



NON NATIVE INVASIVE SPECIES ON RIVER BARROW: FEASIBILITY STUDY



Contents

1. INTRODUCTION.....	2
2. BACKGROUND.....	2
3. LEGISLATION	2
4. SITE.....	3
5. SURVEY FINDINGS.....	5
6. TARGET SPECIES AND CONTROL METHODS	9
6.1 Azolla filiculoides	9
6.2 Fallopia japonica	10
6.3 Gunnera tinctoria.....	12
6.4 Heracleum mantegazzianum	13
6.5 Impatiens glandulifera	14
6.6 Leycesteria formosa.....	16
6.7 Petasites fragrans	17
6.8 Prunus laurocerasus	18
7. RECOMMENDATIONS	19
REFERENCES.....	23
Appendix I.....	25
Appendix II.....	42
Appendix III.....	43

Acknowledgements

This feasibility study was carried out by Flynn Furney Environmental Consultants on behalf of a number of community groups along the River Barrow in Co. Carlow. The authors would like to thank the volunteers of Leighlinbridge Improvement Group, Bagenalstown Improvement Group and Carlow Tidy Towns for all their support and encouragement throughout the project period. This project was funded by grant aid from the Local Authorities Water Programme without which this work would not have been possible.

This report was written by Claudia Pascali and Erin McCrudden. The tireless work of community groups and their ongoing commitment to biodiversity is acknowledged by the authors here.

1. INTRODUCTION

Leighlinbridge Improvement Group, Bagenalstown Community Group and Carlow Tidy Towns commissioned Flynn Furney Environmental Consultants for the purpose of mapping invasive alien species along the banks of the river Barrow in the section between Carlow Town Park and Slyguff Lock, with particular attention devoted to the presence of Himalayan Balsam. This document is the resulting Feasibility Study Report. This project was funded and supported by grant aid from the Local Authority Waters Programme. The aim of this document is to advise on the appropriate course of action to control established invasive species identified during the survey, providing background information in relation to each species observed and direction for monitoring the success of the operation in the future.

As part of the project, and to facilitate the control actions, maps have been produced to illustrate the extent and location of each species found. Maps are reported in Appendix I of this document. GPS points were recorded where non-native species were encountered using Mappit, and area of occupancy (m²) was recorded. Species locations were mapped using QGIS.

2. BACKGROUND

Invasive alien species (IAS) are organisms that have the potential to harm the environment and impact biodiversity (Stokes, O'Neill and McDonald, 2004). IAS are non-native and are often introduced accidentally or intentionally by human action in a novel environment. Here IAS are able to spread aggressively due to the absence of critical limiting factors such as climate, predators, and resources and can transform the landscape as well as outcompete native wildlife and alter local food webs.

IAS also have a considerable impact on the global and local economy: it is estimated that invasive species have costed globally around \$1.3 trillion over the last 50 years, with Ireland alone spending over €260 million per year to prevent, limit or manage the damage many invasive species can do (O'Flynn, Kelly and Lysaght, 2014).

Ecological invasion can be a natural phenomenon, however with the increase in travelling, betterment of trading routes, and the shifting of the native range due to climate change, the introduction of new invasive species is likely to increase over the coming years, making the words "invasive species" more and more familiar to people around the world.

3. LEGISLATION

Several IAS are regulated in Ireland and listed under S.I. No. 477/2011 European Communities (Birds and Natural Habitats) Regulations 2011 as non-native species subject to restriction under Regulation 49 and 50. In particular, article 49 "prohibits on introduction and dispersal of certain species" and article 50 "prohibits on dealing with and keeping certain species", namely those listed in the Third schedule, here reported in Appendix II (S.I. No. 477 of 2011).

On a European level IAS are controlled under regulation (EU) No 1143/2014 of the European parliament and of the council of 22 October 2014. The regulation focuses on preventing and minimizing the introduction and the spread of IAS, and it is legally binding for all member states (EU No 1143/2014).

As for the disposal of IAS after removal, this is regulated by Waste Management Acts, 1996 to 2008, and the NRA's Guidelines for the Management of Waste from National Road Construction Projects (2008d), and as such waste licence or waste facility permits should be acquired where necessary.

Finally, the removal of certain species may require the application of pesticides. In such cases the Good Plant Protection Practice section in the European Communities (Authorization, Placing on the Market, Use and Control of Plant Protection Products) regulation No. 83 of 2003 determines that that all personnel handling chemicals/sprays are registered with the Department of Agriculture, Food and the Marine and that herbicides and pesticides are used in compliance with the product label (S.I. No. 83 of 2003).

4. SITE

The study area comprises habitats directly adjacent to the banks of River Barrow from Carlow Town Park to Slyguff lock (Fig 1). The 25.2 Km stretch is found within Co. Carlow, however 2.95 Km are located along the Carlow-Laois boundary, and 683 m are found along the Carlow-Kilkenny boundary. Major towns found within the site are Carlow, Leighlinbridge and Bagenalstown.

Although it rises from Old Red Sandstone in the Slieve Bloom Mountains, the River Barrow traverses limestone within the survey site. Tributaries were not included in the study area.

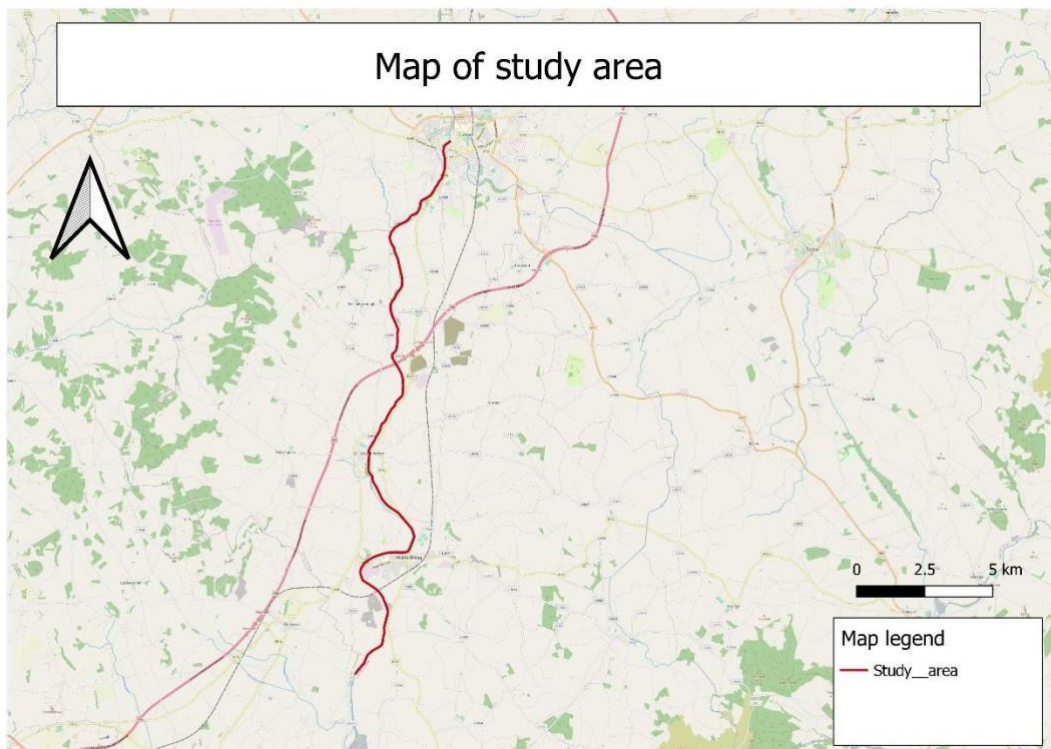


Figure 1. Map of study area from Carlow Townpark to Slyguff lock

The site is part of Special Area of Conservation 002162 - River Barrow and River Nore SAC, which was designed for the presence of the following species and habitats:

