location

	Coliforms		E.coli		Faecal Coliforms		TVC @ 22°C	
	MPN/100ml	+/-	MPN/100ml	+/-	cfu/100ml	+/-	cfu/ml	+/-
1 Western End	8090	7210	313	446	408	596	6469	7768
2 Exit from Central Wetland	4434	3762	472	614	1376	2856	1718	1230
3 Exit from Eastern Wetland	1775	2030	345	565	391	614	1713	1495
4 Near viewing platform	3265	2674	355	229	573	596	3049	2587
5 E point of Eastern Wetland	1387	1297	52	48	109	83	1856	2110
6 W point of Southern Wetland	1742	1880	25	29	94	128	3436	2987
7 N side of Southern Wetland	2852	5176	290	430	301	449	1818	1754
8 Open drainage channels	6350	7862	681	615	1865	2280	5990	5932

Graphical representations of the water quality results are shown here to give an overview of parameter concentrations over the duration of the sampling process. Note that the tides will have influenced the water quality at the Central Wetland and Eastern Wetland locations. On incoming tides, the Eastern Wetland sample was taken from the ingress from beneath the Condell Road and not from the inlet/outlet pipe, which is represented by the Central Wetland sampling results for these times.

Fig. A3.5 Graph of BOD results

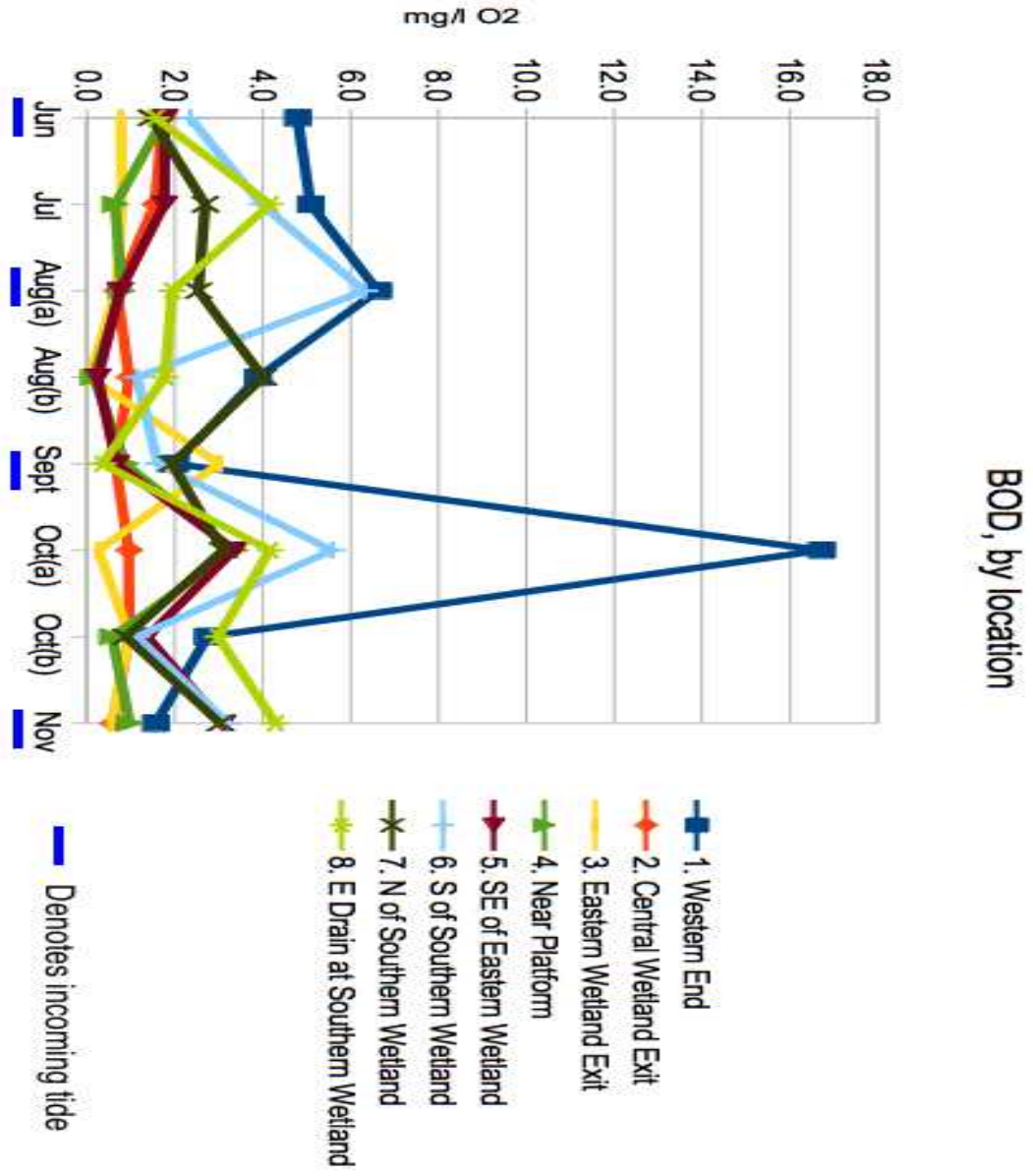


Fig. A3.6 Graph of Dissolved Oxygen (%) results

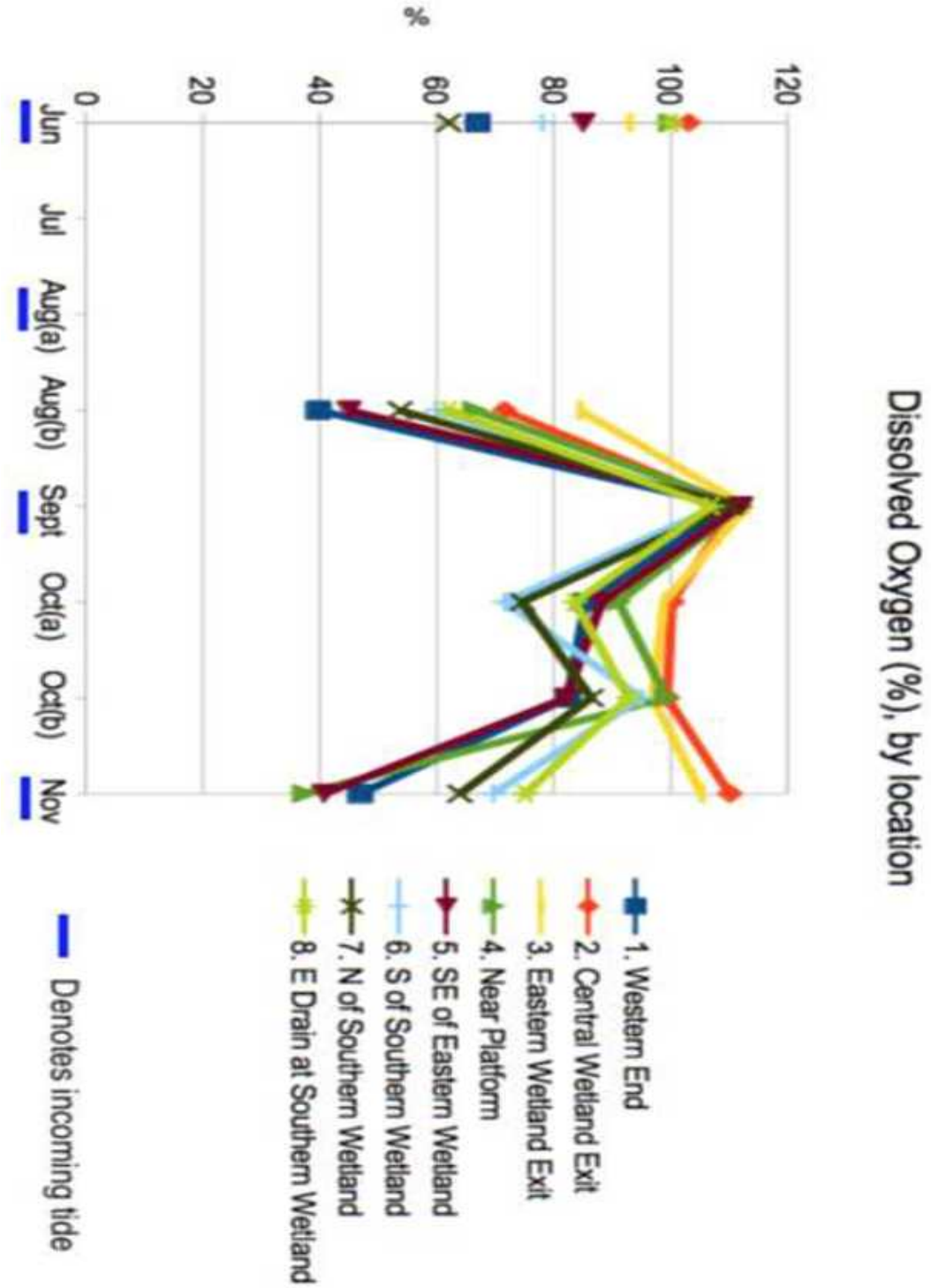


Fig. A3.7 Graph of Dissolved Oxygen (mg/l) results

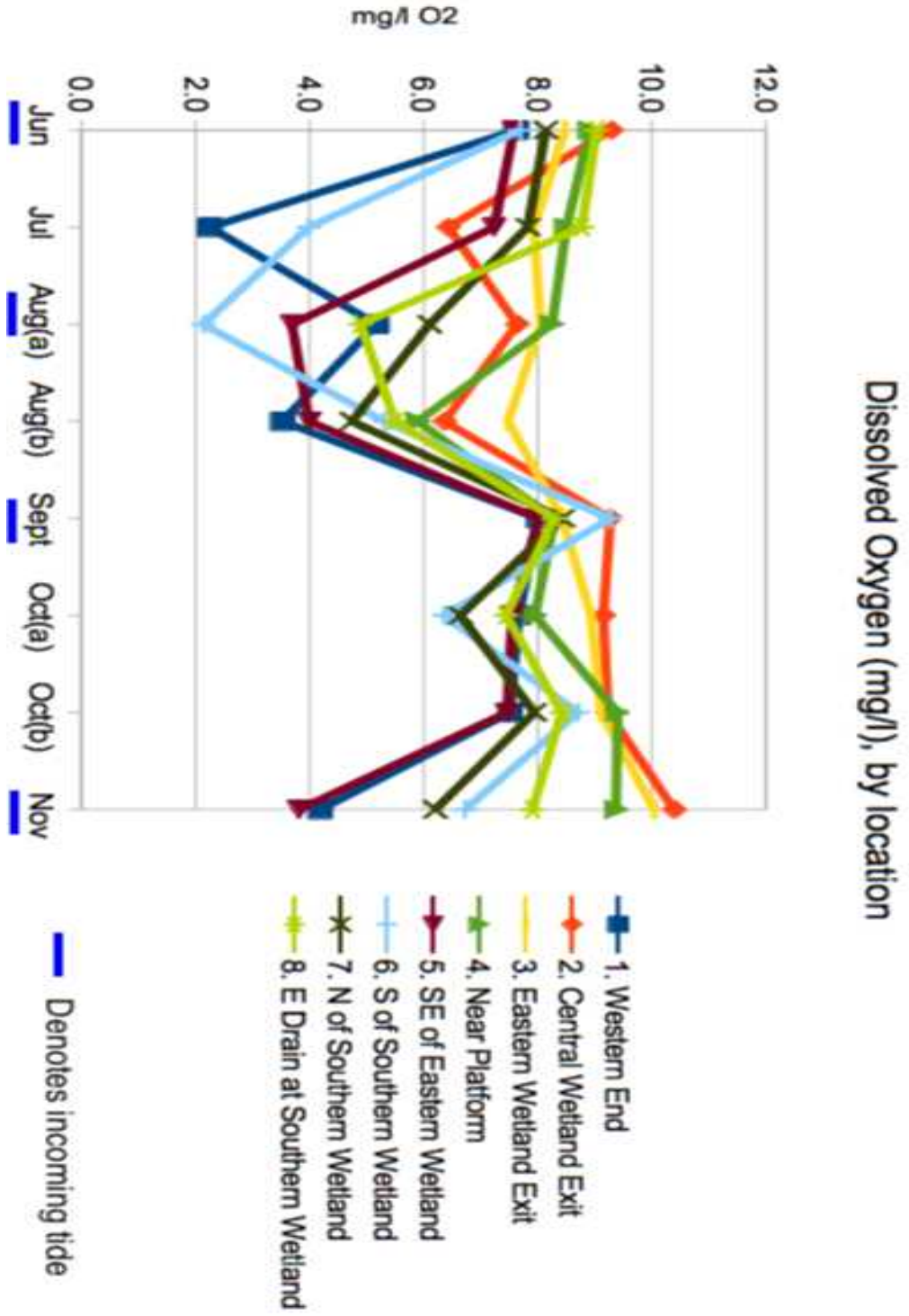


Fig. A3.8 Graph of Suspended Solids results

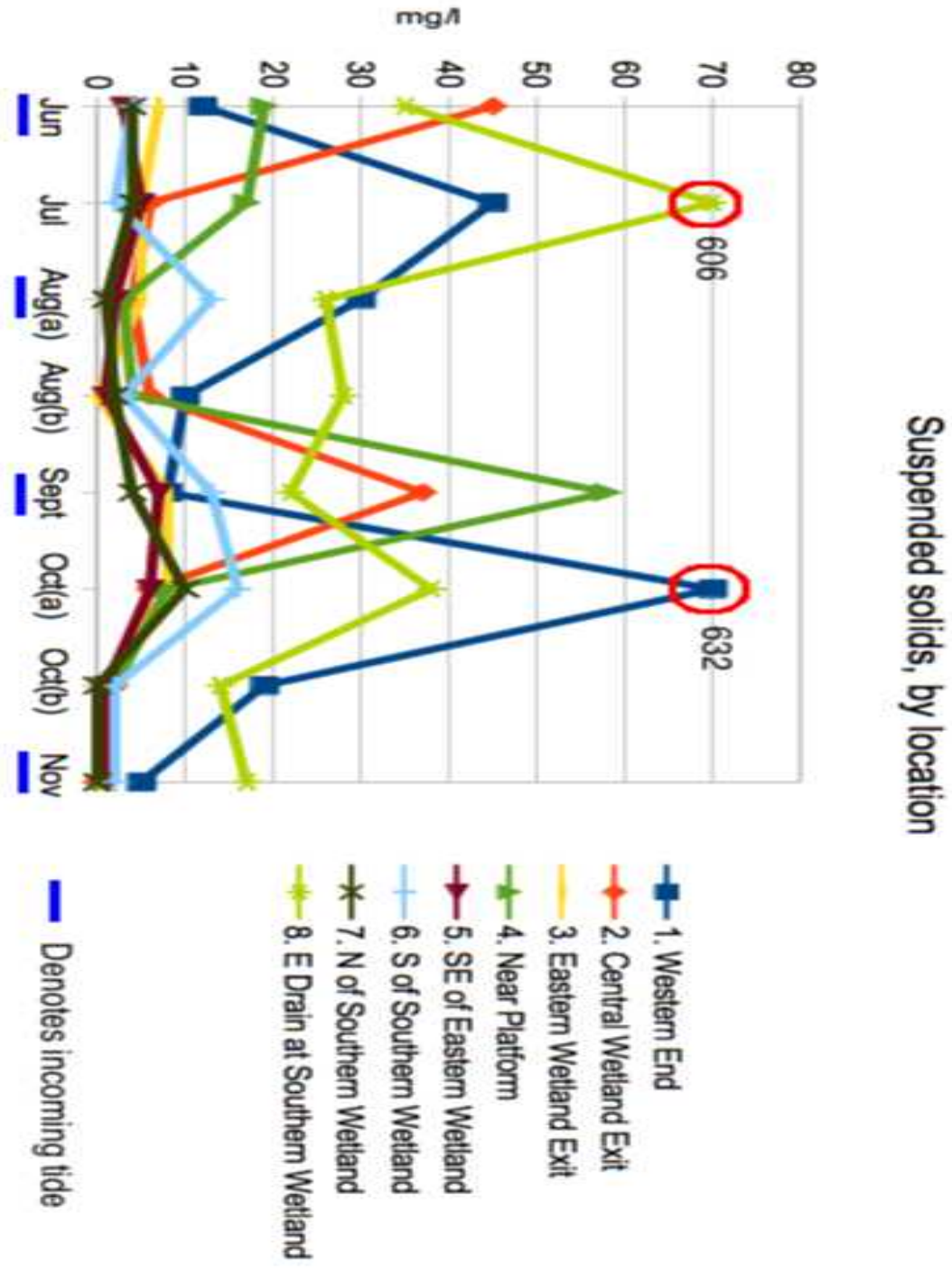


Fig. A3.9 Graph of Ammonia results

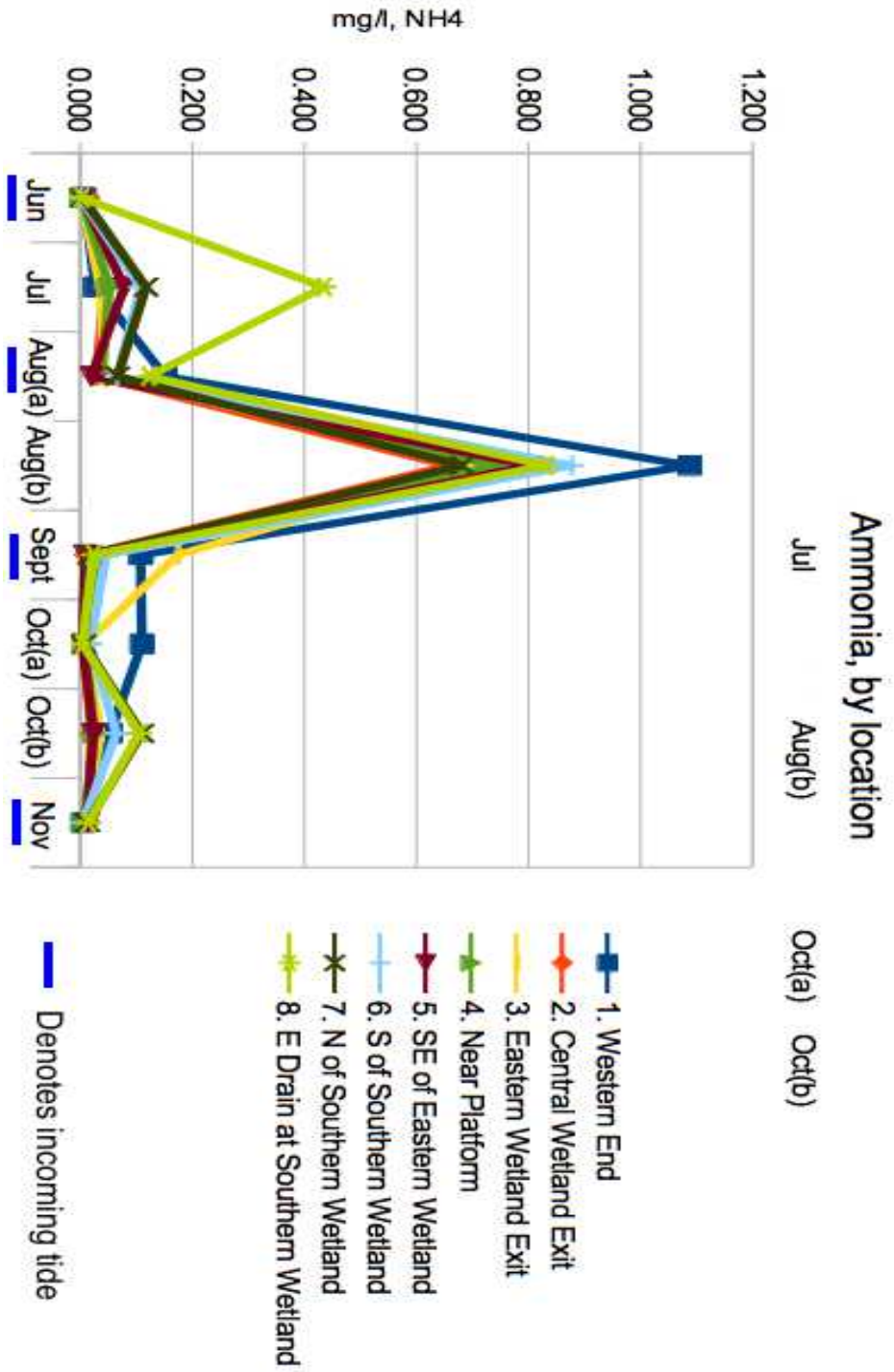


Fig. A3.10 Graph of Nitrate results

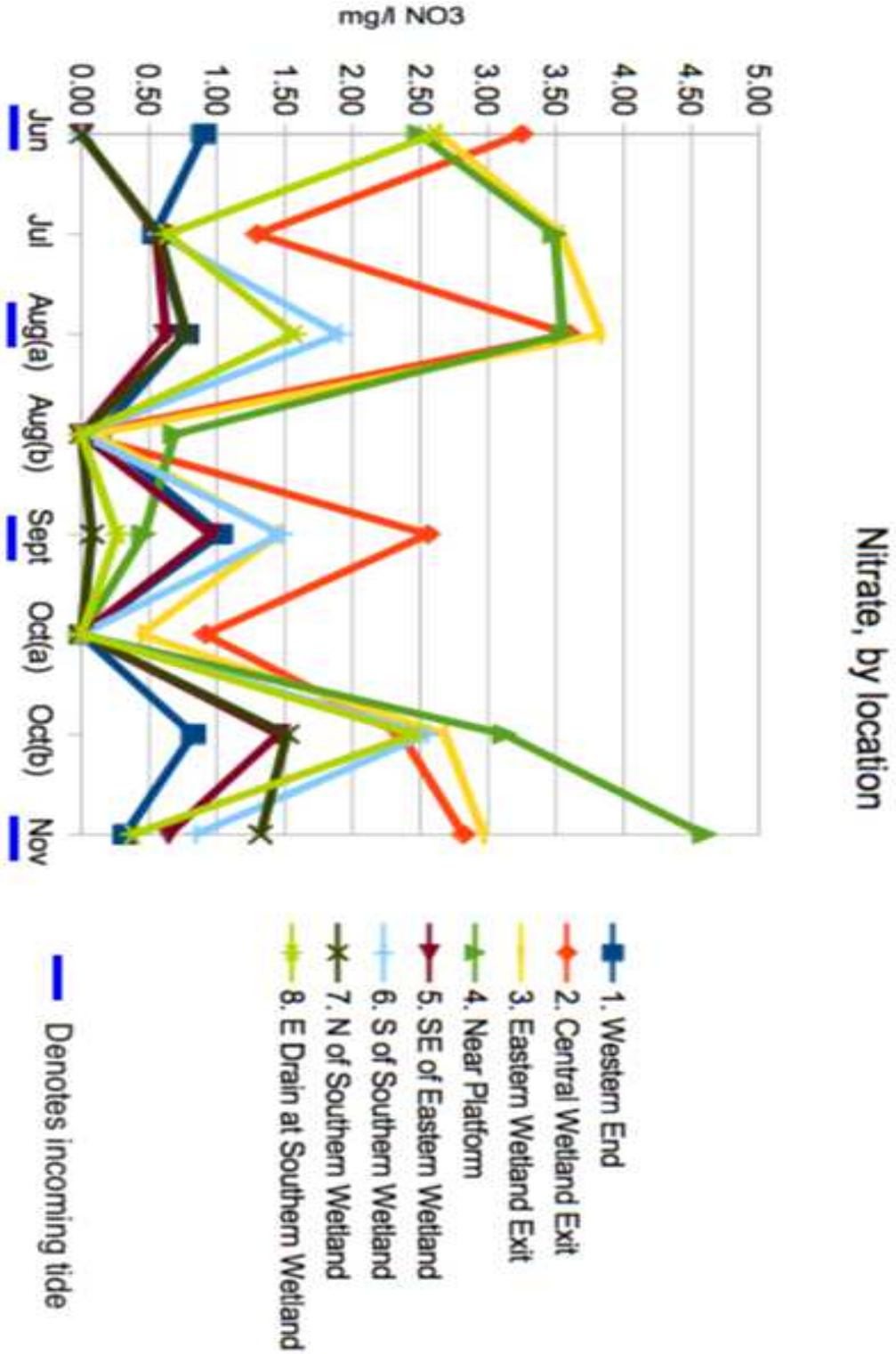


Fig. A3.11 Graph of Nitrite results

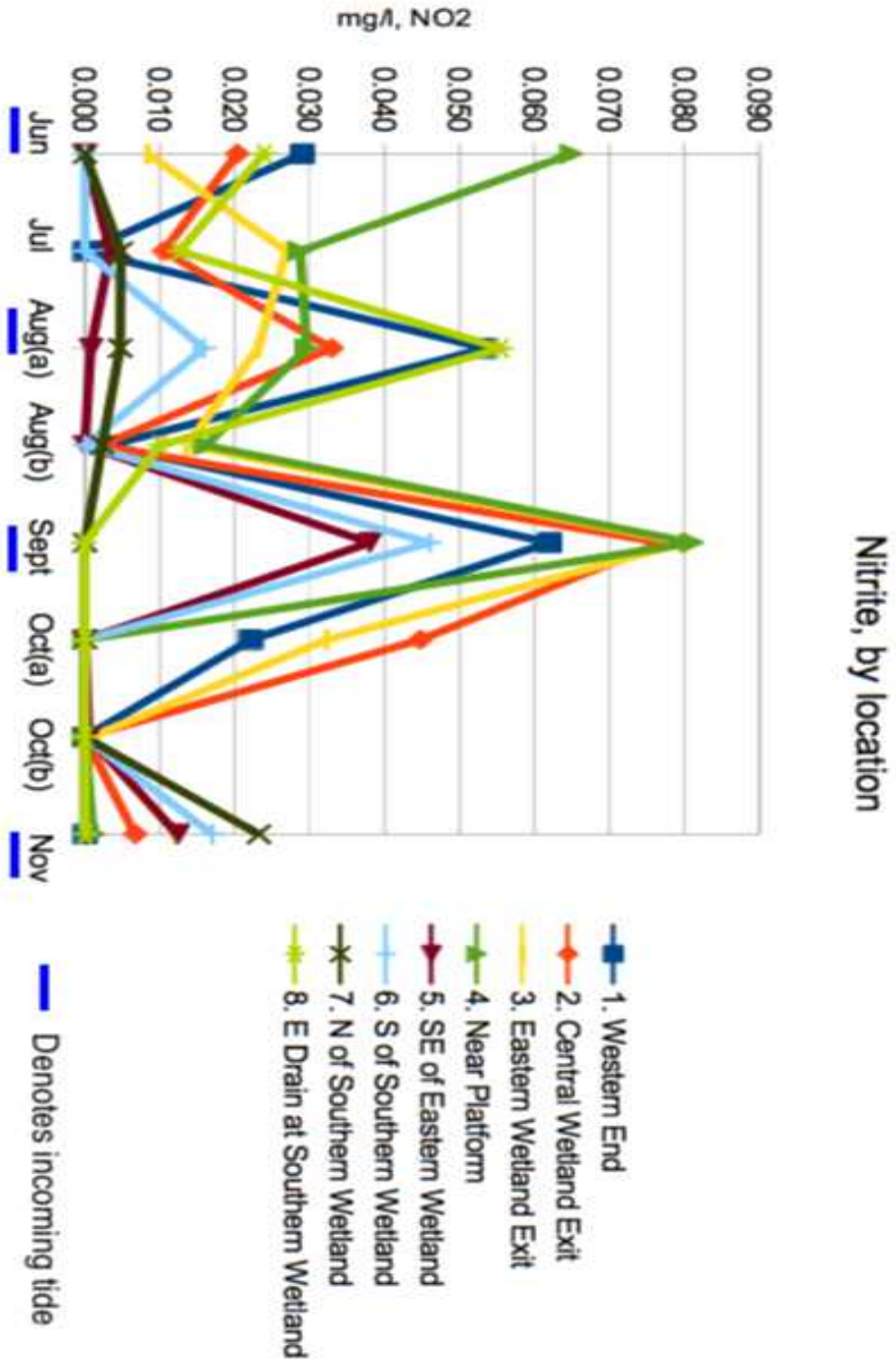


Fig. A3.12 Graph of Orthophosphate results

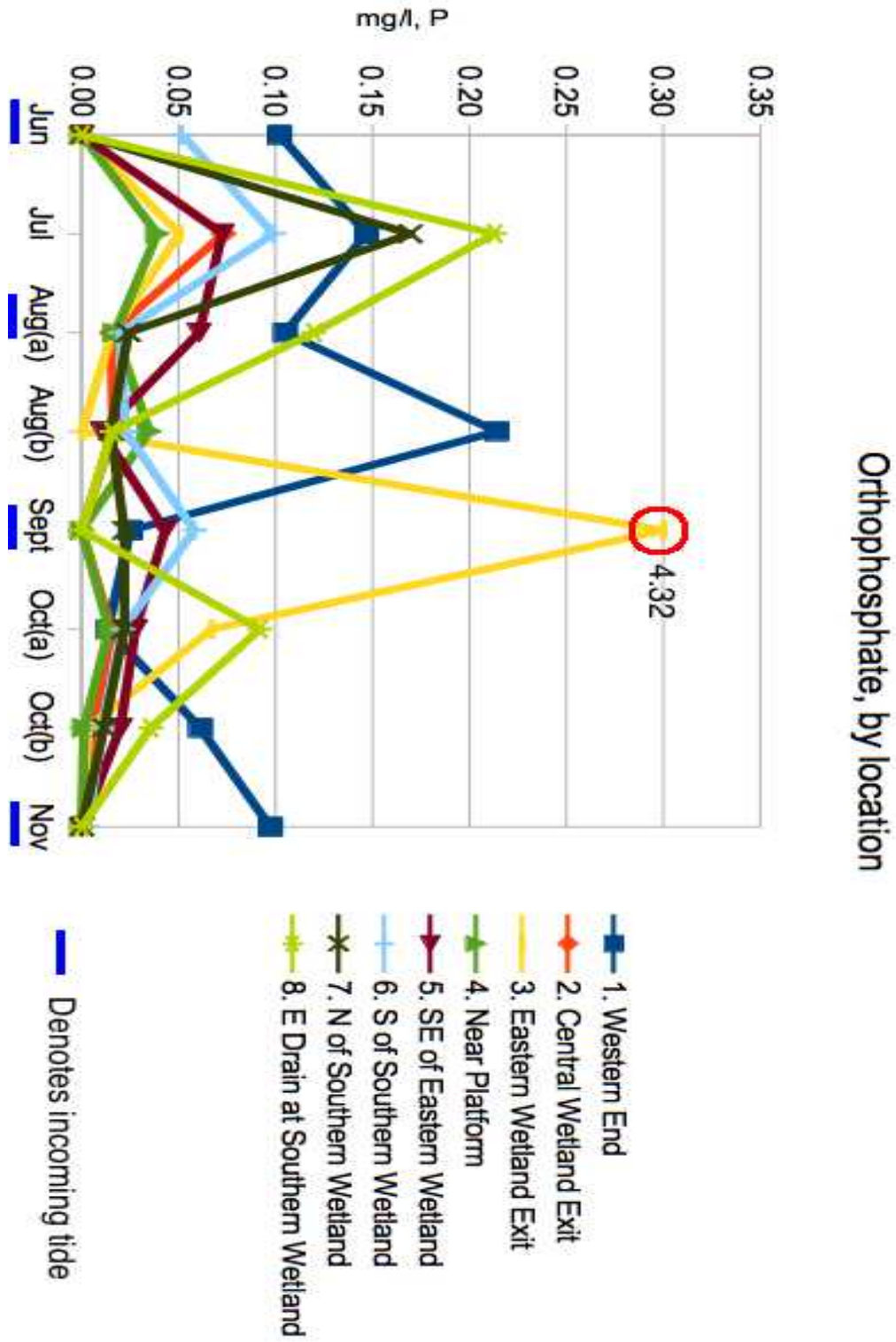


Fig. A3.13 Graph of Total Phosphorus results

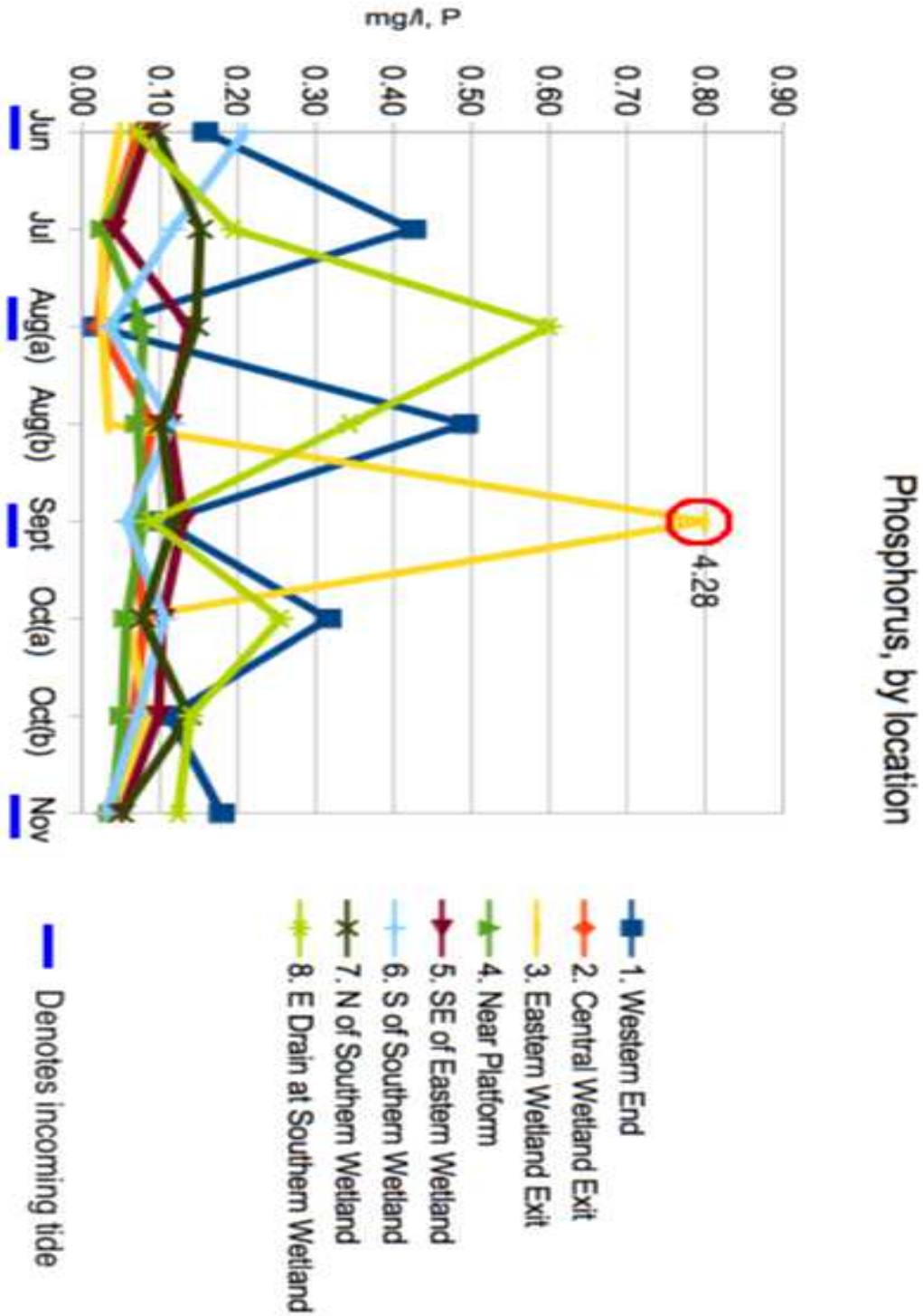


Fig. A3.14 Graph of pH results

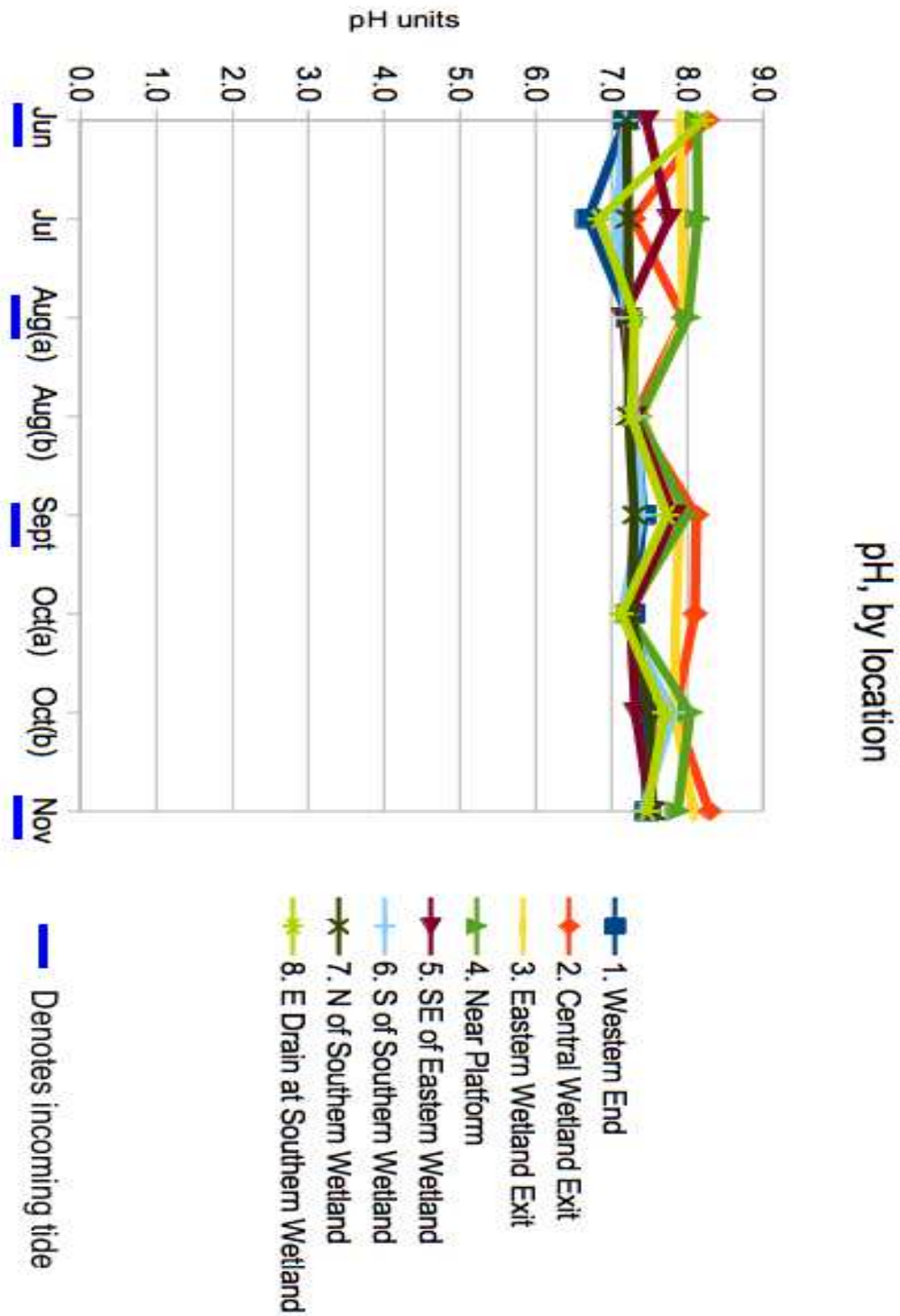


Fig. A3.15 Graph of Conductivity results

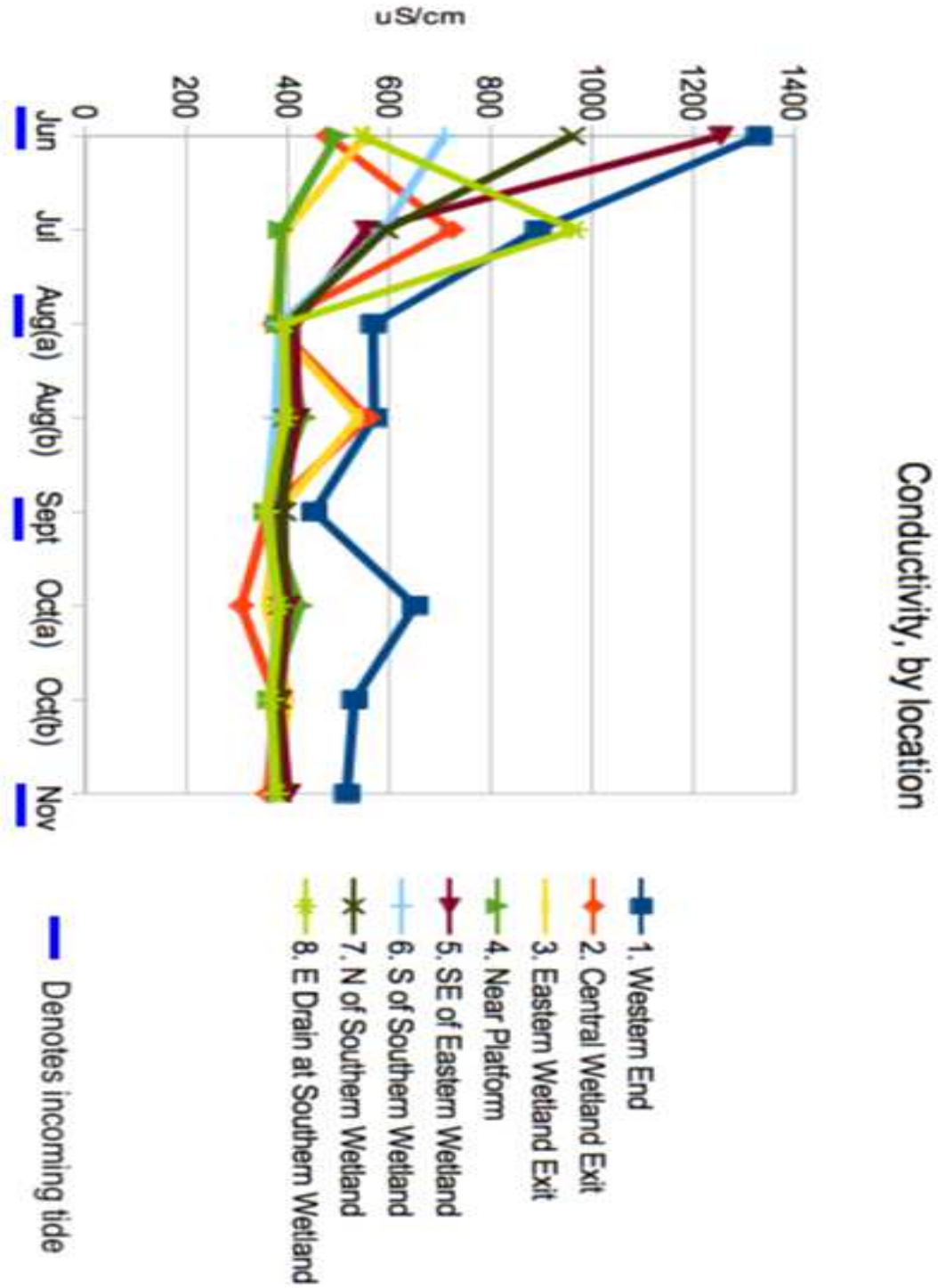


Fig. A3.16 Graph of Alkalinity results

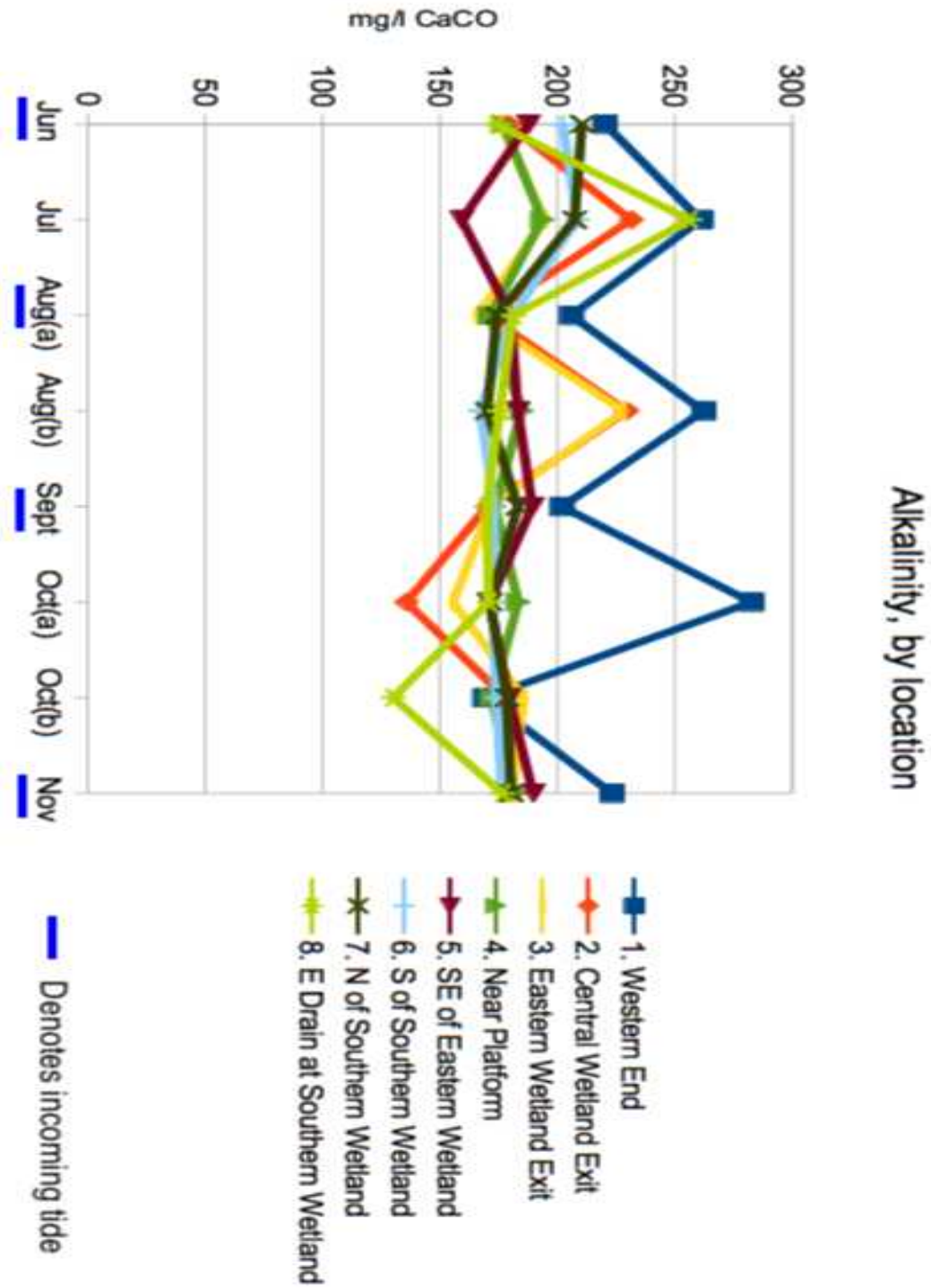


Fig. A3.17 Graph of Hardness results

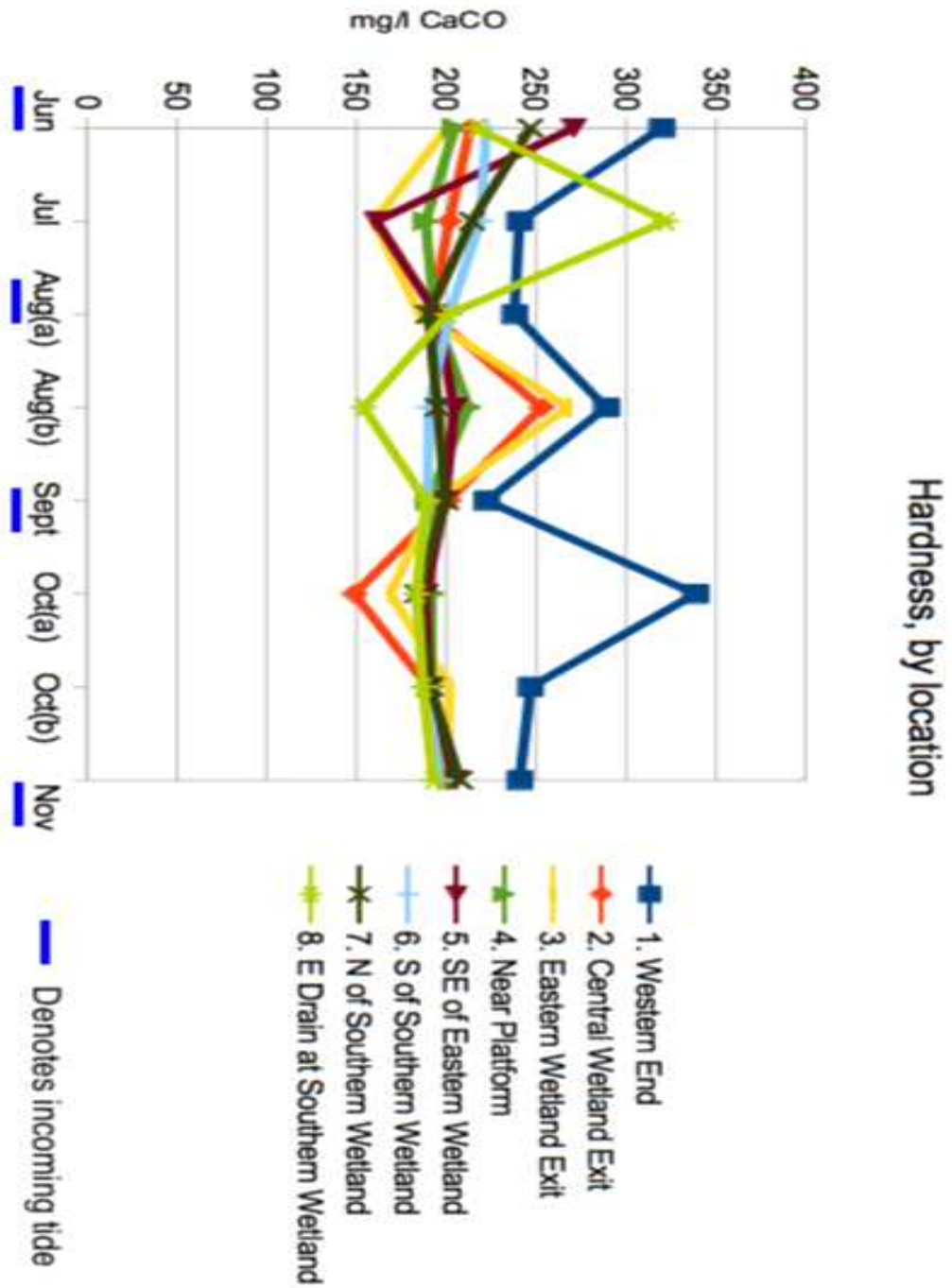


Fig. A3.18 Graph of TOC results

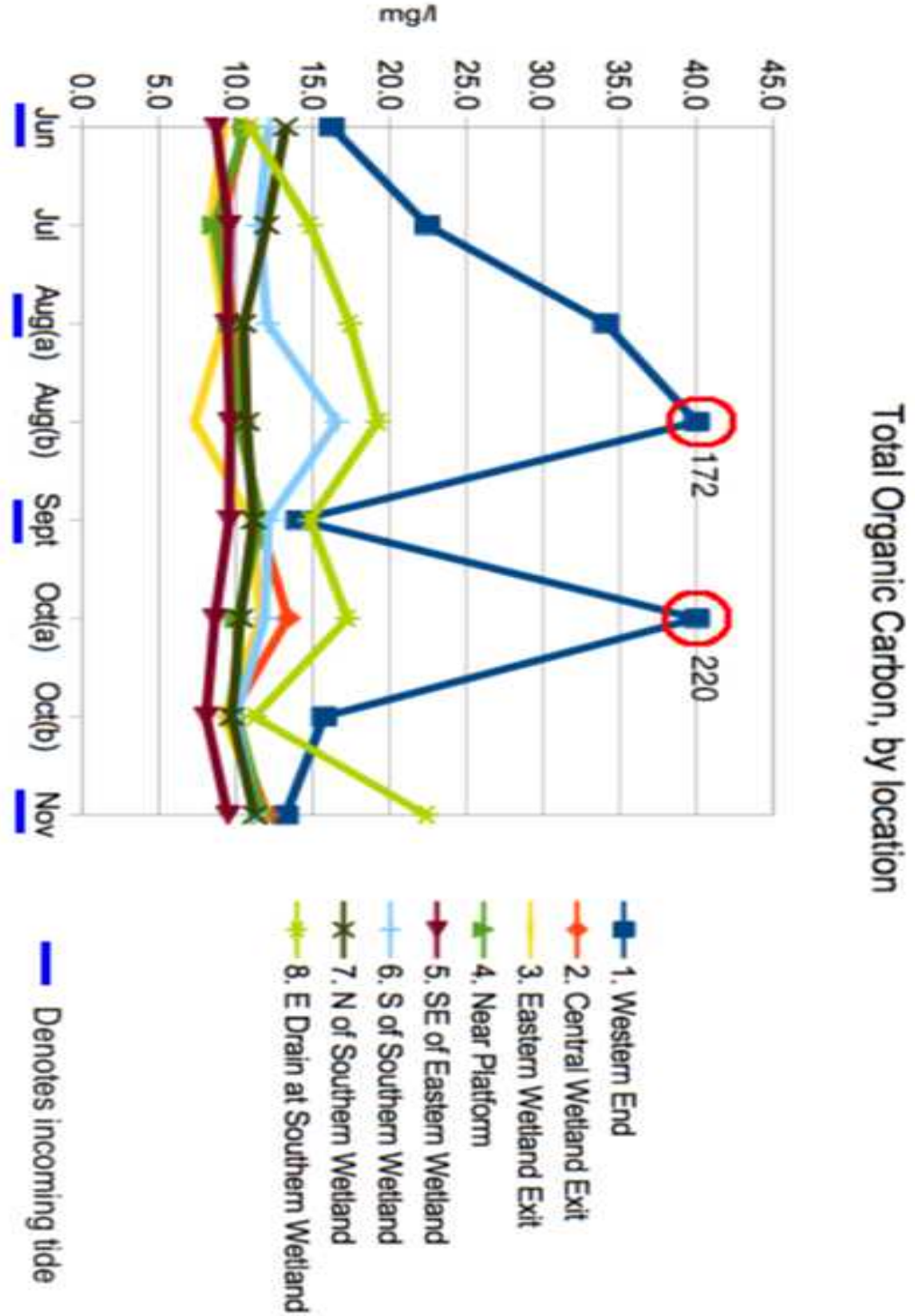


Fig. A3.19 Graph of Dissolved Oxygen Carbon results

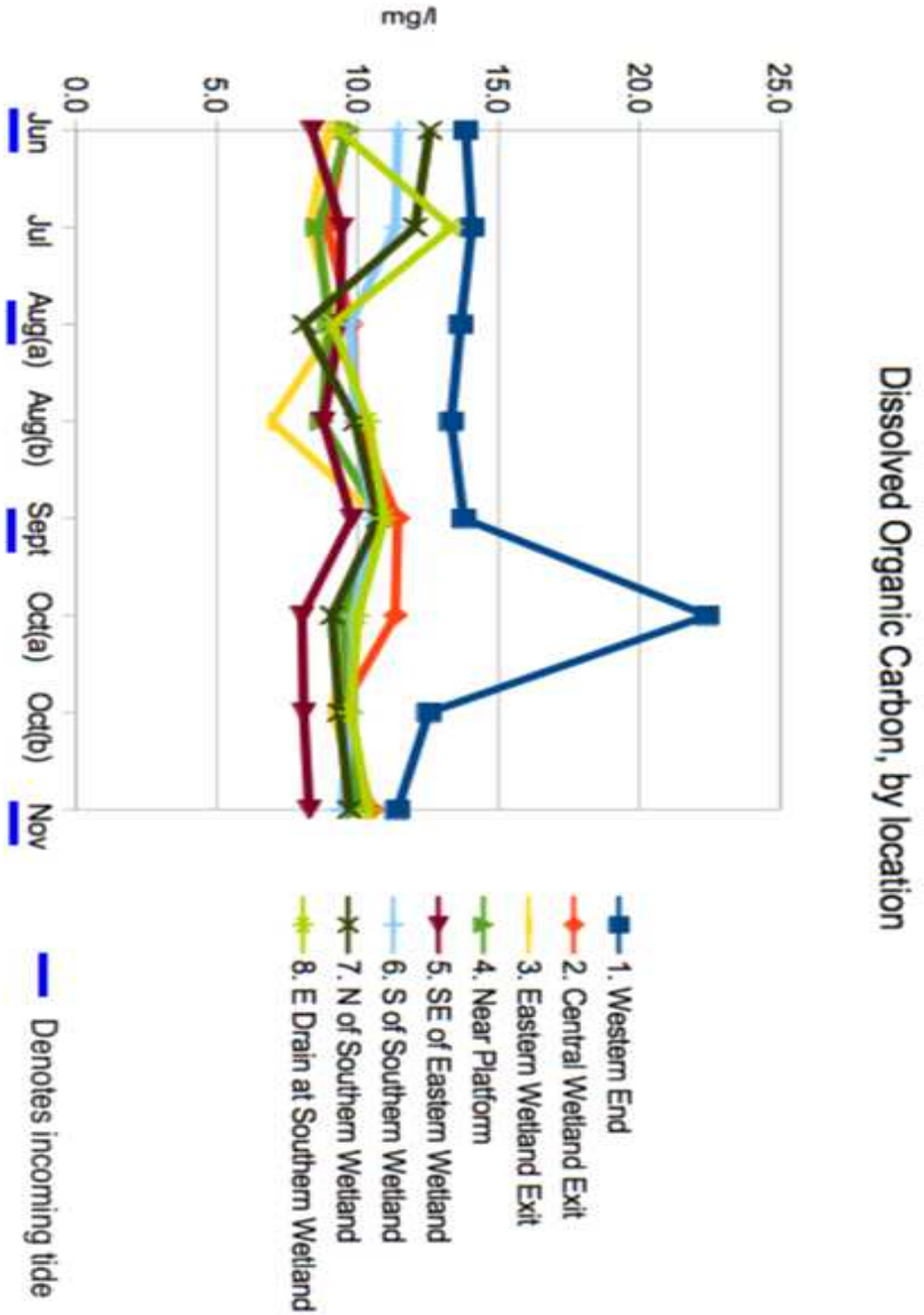


Fig. A3.20 Graph of Sulphate results

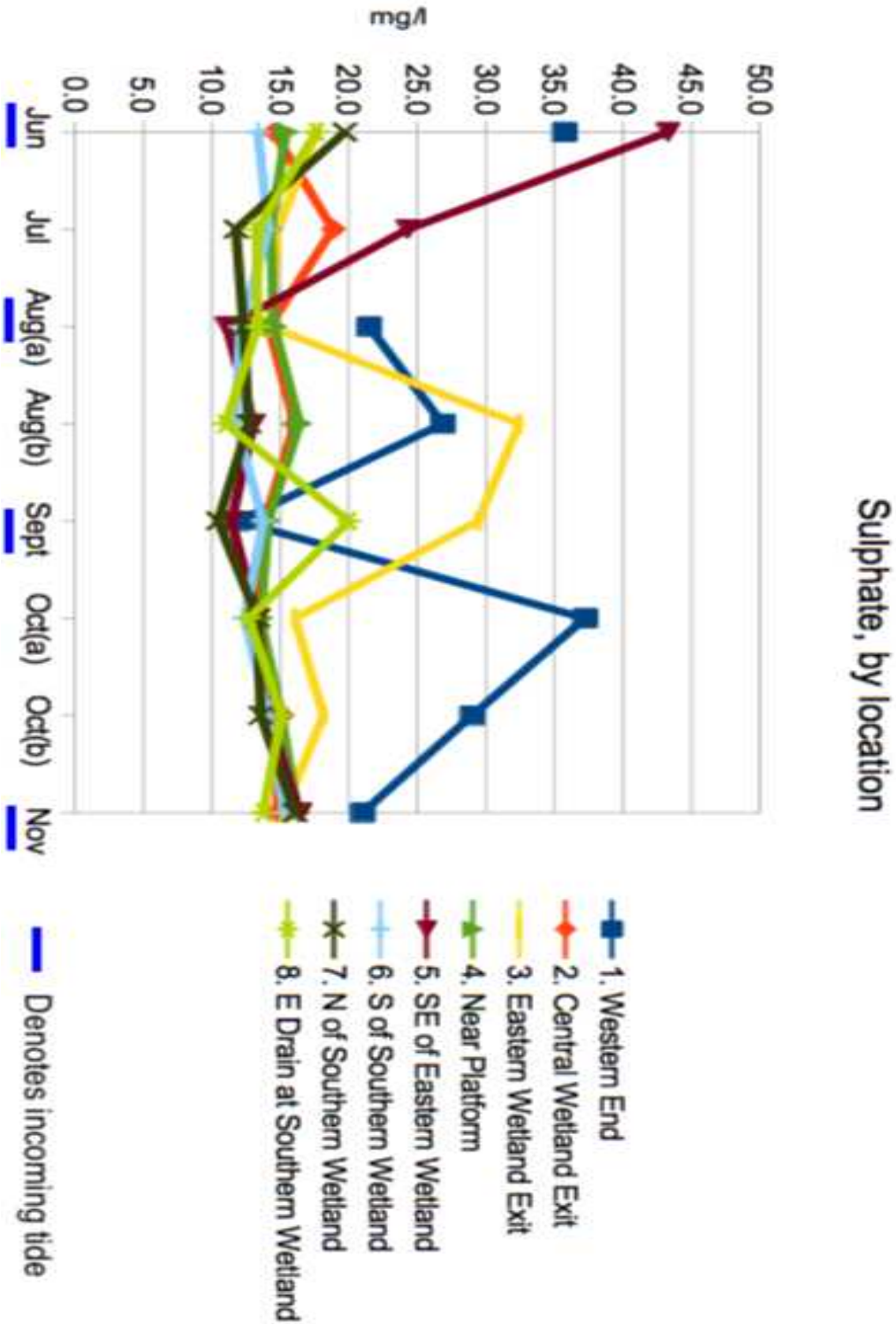


Fig. A3.21 Graph of Salinity results

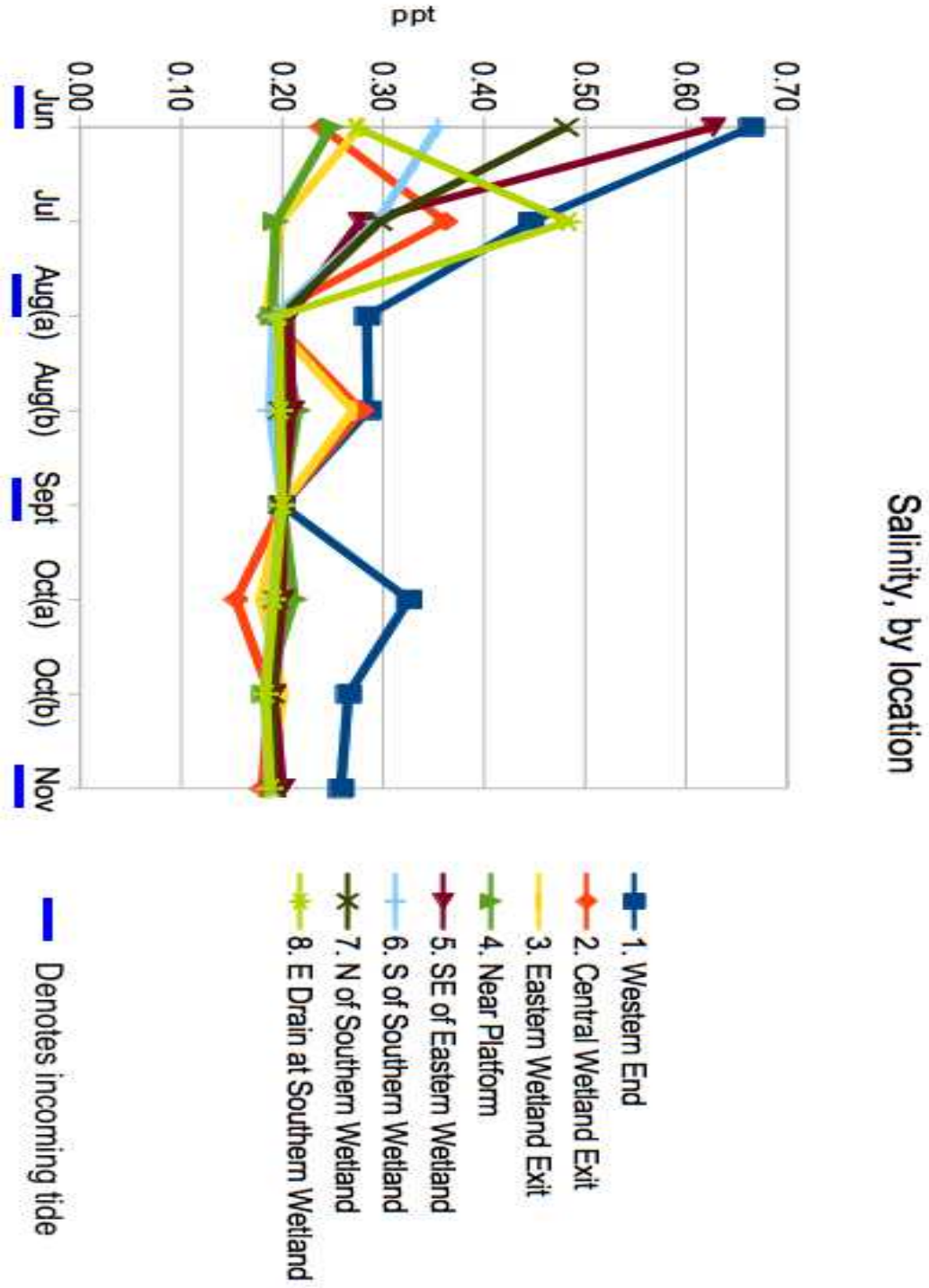


Fig. A3.22 Graph of Total Coliform results

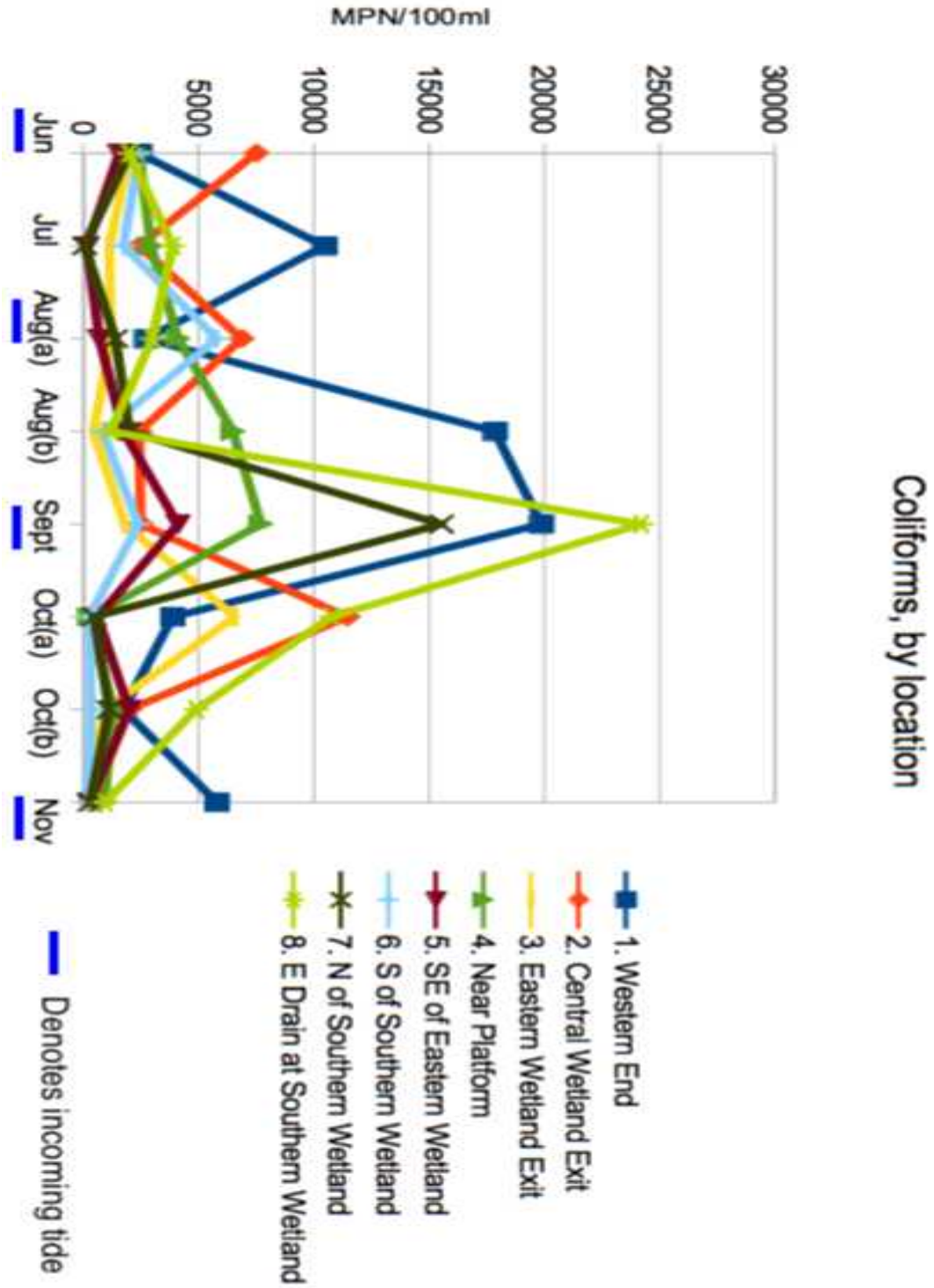


Fig. A3.23 Graph of E.coli results

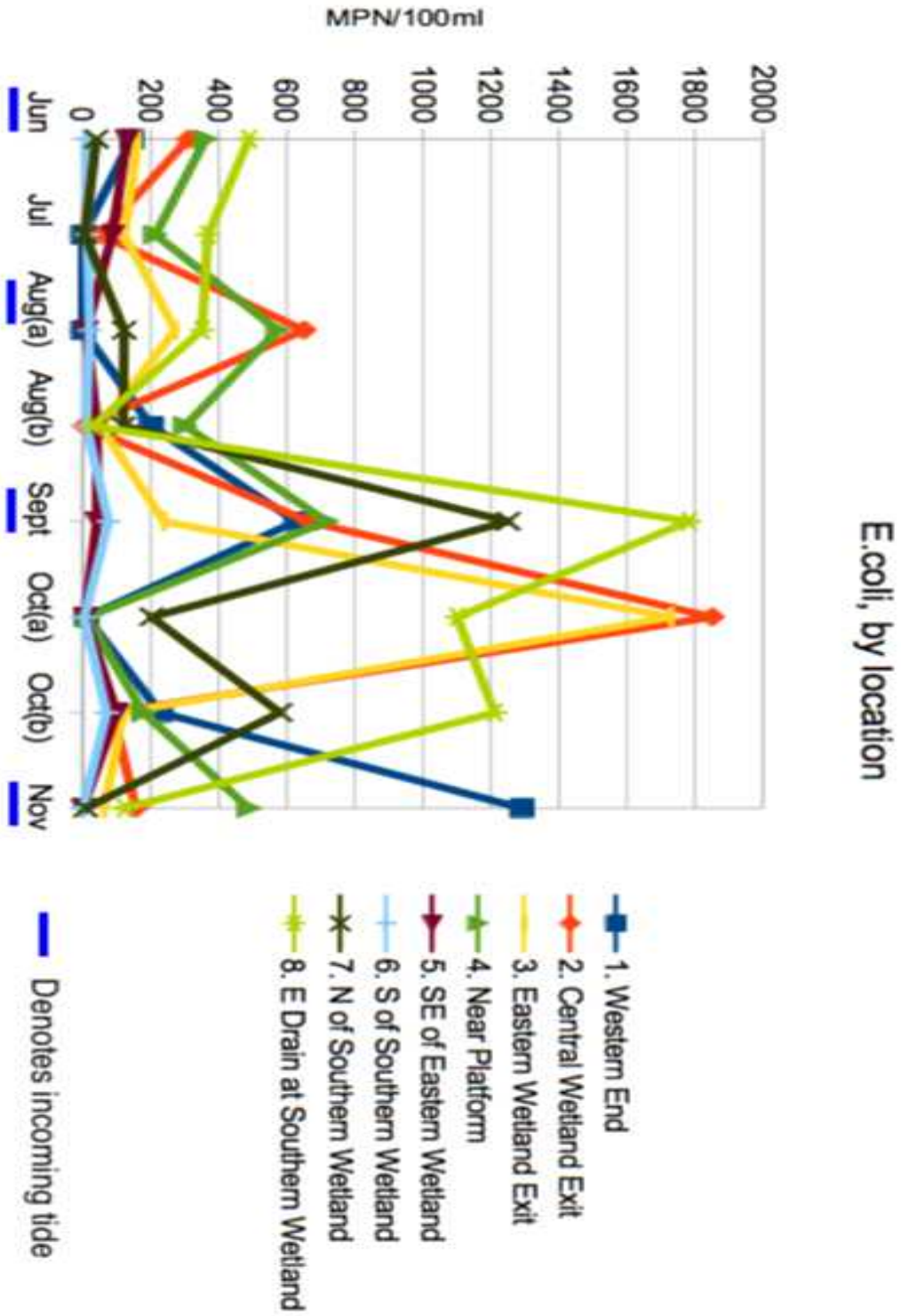


Fig. A3.24 Graph of Faecal Coliform results

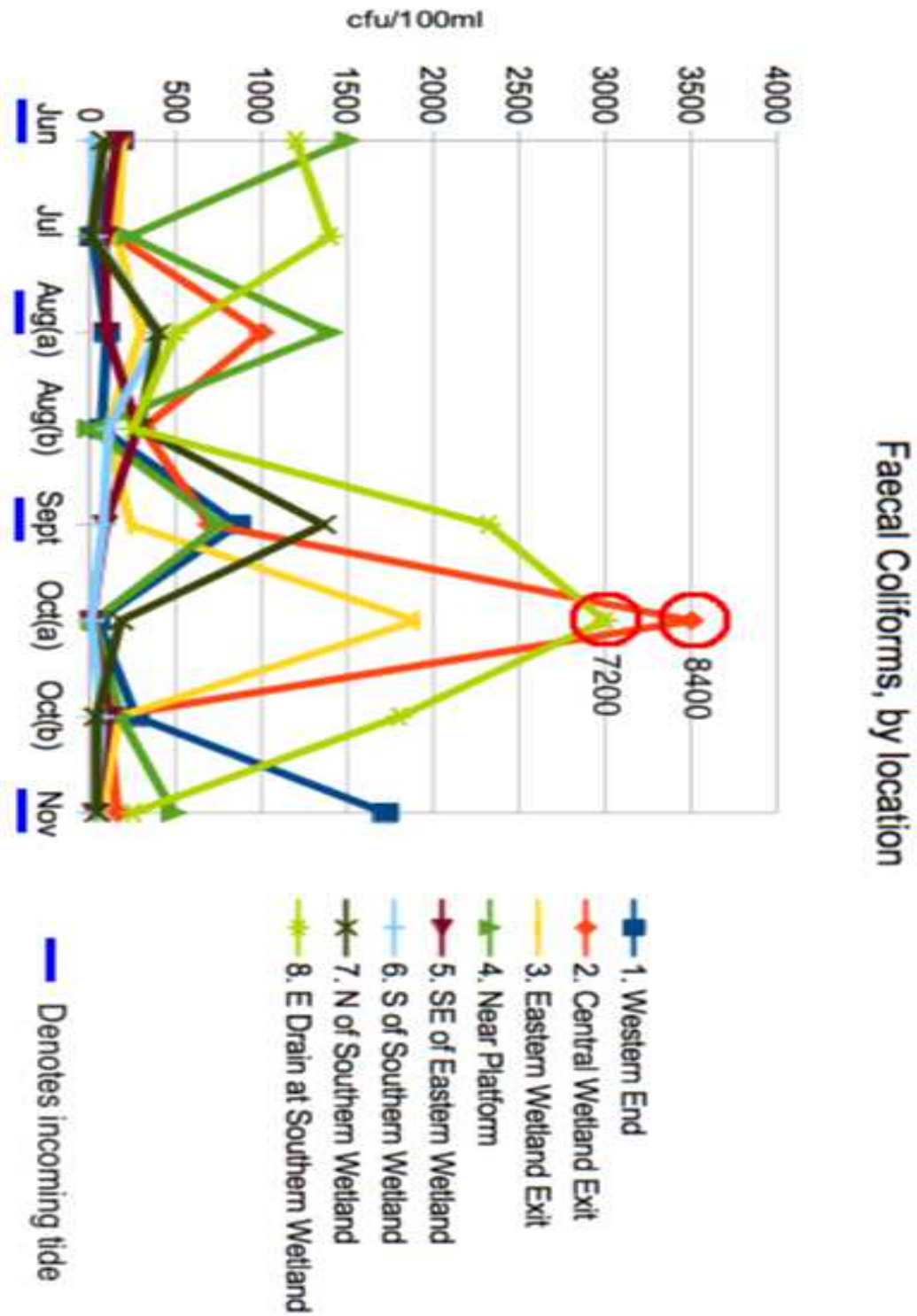
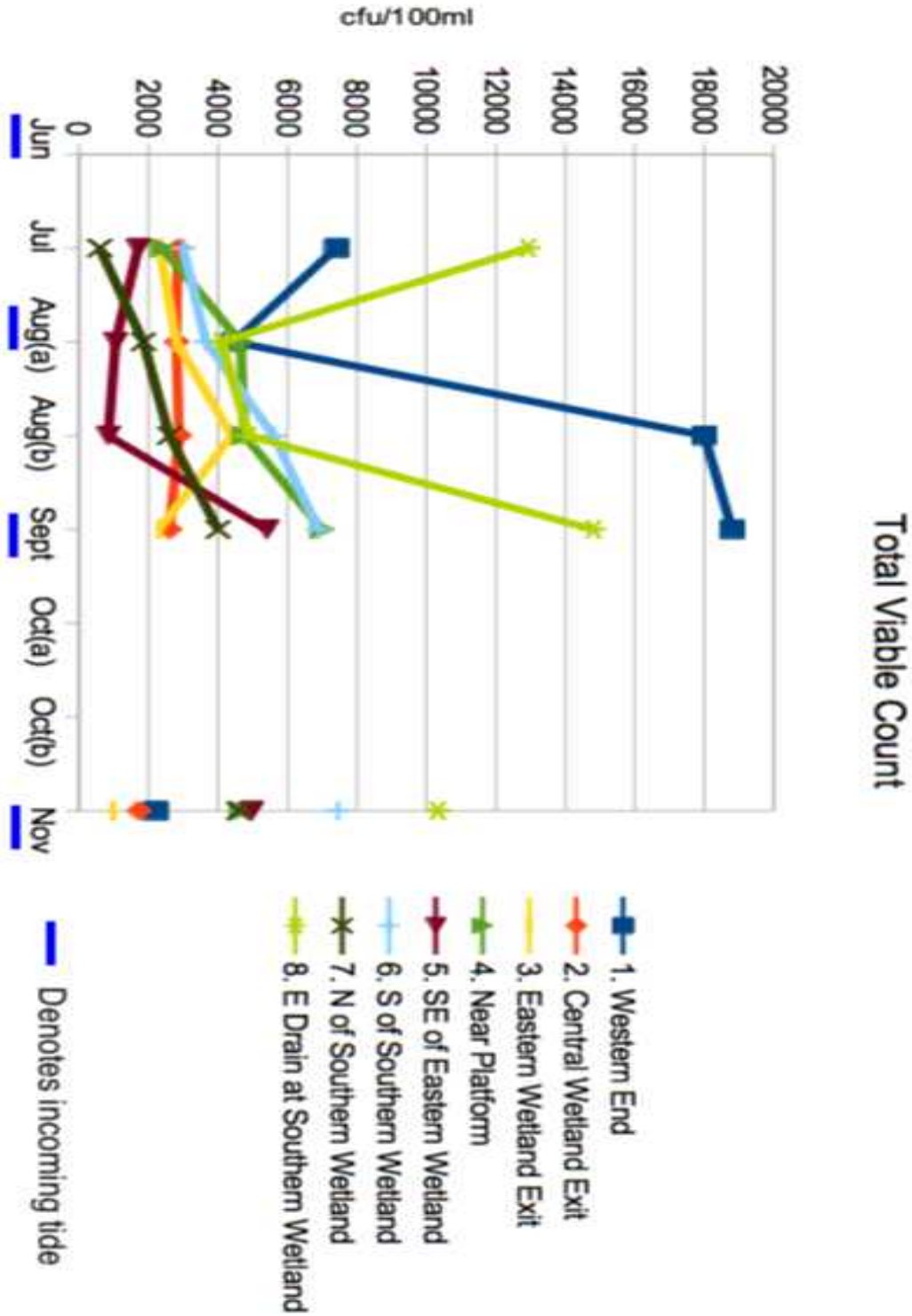


Fig. A3.25 Graph of Total Viable Count (microbial results)



Appendix 3.3 Tidal influence on water quality

The water levels at Westfields rise and fall with the tides, influencing the hydrodynamics and potentially the water quality in the wetland. To more fully understand the potential for water quality impacts from the Shannon, the tides have been marked on the graphs and tables to show whether the flow direction was into or out of the wetland at the time of sampling.

Note that the Central Wetland is the only location where tidal influence is likely to be noticeable in the water quality data, since this is the only location where clear inflows and outflows from the River Shannon are observable. The entry/exit point to the Eastern Wetland would have been equally applicable for assessing Shannon ingress, however for incoming tides the samples were taken from the seepage entering through the bank of the wetland from the direction of the Condell Road. The results of this assessment suggest that the filtration through the substrate under the Condell Road provides a significant degree of filtration en route to the wetland; but renders this location unsuitable for assessing whether there is an influence from the River Shannon on water quality.