- [1016] Desmoulin's Whorl Snail (*Vertigo moulinsiana*)
- [1029] Freshwater Pearl Mussel (*Margaritifera margaritifera*)
- [1092] White-clawed Crayfish (*Austropotamobius pallipes*)
- [1095] Sea Lamprey (*Petromyzon marinus*)
- [1096] Brook Lamprey (*Lampetra planeri*)
- [1099] River Lamprey (*Lampetra fluviatilis*)
- [1103] Twaite Shad (*Alosa fallax*)
- [1106] Atlantic Salmon (*Salmo salar*)
- [1355] Otter (*Lutra lutra*)
- [1421] Killarney Fern (*Trichomanes speciosum*)
- [1990] Nore Freshwater Pearl Mussel (*Margaritifera durrovensis*)

- [1130] Estuaries
- [1140] Tidal Mudflats and Sandflats
- [1170] Reefs
- [1310] Salicornia Mud
- [1330] Atlantic Salt Meadows
- [1410] Mediterranean Salt Meadows
- [3260] Floating River Vegetation
- [4030] Dry Heath
- [6430] Hydrophilous Tall Herb Communities
- [7220] Petrifying Springs
- [91A0] Old Oak Woodlands
- [91E0] Alluvial Forests

Particularly the study area comprises records of the following:

- [1355] Otter (*Lutra lutra*)
- [1029] Freshwater Pearl Mussel (*Margaritifera margaritifera*)
- [1092] White-clawed Crayfish (*Austropotamobius pallipes*)
- [91A0] Old Oak Woodlands

The site coincides with the feeding range of Annex II species Otter (*Lutra lutra*), while White-Clawed Crayfish (*Austropotamobius pallipes*) is recorded previously in the area south of Leighlinbridge. As for the Freshwater Pearl Mussel, the whole catchment is considered to be a *Margaritifera* sensitive area, although its current status is currently under review (NPWS, 2011).

An example of Old Oak Woodland present along the site is Cloghristic Wood, found 500m from Milford Mill on the left bank of the river. This woodland includes species such as Oak (*Quercus spp.*), Ash (*Fraxinus excelsior*), Beech (*Fagus sylvatica*), with Holly (*Ilex aquifolium*) and Bramble (*Rubus fruticosus*) in the understory.

Other adjacent habitats include scrub (WS1), mainly consisting of Nettle, Bramble and Bracken.

The riparian habitat is species rich itself, including Willow (*Salix spp.*), Meadowsweet (*Filipendula ulmaria*), Purple loosestrife (*Lythrum salicaria*), and Water mint (*Mentha aquatica*).

Aquatic species include water-starworts (*Callitriche stagnalis*), amphibious bistort (*Persicaria amphibia*), yellow water lily (*Nuphar lutea*) and yellow flag iris (*Iris pseudacorus*).

Water quality of River Barrow in the section of the study area is reported by EPA as Q3-4 in 2014.

5. SURVEY FINDINGS

A survey of the riparian zone of the River Barrow in Co. Carlow was carried at the end of June 2022 to identify the location of alien invasive species. A total of seven species were recorded and are reported in table 1. Invasive risk category is reported as indicated in the *Biodiversity Ireland Catalogue of Ireland's non-native species* (NBDC, n.d.). Impact score is reported as indicated in the *Risk analysis and prioritisation For invasive and non-native species in Ireland and Northern Ireland* (Kelly, O'Flynn and Maguire, 2013). Species are so categorized:

- High risk species scored 18 and above;
- Medium risk species 14 – 17; • Low risk species scored 0 – 13.

Table 1. Invasive species recorded and associated risk score.

Species name	No. Individuals/patches recorded	Area (m2)	Invasive risk category	Impact score
<i>Azolla filiculoides</i>	3	17	Medium	14
<i>Fallopia japonica</i>	2	6	High	20
<i>Gunnera tinctoria</i>	1	5	High	19
<i>Heracleum mantegazzianum</i>	2	35	High	19
<i>Impatiens glandulifera</i>	131	79,188.06	High	18
<i>Leycesteria Formosa</i>	1	5	Medium	14
<i>Petasites fragrans</i>	1	41	Low	12
<i>Prunus laurocerasus</i>	1	20	High	18

Five species among the ones recorded are listed in the Third Schedule list of the European Communities (Birds and Natural Habitats) Regulations 2011 [S.I. 477/2011], and as such they are subject to restrictions under Regulations 49 and 50. The species listed are:

Azolla filiculoides (Water Fern)

Fallopia japonica (Japanese Knotweed)

Gunnera tinctoria (Giant Rhubarb)

Heracleum mantegazzianum (Giant Hogweed)

Impatiens glandulifera (Himalayan Balsam)



Figure 2. Individual plants of Himalayan Balsam on riverbanks

One species in particular appeared to dominate the riparian landscape of River Barrow: *Impatiens glandulifera* (Himalayan Balsam). This species was observed throughout the study area occurring both as isolated plants (Fig. 2) and as large patches (Fig. 3). Himalayan Balsam occurred on both river banks; however the majority of the species was observed to occur in adjacent woodland habitats and in back channels rather than on the banks themselves. A summary of the area in each habitat is reported in table 2.



Figure 3. Large stands of Himalayan Balsam in wooded area

Table 2. Summary of area per habitat of Himalayan Balsam

Location	Individual plants or small stands (m ²)	Large areas (m ²)	TOTAL (m ²)
River bank	325	4098.45	4,423.45
Back channel	99	31826.26	31,925.26
Islets	64	6139.91	6,203.91
Woodland habitat	42	36593.44	36,635.44
TOTAL AREA			79,188.06

The remaining third schedule species were identified occupying a considerably smaller area. In particular *Azolla filiculoides* (Water Fern) occurred in three patches in the area of Leighlinbridge; *Fallopia japonica* (Japanese Knotweed) was recorded in Bagenalstown in two locations, while *Gunnera tinctoria* (Giant Rhubarb) and *Heracleum mantegazzianum* (Giant Hogweed) appeared to be confined on two of the islets along the river, respectively near Rathellin lock and Carlow Town Park. *Leycesteria Formosa* (Himalayan Honeysuckle), *Petasites fragrans* (Winter Heliotrope) and *laurocerasus* (Cherry Laurel) were identified in one location each. The latter was assessed as High Risk, however it appears to be confined to the area near Milford Weir in a single patch.

A summary map of the finding is reported below (Fig. 4), along with the total area occupied by invasive species in each risk category (Table 3).



Figure 4. Summary map of invasive species recorded in the study area

Table 3. Total area occupied by invasive species in each risk category.

Species name	Area (m ²)
Area occupied by High Risk non-native species	79,254.06
Area occupied by Medium Risk non-native species	22
Area occupied by Low Risk non-native species	41

6. TARGET SPECIES AND CONTROL METHODS

6.1 *Azolla filiculoides*

English name Water fern

Family Azollaceae

Description Small free floating plant that has the tendency of creating dense mats on the surface of water bodies. Leaves are opposite and slightly overlapped giving it the appearance of a small fern. Usually green, but can appear red when exposed to stresses. It has thin brown roots, and it reproduces vegetatively, although it does occasionally produce spores.

Status Established

Origin North and Central America



Figure 5. *Azolla filiculoides*

Invasive status

Risk category **Medium impact**

Impact score 14

Source Otto, M., 2022. *Species Profile Browser* · *Species Profile*. [online] Species.biodiversityireland.ie. Available at: <<https://species.biodiversityireland.ie/profile.php?taxonId=127372&taxonName=fern>> .

Impact

Can form dense mats floating on water that excludes light from the lower parts of the river or lake and can cause de-oxygenation.

Control and Management

The most effective management for Water fern is physical control through the use of a fine meshed net or rakes. However, full eradication with this method is difficult as spores can give rise to another infestation following the initial removal. Due to the EU ban on most herbicides in water, mechanical control seem to be the only treatment available, although further research is done on the possibility of the use of the phytophagous beetle *Stenopelmus rufinasus*. This beetle is already present in Ireland in Co. Fermanagh and Co. Cork, and could potentially help reducing water fern in Ireland (Baars and Caffrey, 2008).

Similarly an experimental physical method proposed for the eradication of water fern involves agitating the water either manually or through the use of a mechanical agitator. This can be effective as water fern has a tendency to fragmentate when exposed to disturbance. These fragments are sensitive to strong lights and would die if exposed to direct sunlight (Hill and McConnachie, 2009).