By comparing the tidal flows with the graphs of results obtained it is possible to observe some correlation for certain parameters. Note that the Aug(a) sampling date was outgoing, but was on a turning high tide so the water exiting the central wetland was an immediate return of very recent inflows. As such it is included as an incoming tide for water quality assessments. While many parameters do not show a clear correlation, in general terms the following can be observed from the graphed results:

Microbial samples, nutrients and suspended solids generally appear to be higher entering the wetland than exiting. While Total Coliforms and *E.coli* are higher in the Shannon than in the wetland, the correlation for Total Viable Count is less clear. Some dates correlate for Faecal Coliforms, but not sufficiently to state with any certainty; with the highest reading for all samples on an outgoing tide in Oct(a), which may have been due to bird activity close to the outlet point before sampling. Nitrates and nitrites appear to be strongly correlated to the tides, with approximately double incoming results compared to outgoing results, although figures are low overall. Phosphates are much more weakly correlated, but may be influenced by the Shannon. Ammonia does not show a clear correlation either way.

Suspended solids for some sampling dates suggest that there may be elevated levels entering the wetland from the Shannon, but the results are not uniform. Clear visual evidence for this can be seen in fig. A3.6, most likely taken after a period of heavy rainfall, hence the high level of suspended solids in the river). pH also appears to be

weakly correlated, with incoming water somewhat more acidic than outgoing wetland flows.

Figure A3.26. Suspended solids inflow during high tide (most likely following heavy rainfall).

By contrast Alkalinity and Conductivity both appear to be higher in the wetland than in the Shannon. Similarly Sulphate levels appear to be marginally higher exiting the wetland than entering from the Shannon. Dissolved Oxygen appears somewhat higher in the Shannon than the wetland.

Interestingly Salinity increases appear to be inversely correlated with inflows from the Shannon. The Western Wetland location, furthest from the Shannon, shows salinity levels that are almost consistently higher than for any other location. Overall the Shannon does not seem to be a source of salinity for Westfields. This was suggested as a possibility in a previous report (Natura Environmental Consultants, 2001), with two samples showing slight salinity level elevations (1.1mg/l and 2.6mg/l compared to sea water at 35mg/l). However sampling carried out for the Plan in 2020 did not show any sample greater than 0.7ppt, and most were in the range of 0.2-0.3ppt, indicating that not only was the Shannon not a source of salinity, but that at this location of the Shannon, the river itself was a freshwater body without salt influence from the wider estuary.

Appendix 3.4 Comparison with water quality standards

In order to make sense of the data from the water quality analysis comparisons with relevant regulations or standards is helpful. The following tables are taken from *Parameters of Water Quality - Interpretation and Standards*[1] and the Surface Water Regulations, 2019[2]. They are shown here for comparison with the measured results from Westfields. Not all parameter are necessarily covered by the WQS document and Surface Water Regs., but most are. Note that some of the footnotes from the original standard or regulation have been quoted, but where the notes are less relevant they may have been omitted. If in doubt about a particular parameter in relation to the relevant EU and Irish legislation, refer directly to the item of legislation or to the 2001 EPA document.

Fig. A3.27 European Water Quality Standards, from EPA, 2001

Parameter	Units	Drinking Water	Surface Water			Freshwater Fish		Bathing Waters	Groundwater	Shellfish	Dangerous Substances
		80/78/EEC	75/440/EEC		I/MAC	78/659/EEC		76/160/EEC	60/66/EEC	79/923/EEC	76/464/EEC
		I/MAC	A1	A2	A3	(S)	(C)				
BOD	O2, mg/l	/	/	/	/	G value ≤3	G value ≤6	/	/	/	/
DO	O2, mg/l	/	/	/	/	G 50%≥9; 100%≥7 I/PV 50%≥9	G50%≥8; 100%≥5 I/PV50%≥7	/	/	G≥80%; I/PV≥70%	/
TSS	solids, mg/l	/	/	/	/	G value ≤25	G value ≤25	/	/	*(2)	/
Nitrate	NO3, mg/l	50	50	50	50	/	/	*(1)	/	/	/
Nitrite	NO2, mg/l	0.1	/	/	/	/	/	/	List 2	/	List 2
Ammonia, ionised	NH4, mg/l	0.5	/	1.5	4	G<0.04, I/MAC<1	G<0.2, I/MAC<1	/	/	/	/
Ammonia, unionise	NH3, mg/l	/	/	/	/	G≤0.005, I/MAC <0.025	G≤0.005, I/MAC <0.025	*(1)	List 2	/	List 2
Orthophosphate	P2O5, mg/l	5	/	/	/	/	/	*(1)	List 2	/	List 2
Sulphate	SO4, mg/l	250	/	/	/	/	/	/	/	/	/
pH	pH Units	≥6.5 & ≤9.5	/	/	/	≥6 & ≤9	≥6 & ≤9	≥6 & ≤9	/	7.0 – 9.0	/
Conductivity	uS/cm	2500	/	/	/	/	/	/	/	/	/
Salinity	ppt	/	/	/	/	/	/	/	/	<40	/

*(1) Sampling to be carried out "where an investigation ... shows, or there are other grounds for believing, that there has been a deterioration in the quality of waters ... or, in the case of... ammonia, that there is a tendency towards eutrophication."

*(2) "A discharge affecting shellfish waters must not cause the suspended solid content of the waters to exceed by more than 50% the content of waters not so affected."

1 EPA (2001) *Parameters of Water Quality - Interpretation and Standards.* Environmental Protection Agency, Wexford.

2 SI No 77 of 2019. *European Union Environmental Objectives (Surface Water) (Amendment) Regulations 2019*.

Fig. A3.28 Irish Water Quality Standards (EPA, 2001 and Surface Water Regs. 2019)

Parameter	Units	Drinking Water	Surface Water Regs				Salmonid Water	Bathing Waters
		SI No. 81,1988	1989-1998		I/MAC	SI No. 77,2019	SI 293 of 1988	1989-1998
		I/MAC	A1	A2	A3	/	I/MAC	
BOD	O2, mg/l	/	5	5	7	High status ≤1.3(mean); ≤2.2(95%ile); Good status≤1.5(mean); ≤2.6(95%ile)	≤5	/
DO	O2	/	>60%	>50%	>30%	95%ile>80% sat.	50%≥9mg/l*(5)	/
TSS	solids, mg/l	/	50	/	/	/	≤25	/
Nitrate	NO3, mg/l	50	50	50	50	/	/	*(1)
Nitrite	NO2, mg/l	0.1	/	/	/	/	95%≤0.05 *(2)	/
Ammonia, ionised	NH4, mg/l	0.3	0.2	1.5	4	/	<1 *(3)	/
Ammonia, unionised	NH3, mg/l	/	/	/	/	High status ≤ 0.04 (mean); ≤0.09 (95%ile); Good status≤0.065 (mean); ≤0.14 (95%ile);	≤0.02 *(4)	*(1)
Orthophosphate	P2O5, mg/l*(6)	/	0.5 (0.22 as P)	0.7 (0.31 as P)	0.7 (0.31 as P)	/	/	*(1)
Total P	P, mg/l	/	/	/	/	High status ≤ 0.01 (mean); Good status ≤0.025 (mean)	/	/
Sulphate	SO4, mg/l	/	200	200	200	/	/	/
pH	pH Units	/	5.5-8.5	5.5-9.0	5.5-9.0	6-9 (hard water)	≥6 & ≤9	/
Conductivity	uS/cm	/	1000	1000	1000	/	/	/

*(1) Sampling to be carried out "where an investigation ... shows, or there are other grounds for believing, that there has been a deterioration in the quality of waters ... or, in the case of... ammonia, that there is a tendency towards eutrophication."

*(2) "≤0.05 in 95% of samples over a sampling period of 12 months, with sampling at least once per month"

*(3) "<1 subject to conforming with the standard for non-ionising ammonia"

*(4) "≤0.02 (Standard may be exceeded in the form of minor peaks in the daytime)"

*(5) "When the oxygen content falls below 6 mg/litre the local authority must prove that there will he no harmful consequences for the balanced development of the fish population."

*(6) Conversion made by FHWS for comparison with results within the tables and graphs.

Fig. A3.29 Summary Mean and 95-percentile figures for selected parameters

Location	NH3 95%ile	NH3 Mean	P Mean	BOD 95%ile	BOD Mean
1 – Western Wetland	0.76	0.19	0.22	13.2	5.4
2 – Central Wetland Exit	0.44	0.10	0.06	1.7	1.0
3 – Eastern Wetland Exit	0.53	0.13	0.57	2.3	0.9
4 – Near Platform	0.50	0.11	0.06	2.8	1.1
5 – SE of Eastern Wetland	0.55	0.12	0.09	3.3	1.6
6 – S of Southern Pond	0.61	0.15	0.09	6.1	3.2
7 – N of Southern Pond	0.48	0.13	0.11	3.7	2.5
8 – Eastern end of Southern Pond	0.69	0.19	0.17	4.2	2.7

NH3 – Ammonia; P – Phosphorus; BOD – Biochemical Oxygen Demand

Fig. A3.29 gives the 95 percentile figures for ammonia and BOD and mean values for ammonia, phosphorus and BOD. This enables a comparison with the water quality standards given in the Surface Water Regs. (SI No.77, 2019) from Fig. A3.27. In summary for BOD, location 2 falls into the High Status category (for both 95%ile and mean values) and location 3 for mean values but not for 95%ile figures, which instead show Good Status. Other locations for BOD are insufficiently clean to qualify. For ammonia, all 95 percentile calculations fall outside the High and Good Status categories for both 95%ile figures and mean values. Likewise for mean values for total phosphorus.

Appendix 3.4.1 Averaged results compared with Water Quality Standards

The following tables compare averages of the results for each location with the relevant water quality standards. For a more accurate assessment of individual sampling dates, see the graphs (fig 3.5-3.25).

Note that while average values provide a useful overview of the general state of health of the watercourse, it is important to also examine the individual readings obtained. In reality aquatic wildlife, or indeed human health in the context of drinking water sources, does not respond in life to averages. If the water is excessively toxic on a single occasion, then that has direct and serious consequences for everything that relies on that water for life. This is borne out in those regulations that require water to be of a certain standard either 50%, 95% or 100% of the time, reflecting the importance of the given parameter for overall health of the species present.

Thus it is important to examine the results in more depth to gain a better understanding of the overall health of the habitat at Westfields. The information below is presented by parameter rather than by location *per se*.

Oxygen, Carbon and Suspended Solids:

Clean surface waters generally have a BOD of <1-2mg/l; with treated sewage generally from <5 to 20mg/l; and raw sewage up around 300mg/l. At Westfields we can see from the results that the BOD results for most locations are <5mg/l, with about half of the locations generally below 2mg/l. Exceptions to this are the Western Wetland, which is the highest concentration of BOD for many sampling days, climbing to >16mg/l in the first October sample.

Average BOD concentrations for locations 1 and 6 are both in excess of the freshwater fish guideline for salmonid waters (waters that have salmon and trout, which are very sensitive to pollution levels). However, at some point during in the sampling period all locations except 2 and 3 had BOD levels above the ≤3mg/l concentration required by these regulations. Interestingly these locations are the interface with the River Shannon, which suggests that both the river and the main wetland water bodies have lower BOD figures than the wetland margins.

Dissolved Oxygen (DO) is a measure of the amount of oxygen in the water, measured as mg/litre of water and as a % of the total saturation possible at a given temperature. In general terms, the higher the DO, the healthier the water for fish and insects.

Guideline levels for dissolved oxygen levels required for freshwater fish are ≥9mg/l for 50% of the samples and ≥7mg/l for 100% of the samples for salmonid species. For cyprinid species (coarse fish, with lower requirements for very clean water to survive

and thrive) these levels drop to ≥8mg/l for 50% of samples and ≥5mg/l for 100% of samples. The required level for 50% of all samples (I/PV, as opposed to guideline) is ≥9 for salmonid waters and ≥7mg/l for cyprinid waters.

Thus at Westfields we can see that no location meets the requirements for salmon and trout. Even for cyprinid species, the locations at the Western Wetland, South of the Southern Wetland, SE of the Eastern Wetland and the East Drain in the Southern Wetland all fail by falling below 5mg/l for some of the sampling times.

For suspended solids the upper limit is ≤25mg/l for Salmonid Regs and also as a guideline figure for the Freshwater Fish Directive for both salmonid and cyprinid waters. For the most part the surface water regulations are satisfied, with the exception of a single sample for each of the Western Wetland (632mg/l), East Drain in the Southern Wetland (606mg/l) and at the Platform (58mg/l), on three different dates. Due to the occasional difficulty of obtaining a clean sample at low water at the Western Wetland and East Drain it is proposed that these readings are the result of heavy contamination during sampling rather than high TSS readings *per se*.

For total organic carbon the only legislation that may reasonably be used here as a reference point is the drinking water directive, which requires “no abnormal change” to tap water. Thus it is not entirely applicable at Westfields, but potentially useful as part of the suite of parameters assessed. Most parameters are below 15mg/l, with the East Drain consistently higher than these and yet generally below 20mg/l. The exception is the Western Wetland which remains mostly above 15mg/l and spikes to 172 and 220mg/l on two occasions. These results suggest high levels of organic matter in the water, which was observed in the form of leaf litter debris at this location on a consistent basis. Care was taken insofar as possible to take a sample from undisturbed water, but at times of low tides this became more difficult.

Nutrients:
For the freshwater fish directive the levels are similar for cyprinid waters and more stringent for salmonid waters. Guideline figures are <0.04mg/l for salmonids and <0.2mg/l for cyprinid species. The former are achieved only for the Central Wetland, with the latter lower quality achieved for all locations except the East Drain of the Southern Wetland, where 2 breaches of the limit occurs rather than the permitted single breach. I/MAC values of <1mg/l (NH_4) for both salmonid and cyprinid waters are breached on one occasion for one location only; the Western Wetland. Thus in the context of achieving compliance with 95% of samples taken, the Central Wetland is the only compliant location for all fish species. All other levels are breached at some point for salmonid waters but are generally acceptable for cyprinid fish.

The upper limit for nitrates (NO_3) in drinking water and also surface waters for abstraction is 50mg/l, which is well above the highest reading at Westfields, at

4.5mg/l. What is more toxic for aquatic life generally is nitrite (NO_2). Again all samples are within the drinking water limit of 0.1mg/l. However the salmonid water limit of 0.05mg/l for 95% of samples is breached at the Platform and the Western Wetland locations on more than the single permitted occasion. In general terms this means that the nitrite levels are generally within the requirements for salmon and trout.

However these phosphate levels do not necessarily equate to good water quality. Like nitrates, phosphates are not generally toxic for human consumption at levels found in surface waters, but act as a potent plant fertiliser which reduces the overall habitat value for fish and aquatic invertebrates. Table A3.1 shows the water quality standards for phosphorus. The Surface Water Regs (2019) state that average P for High Status lakes is to be ≤0.01mg/l and for Good Status ≤0.025mg/l. Westfields mean values (fig. A3.2) range from 0.06mg/l P near the Platform and at the exit from the Central Wetland, up to 0.57mg/l P at the exit from the main lake (Eastern Wetland). Thus none of the results are sufficiently low in P to quality for Good Status under this parameter.

Other physical and chemical parameters:

The pH values are within the ranges required for surface waters for abstraction and drinking waters and also for freshwater fish regulations for both salmonid waters and cyprinid waters. There are no limits to Alkalinity in the regulations or directives and there are no direct limits for Hardness, except where they relate to interactions with heavy metals in the Freshwater Fish Directive and Salmonid Waters Regulations.

Microbiological:

For microbiological parameters, the primary target of concern is people rather than aquatic life. Thus the drinking water, surface water and bathing waters are the main areas of legislation that apply (see table xxx). Shellfish legislation also give maximum guideline figures for faecal coliforms (<300 cfu/100ml) due to the potential for food poisoning, but these won't apply at Westfields.

The surface water regs limit total coliform levels to 5,000 no/100ml for A1 quality waters; 25,000 for A2 and 100,000 for A3. Most Westfields samples (see graph) fall below the lowest of these levels, and all are within the A2 and A3 waters limits for all samples. Bathing waters are to be <5,000 no/100ml for 80% of samples and <10,000 no/100ml for 95% of samples. Thus the locations that would be disqualified for use as bathing waters include the Western Wetland, Central Wetland and the Eastern Drain of the Southern Wetland. Other locations exceed the 5,000 no/100ml level for some sampling dates, but not often enough to disqualify the location for bathing water.

For faecal coliforms the levels are reduced to 1,000, 5,000 and 40,000 no/100ml for A1, A2 and A3 surface waters for abstraction respectively. Thus all locations for all

sampling dates would qualify for A3 status, with exceedances to the A2 levels on one date at two locations. Only at the SE of the Eastern Wetland and the South of the Southern Wetland are all samples within the standard for A1 water quality. For bathing waters, 80% of samples must be <1000 no/100ml; and 95% below 2000 no/100ml. Thus from the perspective of faecal coliforms, the locations that would qualify for use as bathing waters include all locations except the Drain in the Southern Wetland.

Drinking water standards require that no 100ml sample detects *E.coli*. While four samples out of the total of 64 assessed for E.coli returned zero figure, averages for each location range from 25 to 681 MPN/100ml. The drinking water standards also have an upper limit on the total colony count (total viable count) of 100 no/ml (at 22'C). Every single sample returned had a reading of >300no/ml; and because three rounds of sampling were limited by dilution issues at the lab, the lowest actual figure measured was 590 no/ml at the North side of the Southern Wetland in July. The maximum TVC reading was 14800 no/ml at the Drain in the Southern Wetland in September.

Appendix 4.0 Creating Open Water

Appendix 4.1 Principles of still water management

A number of principles for still water management are outlined by the Wildlife Trusts (UK) Wetland Restoration Manual. These are paraphrased as follows:

1. Protection from pollution from nearby landuse is important.
2. Allow a variety of successional stages in any management action.
3. Avoid indiscriminate clearing of marginal or aquatic vegetation (>1/3 of the area of the water body in any maintenance season).
4. Encourage a diversity of plant communities and species.
5. Dredging should be avoided unless absolutely necessary; and should be limited to $1m^3/100m^2/yr$.
6. Retain overhanging trees and shrubs unless absolutely certain of the ecological benefit.
7. During any works retain examples of all habitats present (such as fallen wood, shaded patches, emergent plant growth, muddy margins, damp drawdown zones).
8. Short of addressing pollution inputs, non-intervention may be best management option; or introduction of new wetlands nearby.
9. Time the works with care to protect important species.
10. Contact relevant bodies if protected species are present. Licences may be needed for works.

(Note that in the case of item 10 above, the area is an SAC, so liaison with the NPWS is necessary prior to any works.)

Appendix 4.2 Excerpt from Limerick City Drainage Map

Figure A4.1 below shows an excerpt from the LCCC drainage map, with a key as shown. The drains shown in and around the wetland include combined sewers (both foul sewers and stormwater drainage from road and roof surfaces), surface water sewers taking road runoff at the western and eastern extremities of the site, one trunk drain (oversized stormwater drain) north of the central causeway and pipes to the north-west of the site that are not identified or necessarily in use. Note that the combined sewer outfalls shown here have subsequently been connected to the main drainage system.

Fig. A4.1. Historic and current pipe network in and around Westfield Wetland

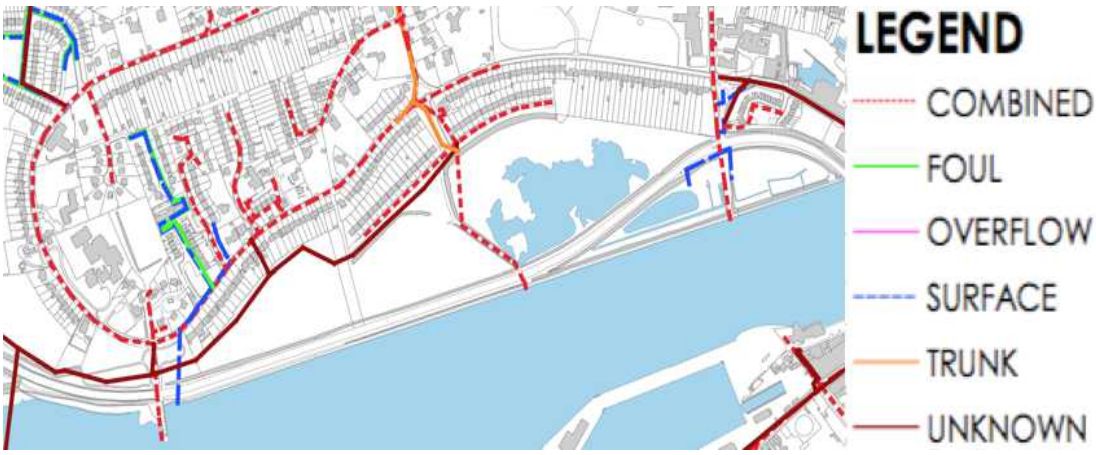
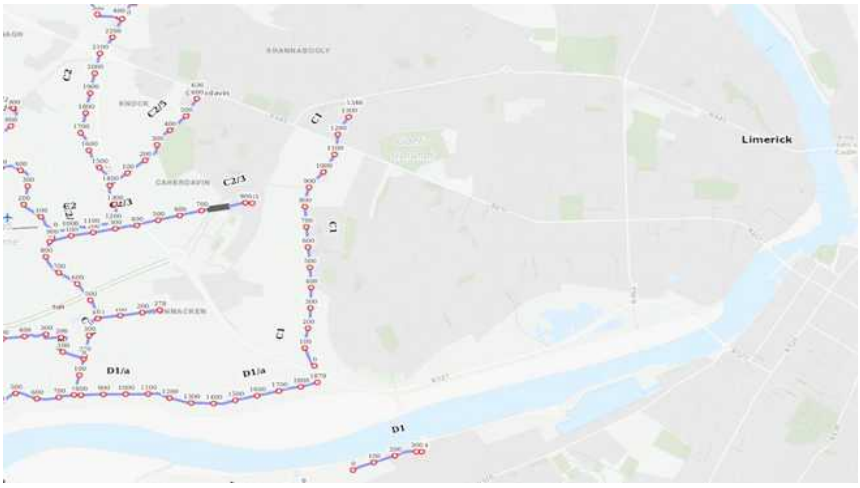


Figure 4.2 shows the absence of streams within the Westfields area, as highlighted on the OPW maintenance map for this portion of the city.

Fig A4.2. Map of work areas for OPW maintenance, showing Westfields outside this area.



Appendix 4.3 Residents concerns about water flows

Local residents have raised concerns about water throughput since the construction of the Condell Road, and this issue is addressed here. They have observed a marked encroachment of bulrush since the construction of the road. This has been attributed to the reduction in the pipe diameter between the wetland area and the Shannon at that time.

From the perspective of water levels and throughput, the local residents outline the history of the area as follows:

- Predating the 1880s maps and the construction of the flood bund, this area would have been a flood plain on the River Shannon, subjected to regular inundation on each incoming tide. After the flood bund was built this area

was used for agriculture, as evidenced in historic maps.

- The Eastern Wetland is reported locally to have been fed by a spring that supplied the Cleeve's Factory nearby. (Note that up to the late 1940s this area was farmland, subject to flooding on spring tides, according to the historic 6" maps, and the spring fed a small stream). The spring is reported to have been abandoned in the fifties and covered with a steel plate.
- Also reported from this time is a breach in the Shannon flood bund, attributed to the flooding of the wetland, and conversion from agricultural land to wetland.
- During the repair works after the flooding, a concrete culvert with a non-return valve is reported to have been constructed between the river and the wetland to drain the area. This is understood locally to have created a tidal wetland, indicating that the water drawdown after this work was not as effective as the previous measures which allowed agriculture to thrive here to that point.
- Close to the completion of the Condell road, in 1988, a 14" diameter steel pipe with steel flap valve was apparently laid to replace the original concrete pipe, which was capped, but left *in situ*. Concerns were raised by residents at the reduction in throughput
- Concerned by the low water throughput and the potential impact on the wetland and the wildlife there, residents met with the Corporation on a number of occasions to try and have the larger pipe reinstated, but no amendments were made.
- The existing flap valve is reported to have jammed closed at one stage, leading to flooding of the wetland area (which suggests that the spring may indeed have a significant influence on the water balance of the wetland). As a result of that flood the flap valve was jammed open rather than closed, leading to free flow of water both in and out of the wetland.
- Residents still seek to change the flow dynamics of the wetland as a solution to the bulrush encroachment and drop in bird numbers.

Essentially, the assertion of many residents is that the reduction in pipe diameter has led to bulrush encroachment, which in turn has led to a drop in waterfowl numbers over the years, expressed in a submission from the residents association as follows: "Prior to the road construction there was no reed incursion in the open water area, however, over the last 20 years there has been a significant incursion which the Residents attribute to the lower water exchange rate."

While there has been an observable correlation between the construction of the Condell Road and the encroachment of bulrush, this does not necessarily imply causation. The use of the smaller pipe with reduced throughput may well have occurred over the same timeframe as the bulrush encroachment without necessarily

being the cause. Other more likely causes are set out in section 4.1.2 of the main Plan.

Appendix 4.4 Flood Studies reporting

The hydraulic engineering section at JBA have commented on the requirements for any measure to raise the water levels in the wetland. It has been proposed that there would be a need to assess the impact of any weir or raising of a stream base on local water levels as part of a Section 47 consent under the Arterial Drainage Act. If planning permission (Part 8 Planning by LCCC) is deemed to be required, then such an assessment could feasibly double up as a formal flood risk assessment. In conclusion, putting in a weir/control is likely to create an expensive paper trail for something that will probably not have much impact. JBA also commented that the issue of the current flap valve not working correctly may be masking how the area might operate if no tidal inflows were allowed.

To proceed with such a study, the hydrological consultant would need the following data:

1. Topographical survey of existing flap valve inlet, outlet and Condell Road.
2. LiDAR DTM – available free of charge.
3. Details of any third party drainage networks that discharge into the lake or stormwater drainage from the surrounding area.
4. Proposed weir crest level and length/width; or proposed amendments to non-return valve.

From this the hydrological consultant would:

1. Estimate inflows.
2. Construct a hydraulic model.
3. Establish baseline levels.
4. Look at post-development design and assist in setting final crest level.
5. Investigate scenario with flap valve working correctly/incorrectly.
6. Liaise with OPW regarding Section 47 consent.
7. Apply for consent.
8. Present results in Flood Risk Assessment format document.

Note that the recommended actions listed in the main Plan include for further investigations into the spring entering the main lake of the Eastern Wetland.

Appendix 5.0 Bulrush Clearing

Appendix 5.1 Bulrush encroachment over time

To gain a clearer understanding of the encroachment in recent years it is worth examining aerial photographs over time. The photographs below show a clear pattern of encroachment over the past decade.

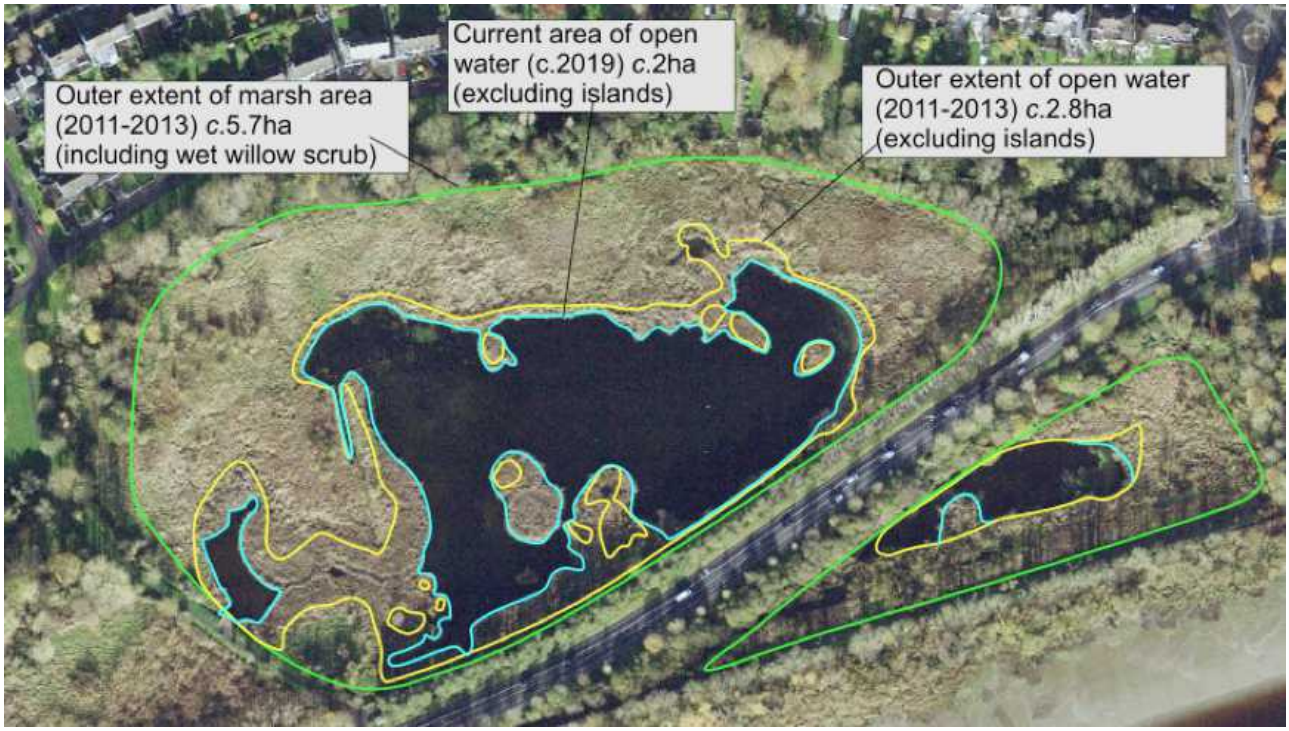
Fig A5.1 shows the OSI GeoHive aerial view for 2011-2013 and fig A5.2 shows the same view from *c.*2018. This is most notable around the platform, as shown below. Note that the rate of regrowth may look more dramatic given that bulrush removal was carried out in c. 2008, which may have slowed down natural succession temporarily, and led to a more advanced successional process between the upper and lower aerial photos.