6.2 *Fallopia japonica*

English name Japanese knotweed

Family Polygonaceae

Description Robust perennial plant that can grow up to 2-3 m in height. It has distinctive hollow stems, which are speckled with red during summer and turn brown during winter. Its leaves are large (7-12 cm) and oval with pointed tip and a flat base. They emerge from the stem in a zigzag pattern. The flowers are cream coloured and small, arising in clusters from the joint of the stem and the leaf. Japanese knotweed flowers between August and October, and dies back in winter leaving behind only the brown stems.

Status Established

Origin Japan, Taiwan, Korea and China

Invasive status

Risk category **High impact**

Impact score 20



Figure 6. *Fallopia japonica*

Source Kelly, J., O'Flynn, C., and Maguire, C. 2013. Risk analysis and prioritisation for invasive and non-native species in Ireland and Northern Ireland. A report prepared for the Northern Ireland Environment Agency and National Parks and Wildlife Service as part of Invasive Species Ireland.

Impact

Creates large stands that can exclude other local species. It can grow through concrete and asphalt, spreading quickly through its extensive rhizome system, and it can compromise structural integrity of manmade structures and lower their economic value. It also increases soil erosion, especially along riverbanks.

Control and Management

The most effective management for Japanese Knotweed is a combination of physical and chemical control. Cutting and injecting can be performed from late October through November before senescence. Canes are cut about 40mm above a node and injected with a solution of glyphosate. Another similar method involves digging and spraying, with rhizomes dug during winter and sprayed the following spring/summer season with the herbicide of choice. Both cutting and digging promote leaf growth, which increases the plant's vulnerability to herbicide for the next application.

Excavation of the rhizomes and containment/disposal is another method that is effective at eliminating the plant. This involves mechanically excavating the root structures and the rhizome, along with all soil material in the section. All excavated material is temporarily placed on top of root barrier membranes and stored until disposal. The temporary storage site is to be appropriately indicated through signs and monitored regularly to ensure contamination does not occur. A non-persistent herbicide can be applied two weeks prior to the excavation in order to further help eradicating Japanese Knotweed. All material collected during excavation can be disposed of either through deep burial, incineration or disposal to landfill. Deep burial involves placing all material at a depth of at least 5 m. This material is covered by a root barrier membrane before finally filling the site with topsoil or inert fill. This site is appropriately mapped and signalled to inform landowners/visitors of its location. As for incineration and disposal to landfill, excavated materials are transported off site to licensed waste management facilities or licensed incinerators. In order to ensure no material is lost during transportation to these facilities, the material can be placed in heavy duty waste bags and double bagged if necessary. It is good practice to inform the receiving facility in advance.

Chemical treatment alone can be effective, however labour intensive. In this case multiple applications of glyphosate or 2,4-D amine are recommended. These can be used in the form of foliar spray, however it is necessary to be aware that this method could affect non-target species. Stem injection and wiper applications can be more target-specific, but they are more labour intensive. The recommended period of treatment is from May to October, as these herbicides require living foliage to be absorbed and translocated to the rhizome. It is possible to use herbicides as foliar spray

Complete eradication of Japanese Knotweed is difficult and laborious. The roots of the plant can remain viable hidden in the soil for long periods, hence a periodic monitoring of the area affected is strongly recommended.

6.3 *Gunnera tinctoria*

English name Giant Rhubarb

Family Gunneraceae

Description Giant rhubarb is a large perennial plant easily identifiable thanks to the broad leaves that can grow 2 m tall and 1 m in diameter. Leaves are coarse textured and covered in small bristles, which are also found along the stem. Flowers are green and densely packed in a cone shaped inflorescence that emerges from the base between July and August. During winter leaves die back exposing the large overwintering buds and the rhizomes. Seeds are wind dispersed. Also spreads through root fragments.



Figure 7. *Gunnera tinctoria*

Status Established

Origin South America

Invasive status

Risk category High impact

Impact score 19

Source Kelly, J., O'Flynn, C., and Maguire, C. 2013. Risk analysis and prioritisation for invasive and non-native species in Ireland and Northern Ireland. A report prepared for the Northern Ireland Environment Agency and National Parks and Wildlife Service as part of Invasive Species Ireland.

Impact

Creates large stands that can exclude other local species. It can form monospecific stands, shading and displacing native plants and lowering the value of a habitat. It can also impede drainage and waterflow and limit access to an area.

Control and Management

The most effective management for Giant Rhubarb is chemical control. This involves the use of glyphosate, 2,4-D amine or triclopyr in the form of foliar spray or spot treatment. Note that glyphosate is the only herbicide that is allowed for use near water. The optimal season to carry out chemical treatment is the end of summer, from late August to early September. As the plant regenerates through root fragments regular follow up through the years is necessary as well as repeated applications. Physical control can also be suitable for young plants or small stands. Grubbing can be carried out before flowering in early spring, while cutting can be most effective around June. In most cases it is advisable to follow up physical treatment with herbicide application for better results.

6.4 *Heracleum mantegazzianum*

English name Giant hogweed

Family Apiaceae

Description impressive biennial plant characterised by large pinnately divided leaves that bear bristles on the underside. The plant itself can grow up to 5m in height, and it has hollow erect stems that can reach 10 cm in diameter. The stem presents characteristic red purple mottles throughout, while the pale flowers, which appear in June-July, are arranged in large umbels. The plant dies after flowering.

Status Established

Origin Caucasus mountains and Central Asia



Figure 8. *Heracleum mantegazzianum*

Invasive status

Risk category **High impact**

Impact score 19

Source Kelly, J., O'Flynn, C., and Maguire, C. 2013. Risk analysis and prioritisation for invasive and non-native species in Ireland and Northern Ireland. A report prepared for the Northern Ireland Environment Agency and National Parks and Wildlife Service as part of Invasive Species Ireland.

Impact

Creates large stands that can exclude other local species and it can contribute to soil erosion, compromising bank stability. It poses risk to public health and safety due to phototoxic sap and can limit recreational use of an area.

Control and Management

The most effective management for Giant Hogweed is a combination of chemical and physical control over several years. Hand cutting of the stems can be carried out in spring following rain, with stems cut at a 45 degree angle. The personnel tasked with the cutting must be wearing protective gear. It is important to note that the toxic sap contained in the cut plant material will remain active for several hours, hence any handling must be carried out with due diligence and care. Physical control by itself will not eradicate the plant, but will act as a temporary control measure. Cut material should be disposed of at a licenced landfill (Maguire et al., 2008). Once cut the stems can be injected with herbicides, usually glyphosate or 2,4 amine. However glyphosate is the recommended herbicide for use near water, where most of the giant hogweed grows. Chemical treatment has also proved to be effective on its own with repeated applications over a period of minimum five years (due to the viability of the seed bank). This can be done using glyphosate with long-lanced sprayers or as spot treatment with handheld equipment (Maguire et al., 2008). Chemical treatment should be performed during active growing season. Regular follow up is necessary in all cases.

6.5 *Impatiens glandulifera*

English name Himalayan balsam

Family Balsaminaceae

Description Annual herbaceous plant that can grow up to 1-2 m in height, forming monospecific stands. It has erect stems that are red near the flowerhead and green, brown near the base. Stems are hollow. Leaves emerge throughout the stems in whorls of 3 and they are lanceolate and toothed with a reddish midrib. Flowers emerge from July throughout the summer until October. Their colour varies from pale pink to purple, and they are trumpet shaped and sweetly scented.



Figure 9. *Impatiens glandulifera*

Status Established

Origin Himalayas

Invasive status

Risk category **High impact**

Impact score 18

Source Kelly, J., O'Flynn, C., and Maguire, C. 2013. Risk analysis and prioritisation for invasive and non-native species in Ireland and Northern Ireland. A report prepared for the Northern Ireland Environment Agency and National Parks and Wildlife Service as part of Invasive Species Ireland.

Impact

Creates large stands that can exclude other local species. Spreads rapidly along riparian environments, increases soil erosion, compromising bank stability. It increases sedimentation, alters water quality.

Control and Management

The most effective management for Himalayan Balsam is mechanical control, either hand pulling, cutting or mowing. Hand pulling is particularly effective for small stands, as the plant has inconspicuous roots that can be unearthed with little effort, and the plant can be discarded off site. Protective gloves are recommended to avoid injuries. This method can however be labour intensive for areas where the plant has spread considerably. In these cases, if the terrain allows it, cutting or strimming would be an efficient management method. When cutting it is important to make sure to cut below the first node of the plant. The drawback to this method is that other non-target species could be affected, hence this method would be best used in areas of low ecological value. Hand pulling should be carried out before seed pods emerge, ideally between May and June. Any plant with seed pods

should be avoided as Himalayan Balsam has an “explosive seed head”, and simply touching the plant could set off the explosive mechanism that propels the seeds from their pods, helping the spread of the plant. Cutting/ strimming should always be carried later in the season, right before the flowering, as cutting too early could promote better growth and better seed yield as the plant grows again. Once cut or pulled plants should be allowed to dry, never placed on damp soil as they could easily reroot. In both cases follow up will be necessary for the next three to four growing seasons. It is also good practice to monitor the sites more than once in one growing season: three visits are usually recommended, May/June, July/August, September/October.

6.6 *Leycesteria formosa*

English name Himalayan honeysuckle

Family Caprifoliaceae

Description Tall deciduous shrub that can grow up to 2 m in height, with bamboo-like hollow stems. Leaves are heart shaped, with a paler underside, and grow numerous around the branches. It flowers between July and September, with characteristic funnel shaped flowers. Flowers are white with burgundy bracts and are arranged in drooping spikes. They emit a sweet scent throughout the summer.



Figure 10. *Leycesteria formosa*

Status Established

Origin Himalayas

Invasive status

Risk category **Medium impact**

Impact score 14

Source Otto, M., 2022. *Species Profile Browser - Species Profile*. [online] Species.biodiversityireland.ie. Available at: <<https://species.biodiversityireland.ie/profile.php?taxonId=42928&taxonName=himalaya>>.

Impact

Creates large stands that can exclude other local species.

Control and Management

The most effective management for Himalayan Honeysuckle is manual control for young plants and a combination of manual and chemical for larger stands. Hand pulling works well with young plants. Plant material can be left onsite to rot. This type of control can be carried out all year round. For established plants it is necessary to implement chemical control after cutting it at the base. The stump can be painted with a solution of glyphosate or triclopyr, however triclopyr is not recommended for use near water. This combination of methods is effective all year round. If only using chemical control the plant can be sprayed with glyphosate during spring and summer.

Regular follow up is necessary for plants of flowering age in order to eradicate the seed bank over the years.

6.7 *Petasites fragrans*

English name Winter heliotrope

Family Asteraceae

Description Herbaceous perennial, easily recognizable thanks to its characteristic round leaves with lightly toothed margins. Leaves can be quite large (30-50 cm) and have a hairy underside. Flowers emerge in winter between December and March, and are arranged in tightly packed flower heads that arise from an erect stalk. Individual flowers are quite small and lightly pink coloured. It is said to smell like liquorice or vanilla. It only reproduces vegetatively through rhizomes that can be spread through trampling. Only male plants are present in Ireland.



Figure 11. *Petasites fragrans*

Status Established

Origin Italy, North Africa

Invasive status

Risk category Low impact

Impact score 12

Source National Biodiversity Data Centre, 2022. *Winter Heliotrope (Petasites fragrans) - Detail - Biodiversity Maps*. [online] Maps.biodiversityireland.ie. Available at: <<https://maps.biodiversityireland.ie/Species/43895>>.

Impact

Creates dense carpets that can exclude light to other native species.

Control and Management

The most effective management for Winter Heliotrope is chemical treatment with a solution of glyphosate. Spot treatment, wiper application and stem injection are effective, but time consuming. Foliar spray is also effective, but it has the disadvantage of potentially harming non target species and it is discouraged in sensitive areas. The optimal season for this type of treatments is after flowering in February to March, and in mid summer before the foliage dies back. This method requires follow up, as the rhizome system has the potential to generate a new plant. Physical control can also be employed, but it is necessary to excavate soil up to 30 cm in depth as all rhizomes should be removed. This can be carried out throughout the year on dry soil. This methods can be particularly efficient if paired with herbicide treatment. All plant material should be disposed of at a licensed landfill (Transport Infrastructure Ireland, 2020).

6.8 *Prunus laurocerasus*

English name Cherry laurel

Family Rosaceae

Description Upright evergreen shrub that can grow up to 8m in height. It has large glossy leaves, oblong in shape and leathery to the touch. It flowers between April and June. Its flowers are arranged in a raceme, and are small and white, with long stamens emerging from the centre.

Status Established

Origin Mediterranean countries and the Black sea



Figure 12. *Prunus laurocerasus*

Invasive status

Risk category **High impact**

Impact score 18

Source Kelly, J., O'Flynn, C., and Maguire, C. 2013. Risk analysis and prioritisation for invasive and non-native species in Ireland and Northern Ireland. A report prepared for the Northern Ireland Environment Agency and National Parks and Wildlife Service as part of Invasive Species Ireland.

Impact

Creates large stands that can exclude other local species. Contains cyanogenic glycosides and amygdalin, making it poisonous to many species. Cannot be controlled by grazing.

Control and Management

The most effective management for Cherry Laurel is manual and mechanical control. The plant should be cut by chainsaw or by flailing as close to the ground as possible, and the stump removed either manually or with a tractor depending on the level of infestation and location (Maguire, Kelly and Cosgrove, 2008). The material should not be left on site, but either discarded in a landfill or chipped. The soil should be brushed as to ensure no roots are present. This type of control can be carried out anytime throughout the year.

For more extensive infestations, or for locations where the stump removal is difficult, herbicides can be used on the stump. In these cases spot spraying the freshly cut stump with glyphosate or ammonium sulphide solutions is an effective solution. Alternatively, stem injection with glyphosate can also be carried out. Optimum treatment time for the use of glyphosate is during the winter months from November through to April. Ammonium sulphide can be used in the summer months from June through to September (Maguire et al., 2008). However, the use of ammonium sulphide is not recommended if the infested site is adjacent to a water body.

Regular follow up is necessary for plants of flowering age in order to eradicate the seed bank over the years.

7. RECOMMENDATIONS

Due to the level of infestation and the timing of the operation, urgent action is recommended to be focused on the removal of Himalayan Balsam. For this purpose an interim report was generated, illustrating the priority points in need of immediate action. These were decided based on three criteria: ease of access, hazard and time sensitivity. Figure 13 illustrates the areas reported in the interim report as urgent and the relative risk associated with their removal. The remaining areas can be tackled in following years, or possibly during this current year if not in flower. However, due to the invasiveness of the plant repeated action and monitoring will be necessary in the following years nonetheless.