Fig A5.1. OSI GeoHive aerial photograph of Westfields Lake, "Digital Globe 2011-2013".

Fig A5.2. OSI GeoHive aerial photo of Westfields Lake, "Aerial Premium" (c.2018).

The encroachment of bulrush has been shown in more detail in figure A5.3. Note the encroachment of bulrush around the islands in the middle of the lake and at the western end of the lake, near the platform.

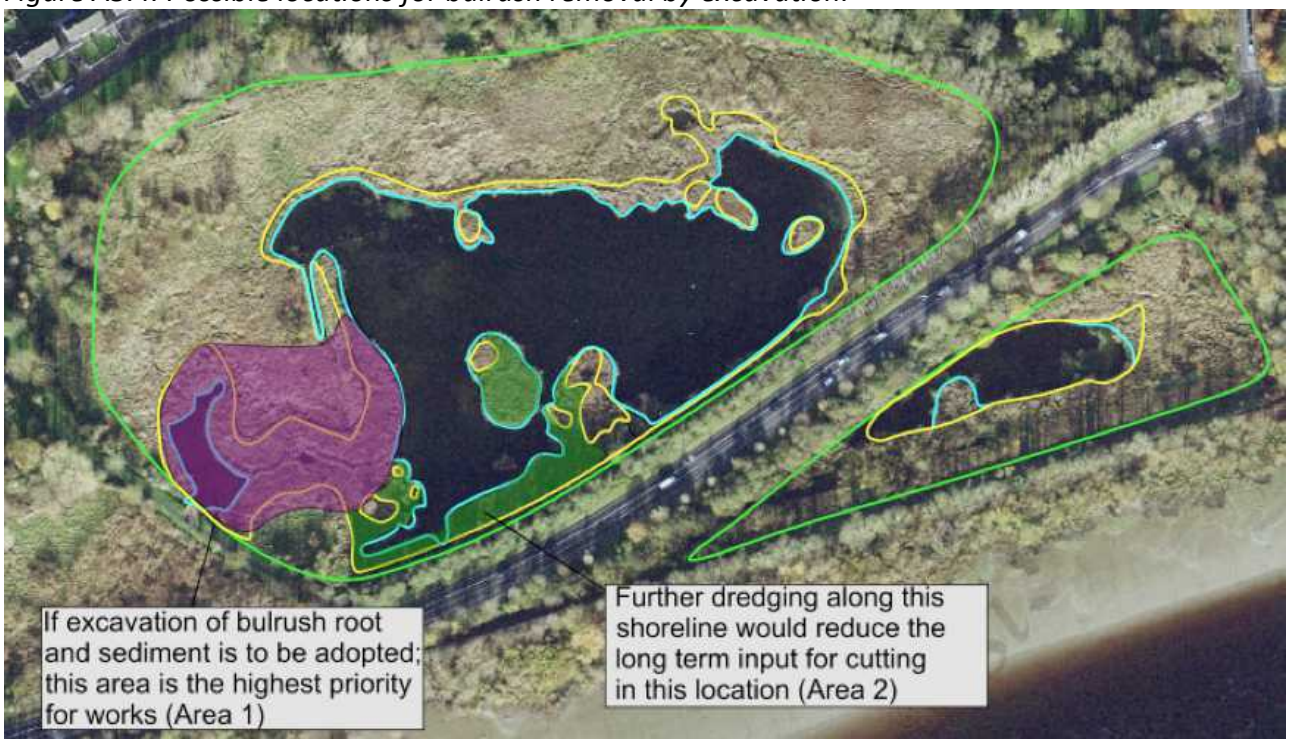
Figure A5.3. Encroachment of bulrush from c.2012 to c.2018



Appendix 5.2 Considerations regarding excavation

In addition to the removal methods outlined in the main Plan document, excavation may be considered a suitable method if a budget were made available. The location for excavation works will be different from those selected for clearing by harvesting or root removal. Figure A5.4 outlines the most suitable locations for dredging works; removing both sediments and roots at the same time.

Figure A5.4. Possible locations for bulrush removal by excavation.



By prioritising Area 1 it is possible that the frequency of cutting years may be dramatically reduced.

Excavating Area 2 would also be beneficial insofar as it would open the view from this section of the southern pathway to the lake. Deep water should not be created beside the pathway, so some regular cutting may also be needed here to control bulrush growth in the shallow margins for c.5m into the lake. Further east along this pathway may be a suitable location for a bird hide, so some bulrush here is desirable as an additional screen.

The areas to the north and east of the lake shows much slower encroachment of bulrush, so removal by excavation is likely to be less feasible from a cost-benefit perspective. However should there be both the budget and the desire for it, the lake area may be widened by excavating bulrush and sediments in either of these areas to create more open water and large islands for habitat value.

Note that these excavation works should limit the amount of silt excavated to $1m^3/100m^2$ of habitat area. Thus over a total lake area of *c*.2ha, the total volume of silt excavated should not exceed $200m^3$. Thus across Area 1 (*c*.0.7ha) this would equate to a dredge depth of 28cm in a given year; or alternatively a 1.1m dredge carried out over a quarter of the area in each of 4 successive years.

For Area 2 (*c*.0.3ha) the dredge depth may be 66cm in any given year. This would probably be needed only on one occasion to achieve a clear sightline of open water from the pathway. Such a dredge would probably be effective for *c*.10 years in the deeper areas, but follow-up clearing by bulrush cutting or removal may also be needed where the water shallows out towards the path.

Note that ecologically, excavation is quite an invasive and disturbing process to any habitat, so should be carried out only after careful consideration of the other options and of the habitat considerations at hand. See the ecological considerations in the excavation section later in this section.

Appendix 5.3 Summary of bulrush removal & disposal

Excavation Overview:

Methodology	Damming of the exit from the lake to prevent ingress at high tide; accompanied by pumping to lower overall water levels. Dredging of lake sediments onto shoreline by excavator. Dewatering on site to minimise volumes. Removal to Mungret Recycling Centre. Reinstatement of pathways and lawns after works.
Ecological implications:	Disturbance of birds and their nesting areas, disturbance of base sediments; generation of sediments in water body with possible implications for algal growth etc. in the season following the works.
Effectiveness:	Most effective method listed.
Durability:	Most durable method listed.
Estimated cost:	*c*.€50,000-€500,000 depending on area adopted.
Project considerations:	Ecological Screening by LCCC and liaison with NPWS. Confirmation from LCCC as to capacity at Mungret Recycling Centre for acceptance of excavated material for composting/dewatering. Heavy machinery on site would necessitate Health and Safety review. Pathways would need to be repaired and reseeded after completion.

Root Removal Overview:

Methodology	Possible damming of the exit from the lake to prevent ingress at high tide; with or without pumping to lower overall water levels (or work with tides). Remove bulrush roots by pulling plants by hand and loading into boats for removal to the shore. Removal from the site to Mungret Recycling Centre.
Ecological implications:	Possible disturbance of birds and their nesting areas, some disturbance of base sediments
Effectiveness:	Effective method if followed-up with modest but consistent annual repeat root removal or cutting regime.
Durability:	Durable only if carried out in conjunction with annual maintenance regime.
Estimated cost:	*c.*€5,000-50,000 depending on extent of works.
Project considerations:	Ecological Screening by LCCC and liaison with NPWS. Confirmation from LCCC as to capacity at Mungret Recycling Centre for acceptance of removed plant material for composting.

Plant Cutting Overview:

Methodology	Work with tides to remove the need to block the outlet weir and pump water from the wetland. Cut bulrush stems and leaves by mechanical harvester or using a hand scythe. Cut as low as possible below water surface for maximum effectiveness. Load into boats or use floating booms to remove cut material to the shore. Removal from the site to Mungret Recycling Centre or composting on site.
Ecological implications:	Potential disturbance of birds and their nesting areas.
Effectiveness:	Effective method if followed-up with annual cutting regime.
Durability:	Durable only if carried out in conjunction with annual maintenance regime.
Estimated cost:	*c.*€3000-20,000 depending on the extent of works.
Project considerations:	Ecological Screening by LCCC and liaison with NPWS. Confirmation from LCCC as to capacity at Mungret Recycling Centre for acceptance of removed plant material for composting.

Herbicide Application Overview:

Methodology	Sponge application of biocide onto growing leaf surface.
Ecological implications:	Disturbance of birds and their nesting areas possibly during nesting season. Potential contribution of biocidal toxins to the water body and impact on flora and fauna as a result.
Effectiveness:	Effective method if followed-up with annual cutting regime, root removal or repeated herbicide application.
Durability:	Durable only if carried out in conjunction with annual maintenance regime.
Estimated cost:	Not considered.
Project considerations:	Ecological Screening by LCCC and liaison with NPWS. Due to the growing health implications of glyphosate use, and the availability of other options, this method is not recommended.

Flooding Overview:

Methodology	Construct weir at outlet from lake to raise levels in accordance with the limits set out in the Water Levels section of this Plan.
Ecological implications:	Not to be initiated/altered during the nesting season, so as to avoid disturbance to nests. Otherwise likely to be benign.
Effectiveness:	As a stand-alone measure this is the least effective method listed, but it may be valuable for use in conjunction with cutting to discourage regrowth.
Durability:	If the final selected water level for the lake is set at significantly above the current level at low tide, then this method may be a durable solution for prevention of regrowth, in conjunction with another method such as consistent annual cutting.
Estimated cost:	Weir construction cost of *c.*€2,000-5,000 depending on the construction method selected; excludes Flood Risk Assessment and OPW liaison.
Project considerations:	Ecological Screening by LCCC and liaison with NPWS. Flood Risk Assessment by JBA or other suitable contractor required to ensure that sufficient flood capacity remains for high tide ingress during spring tides. OPW Section 47 required for weir construction.

Appendix 5.4 Contacts for bulrush removal works

The following key areas are listed as contact information for consultation in advance of or during bulrush removal works.

Organisation	**Area of input**
FH Wetland Systems	Westfields Management Plan co-ordinator
LCCC	Natura Impact Statement
OPW	Any weir works
JBA or LCCC	Flood Risk Assessment
NPWS	Ecological impacts
LCCC	Offsite storage of removed biomass
LCCC	Senior Executive Engineer

Appendix 6.0 Biodiversity & Invasives

Appendix 6.1 Relevant conservation areas

Lower River Shannon Special Area of Conservation (SAC)
This very large site stretches along the Shannon valley from Killaloe in Co. Clare to Loop Head/ Kerry Head, a distance of 120 km (NPWS 2013). This extensive Special Area of Conservation (SAC) encompasses the Rivers Shannon, Feale, Mulkear and Fergus. The River Shannon within this SAC flows through Carboniferous limestone as far as Foynes town and west of Foynes, through mostly Namurian shales and flagstones. The section of the River Shannon, which is adjacent to the Westfield Wetlands site, is part of the Shannon Estuary and so is influenced by the tides. Salinity levels vary throughout the estuary (NPWS, 2013). Saltmarsh and mud flat habitats are present along the estuary, with specialised colonisers of mud dominating areas between the two habitats.

The Shannon Estuary provides support to large numbers of wintering water birds, including some Annex I species including Great Northern Diver, Whooper Swan, Pale-bellied Brent Goose, Golden Plover and Bar-tailed Godwit. Otter has been commonly found in the River Shannon, as have Salmon and Lamprey (NPWS, 2013).

Several Irish Red Data Book species have been recorded within this SAC including (but not limited to) Triangular Club-rush (*Scirpus triquetrus*) and Opposite-leaved Pondweed (*Groenlandia densa*). Triangular Club-rush is a rare and highly threatened vascular plant in Ireland with restricted distribution to tidal stretches of the River Shannon. It is protected under the Wildlife Acts (1976 and 2000) and is listed on the Flora Protection order 2015. Opposite-leaved Pondweed is typically associated in Ireland with tidal stretches of rivers or disturbed watercourses. It is protected under the Wildlife Acts (1976 and 2000) and is listed on the Flora Protection Order 2015 (NPWS, 2012b). Locations where Opposite-leaved Pondweed and Triangular Club-rush are present on this site are classified as sub-types of the Annex I habitat Water courses of plain to montane levels with the *Ranunculion fluitanis* and *Calltricho-Batrachion* vegetation (3260).

The Lower Shannon SAC has a number of species and habitats that are Qualifying Interests (QIs) protected by the site (NPWS 2012). However, as the Lower River Shannon is such a large site, not all QIs are found near or in Westfield Wetlands. Therefore, only the relevant features are listed below. The qualifying features that could be potentially impacted through actions from the Westfield Wetlands Management Plan are:

- Estuaries [1130]
- Mudflats and sandflats not covered by seawater at low tide [1140]

- Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae, Salicion albae*) [91E0]
- *Petromyzon marinus* (Sea Lamprey) [1095]
- *Lampetra planeri* (Brook Lamprey) [1096]
- *Lampetra fluviatilis* (River Lamprey) [1099]
- *Salmo salar* (Salmon) [1106]
- *Lutra lutra* (Otter) [1355]

River Shannon and River Fergus Estuaries SPA

The River Shannon and River Fergus Estuaries SPA is an internationally important site that supports an assemblage of over 20,000 wintering waterbirds. It holds internationally important populations of four species, i.e. Light-bellied Brent Goose, Dunlin, Black-tailed Godwit and Redshank. In addition, there are 17 species that have wintering populations of national importance. The site also supports a nationally important breeding population of Cormorant. Of particular note is that three of the species which occur regularly are listed on Annex I of the E.U. Birds Directive, i.e. Whooper Swan, Golden Plover and Bar-tailed Godwit. Parts of the River Shannon and River Fergus Estuaries SPA are also Wildfowl Sanctuaries (NPWS, 2015). The estuaries of the River Shannon and River Fergus form the largest estuarine complex in Ireland. The site comprises the entire estuarine habitat from Limerick City westwards as far as Doonaha in Co. Clare and Dooneen Point in Co. Kerry (NPWS 2015). Westfield Wetlands is an important part of the wetlands complex for some of the wintering birds protected by the SPA.

Fergus Estuary and Inner Shannon, North Shore Proposed Natural Heritage Areas (pNHA).

These pNHAs have approximately the same boundary as River Shannon and River Fergus Estuaries SPA and the Lower Shannon SAC. Little information has been provided by NPWS on the ecological features of this pNHA but it can be assumed many of the features of the SPA and SAC are shared with this site. The pNHA encompasses the entire area of the wetlands. The site is deemed to be of national importance and is protected under the Wildlife Acts.

Appendix 6.2 Plant species record

Note * denotes non-native species

Scientific name	Species
Acer pseudoplatanus	Sycamore
Achillea millefolium	Yarrow
Aegopodium podagraria	Ground elder
Aesculus hippocastanum	Horse Chestnut
Alisma plantago-aquatica	water plantain
Alnus cordata	Italian Alder*
Alnus glutinosa	Alder
Berula erecta	Lesser Water-parsnip
Betula pendula	Birch
Buddleja davidii	Butterfly-bush*
Calystegia sepium	Bindweed
Carex pendula	Pendulous sedge*
Centaurea scabiosa	Knapweed
Corylus avellana	Hazel
Crataegus monogyna	Hawthorn
Crocosmia X crocosmiflora	Montbretia*
Cupressus macrocarpa	Monterey Cypress
Elodea nuttallii	Nuttall's waterweed*
Epilobium hirsutum	Great willowherb
Epilobium montanum	Broad-leaved willowherb
Fagus sylvatica	Beech
Fallopia japonica	Japanese Knotweed*
Fallopia x bohemica	Bohemian Knotweed*
Festuca rubra	Red fescue
Fraxinus excelsior	Ash
Glyceria maxima	Reed Sweet-grass
Griselinia littoralis	Griselinia*
Gunnera manicata	Giant Rhubarb*
Hedera hibernica	Ivy
Heracleum mantegazzianum	Giant Hogweed*
Impatiens glandulifera	Himalayan Balsam*
Jacobaea aquatica	Marsh ragwort
Koenigia polystachya	Himalayan Knotweed*
Lemma minor	Common Duckweed
Lemna minuta	Least Duckweed
Leucojum aestivum	summer snowflake
Leycesteria formosa	Himalayan Honeysuckle*

Lolium perenne	Yorkshire-fog
Lotus corniculatus	Birds-foot trefoil
Lycopus europaeus	Gypsywort
Lythrum salicaria	purple loosestrife
Mentha aquatica	water mint
Myriophyllum spicatum	Spiked Water-milfoil
Myriophyllum verticillatum	whorled water-milfoil
Oenanthe crocata	Hemlock Water-dropwort
Petasites hybridus	Butterbur
Petasites fragrans	Winter Heliotrope*
Phalaris arundinacea	reed canary grass
Phragmites australis	Common reed
Populus	Poplar
Prunus laurocerasus	Cherry Laurel*
Quercus petraea	Oak
Quercus rubra	Red oak*
Ranunculus repens	Creeping buttercup
Rubus fruticosus	Bramble
Rumex crispus	Curled Dock
Salix alba	White Willow*
Salix cinerea	Grey Willow
Salix viminalis	Osier Willow
Sambucus nigra	Elderberry
Schoenoplectus lacustris	Common Club rush
Sorbus aria	Whitebeam
Sorbus aucuparia	Rowan
Spirodela polyrhiza	Greater Duckweed
Stachys sylvatica	Hedge woundwort
Symphoricarpos albus	Snowberry*
Tilia cordata	Lime
Tussilago farfara	Coltsfoot
Typha latifolia	Bulrush
Ulmus glabra	Wych Elm
Urtica dioica	Nettle
Veronica serpyllifolia	Ivy-leaved Speedwell

Appendix 6.3 Bird count and species data from 1988-2020

Date collated from Tom Tarpey, Birdwatch Ireland volunteer, Limerick Branch. Note that the decline in bird number is not specific to Westfields, but correlates with a wider drop in many bird species and biodiversity numbers generally.

Figure A6.1. Bird counts for 1988 to 2020; A

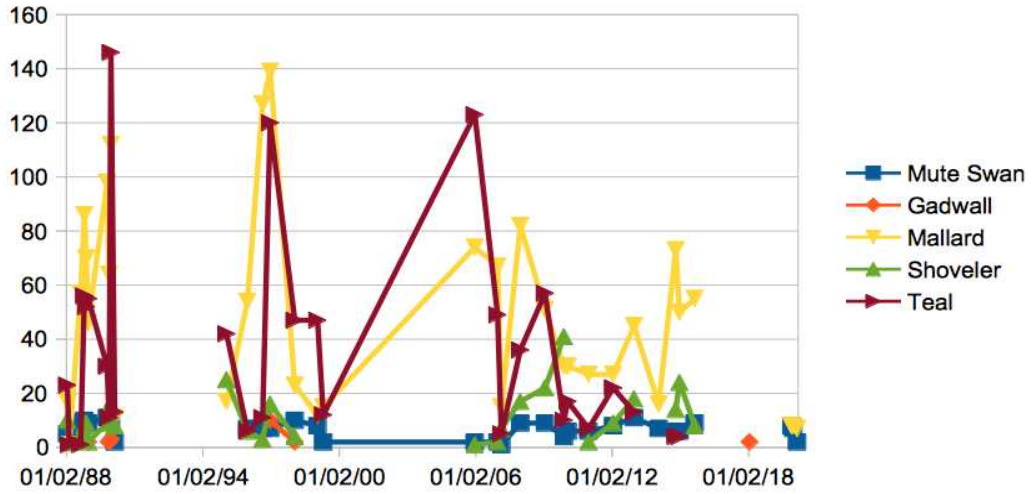


Figure A6.2. Bird counts for 1988 to 2020; B

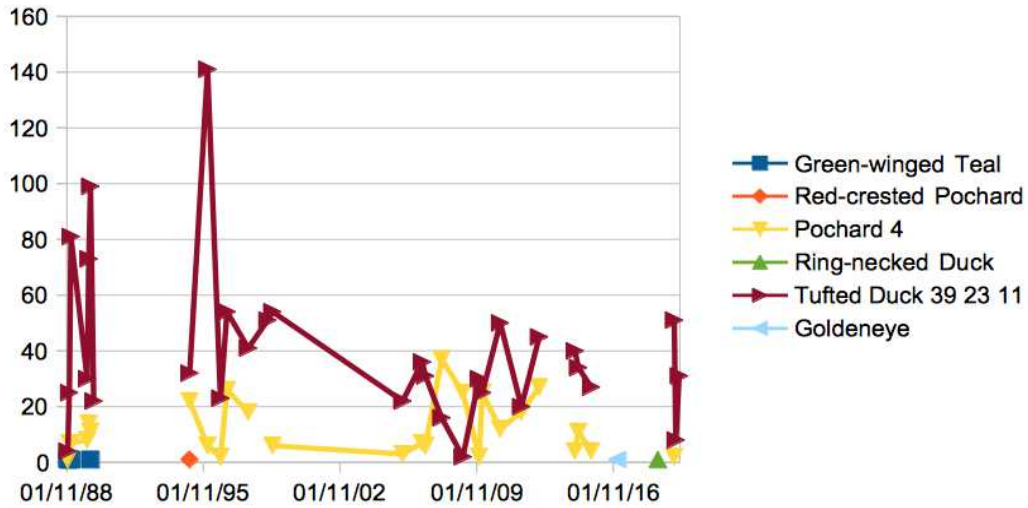


Figure A6.3 Bird counts for 1988 to 2020; C

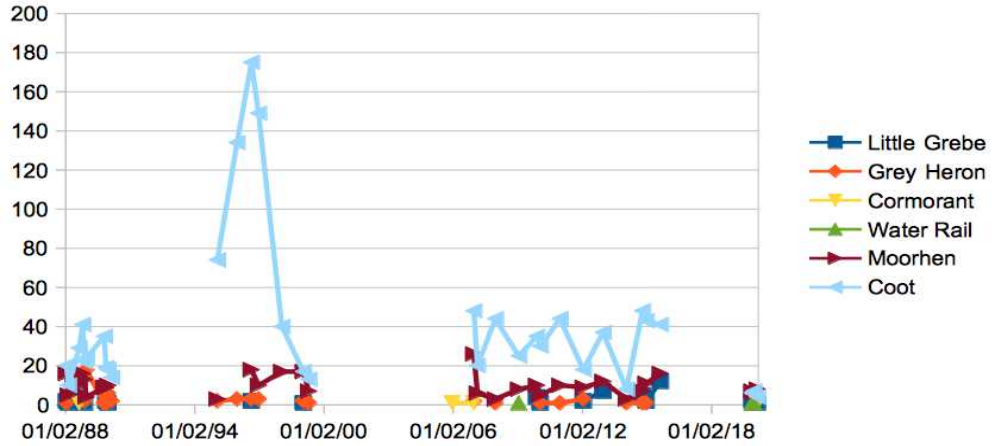


Figure A6.4. Bird counts for 1988 to 2020; D

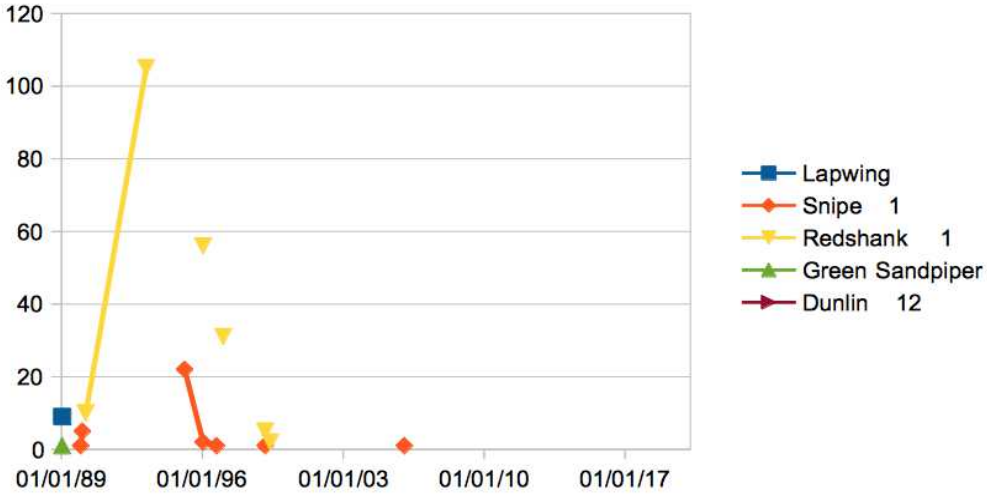
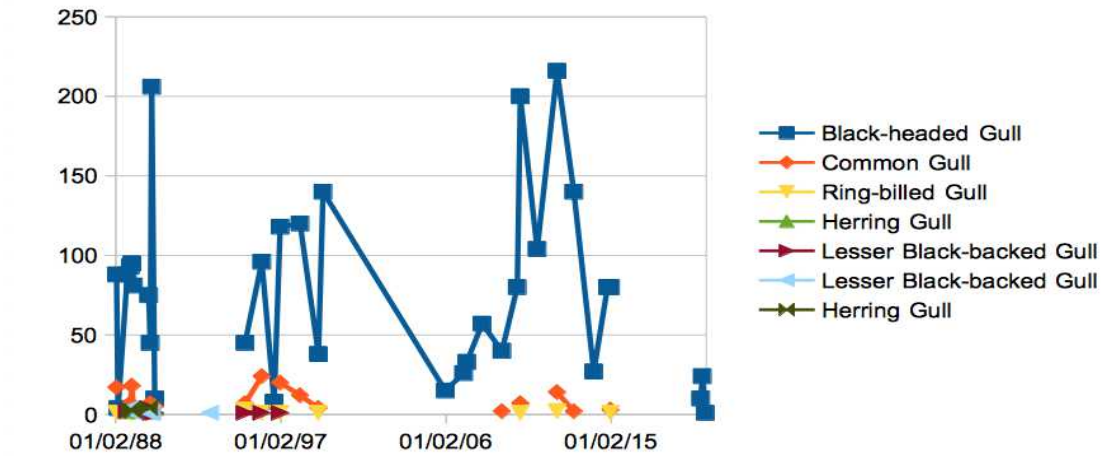


Figure A6.5. Bird counts for 1988 to 2020; E



Appendix 6.4 Biodiversity Database records at Westfields

Following is a table of National Biodiversity Database Centre records within the past 20 years (for a custom polygon intersecting with Westfields Wetland.