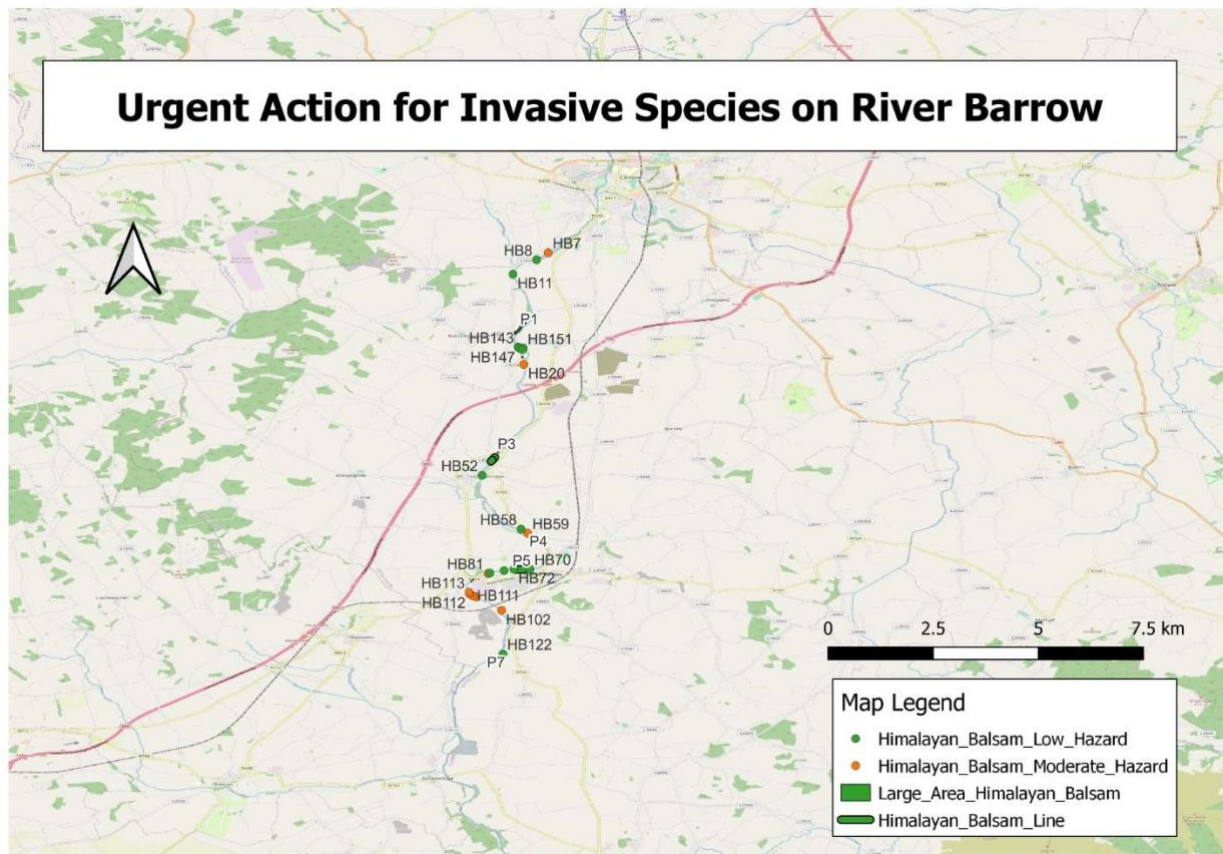


Figure 13. Map with priority action for the removal of Himalayan Balsam.

Himalayan Balsam is extensively present throughout the riparian zone of River Barrow and it occurs in locations that are sometimes challenging and hazardous to access. For this purpose the appropriate PPE is recommended as illustrated in Table 4. A boat will be necessary to access some of these areas, as represented in Figure 14. Further detailed maps with hazard levels are reported in Appendix I.



Figure 14. Map with invasive species on River Barrow organized for hazard associated with removal action

Table 4. PPE recommended for the removal of each Invasive Species identified on River Barrow.

Species name	Boat needed	Life jacket	Gloves	Visibility vest	Eye protection	Full coverage	Pesticide licence
<i>Azolla filiculoides</i>	High	x	x				
<i>Fallopia japonica</i>	Low		x	x	x		x
<i>Gunnera tinctoria</i>	Medium	x	x				x
<i>Heracleum mantegazzianum</i>	High	x	x		x	x	x
<i>Impatiens glandulifera</i>	See Appendix I and III	x	x	x			
<i>Leycesteria Formosa</i>	Low		x		x		
<i>Petasites fragrans</i>	Low		x	x	x		
<i>Prunus laurocerasus</i>	Low		x	x	x		

As for the remaining species, action is recommended to be prioritized for those Third Schedule List species such as:

Azolla filiculoides (Water Fern)

Fallopia japonica (Japanese Knotweed)

Gunnera tinctoria (Giant Rhubarb)

Heracleum mantegazzianum (Giant Hogweed)

With the exception of Japanese Knotweed, the removal of these species will require the use of a boat, as they are found on locations not accessible from the riverbanks. This will require permission from Waterways Ireland. Likewise, for any infestation which occurs on private land, it is necessary to obtain permission from the landowner.

Japanese knotweed and Giant Hogweed are likely to be the more labour intensive and challenging species to eliminate. For Japanese knotweed it is recommended to affix appropriate signage to warn passers-by not to interfere with the plant in the time before the removal is initiated. For both above mentioned species the acquisition of a licence for the application of glyphosate is mandated by S.I. No. 83/2003 European Communities (Authorization, Placing on The Market, Use and Control of Plant Protection Products) Regulations 2003. Chemical agents should be used as indicated on the product label.



Figure 15. Example of signage associated with Japanese Knotweed stands

Table 5. Action recommended of each Invasive Species identified on River Barrow..

Species name	Hazard	Prevention strategy recommended	Cost*
<i>Azolla filiculoides</i>	High	Physical removal using fine meshed net or rakes. Any time of the year.	€€
<i>Fallopia japonica</i>	Low	Combination. Digging and spraying. Rhizomes are dug during winter. The plant is then sprayed the following spring/summer season with glyphosate. Erect appropriate signage.	€€€
<i>Gunnera tinctoria</i>	Medium	Combination. Grubbing for young plants in early spring before flowering. Foliar spray with glyphosate for established plants in late August to early September.	€€
<i>Heracleum mantegazzianum</i>	High	Combination. Hand cutting and stem injection. Stems are cut in spring following rain. Stems are then injected with glyphosate.	€€€
<i>Impatiens glandulifera</i>	See Appendix I and III	Physical. Hand pulling in May/June before flowering. Use trimmers for large stands in June.	€/€€
<i>Leycesteria Formosa</i>	Low	Combination. Cut and paint. Cut of stump, which is then painted with glyphosate. Any time of the year.	€
<i>Petasites fragrans</i>	Low	Physical. Mowing and excavation of rhizomes up to 30 cm. Any time of the year.	€
<i>Prunus laurocerasus</i>	Low	Physical. Cutting and stump removal. Any time of the year.	€

*€: Can be done manually with essential PPE; €€: requires boat and/or special equipment; €€€: requires specialized personnel and special equipment.

In most cases a combination of physical and chemical treatment should be successful in managing the remaining invasive species identified on River Barrow. A summary of actions recommended is reported in the table above.

Note that in order to successfully and completely eradicate the invasive species on River Barrow regular follow up and continuous monitoring should be implemented over the following years, as seed banks of many of these species can persist for years.

REFERENCES

Baars, J-R. and Caffrey, J.M. (2008). Invasive Species Ireland, Case Study 4, Water fern, *Azolla filiculoides* – Under biological control in Ireland. Report prepared for Invasive Species Ireland.

EPA, n.d.. Epa river quality surveys: biological. Hydrometric Area 14.

EU No 1143/2014: Available at: <https://eur-lex.europa.eu/legalcontent/EN/TXT/?uri=celex%3A32014R1143>

Hill, M. and McConnachie, A., 2009. *Azolla filiculoides* Lamarck (Azollaceae). *Biological Control of Tropical Weeds Using Arthropods*, pp.74-87.).

Invasive Species of Ireland, n.d. [online] invasivespeciesireland.com. Available at: <<http://invasivespeciesireland.com/wp-content/uploads/wp-post-to-pdf-enhanced-cache/1/thirdschedule-part-1-plants.pdf>>.

Invasives, n.d. *Catalogue of Ireland's Non-native Species*. [online] invasives.ie. Available at: <<https://invasives.ie/about/catalogue/>>.

Kelly, J., O'Flynn, C., and Maguire, C. 2013. Risk analysis and prioritisation for invasive and non-native species in Ireland and Northern Ireland. A report prepared for the Northern Ireland Environment Agency and National Parks and Wildlife Service as part of Invasive Species Ireland.

Maguire, C.M., Kelly, J. and Cosgrove, P.J. (2008). Best Practice Management Guidelines *Rhododendron ponticum* and *Cherry Laurel Prunus laurocerasus*. Prepared for NIEA and NPWS as part of Invasive Species Ireland.

Maguire, C.M., Cosgrove, P.J. and Kelly, J. (2008). *Giant Hogweed (Heracleum mantegazzianum) Management Plan*. Prepared for NIEA and NPWS as part of Invasive Species Ireland.

NPWS, 2011. River Barrow and River Nore SAC (002162): Conservation objectives supporting document - woodland habitats [Version 1].

NPWS, 2011. River Barrow and River Nore SAC (002162): Conservation objectives.

NPWS, 2011. River Barrow and River Nore SAC (002162): Site synopsis.

O'Flynn, C., Kelly, J. and Lysaght, L. (2014). Ireland's invasive and non-native species – trends in introductions. National Biodiversity Data Centre Series No. 2. Ireland

S.I. No. 83 of 2003. Available at: https://www.pcs.agriculture.gov.ie/media/pesticides/content/archive/SI_83.pdf

S.I. No. 477 of 2011. Available at: <https://www.irishstatutebook.ie/eli/2011/si/477/made/en/pdf>

Stokes, K., O'Neill, K. & McDonald, R.A. (2004) Invasive species in Ireland. Unpublished report to Environment & Heritage Service and National Parks & Wildlife Service. Quercus, Queens University Belfast, Belfast.

Transport Infrastructure Ireland, 2020. [online] Tiipublications.ie. Available at: <<https://www.tii.ie/>> O'Flynn, C., Kelly, J. and Lysaght, L. (2014). Ireland's invasive and non-native species – trends in introductions. National Biodiversity Data Centre Series No. 2. Ireland

Waste Management Acts, 1996. Available at:
<https://www.irishstatutebook.ie/eli/1996/act/10/enacted/en/html>

Appendix I

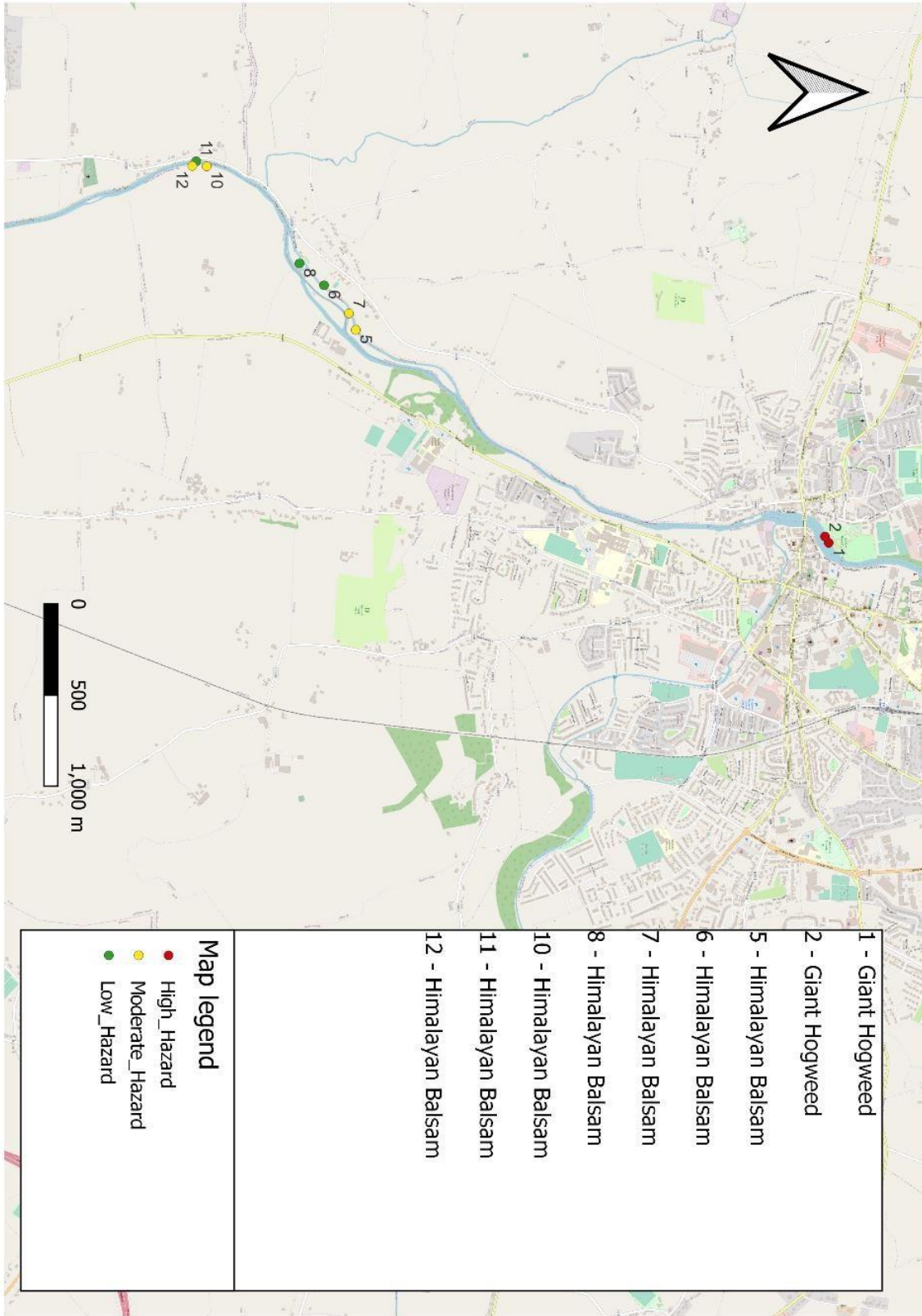


Figure 16. Section 1 detail.