Species group	Species name	date	Designation, where applicable
annelid	*Nais elinguis*	31/12/2003	
annelid	*Potamothrix moldaviensis*	31/12/2003	
annelid	*Potamothrix vejdovskyi*	31/12/2003	
annelid	*Stylaria lacustris*	31/12/2003	
bird	Greylag Goose (*Anser anser*)	31/12/2011	Invasive Species: Invasive Species || Invasive Species: Invasive Species >> Regulation S.I. 477 (Ireland) || Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section I Bird Species || Protected Species: EU Birds Directive >> Annex III, Section II Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	Little Egret (*Egretta garzetta*)	24/08/2013	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex I Bird Species
bird	European Golden Plover (*Pluvialis apricaria*)	31/12/2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex I Bird Species || Protected Species: EU Birds Directive >> Annex II, Section II Bird Species || Protected Species: EU Birds Directive >> Annex III, Section III Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Red List

bird	Common Kingfisher (*Alcedo atthis*)	31/12/2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex I Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	Dunlin (*Calidris alpina*)	31/12/2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex I Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	Hen Harrier (*Circus cyaneus*)	31/12/2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex I Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	Mediterranean Gull (*Larus melanocephalus*)	31/12/2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex I Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	Merlin (*Falco columbarius*)	31/12/2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex I Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List

bird	Short-eared Owl (*Asio flammeus*)	31/12/2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex I Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	Whooper Swan (*Cygnus cygnus*)	31/12/2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex I Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	Rock Pigeon (*Columba livia*)	13/10/2012	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section I Bird Species
bird	Common Pheasant (*Phasianus colchicus*)	31/12/2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section I Bird Species || Protected Species: EU Birds Directive >> Annex III, Section I Bird Species
bird	Common Wood Pigeon (*Columba palumbus*)	31/12/2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section I Bird Species || Protected Species: EU Birds Directive >> Annex III, Section I Bird Species
bird	Mallard (*Anas platyrhynchos*)	10/08/2016	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section I Bird Species || Protected Species: EU Birds Directive >> Annex III, Section I Bird Species

bird	Eurasian Wigeon (*Anas penelope*)	31/12/2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section I Bird Species || Protected Species: EU Birds Directive >> Annex III, Section II Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	Northern Pintail (*Anas acuta*)	31/12/2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section I Bird Species || Protected Species: EU Birds Directive >> Annex III, Section II Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Red List
bird	Common Coot (*Fulica atra*)	10/08/2016	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section I Bird Species || Protected Species: EU Birds Directive >> Annex III, Section II Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	Common Pochard (*Aythya ferina*)	14/11/2012	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section I Bird Species || Protected Species: EU Birds Directive >> Annex III, Section II Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List

bird	Eurasian Teal (*Anas crecca*)	15/11/2017	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section I Bird Species || Protected Species: EU Birds Directive >> Annex III, Section II Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	Tufted Duck (*Aythya fuligula*)	15/11/2017	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section I Bird Species || Protected Species: EU Birds Directive >> Annex III, Section II Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	Jack Snipe (*Lymnocryptes minimus*)	31/12/2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section I Bird Species || Protected Species: EU Birds Directive >> Annex III, Section III Bird Species
bird	Common Snipe (*Gallinago gallinago*)	31/12/2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section I Bird Species || Protected Species: EU Birds Directive >> Annex III, Section III Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List

bird	Northern Shoveler (*Anas clypeata*)	15/11/2017	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section I Bird Species || Protected Species: EU Birds Directive >> Annex III, Section III Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Red List
bird	Greater Scaup (*Aythya marila*)	31/12/2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section II Bird Species || Protected Species: EU Birds Directive >> Annex III, Section III Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	Goosander (*Mergus merganser*)	31/12/2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section II Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	Northern Lapwing (*Vanellus vanellus*)	31/12/2011	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section II Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Red List

bird	Common Goldeneye (*Bucephala clangula*)	15/11/2017	Protected Species: Wildlife Acts || Protected Species: EU Birds Directive || Protected Species: EU Birds Directive >> Annex II, Section II Bird Species || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	Black-tailed Godwit (*Limosa limosa*)	31/12/2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	Common Grasshopper Warbler (*Locustella naevia*)	31/12/2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	Common Greenshank (*Tringa nebularia*)	31/12/2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	Common Kestrel (*Falco tinnunculus*)	31/12/2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	Common Linnet (*Carduelis cannabina*)	31/12/2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	Common Sandpiper (*Actitis hypoleucos*)	31/12/2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List

bird	Common Shelduck (*Tadorna tadorna*)	31/12/2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	Common Starling (*Sturnus vulgaris*)	31/12/2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	Common Swift (*Apus apus*)	31/12/2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	Eurasian Oystercatcher (*Haematopus ostralegus*)	31/12/2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	Great Black-backed Gull (*Larus marinus*)	31/12/2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	Great Crested Grebe (*Podiceps cristatus*)	31/12/2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	House Martin (*Delichon urbicum*)	31/12/2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	House Sparrow (*Passer domesticus*)	31/12/2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List

bird	Lesser Black-backed Gull (*Larus fuscus*)	31/12/2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	Mew Gull (*Larus canus*)	31/12/2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	Ringed Plover (*Charadrius hiaticula*)	31/12/2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	Sky Lark (*Alauda arvensis*)	31/12/2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	Spotted Flycatcher (*Muscicapa striata*)	31/12/2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	Stock Pigeon (*Columba oenas*)	31/12/2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	Water Rail (*Rallus aquaticus*)	31/12/2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	Great Cormorant (*Phalacrocorax carbo*)	13/10/2012	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List

bird	Little Grebe (*Tachybaptus ruficollis*)	15/11/2017	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	Mute Swan (*Cygnus olor*)	15/11/2017	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	Barn Swallow (*Hirundo rustica*)	23/08/2013	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	Sand Martin (*Riparia riparia*)	24/08/2013	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Amber List
bird	Common Redshank (*Tringa totanus*)	31/12/2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Red List
bird	Herring Gull (*Larus argentatus*)	31/12/2011	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Red List
bird	Black-headed Gull (*Larus ridibundus*)	23/08/2013	Protected Species: Wildlife Acts || Threatened Species: Birds of Conservation Concern || Threatened Species: Birds of Conservation Concern >> Birds of Conservation Concern - Red List
bird	Black Redstart (*Phoenicurus ochruros*)	31/12/2011	
bird	Black Swan (*Cygnus atratus*)	31/12/2011	
bird	Bohemian Waxwing (*Bombycilla garrulus*)	31/12/2011	
bird	Brambling (*Fringilla montifringilla*)	31/12/2011	

bird	Coal Tit (*Periparus ater*)	31/12/2011	
bird	Common Bullfinch (*Pyrrhula pyrrhula*)	31/12/2011	
bird	Common Chiffchaff (*Phylloscopus collybita*)	31/12/2011	
bird	Common Cuckoo (*Cuculus canorus*)	31/12/2011	
bird	Common Raven (*Corvus corax*)	31/12/2011	
bird	Common Whitethroat (*Sylvia communis*)	31/12/2011	
bird	Eurasian Collared Dove (*Streptopelia decaocto*)	31/12/2011	
bird	Eurasian Siskin (*Carduelis spinus*)	31/12/2011	
bird	Eurasian Sparrowhawk (*Accipiter nisus*)	31/12/2011	
bird	Eurasian Treecreeper (*Certhia familiaris*)	31/12/2011	
bird	European Goldfinch (*Carduelis carduelis*)	31/12/2011	
bird	European Greenfinch (*Carduelis chloris*)	31/12/2011	
bird	Fieldfare (*Turdus pilaris*)	31/12/2011	
bird	Goldcrest (*Regulus regulus*)	31/12/2011	
bird	Great Tit (*Parus major*)	31/12/2011	
bird	Grey Wagtail (*Motacilla cinerea*)	31/12/2011	
bird	Hedge Accentor (*Prunella modularis*)	31/12/2011	
bird	Hooded Crow (*Corvus cornix*)	31/12/2011	
bird	Lesser Redpoll (*Carduelis cabaret*)	31/12/2011	
bird	Long-eared Owl (*Asio otus*)	31/12/2011	
bird	Long-tailed Tit (*Aegithalos caudatus*)	31/12/2011	
bird	Meadow Pipit (*Anthus pratensis*)	31/12/2011	
bird	Mistle Thrush (*Turdus viscivorus*)	31/12/2011	
bird	Redwing (*Turdus iliacus*)	31/12/2011	
bird	Reed Bunting (*Emberiza schoeniclus*)	31/12/2011	
bird	Ring-billed Gull (*Larus delawarensis*)	31/12/2011	
bird	Ruddy Turnstone (*Arenaria interpres*)	31/12/2011	

bird	Sedge Warbler (*Acrocephalus schoenobaenus*)	31/12/2011	
bird	Song Thrush (*Turdus philomelos*)	31/12/2011	
bird	Stonechat (*Saxicola torquata*)	31/12/2011	
bird	White Wagtail (*Motacilla alba*)	31/12/2011	
bird	White-throated Dipper (*Cinclus cinclus*)	31/12/2011	
bird	Yellow-legged Gull (*Larus michahellis*)	31/12/2011	
bird	Blackcap (*Sylvia atricapilla*)	29/01/2015	
bird	Chaffinch (*Fringilla coelebs*)	13/10/2012	
bird	Common Moorhen (*Gallinula chloropus*)	15/11/2017	
bird	Eurasian Jackdaw (*Corvus monedula*)	13/10/2012	
bird	European Robin (*Erithacus rubecula*)	13/10/2012	
bird	Pied Wagtail (*Motacilla alba subsp. yarrellii*)	20/04/2008	
bird	Rook (*Corvus frugilegus*)	13/10/2012	
bird	Winter Wren (*Troglodytes troglodytes*)	13/10/2012	
bird	Black-billed Magpie (*Pica pica*)	24/08/2013	
bird	Blue Tit (*Cyanistes caeruleus*)	24/08/2013	
bird	Common Blackbird (*Turdus merula*)	24/08/2013	
bird	Grey Heron (*Ardea cinerea*)	23/08/2013	
bird	Willow Warbler (*Phylloscopus trochilus*)	24/08/2013	
bony fish (Actinopterygii)	European Eel (*Anguilla anguilla*)	17/05/2016	Threatened Species: OSPAR Convention || Threatened Species: Critically Endangered
fern	Water Fern (*Azolla filiculoides*)	07/01/2019	Invasive Species: Invasive Species || Invasive Species: Invasive Species >> Medium Impact Invasive Species || Invasive Species: Invasive Species >> Regulation S.I. 477 (Ireland)
fern	Hart's-tongue (*Phyllitis scolopendrium*)	23/08/2013	

flowering plant	Nuttall's Waterweed (*Elodea nuttallii*)	31/12/2007	Invasive Species: Invasive Species || Invasive Species: Invasive Species >> High Impact Invasive Species || Invasive Species: Invasive Species >> Regulation S.I. 477 (Ireland)
flowering plant	Giant Hogweed (*Heracleum mantegazzianum*)	22/07/2019	Invasive Species: Invasive Species || Invasive Species: Invasive Species >> High Impact Invasive Species || Invasive Species: Invasive Species >> Regulation S.I. 477 (Ireland)
flowering plant	Japanese Knotweed (*Fallopia japonica*)	22/07/2019	Invasive Species: Invasive Species || Invasive Species: Invasive Species >> High Impact Invasive Species || Invasive Species: Invasive Species >> Regulation S.I. 477 (Ireland)
flowering plant	Butterfly-bush (*Buddleja davidii*)	05/07/2018	Invasive Species: Invasive Species || Invasive Species: Invasive Species >> Medium Impact Invasive Species
flowering plant	Traveller's-joy (*Clematis vitalba*)	12/01/2018	Invasive Species: Invasive Species || Invasive Species: Invasive Species >> Medium Impact Invasive Species
flowering plant	Three-cornered Garlic (*Allium triquetrum*)	28/04/2018	Invasive Species: Invasive Species || Invasive Species: Invasive Species >> Medium Impact Invasive Species || Invasive Species: Invasive Species >> Regulation S.I. 477 (Ireland)
flowering plant	Triangular Club-rush (*Schoenoplectus triqueter*)	31/12/2010	Threatened Species: Endangered
flowering plant	Curled Dock (*Rumex crispus*)	31/12/2010	
flowering plant	Ribbed Melilot (*Melilotus officinalis*)	31/12/2007	
flowering plant	Alder (*Alnus glutinosa*)	23/08/2013	
flowering plant	Common Nettle (*Urtica dioica*)	23/08/2013	
flowering plant	Common Ragwort (*Senecio jacobaea*)	23/08/2013	
flowering plant	Dandelion (*Taraxacum*)	23/08/2013	
flowering plant	Gorse (*Ulex europaeus*)	23/08/2013	
flowering plant	Great Willowherb (*Epilobium hirsutum*)	23/08/2013	
flowering plant	Hawthorn (*Crataegus monogyna*)	23/08/2013	

flowering plant	Holly (*Ilex aquifolium*)	23/08/2013	
flowering plant	Honeysuckle (*Lonicera periclymenum*)	23/08/2013	
flowering plant	Ivy (*Hedera helix*)	23/08/2013	
flowering plant	Lords-and-Ladies (*Arum maculatum*)	23/08/2013	
flowering plant	Marsh Ragwort (*Senecio aquaticus*)	23/08/2013	
flowering plant	Red Clover (*Trifolium pratense*)	23/08/2013	
flowering plant	Ribwort Plantain (*Plantago lanceolata*)	23/08/2013	
flowering plant	Wild Strawberry (*Fragaria vesca*)	23/08/2013	
flowering plant	Wood Avens (*Geum urbanum*)	23/08/2013	
flowering plant	Bee Orchid (*Ophrys apifera*)	19/06/2018	
flowering plant	Bramble (*Rubus fruticosus agg.*)	07/07/2018	
flowering plant	Bulrush (*Typha latifolia*)	12/01/2018	
flowering plant	Coltsfoot (*Tussilago farfara*)	07/07/2018	
flowering plant	Common Duckweed (*Lemna minor*)	07/07/2018	
flowering plant	Common Reed (*Phragmites australis*)	07/07/2018	
flowering plant	Creeping Buttercup (*Ranunculus repens*)	07/07/2018	
flowering plant	Daisy (*Bellis perennis*)	07/07/2018	
flowering plant	Enchanter's-nightshade (*Circaea lutetiana*)	07/07/2018	
flowering plant	Greater Plantain (*Plantago major*)	07/07/2018	
flowering plant	Groundsel (*Senecio vulgaris*)	07/07/2018	
flowering plant	Guelder-rose (*Viburnum opulus*)	05/07/2018	
flowering plant	Hedge Woundwort (*Stachys sylvatica*)	07/07/2018	
flowering plant	Hemlock Water-dropwort (*Oenanthe crocata*)	07/07/2018	
flowering plant	Lesser Celandine (*Ranunculus ficaria*)	24/03/2017	
flowering plant	Lesser Water-parsnip (*Berula erecta*)	07/07/2018	
flowering plant	Meadow Buttercup (*Ranunculus acris*)	07/07/2018	
flowering plant	Oxeye Daisy (*Leucanthemum vulgare*)	07/07/2018	

flowering plant	Smooth Sow-thistle (*Sonchus oleraceus*)	07/07/2018	
flowering plant	Timothy (*Phleum pratense*)	07/07/2018	
flowering plant	Tufted Vetch (*Vicia cracca*)	07/07/2018	
flowering plant	Water Figwort (*Scrophularia auriculata*)	07/07/2018	
flowering plant	Water Forget-me-not (*Myosotis scorpioides*)	07/07/2018	
flowering plant	Winter Heliotrope (*Petasites fragrans*)	18/02/2018	
flowering plant	Yarrow (*Achillea millefolium*)	12/01/2018	
flowering plant	Celery-leaved Buttercup (*Ranunculus sceleratus*)	30/06/2000	
flowering plant	Common Scurvygrass (*Cochlearia officinalis*)	30/06/2000	
flowering plant	Common Spike-rush (*Eleocharis palustris*)	30/06/2000	
flowering plant	Creeping Bent (*Agrostis stolonifera*)	30/06/2000	
flowering plant	Fool's-water-cress (*Apium nodiflorum*)	30/06/2000	
flowering plant	Grey Club-rush (*Schoenoplectus tabernaemontani*)	30/06/2000	
flowering plant	Jointed Rush (*Juncus articulatus*)	30/06/2000	
flowering plant	Marsh-marigold (*Caltha palustris*)	30/06/2000	
flowering plant	Sea Aster (*Aster tripolium*)	30/06/2000	
flowering plant	Sea Club-rush (*Bolboschoenus maritimus*)	30/06/2000	
flowering plant	Summer Snowflake (*Leucojum aestivum*)	30/06/2000	
flowering plant	Water Dock (*Rumex hydrolapathum*)	30/06/2000	
flowering plant	Water-pepper (*Persicaria hydropiper*)	30/06/2000	
flowering plant	Water-plantain (*Alisma plantago-aquatica*)	30/06/2000	
fungus	Sycamore Tarspot (*Rhytisma acerinum*)	23/08/2013	
insect - butterfly	Clouded Yellow (*Colias croceus*)	09/09/2014	
insect - butterfly	Holly Blue (*Celastrina argiolus*)	07/05/2015	
insect - butterfly	Orange-tip (*Anthocharis cardamines*)	17/05/2016	
insect - butterfly	Small Tortoiseshell (*Aglais urticae*)	07/05/2015	

insect - butterfly	Speckled Wood (*Pararge aegeria*)	09/04/2015	
insect - caddis fly (Trichoptera)	*Allotrichia pallicornis*	31/12/2015	
insect - caddis fly (Trichoptera)	*Glyphotaelius pellucidus*	31/12/2015	
insect - caddis fly (Trichoptera)	*Hydropsyche pellucidula*	31/12/2015	
insect - caddis fly (Trichoptera)	*Hydroptila sparsa*	31/12/2015	
insect - caddis fly (Trichoptera)	*Limnephilus incisus*	31/12/2015	
insect - caddis fly (Trichoptera)	*Mystacides longicornis*	31/12/2015	
insect - caddis fly (Trichoptera)	*Neureclipsis bimaculata*	31/12/2015	
insect - caddis fly (Trichoptera)	*Oecetis furva*	31/12/2015	
insect - caddis fly (Trichoptera)	*Sericostoma personatum*	31/12/2015	
insect - caddis fly (Trichoptera)	*Tinodes waeneri*	31/12/2015	
insect - dragonfly (Odonata)	Azure Damselfly (*Coenagrion puella*)	13/05/2005	
insect - dragonfly (Odonata)	Blue-tailed Damselfly (*Ischnura elegans*)	17/06/2002	
insect - dragonfly (Odonata)	Brown Hawker (*Aeshna grandis*)	05/08/2003	
insect - dragonfly (Odonata)	Common Blue Damselfly (*Enallagma cyathigerum*)	05/08/2003	
insect - dragonfly (Odonata)	Common Darter (*Sympetrum striolatum*)	05/08/2003	
insect - dragonfly (Odonata)	Large Red Damselfly (*Pyrrhosoma nymphula*)	05/08/2003	
insect - dragonfly (Odonata)	Emperor Dragonfly (*Anax imperator*)	07/05/2015	
insect - dragonfly (Odonata)	Hairy Dragonfly (*Brachytron pratense*)	17/05/2016	
insect - dragonfly (Odonata)	Variable Damselfly (*Coenagrion pulchellum*)	17/05/2016	

insect - hymenopteran	Large Red Tailed Bumble Bee (*Bombus* (*Melanobombus*) *lapidarius*)	09/04/2015	Threatened Species: Near threatened
insect - hymenopteran	*Bombus (Bombus) lucorum*	30/07/2014	
insect - hymenopteran	*Bombus (Bombus) terrestris*	09/04/2015	
insect - hymenopteran	Common Carder Bee (*Bombus (Thoracombus) pascuorum*)	09/04/2015	
insect - hymenopteran	Early Bumble Bee (*Bombus (Pyrobombus) pratorum*)	09/04/2015	
insect - hymenopteran	Small Garden Bumble Bee (*Bombus (Megabombus) hortorum*)	30/07/2014	
insect - moth	*Acleris laterana*	24/08/2013	
insect - moth	*Caloptilia stigmatella*	23/08/2013	
insect - moth	*Celypha lacunana*	24/08/2013	
insect - moth	Cinnabar (*Tyria jacobaeae*)	10/06/2006	
insect - moth	*Cochylis atricapitana*	24/08/2013	
insect - moth	Common Grass-veneer (*Agriphila tristella*)	24/08/2013	
insect - moth	Common Wave (*Cabera exanthemata*)	24/08/2013	
insect - moth	Crescent (*Celaena leucostigma*)	24/08/2013	
insect - moth	*Elachista maculicerusella*	23/08/2013	
insect - moth	Firethorn Leaf Miner (*Phyllonorycter leucographella*)	23/08/2013	
insect - moth	Flame Carpet (*Xanthorhoe designata*)	24/08/2013	
insect - moth	Flame Shoulder (*Ochropleura plecta*)	24/08/2013	
insect - moth	Large Yellow Underwing (*Noctua pronuba*)	24/08/2013	
insect - moth	Lesser Broad-bordered Yellow Underwing (*Noctua janthe*)	24/08/2013	
insect - moth	*Parornix anglicella*	23/08/2013	
insect - moth	*Phyllonorycter nigrescentella*	23/08/2013	
insect - moth	Rosy Rustic (*Hydraecia micacea*)	24/08/2013	
insect - moth	Silver Y (*Autographa gamma*)	10/06/2006	
insect - moth	Small Square-spot (*Diarsia rubi*)	24/08/2013	
insect - moth	Small Wainscot (*Chortodes pygmina*)	24/08/2013	
insect - moth	Spectacle (*Abrostola*	24/08/2013	

	tripartita)		
insect - moth	Square-spot Rustic (*Xestia xanthographa*)	24/08/2013	
mollusc	Zebra Mussel (*Dreissena* (*Dreissena*) *polymorpha*)	27/04/2016	Invasive Species: Invasive Species || Invasive Species: Invasive Species >> High Impact Invasive Species || Invasive Species: Invasive Species >> Regulation S.I. 477 (Ireland)
mollusc	Large Amber Snail (*Succinea putris*)	24/08/2013	
moss	River Bristle-moss (*Orthotrichum rivulare*)	13/06/2005	Threatened Species: Near threatened
terrestrial mammal	Fallow Deer (*Dama dama*)	31/12/2008	Invasive Species: Invasive Species || Invasive Species: Invasive Species >> High Impact Invasive Species || Invasive Species: Invasive Species >> Regulation S.I. 477 (Ireland) || Protected Species: Wildlife Acts
terrestrial mammal	Pipistrelle (*Pipistrellus pipistrellus sensu lato*)	22/06/2007	Protected Species: EU Habitats Directive || Protected Species: EU Habitats Directive >> Annex IV || Protected Species: Wildlife Acts
terrestrial mammal	Eurasian Badger (*Meles meles*)	26/06/2016	Protected Species: Wildlife Acts
terrestrial mammal	West European Hedgehog (*Erinaceus europaeus*)	13/02/2017	Protected Species: Wildlife Acts
terrestrial mammal	Red Fox (*Vulpes vulpes*)	18/09/2015	

Appendix 7.0 Signage and Education

Appendix 7.1 Signage about feeding ducks and swans

There have been divided views on the merits of feeding bread to ducks and swans. On the one hand, it is not the natural food for water fowl, and they won't get sufficient nutrition from bread alone. On the other, food given by members of the public has become an increasingly important part of the diet of waterfowl in city parks, so it is better to feed them something rather than nothing at all. Hand in hand with this, many of our early experiences of nature are of feeding water birds in the company of our grandparents or parents. This helps of engender a love of nature, which is important to continue, as long as it is not done in a harmful way for wildlife.

In addition to bread not being part of the natural diet of waterfowl, some other problems also exist. Uneaten bread can attract rodents and lead to a build-up of pollutants in the water if left uneaten. Even when eaten, artificially high numbers of waterfowl which may be attracted by artificial feeding can stress the birds and lead to a degradation of the habit, such as lake edges where regular feeding occurs. Elevated bird numbers would also lead to artificial enrichment of the water with nitrates and phosphates, which can lead to algal growth and excessive plant growth. However, records show a reduced overall number of water birds at Westfields, so it appears that feeding with bread is not leading to such an elevation in numbers.

Taking these points into consideration, with care and education, feeding the ducks can continue to be a shared activity with grandparents and their grandchildren, while at the same time helping to support bird numbers at Westfields. Foods such as sweetcorn, lettuce, peas, oats, seeds and rice are all recommended by UK Canal Rivers Trust as an alternative to bread. Even bread is recommended in small quantities by The Swan Sanctuary (UK), as long as it is not mouldy. In recent years initiatives to halt the feeding of birds in the UK has led to serious problems of undernourishment in swans there. The trick is to keep the quantities modest and to ensure that no more is added than will be eaten at that time.

Despite the fact that bread isn't the ideal diet for water fowl, it has become an important part of their diet in urban areas. This may keep their numbers artificially high in urban lakes, but bear in mind that global bird numbers are falling at a dramatic rate, so support by feeding is an important boost and should not be discouraged.

Resources for additional information can be found at the following websites:

- https://www.unilad.co.uk/animals/ducks-and-swans-are-dying-because-no-one-feeds-them-bread-anymore
- http://www.theswansanctuary.org.uk/cause/official-statement-bread-queens-swan-marker/
- https://canalrivertrust.org.uk/enjoy-the-waterways/canal-and-river-wildlife/keeping-our-ducks-healthy/why-is-bread-bad-for-ducks
- https://canalrivertrust.org.uk/enjoy-the-waterways/canal-and-river-wildlife/keeping-

our-ducks-healthy/six-things-you-didnt-know-you-could-feed-ducks

In summary, modest amounts can be beneficial, but no more than will be eaten at a given time. Feeding waterfowl has the advantage of introducing young children to the area and to nature, and supplementary feeding is cited as an important food source for water birds. Thus, it is not recommended to discourage it, but rather that signage be used to encourage visitors to add only as much food as the birds will eat there and then. While this won't reduce bird numbers, it will reduce nutrient ingress from surplus food and reduce the potential for attracting rodents

Appendix 7.2 Mapping tools as a signage resource

The following online mapping tools may provide a useful resource for the creation of signage at Westfields, or for school projects or citizen science initiatives.

Fig. A7.1 Folio map information showing the outline of site boundaries is available on https://www.landdirect.ie/, as shown here, with details of land ownership available on a paid basis if required.

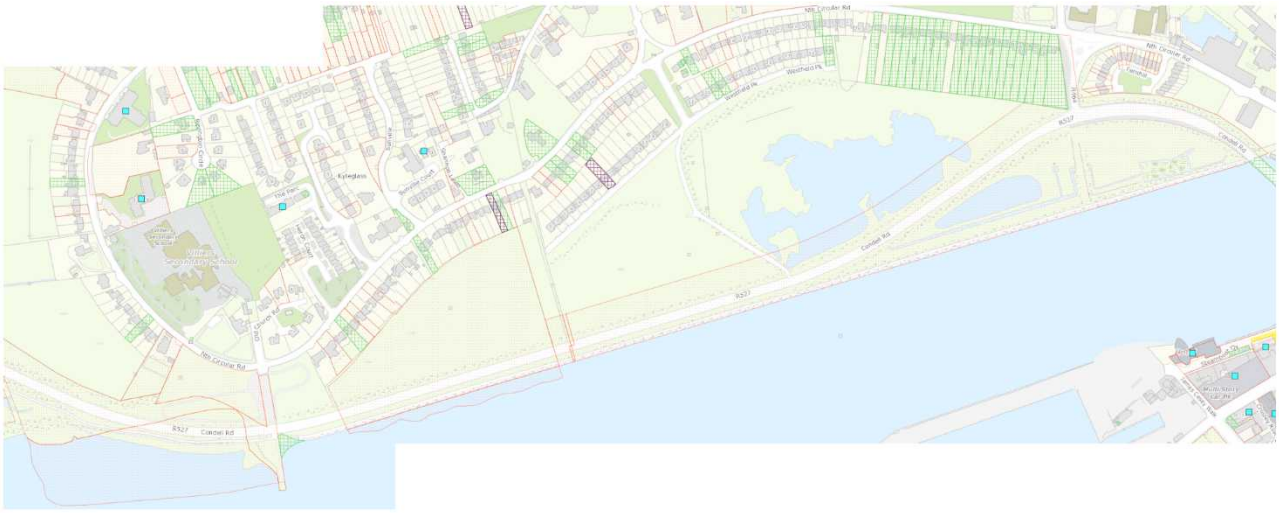


Fig. A7.2 GeoHive mapping tool from the OSI (http://map.geohive.ie/mapviewer.html) shows a whole variety of different map layers from publicly available data, shown below with the National Monuments layer active.

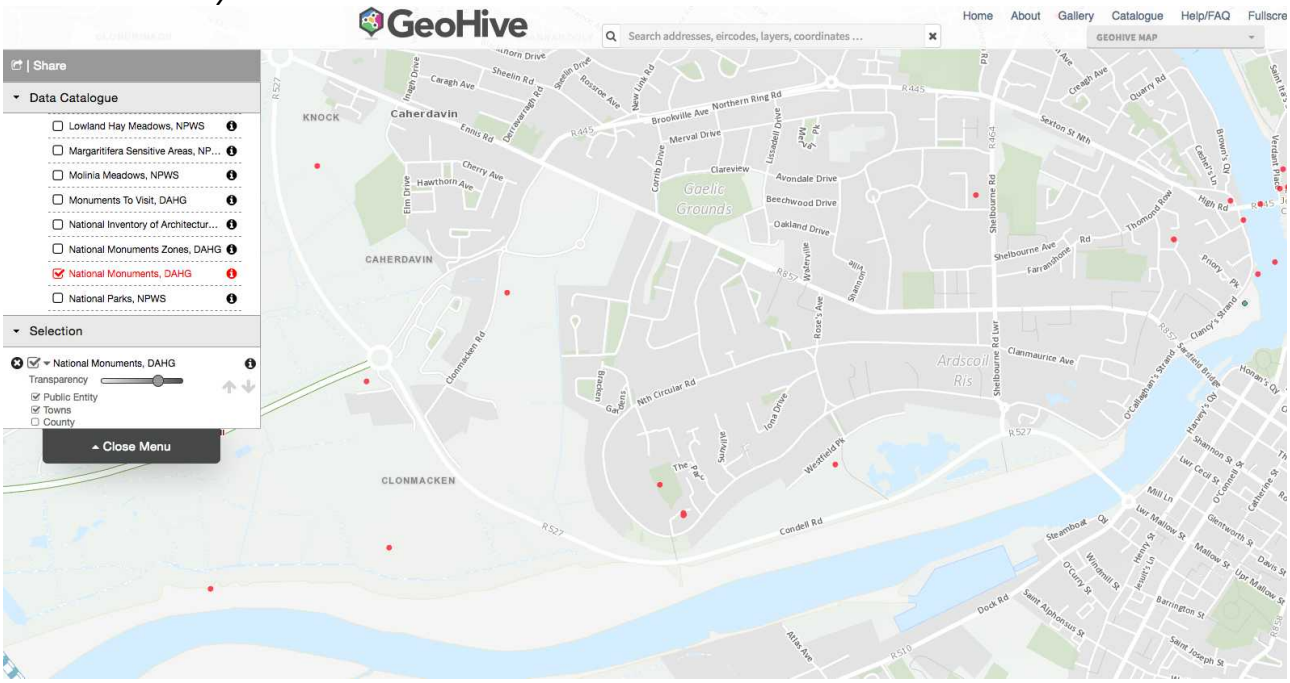


Fig. A7.3 Limerick City Biodiversity Plan shows the different habitats across the city. While not an online resources, this map provides a good insight into the different areas of biodiversity interest in the city.

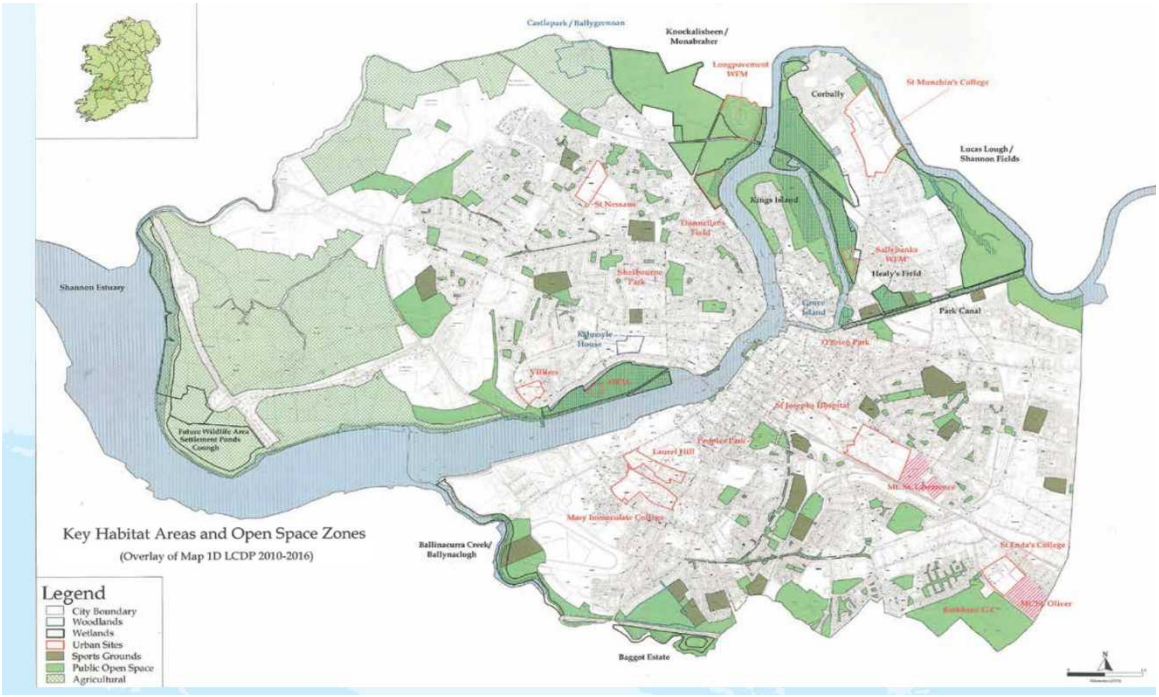


Fig. A7.4 NPWS Designations Viewer (https://dahg.maps.arcgis.com/) shows SPAs pNHAs, NHAs and SACs in Ireland.

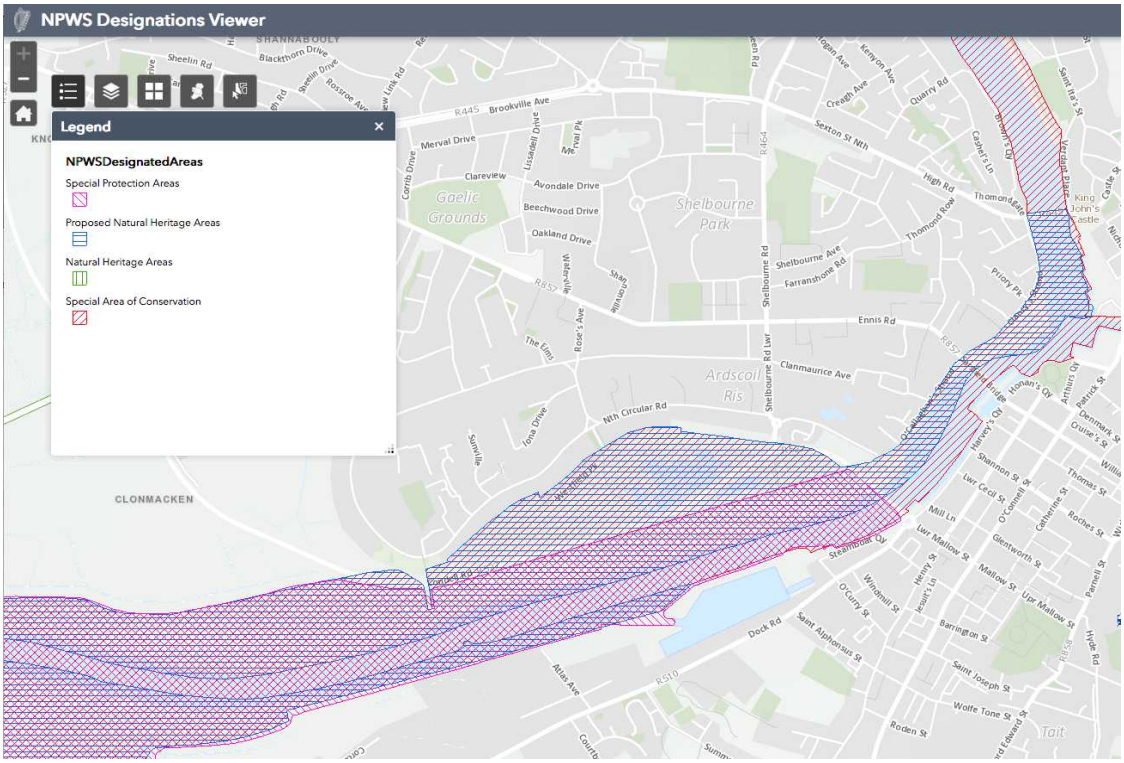


Fig. A7.5 EPA Maps (https://gis.epa.ie/EPAMaps), shown here with the Subcatchments layer (yellow boundary showing Westfields in the North Ballycallan River Sub Basin) and Flow Network layers (blue) active.

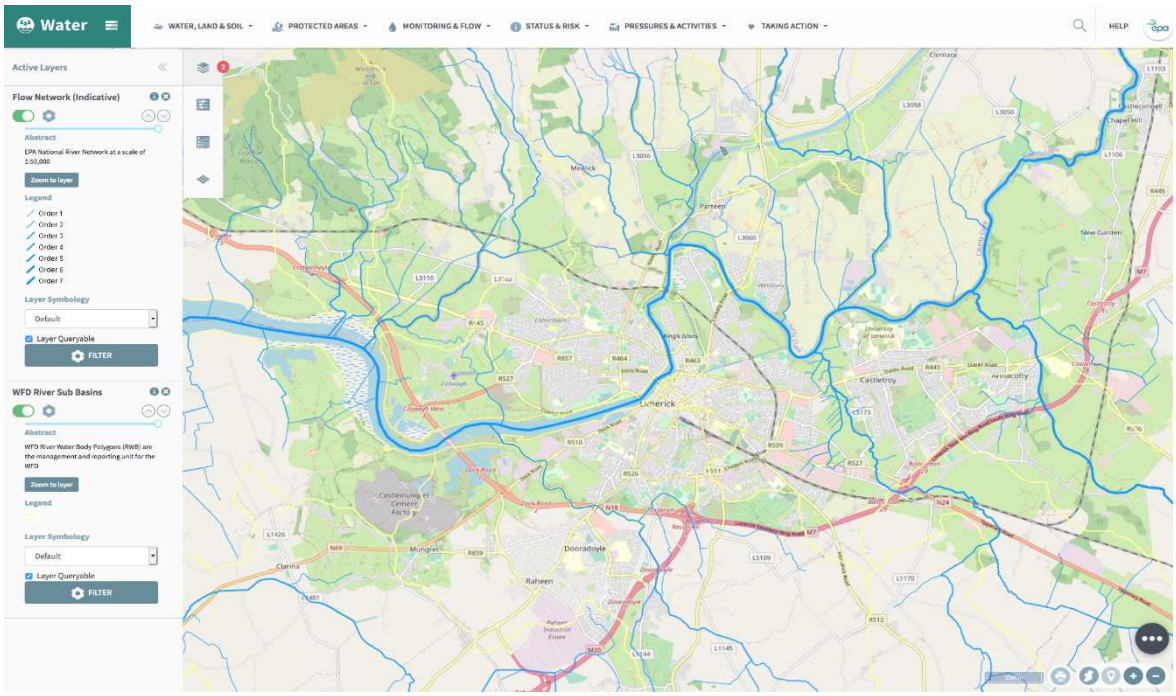


Fig. A7.6 Wetlands of Ireland have been mapped by Wetland Surveys Ireland and Foss Environmental (http://www.wetlandsurveysireland.com) and show the patchwork of wetland habitats in Limerick city and across the country.

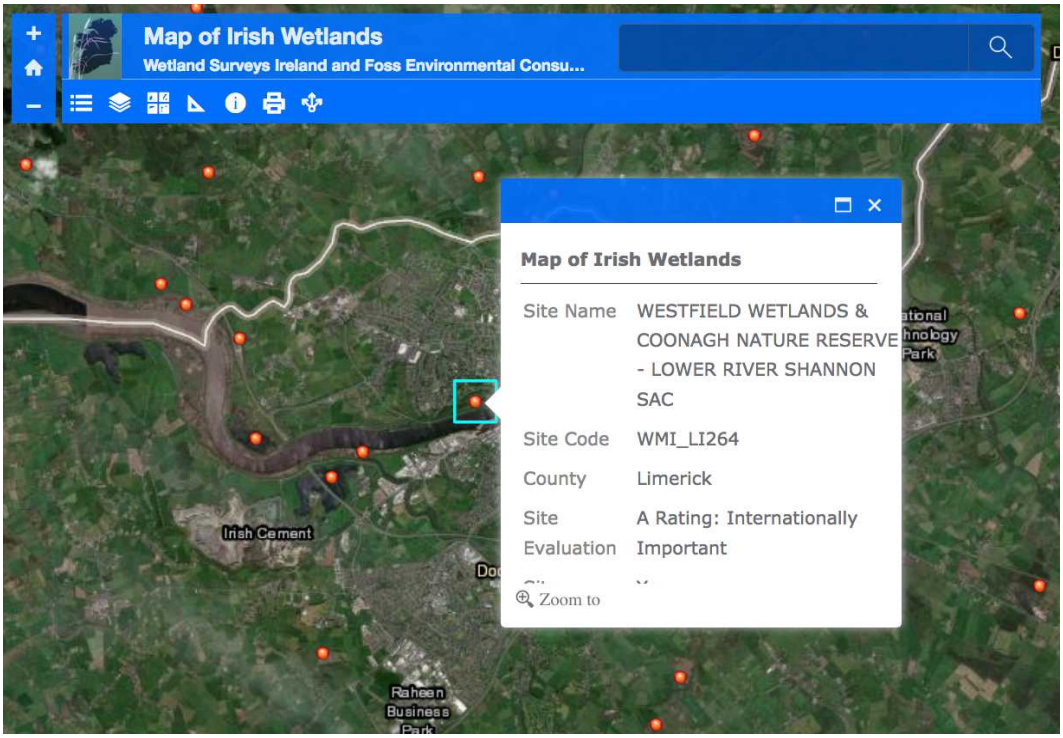
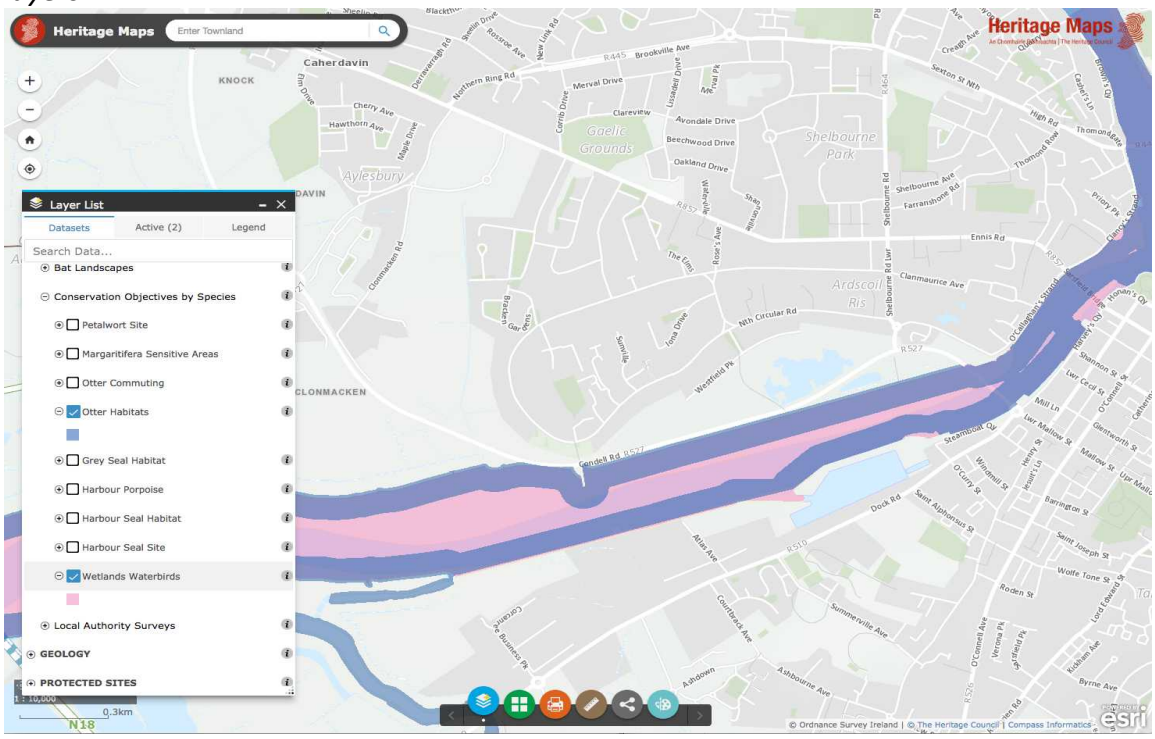


Fig. A7.7 Heritage Council's Heritage Maps website shows a variety of built and natural heritage layers (www.heritagemaps.ie). Shown here are the Otter Habitats and the Wetlands Waterbirds layers.



Appendix 7.3 Schools in the area

Fig. 7.3.1 Schools within 1km radius of Westfields

Ardscoil Rís
Colaiste Mhichil CBS Sexton St.
JF Kennedy Memorial School
Laurel Hill Secondary School
Limerick School Project NS
Salesian Primary School
Schoil Iosagain
Scoil Chríost Rí Boys NS
St. Michael's National School
Villiers School

Fig. 7.3.2 Other schools within and around Limerick City

An Mhodscoil
Castletroy College
Catherine McAuley School
Colaiste Nano Nagle
Corpus Christi Catholic School
Knockea National School
Le Cheile National School
Limerick and Clare Education Board
Limerick City East Educate Together
Mary Immaculate College
Milford National School
Monaleen National School
Parteen NS
Red Hill School
Scoil Íde, Corbally
Scoil Mhuire Banríon na hÉireann
Southhill Pre School
St. Brigid's National School
St. Gabriel's School
St. Munchin's College
St. Patrick's Boys NS
St. Paul's National School
St. Paul's NS
Thomond Community College
Thomond Primary School

Appendix 7.4 Bird hides – opportunities and drawbacks

One specific issue raised with local birdwatchers was the merit of a bird hide at Westfields. The southern walkway would be a suitable location, given that the sun would be behind the viewer and the location would offer a vista onto the open waterbody. However, feedback from birdwatchers suggests that a hide may be unnecessary since birds are already clearly visible from this pathway and show no apparent fear of people when swimming out in the lake. There may not be any advantage to a hide here, and it may hinder viewing rather than enhance it.

In addition, the presence of a hide poses potential challenges of providing a gathering place which may encourage antisocial behaviour. Fire damage has been an issue for wooden signage at Westfields in the past and may be a form of vandalism of a wooden bird hide. Limerick birdwatcher and ecological consultant Geoffrey Hunt has suggested a number of designs such as screens rather than the more traditional hut type designs. Thus they don't provide a sheltering place for people to gather, with metal screens (potentially as artwork in themselves) would be more resilient to possible vandalism.

Overall it is not proposed to include a hide at Westfields since it is deemed to be unnecessary and also a potential focus of vandalism and source of ongoing maintenance input.

Appendix 7.5 Citizen Science initiatives

The scope of citizen science initiatives that could apply are as broad as the imaginations of those involved. Here is a short list of possible projects that could be undertaken as a starting point:

1. Litter assessment within the wetland area, Condell Road, Ted Russell Park and the banks of the Shannon to determine sources and explore possible solutions.

2. Mapping of the wetland area to record the different habitats, species, historic features or other notable aspects. Mapping is a central tool of ecological surveying and one that is easier than ever with online resource such as aerial maps and OpenStreetMaps platforms (https://www.openstreetmap.org/).

3. Participation in existing citizen science initiatives such as BirdWatch Ireland's annual garden bird survey (https://birdwatchireland.ie/our-work/surveys-research/research-surveys/irish-garden-bird-survey/); the Irish Peatland Conservation Council's Hop to-it Frog Survey (http://www.ipcc.ie/hop-to-it-in-2020-and-take-part-in-irelands-longest-running-citizen-science-frog-survey/); or one of the Irish Wildlife Trust citizen science surveys on reptiles, bees or waterways (https://iwt.ie/what-we-do/citizen-science/).

- For a more in depth process, the National Biodiversity Data Centre always welcome input for biodiversity recording (https://www.biodiversityireland.ie/record-biodiversity/). Their interactive maps are built on the work done by ecologists and members of the public alike.

- Bio blitz events are a great way to engage in local citizen science as a one-off community initiative to record as many species in an area as possible over 24 hours.

- At Westfields an interesting study, whether by way of a LCCC initiative or local citizen's science project, would be to examine the migratory routes of the birds of Westfields. By examining which birds have declined in number in recent decades a citizen science group could explore general land management practices across the migratory routes and form links with other parts of the world that directly interact Westfields. Preparation of a map similar to the one used by Gardenbird.co.uk, (fig A7.8), is proposed, with an emphasis on the birds that visit Westfields and the wider wetland habitats of Limerick City. A short video advertising Anthony McGeehan's book *To the Ends of the Earth – Ireland's Place in Bird Migration*[3] gives a good overview of migrations with a particularly Irish context.

  In her book *Water in Plain Sight*, Judith Schwartz[4] outlines the importance of stable habitat along migratory bird routes. In her example, bird conservation organisations in the US and Mexico collaborate to offer support to farmers using holistic grazing management techniques. These farming practices not only produce higher beef yields with lower inputs, but also provide valuable habitat for migratory birds in an otherwise arid landscape.

  By exploring international migratory routes for Westfields birds and how the land use and farming practices in other parts of the world impacts on bird numbers here in Ireland we have the potential to generate tangible benefits for our birds. Research could be done on linking up with conservation charities in far flung places to help support the conditions for our summer and winter migrants to thrive and return to our shores in greater numbers.

Fig A7.8. Example of bird migration map which could put Westfields at its centre, and species of the area described in detail on the map.

Source: http://voice.gardenbird.co.uk/attract-birds/migration/, with permission from Gardenbird.co.uk

- A similar but more local project would be to explore the potential for interconnection with

[3] McGeehan A (2018) *To the Ends of the Earth – Ireland's Place in Bird Migration*. The Collin's Press, Cork.
[4] Schwartz J (2016) *Water in Plain Sight – Hope for a Thirsty World*. Martin's Press, NY.

other notable habitats in Limerick city via wildlife corridors along the existing river system. This would include assessment of the potential networks that exist, proposals for enhancement of interconnections and exploration of removal of, or navigation around, blockages such as walls, fences, roads etc. These could be mapped and then systematically addressed to facilitate greater movement of wildlife along these corridors.

- Other Citizen Science projects can be found on the Citizen Science page, the EPA website and others:
  - http://citizen-science.ie/projects/
  - http://www.epa.ie/irelandsenvironment/getinvolved/citizenscience/nationalcitizenscienceinitiatives/
  - https://www.biodiversityireland.ie/irelands-citizen-science-portal/
  - https://www.catchments.ie/citizen-science-how-you-can-help-monitor-and-understand-your-local-environment/
  - https://growobservatory.org/

Appendix 9.0 Infrastructure

Appendix 9.1 Integration of Westfields with wider walking routes

An existing walking route is already published as "Walkable Neighbourhood – Limerick City" (https://www.limerick.ie/council/newsroom/news/new-limerick-walking-map-launched and map download : https://www.limerick.ie/discover/visiting/travel-guide/visitor-maps-guides/limerick-city-walking-map). This map already includes Westfields and Barrington's Pier as shown in Fig A9.1. While this map provides easy navigation to the main attractions in the city centre and immediate area around it, there is further potential available to show hidden byways, river paths and trails.

Figure A9.1. Walkable Neighbourhood map of Limerick City. (https://www.limerick.ie/council/newsroom/news/new-limerick-walking-map-launched and map download: https://www.limerick.ie/discover/visiting/travel-guide/visitor-maps-guides/limerick-city-walking-map).

Appendix 10 Action Summary

Appendix 10.1 Table of Actions

The tables below outline the actions proposed to protect and increase the biodiversity of Westfields Wetland and to enhance the area for people visiting. Each action has suggested organisations who may be involved to carry out this action. Approximate cost of each action is also provided from No cost (-€), Low Cost up to €500 (€), Medium Cost up to €1000 (€€) and high cost over €1000 (€€€).

Appendix 10.1.1 Recommended Water Quality Actions

Actions for Water Quality	Organisation involved	Approx. Cost
Main inflow from the Shannon	LCCC	€€€
Recommended Actions: • Harvest bulrush on an annual basis as a way to remove nutrients from the lake. Although not addressing nutrient levels in the Shannon directly, this method of nutrient reduction will provide long term removal while at the same time achieving the objective desired by the local community of creating more open water space.		
Stormwater inputs	LCCC	€€€
Recommended Actions: • Select the SUDS type (or combination) that best fits each stormwater input. • Design accordingly (in coordination with other site works). • Implement as and when appropriate in the context of other site works.		
Sewage or grey water assessments	LCCC	€
Recommended Actions: • Explore the possible presence of greywater pipework at the Western Wetland sampling point when an excavator is on-site for other works. • If unauthorised grey water connections are found, these should be reconnected to the mains sewers, or if inputs are found but are not possible to trace back to source, a designated filter wetland may be constructed to clean modest inputs *in situ*.		
Feeding of water birds	LCCC	€
Recommended Actions: • Signage to limit (but not discourage) bird feeding. (see the Signage and Education section)		
Maintenance: Discontinue biocide use	Park contractors	-€
Recommended Actions: • Cease all use of biocides within the park area unless as part of non-native invasive species control measures. • Amend the management regime for contractors so that biocide spraying is stopped.		
Remobilisation of nutrients, sediments or plant decay	LCCC	€€€
Recommended actions:		

- Remove bulrush annually as part of an ongoing nutrient and biomass removal strategy. (see Bulrush removal chapter)
- Remove sediments on successional basis, taking cognisance of ecological considerations.
- Analyse sediments for stored nutrients and sediment oxygen demand at a number of locations, to assess the merit of sediment removal as a nutrient removal measure.

Appendix 10.1.2 Recommendations regarding Levels and Flows

Actions for Water Levels and Flows	Organisation involved	Approx. Cost
Further Exploration of Hydrodynamics	LCCC	€€€

- It is proposed that the freshwater spring be located; checked to confirm presence or absence of the reported cap; and that the volumetric potential be estimated by a hydrogeological study to assess the potential for using this as a source of water for the wetland. Water quality monitoring is also recommended.
- Further hydrological assessments, as well as water quality analysis, are also recommended to ascertain both the merits and logistics of any water level amendments that may be considered.
- Before any weir works are carried out a flood risk assessment would be needed to assess the potential for raising the water level.

Appendix 10.1.3 Bulrush Clearing and Open Water

Actions for Creating Open Water	Organisation involved	Approx. Cost
Maintenance: Bulrush Clearing	LCCC	€€€

- Bulrush clearing is an important part of the long term site maintenance and management. Due to the short window available for carrying out the work, allocation of finance and planning of work should be carried out in the spring, along with booking of the contractor for works to commence promptly in mid September; and to be completed by mid October.
- Annual bulrush removal should be carried out for at least the next 5 years to ensure that root remnants do not regrow successfully and recolonise the area. Thereafter, a new assessment should be carried out to explore the appropriate removal frequency.
- Bulrush removal is part of a natural successional process, so long term management will be required in some form. It is recommended that a number of different removal approaches are used and that the effectiveness of each be carefully recorded to help inform long term management.
- It is likely an AA screening will have to be completed before these works are undertaken, to rule out any impacts to the Lower River Shannon SAC[5]. Also, Health and safety should be considered due to working in/near water

Maintenance: Sediment removal	LCCC	€€€

- Removal of sediments should be assessed on a case by case basis in any given year,

[5] NPWS (2012) *Conservation Objectives: Lower River Shannon SAC 002165*, Conservation Objective Series, National Parks and Wildlife Service / Department of Arts, heritage and the Gaeltacht. https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO002165.pdf

and should be carried out in tandem with bulrush removal rather than as a stand-alone measure in order to minimise costs, resource inputs and ecological disturbance.		
Submerged aquatic vegetation	LCCC	€€
• Annual removal of submerged waterweeds to be carried out initially, with the possibility to reduce this if the plant cover becomes significantly reduced in subsequent years. • Removal of submerged aquatic plants to be carried within the same timeframe as bulrush removal to minimise habitat disturbance.		