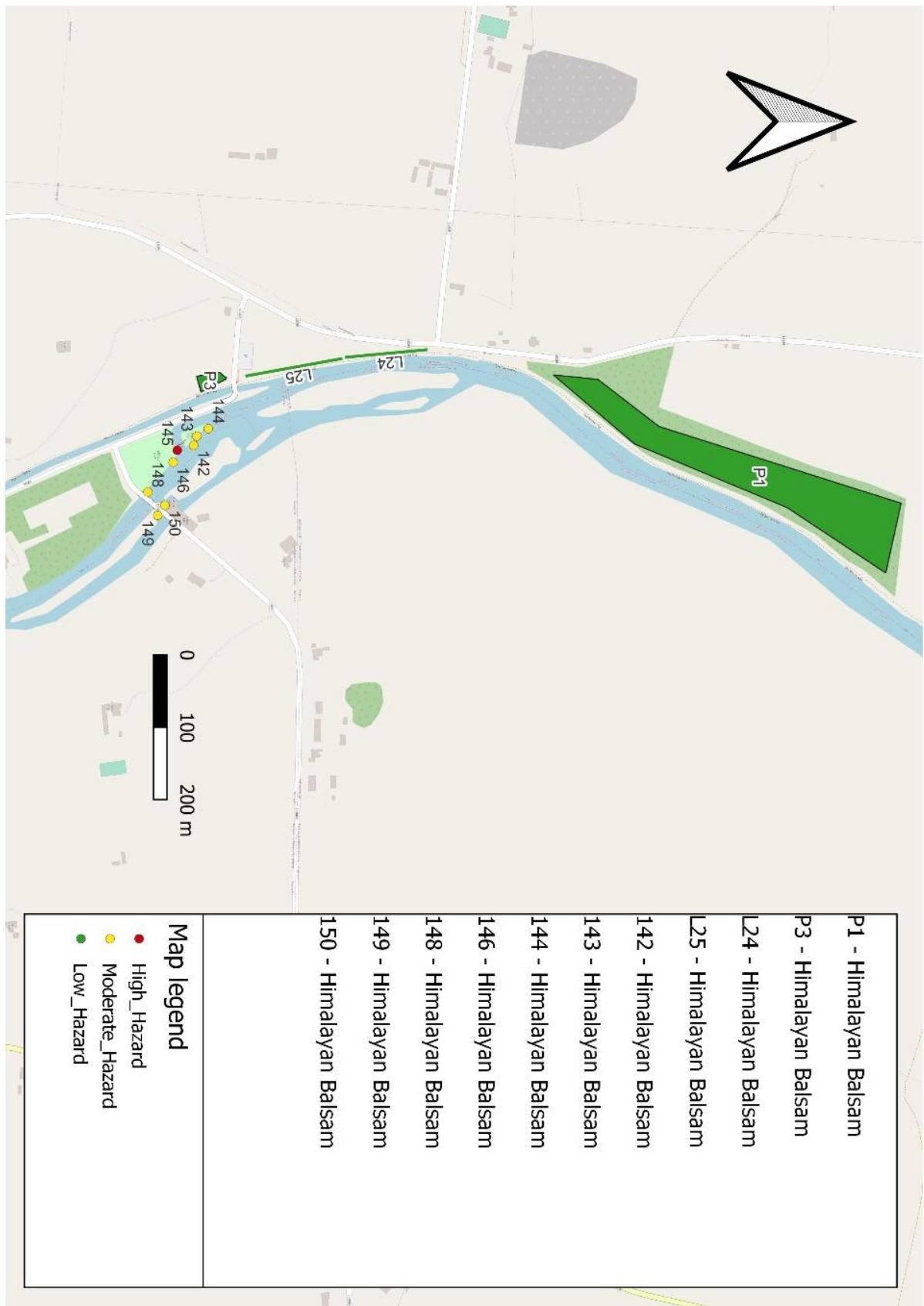


Figure 17. Section 2 detail

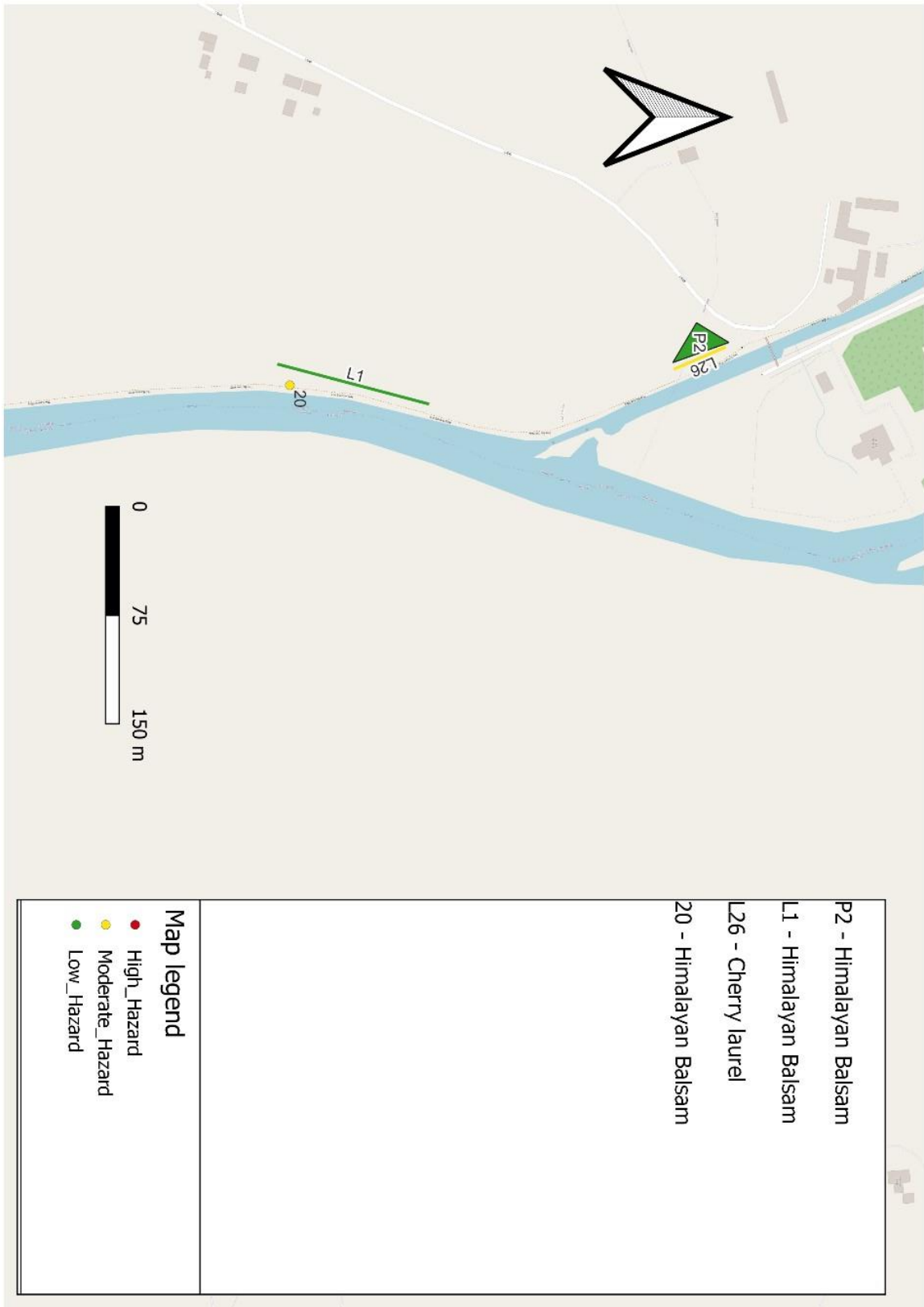


Figure 18. Section 3 detail



Figure 19. Section 4 detail

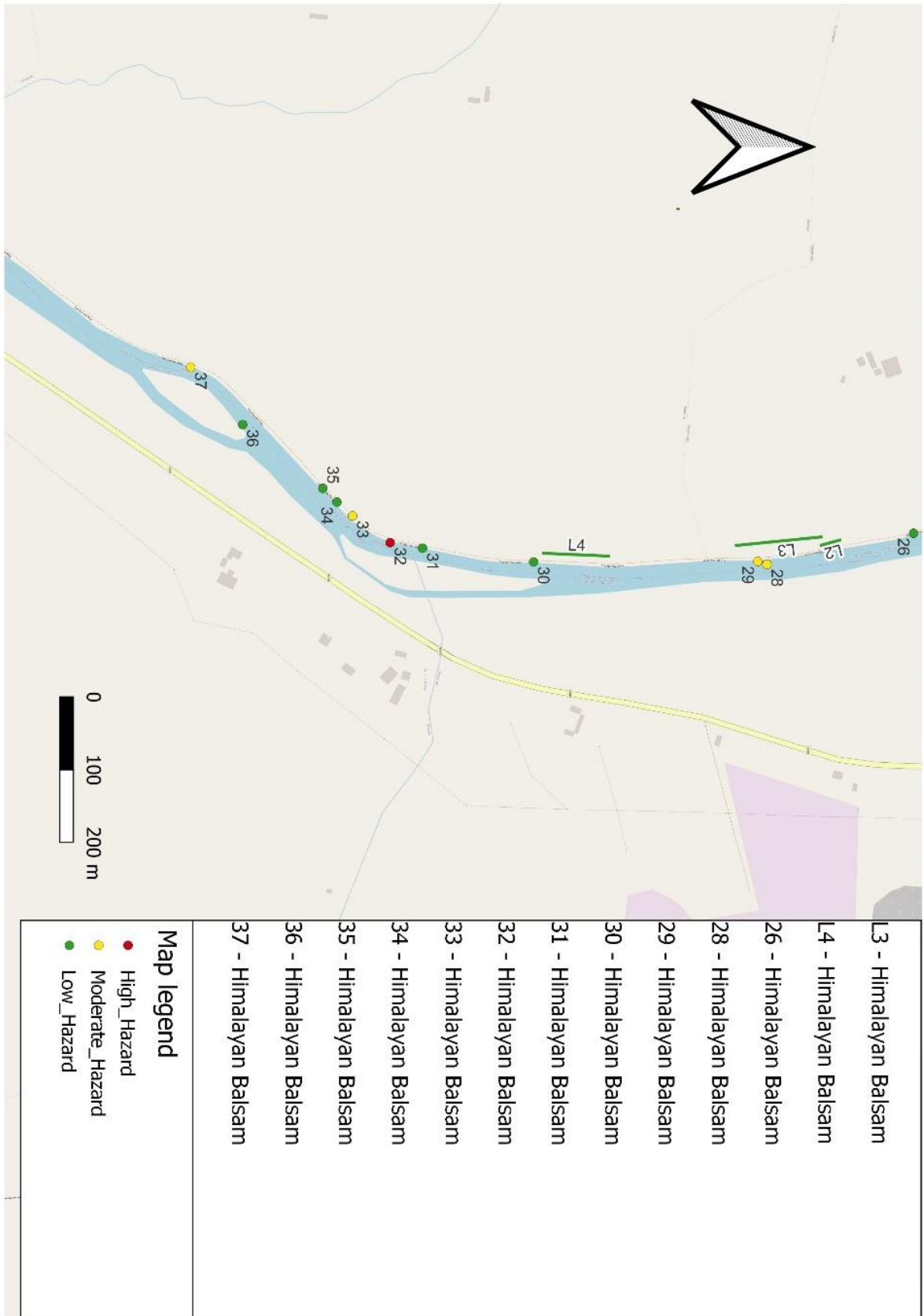