Appendix 10.1.4 Protection and Enhancement of area for Wildlife

10.1.4.1 All-Ireland Pollinator plan actions

Actions for Pollinators	Organisation involved	Approx. Cost
Action A- Protect what you have	LCCC Park, Biodiversity Officer	No cost
This action should identify and protect the habitats that have good diversity or high sensitivity that are located at Westfields Wetland. From the habitat mapping carried out for this project this includes: • Woodland areas • Hedgerows • Grassy verges • Reed/sedge/herb swamps, particularly the edge of the main Westfield lake • Freshwater bodies These habitats should remain undisturbed with only light maintenance if necessary		
Action B- reduce mowing frequency **See Figure 6.21 for suggested locations**	LCCC parks and contractors, Biodiversity Officer, Tidy Towns, Westfield Park Residents Association	No change from existing mowing regime
Open areas of low diversity grassland to have different timings of mowing applied: • Areas beside pathways and high footfall areas should be mown regularly throughout the growing season. However these areas should remain uncut over the winter months. Avoid all spring mowing until 15th April to allow early flowers to provide food for emerging pollinators. Note that this mowing pattern includes grass pathways within the wildflower lawn/meadow areas. • Verges and banks to be cut once per year (in September, with cut materials removed for composting off-site). • Spring wildflower lawn areas beyond pathways: First cut in July, with continued mowing until the year end. These will have spring wildflowers and then short grass during summer months, autumn and winter. • Wildflower meadow areas: Annual September cut for areas beyond the spring flowering lawn areas. Note: grass clippings should be lifted after cutting (allowing a few days sitting in situ if possible to allow seeds and insects to move towards the soil). This will decrease nutrients in the soil and increase plant diversity. Clippings should be composted off-site.		

Action C- Pollinator friendly planting	LCCC, tidy towns, Westfield Park Residents Association	€ to €€
• Engage with the local community to plant ornamental plant boxes with perennials, annuals and bulb plants that are pollinator-friendly such as Lavender, *Mahonia*, Crocus, Michaelmas daisy, *Salvia*, Borage etc. Further guidance can on planting can be found on pollinators.ie/resources. • Explore the possibility of re-establishing the sensory garden planted by local residents to increase the benefits for pollinators and other wildlife. Further guidance on planting can be found on pollinators.ie/resources. • Sow native wildflower seed in areas where bare soil is exposed after other work. It is advised that seeding areas with any wildflower meadow should be considered carefully, and there be a preference to Action B (to create meadows through reduced mowing). However, this can be done for smaller areas, perhaps close to areas with high footfall and clear signage that indicates the purpose. NOTE on `wildflower seed`- caution is advised regarding sowing of wildflower seed packets. Things to consider: • Seed packets may contain seeds not native to area/Ireland. Seeds should only be purchased from growers of Irish providence seed. • They often require a high level of management and costs, and only maintain their 'showiness' for one or two years, after which the annuals disappear, and thistle and docks may establish. • Do not replace or spread seed in habitats that already have a good representation of native meadow plants i.e. grassy verges. • Be careful with public communications: 'showy/annual' meadows may give an unrealistic expectation of what a native wildflower meadow looks like. • Through all of these actions, there is potential to introduce undesirable/invasive plants. Take care to avoid spreading existing non-native invasive species throughout the site.		
Action D- Provide/protect nesting habitats	LCCC, tidy towns, Westfield Park Residents Association	€
• Evidence of Mining-bees were discovered during the ecological survey- the bank dividing the lake and Condell Road should be lightly maintained to keep earth bare for these insects, and never sprayed with pesticides. • Where wooden or concrete fencing exists in public areas, consider drilling small south or east facing holes for cavity nesting solitary bees • Create Bee/bug hotels, which must be situated close to food sources (flowers). It is more beneficial to create small but many hotels, rather than one large hotel. • Create sand pit/pile/earth banks for mining bees, which must be situated close to food sources.		
Action E- Reduce use of pesticides	LCCC, tidy towns, Westfield Park Residents Association, contractors	-€

• LCCC and other stakeholders managing the amenity of the Wetlands should work to towards reducing/eliminating use of pesticides, particularly as a method for weeding; and should explore alternatives. • In particular there should be designated no-mow and no-spray areas around trees and along wetland verges, where such inputs are neither necessary nor beneficial for the area. • An exception to this is during the treatment of Invasive plant species in which glyphosate is a recommended tool. This in outlined in the Invasive Species Management Plan.		
Action F- Raise awareness	LCCC	€ to €€
It is important that members of the public understand why certain actions are being implemented e.g. change in mowing regime. Signage and education is further discussed in section 10.1.5.		

Appendix 10.1.4.2 Management Actions for Birds

Actions for bird species in Westfields Wetland	Organisation involved	Approx. Cost
Install bird boxes throughout the wetlands	LCCC, NPWS, Birdwatch Ireland – Limerick Branch, Limerick Men's Shed	€
The provision of nest boxes could increase the number and variety of birds utilising the woodland for nesting. Different types of bird boxes are suitable for different species.		
Establish/maintain winter bird feeding station in Westfields Wetland	Local Residents, LCCC parks dept.	€
Non-wetland birds living in the wetlands could be supported through the winter, through supplying bird-feed. Bird feeders must be sterilised regularly to prevent spread of trichomoniasis. This may best be carried out as part of a local biodiversity initiative with local residents.		
Monitor Mink population	LCCC Biodiversity Officer, NPWS Ranger	No cost
Monitor Mink population in Westfields Wetland to assess the possible impact on breeding waterbirds. Any sightings of mink can be added to the National Biodiversity Data Centre through their website or app, and can be reported to the Westfields steering committee for possible follow-up action (section 10.1.8).		
Clear bulrush from Central Wetlands	LCCC, contractors	€€€
Clearing bulrush from the main lake will benefit waterfowl as it will open up water for these birds to swim in. See section 10.1.3.		
Signage and Education	LCCC, Birdwatch Ireland – Limerick Branch,	€€
Raise local awareness about the importance of the wetland as a habitat for birds. Signage and education is further discussed in section 10.1.5. This should also include the promotion of the wetlands as a place to watch birds safely.		

Appendix 10.1.4.3 Management Actions for enhancement of Bat Populations

As outlined in Chapter 6, a number of bat species are using Westfields Wetland. There are many opportunities to create enhancements for the bat populations that roost, feed and commute within the wetlands. These actions are outlined below.

Actions for bats	Organisation involved	Approx. Cost
Install bat boxes	LCCC, NPWS Ranger, Limerick Bat Group, Limerick Men's Shed	€
• Simple bat boxes suitable for Pipistrelles and Leislers bats can be bought online or constructed by local community groups e.g. Men's Sheds. Some bat box designs (specifically those that are enclosed at the base) require annual cleaning out, which must be carried out by a Bat Specialist or NPWS Ranger. A map showing suitable locations in the wetlands area for bat boxes is shown below (Fig. 10.1). • Guidance on installing bat boxes: ◦ Suggested locations include areas with mature trees located near other treelines and water edges. ◦ All bat boxes should be mounted at least 3-4 metres above the ground. ◦ Mount on the south facing side of the tree where the box is exposed to the sun for part of the day. ◦ Do not install bat boxes on a tree that is near any lighting column. ◦ Construction details can be downloaded here: http://www.batcon.org/images/InstallingYourBatHouse_Building.pdf *Figure 10.1 Suggested locations of placement of bat boxes within Westfield wetland*		
Organise bat walks	Limerick Bat Group/ Local Ecologists	€
Bat walks can be undertaken during summer months and are an effective way to engage members of the public and increase awareness of bats. Bat walks require bat detectors to be able to hear and identify the species present - Contact Limerick Bat Group (local voluntary group) to borrow one or to organise a walk.		
Increase native tree, shrubs and flowers planting	LCCC	€€
Native shrubs and trees increases feeding habitat for bats as they forage for insects that live on these plants. Guidance on tree planting can be found in the All Ireland Pollinator Plan[6] and Clare County Council's publication *Buds of the Banner*[7] (Fuller 2012).		
Consider impacts of Lighting on	LCCC	€€

[6] https://pollinators.ie/wp-content/uploads/2021/03/FINAL-All-Ireland-Pollinator-Plan-2021-2025-WEB.pdf

[7] Fuller, J. (2012) *Buds of the Banner: A Guide to Growing Native Trees and Shrubs in Clare*, Rural Resource Development Ltd.: Clare County Council: Co. Clare.

Nocturnal animals		
• It is important that dark spaces are maintained for all nocturnal animals, including night-flying insects and bats. Any lighting added to the park, or any change in bulbs, must consider impacts to nocturnal animals. Control light spill using cowls, and use bulbs with 2500K or below. • Avoid felling treelines and hedgerows as these provide commuting lines and feeding habitat for bats, and may be shielding light from other feeding habitats. • Bat Conservation Trust guidance on appropriate lighting for bats can be found here: https://theilp.org.uk/publication/guidance-note-8-bats-and-artificial-lighting/ • Map light spill at night to determine potential enhancement measures and feed into future planting.		

Appendix 10.1.4.4 Management Actions for Other Mammals living in Westfields Wetland

Actions for mammals	**Organisation involved**	**Approx. Cost**
Remove litter	LCCC	€ to €€
As outlined in Chapter 6, it is important to clean up of areas with high dumping and river borne litter as this may pose a threat of ensnaring or causing injuries to animals from broken glass, sharp metal edges etc. to foraging animals, i.e. fox badger and otter.		
Signage and education	LCCC	€
Connect the importance of the wetlands as a wild space that is used by mammals in the context of an urban environment. See more on signage and education in section 10.1.5.		
Monitor populations	LCCC, local residents	€
Monitor any mammals in Westfields Wetland to better understand how mammals are using the wetlands in the context of a wild space or refuge in an urban environment. Any sightings of mammals can be inputted by users of the wetlands to the National Biodiversity Data Centre through their website or app.		
Hedgehog houses/habitat	LCCC, local residents, community group, men's sheds.	€ to €€
As hedgehog populations are decreasing in Ireland, it is important to support this vulnerable mammal where populations are still strong. There is evidence that hedgehogs are using Westfield Wetland; therefore it may be appropriate to establish a few hedgehog houses around the wetlands area. The following guidance shows a few ways to build a hedgehog a place to sleep or hibernate: • https://www.nhm.ac.uk/discover/how-to-make-a-hedgehog-house.html • http://www.hedgehog-rescue.org.uk/houses.php		

Appendix 10.1.4.5 Management actions for Invertebrates

Actions for Invertebrates	Organisation involved	Approx. Cost
Follow actions for the All-Ireland Pollinator	LCCC	€ to €€
Follow the actions described in section 10.1.4.1. Most of these actions are aimed to increase habitat and food for pollinators, but also provided for other invertebrates too. These include: ○ increasing habitat for invertebrates/pollinators ○ introducing varied grass cutting regimes ○ reduce/eliminate pesticide use		
Carry out study of invertebrates	LCCC	€€€
Record and monitor invertebrate populations within Westfields Wetland. This could include: ○ pond-dipping surveys to monitor aquatic species ○ moth trapping to observe moths and other nocturnal species ○ pit-fall traps to monitor invertebrates on woodland floors/grasslands. As outlined in section 7.2.1 a BioBlitz event could be held to record species, either as a stand-alone project or part of a citizen science initiative (section 7.2.4).		

Appendix 10.1.4.6 Introduction of rare plant Opposite-leaved pondweed into Wetland

There is opportunity to introduce rare and protected aquatic plant Opposite leaved pondweed *Groenlandia densa* in collaboration King's Island Flood Relief scheme project into the Westfields Wetland. There is an opportunity in increase the population of this rare plant in Limerick City, which is the main stronghold for this rare plant in Ireland.

Groenlandia densa is listed as 'Near Threatened' on the Irish Vascular Plant Red List (Wyse Jackson, *et al.* 2016[8]); and is identified as one of the three high conservation elements (subtypes) of the Feature of Interest (Qualifying interest) of the Annex I habitat 'Water courses of plain to montane levels with the *Ranunculion fluitanis* and *Callitricho-Batrachion* vegetation [3260]' within the Lower River Shannon Special Area of Conservation (SAC) (NPWS 2013)

This species is protected by Section 21 of the Wildlife Act (1976) and is listed on the Flora (Protection) Order (2015).

Introduction of Groenlandia densa	Organisation involved	Approx. Cost
Carry out feasibility study for Groenlandia introduction	LCCC, NPWS, Botanical expert/ Ecological consultant	€€€
A study could be carried out to determine if the receiving environment in Westfields Wetland lake is appropriate for this plant. Either translocation of plants or of soil material from the ditch on King's Island could be included in the mitigation programme for this plant. This action should be carried out in consultation with NPWS and a botanical expert.		

[8] Wyse Jackson, Cole, E., Jebb, M., McFerran, D., Sheehy Skeffington, M. &, Wright, M., FitzPatrick, Ú (2016) *Ireland Red List No. 10: Vascular Plants*, National Parks and Wildlife Service / Department of Arts, Heritage, Regional, Rural and Gaeltacht, Dublin, Ireland, available: https://www.npws.ie/sites/default/files/publications/pdf/RL10%20VascularPlants.pdf [accessed 18 Dec 2020].

Appendix 10.1.4.6 Management Actions for Control of Non-Native Invasive Species

Invasive species management	Organisation involved	Approx. Cost
Non-Native Invasive Species Management	LCCC, Contractors, Local community groups	€€€
An Invasive Species Management Plan for Westfields Wetland accompanies this document. The management measures outlined in this plan should be implemented to control the spread of Japanese Knotweed, Himalayan Balsam, Giant Hogweed, Winter heliotrope and *Montbretia* within the wetlands boundary.		

Appendix 10.1.5 Signage and Education

Actions for Signage and Education	Organisation involved	Approx. Cost
Signage infrastructure	LCCC	€€€
◦ Erect a sign at the platform and along the Condell Road path to highlight that feeding ducks and swans is welcome, but that the volumes must be modest and a varied diet is important. ◦ Other additional signage as outlined in section 7.1, keeping the size and placement sensitive to the natural feel of the area and not excessively intrusive or prominent. ◦ Overhaul the Westfields Website on limerick.ie to include educational resources and information about the wildlife and history of Westfields. Add QR codes to new and/or existing signage, linking to corresponding information on the website.		
Signage maintenance	LCCC	€
• Clean signage and/or repair or replace as needed to keep the information readily accessible to visitors.		
Examine the feasibility of employing a biodiversity officer	LCCC	€€€
• Examine the feasibility of employing a Biodiversity Officer by LCCC with responsibilities which include the following: 1. co-ordinating regular walks, talks and other events, taking cognisance of the wildlife priorities and values inherent in this management plan. 2. engagement with local schools in hosting and organising events and personnel for tours and activities. 3. Liaison with local art schools or groups to explore the option for sculpture or art installations or trails. 4. coordination of citizen science initiatives and liaise with local art schools or groups to have permanent or temporary sculpture or art trails on the walkways here. 5. engagement in sensitive communication with members of the public about feeding water birds. Alternatively or additionally, these educational roles may potentially be coordinated by existing LCCC staff, local biodiversity expertise or the local community.		
Education infrastructure	LCCC/local biodiversity expertise	€€
Provide access for pond dipping; either as a wooden platform, short boardwalk or gravelled area to wade into.		

Awareness-raising on wildlife in the wetlands	All local wildlife groups, Community groups, LCCC	€€
A campaign to raise awareness of the wildlife and amenity value of Westfields Wetlands should be organised to help promote the wetland and secure its future as a protected space for wildlife. A programme of guided walks and talks, and the development of promotional material (such as information leaflets and boards) should be initiated to help raise awareness of the value of the site among the local community and the wider city population, including visitors. Suitable themes may include the following: ○ Bat walks ○ Pollinator Plan ○ Bird watching ○ Aquatic plants ○ Life below water ○ Invasive species ○ Importance of wetlands to wider area (SAC/SPA – biodiversity in urban environment)		
Awareness campaign to reduce Pesticide use	All local wildlife groups, Community groups, LCCC	€€
A campaign to raise awareness on the damage cause by pesticides to wildlife and to human health, as well as the unnecessary and unsightly use of the of these chemicals. If weeds need to be removed, alternatives should be sought, and pesticides should only be used a last resort, or as a tool to kill non-native invasive species. Additionally, a campaign could also be set up to change people's perceptions of urban plants growing on walls, pavement or tree pits. Similar awareness campaigns have been successfully implemented in many countries, for example a campaign devised in the UK called 'morethanweeds' (https://morethanweeds.co.uk/).		

Appendix 10.1.6 Social Aspects

Actions to address Social Challenges	Organisation involved	Approx. Cost
Lighting issues	LCCC	€€
○ In order to protect and enhance the area for bats, no new lighting is to be introduced. ○ Existing lighting to be assessed and capped if needed to limit night-time light pollution.		

Appendix 10.1.7 Infrastructure

Infrastructure Recommendations	Organisation involved	Approx. Cost
5.1.2 - Access to water and views	LCCC	€€€
Infrastructure measures: • Create views of open water in Eastern Wetland from the Condell Road Path. This will be achieved by removing bulrush cover along certain sections of the pathway. It is important that this measure be followed up with regular annual clearing in selected areas to keep the views and access to the water edge open into the future.		

• Create a raised platform along this path. The most suitable location is at the opposite end of the lake from the existing platform, close to the eastern end of the path. It is proposed that this be simply a raised mound within the pathway, constructed as part of the improvement works to the path itself. • Create openings through the trees at view height along the River Shannon to allow occasional views of open water. This can be done as a short term measure without waiting for further works on the wider flood bund. Any works would need to be done in collaboration with NPWS. • Extend platforms out into River Shannon. The current LCCC Flood Relief Scheme process is progressing, and will set out changes to the existing flood bund between the Shannon and the rest of the city. As part of this process Cleeve's Bank, the flood bund bordering Westfields, will undergo improvements for flood protection. As part of that process it is recommended that extended platforms or piers be considered for construction to enhance the view from this part of the Westfields area out over the River Shannon. Maintenance: • Keep bulrush clear in selected areas, in line with methods and timing outlined in the chapter 5. • Keep selected views of open water clear of overhanging branches or growth of scrub or shrubs.		
Pathways, access and interconnectivity	LCCC	€
• Expand the walking routes at Westfields with a walkway to connect the platform with Ted Russell park along one of the routes suggested in section 9.2.1. • Include perimeter walkways within the meadow habitat of the green area north of the Central Wetland. • Keep new and existing pathways well maintained to ensure that they can continue to be used safely and comfortably by walkers, cyclists, push chairs and buggies etc. Factors include encroachment of perimeter grass growth; encroachment of branches from shrubs and trees; and maintenance of path surfaces as needed. • Renew perimeter pathways through meadow areas each year and keep these cut as part of the lawn mowing regime. The locations should be kept by contactors to ensure that the pathways are selected with care each year.		
Improved access between wetland areas	LCCC	€
• Explore options for improved access between the River Shannon flood bund and the main wetland walkways. This should be carried out in conjunction with LCCC Roads Department taking account of best practice examples from cities with good, long-established cyclist and pedestrian routes, and taking into account the feedback offered in Appendix 2.1 (Stakeholder Feedback).		
Pathways	LCCC	€
• As part of the Flood Relief Scheme flood bund upgrade works consider including tarmac pathways to allow for roller blading and/or children's scooters etc. • Gravel surfaces have the advantage of being lower cost, lower overall environmental footprint, and providing infiltration rather than runoff, so these are recommended for use in selected areas where appropriate.		

• All existing pathways to be mown regularly at the sides, and augmented with woodchips or gravel where necessary to provide a safe and dry surface to walk on. • Carry out a consultation process with residents and other stakeholders to explore the introduction of looped walks to complement existing pathways at Westfields.		
Cycleways	LCCC	€€€
○ Assess the cycle lane infrastructure on the Condell Road and ensure that it is safe and effective for users. Make amendments if needed. ○ Include off-road cycle path infrastructure into the new flood bund works. ○ Keep the current pathways maintained so that cyclists can use them with ease and comfort and so that it is easy for a walker and a cyclist to pass safely with ease.		
Safety Fencing	LCCC	€€
○ Explore further the merits of erecting safety fencing at the inlet/outlet water points of the Central and Eastern Wetlands. ○ Annual assessment of fencing and repair, cleaning or replacement as needed.		
Integration of Westfields with wider walking routes	LCCC	€
○ Produce a map to complement the existing Walkable Neighbourhood map to show a larger area, linking to the main wetland areas around the extremities of the city as per section 9.2.5. The map could be made available on the LCCC website or printed for distribution via tourist office, schools, sports clubs etc. Any work on such a route should also take due consideration of the wider city population and relevant stakeholders prior to creation and publication. ○ Preparation of a detailed Wild Waterways Network map, based on fig 9.3 of the Management Plan. It is recommended that this map stick to off-road routes insofar as possible, and/or routes that run parallel to canals, streams and rivers in and around the city. It is also envisaged that this would also show navigable rivers and streams for use by kayakers and other boat users.		
Seating	LCCC	€€
○ Install 2 temporary benches at suitable locations on the Shannon flood bund, for removal once Flood Relief Scheme works commence. ○ Install 2 log benches or other benches along the path to the south of the lake, set back from the path, but with views over open water. ○ Ensure that no new seating is installed in proximity to Westfields Park houses or the green area nearby (see section 9.3). ○ Carry out repair and/or cleaning of seating as needed.		
Litter control and provision of bins	LCCC/Tidy Towns/Volunteers	€-€€
○ Assess the merits of Installing litter bins at the main pedestrian junctions at the site. ○ Conduct regular checking of bins and emptying as needed. ○ Conduct regular litter clean-ups of all park space, pathways and lawns; and within the water of the wetland areas and the banks of the River Shannon.		
Remove metal box	LCCC	€
Assess the ownership and usage status of the metal box on path between Condell Road and the lake, removing the box if possible, or moving it off the path if it is still in use.		

General maintenance issues	LCCC/designated contractors/local residents and volunteers	€
○ Follow careful adherence to a minimum intervention management approach at Westfields generally. ○ Carry out annual cleaning, repair and/or replacement of park infrastructure such as pathways, signage, platform structure. ○ Carry out annual mulching, pruning and general care of the orchard area at Westfields Park.		

Appendix 10.1.8 Ongoing Management

Actions for ongoing management	Organisation involved	Approx. Cost
Establishment of Steering Committee	LCCC, broad local community input	€
○ Establish a steering committee to keep the works outlined in this document in focus and to ensure that future work is carried out in a manner that is consistent with the ethos of protecting and enhancing nature in the area and keeping the natural feel of the area for people visiting. Further details are outlined in section 10.2 below.		

Appendix 10.2 Using permaculture to guide the work

Permaculture is a design process that helps to meet human needs without compromising the needs of nature. Too often we see these as being either/or; to the point where we risk eroding the capacity of nature to continue her work of supporting all species present, including our own. Permaculture design uses a set of principles to help steer the design process and has an underlying foundation of ethics which underlie the ethos behind our decisions and actions.

There is an extensive list of permaculture principles which can help with any project (https://knowledgebase.permaculture.org.uk/principles) but for our purposes here at Westfields the most useful design principles are those developed by David Holmgren[9], as follows:

1. Observe and Interact
2. Catch and Store Energy
3. Obtain a Yield
4. Apply Self-regulation and Accept Feedback
5. Use and Value Renewable Resources and Services
6. Produce no Waste
7. Design from Patterns to Details
8. Integrate rather than Segregate
9. Use Small and Slow Solutions
10. Use and Value Diversity
11. Use Edges and Value the Marginal
12. Creatively Use and Respond to Change

[9] Holmgren D (2011) *Permaculture - Principles and Pathways Beyond Sustainability*. Permanent Publications, Hampshire, UK.

Bear in mind that these principles only skim the surface. Many phrases will be clear while others may be less obvious without a further understanding of the subject. There are many excellent resources available online, such as Maddy Harland's *What is Permaculture?* series of articles in Permaculture Magazine[10].

The permaculture /ethics have been summed up as “Earth Care, People Care and Fair Shares".

1. Earth Care essentially acknowledges that we cannot live without due regard and care for the Earth's natural environment. Without a solid ecological basis, our life on this planet is impossible.
2. People Care states simply that you and I matter; we count. A healthy environment is a crucial starting point, but we also need to develop systems that are socially just, and that support our growth and wellbeing.
3. Fair Shares recognises that many people and beings on the planet rely upon the available resources for their lives and livelihoods and that there are thus limits to growth and consumption. In other words, there is plenty to meet all of our needs, but not to satisfy our greed for ever more stuff, ever higher shareholder dividends and unlimited growth of urban areas, economic activity and population.

So as we go forward with the work at Westfields we can use these pointers as reminders to achieve our aims for people living in and visiting the area, while at the same time minimising our impact on the local ecology and the wider environment.

Appendix 10.3 Potential funding sources

A10.2.1 Potential long-term funding sources for dedicated ranger or manager

- Leader funding

https://www.gov.ie/en/publication/46cecf-leader-programme-funding/

- Citizens Information - schemes to support employment https://www.citizensinformation.ie/en/employment/unemployment_and_redundancy/employment_support_schemes/schemes_to_support_employment.html

- Department of Social Protection – Community Employment Schemes https://www.gov.ie/en/service/412714-community-employment-programme/

- ESB Energy for Generations fund https://esb.ie/acting-responsibly/community-stem-and-the-arts/esb-corporate-responsibility

A10.2.2 Potential funding sources for significant capital works

Some of the sources mentioned in the previous list may also be valid here.

- LAWPro (Local Authorities Waters Programme) Community Water Development Fund

[10] Maddy Harland (23 Jan 2013) What is Permaculture – Part 1: Ethics. *Permaculture*. https://www.permaculture.co.uk/articles/what-permaculture-part-1-ethics

https://www.catchments.ie/community-water-development-fund-2020-grant-awards/

- National Lottery funding
  https://www.lottery.ie/useful-info/apply-for-good-causes-funding

- The Community Foundation for Ireland
  https://www.communityfoundation.ie/grants/types-of-grants/environment-and-nature-fund

- Green News funding list
  https://greennews.ie/e500-million-climate-action-fund-large-scale-projects-funds/

- Atlantic Philanthropies list of grant streams
  https://www.atlanticphilanthropies.org/grants

- Circular City Funding – EU LIFE
  https://www.circularcityfundingguide.eu/funding-types-and-their-applicability/grants-and-subsidies/life/

- EU LIFE Environment Funding
  https://ec.europa.eu/easme/en/life

- AER (Assembly of European Regions) Circular Economy funding opportunities
  https://aer.eu/closing-loop-funding-opportunities-circular-economy-projects/

A10.2.3 Potential funding sources for smaller projects, events or initiatives
Some of the sources mentioned in the previous list may also be valid here.

- Limerick City and County Council grants and funding pages
  https://www.limerick.ie/council/services/community-and-leisure/grants-and-funding
  https://www.limerick.ie/council/services/community-and-leisure/grants-and-funding/grants-and-funding
  https://www.limerick.ie/council/services/community-and-leisure/grants-and-funding/community-environment-action-fund

- Limerick PPN funding opportunities
  https://www.limerickppn.ie/resources/

- Biodiversity funding routes listed on the NPWS website:
  https://www.npws.ie/biodiversity/biodiversity-funding

- Funding for biodiversity recording
  https://www.biodiversityireland.ie/funding-for-biodiversity-recording/

- Funding opportunities on The Wheel

https://www.wheel.ie/funding

A10.2.4 Other possible funding streams that may be of use at Westfields

- Enterprise Ireland funding supports for business initiatives
  https://www.enterprise-ireland.com/en/funding-supports/

- EU Prize for Cultural Heritage
  https://www.europeanheritageawards.eu/

- EU Prizes and Awards
  https://ec.europa.eu/programmes/creative-europe/actions_en

- Beltaine Festival artists tour fund
  http://bealtaine.ie/page/opportunities?utm_source=Arts%20%26%20Culture&utm_campaign=10b82abe4b-EMAIL_CAMPAIGN_2018_09_12_11_21&utm_medium=email&utm_term=0_243877177d-10b82abe4b-126764629

- Artist in the Community Scheme Bursary Award
  http://www.artscouncil.ie/Funds/Artist-in-the-community-scheme-bursary-award/

- Atlantic Fellowship for Social and Economic Equity
  https://afsee.atlanticfellows.org/apply

- Government of Ireland Postdoctoral Fellowships, 2019
  http://research.ie/funding/goipd/?f=postdoctoral

- Irish Aid - Development Education Funding Scheme
  https://www.irishaid.ie/what-we-do/who-we-work-with/civil-society/development-education-funding/

- Irish Research Council: New Foundations 2018
  http://research.ie/funding/new-foundations/