Figure 20. Section 5 detail

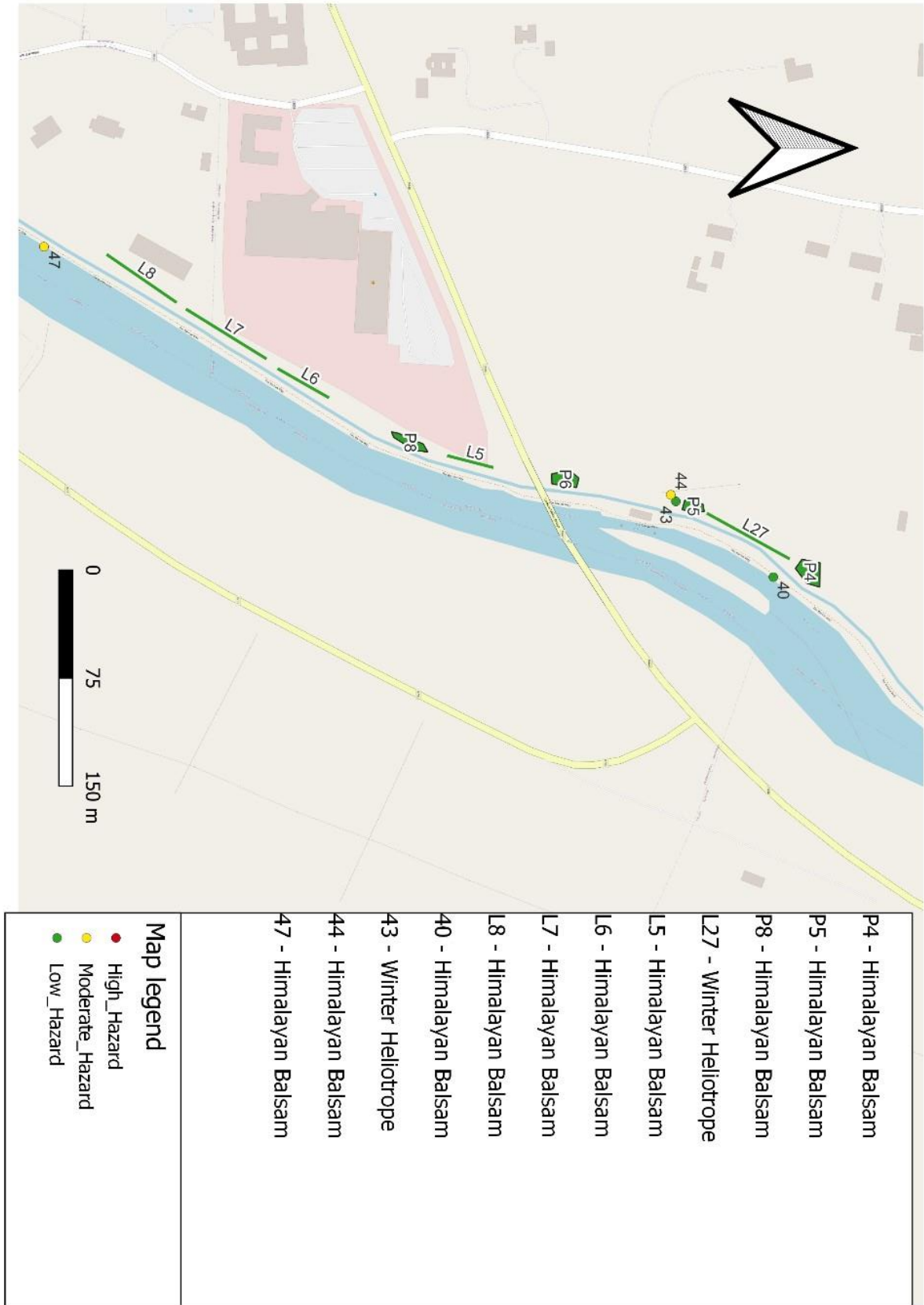


Figure 21. Section 6 detail



Figure 22. Section 7 detail

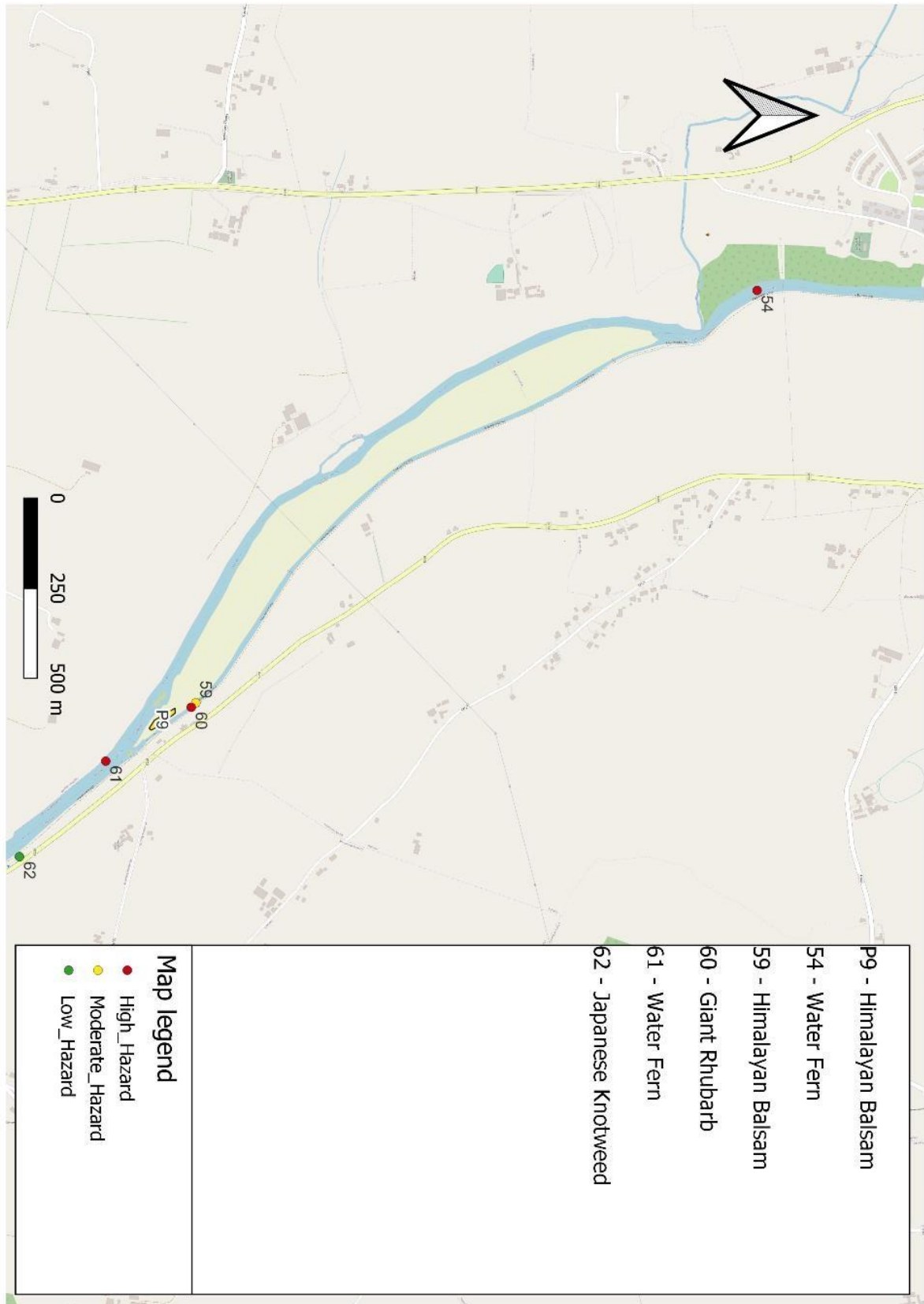


Figure 23. Section 8 detail

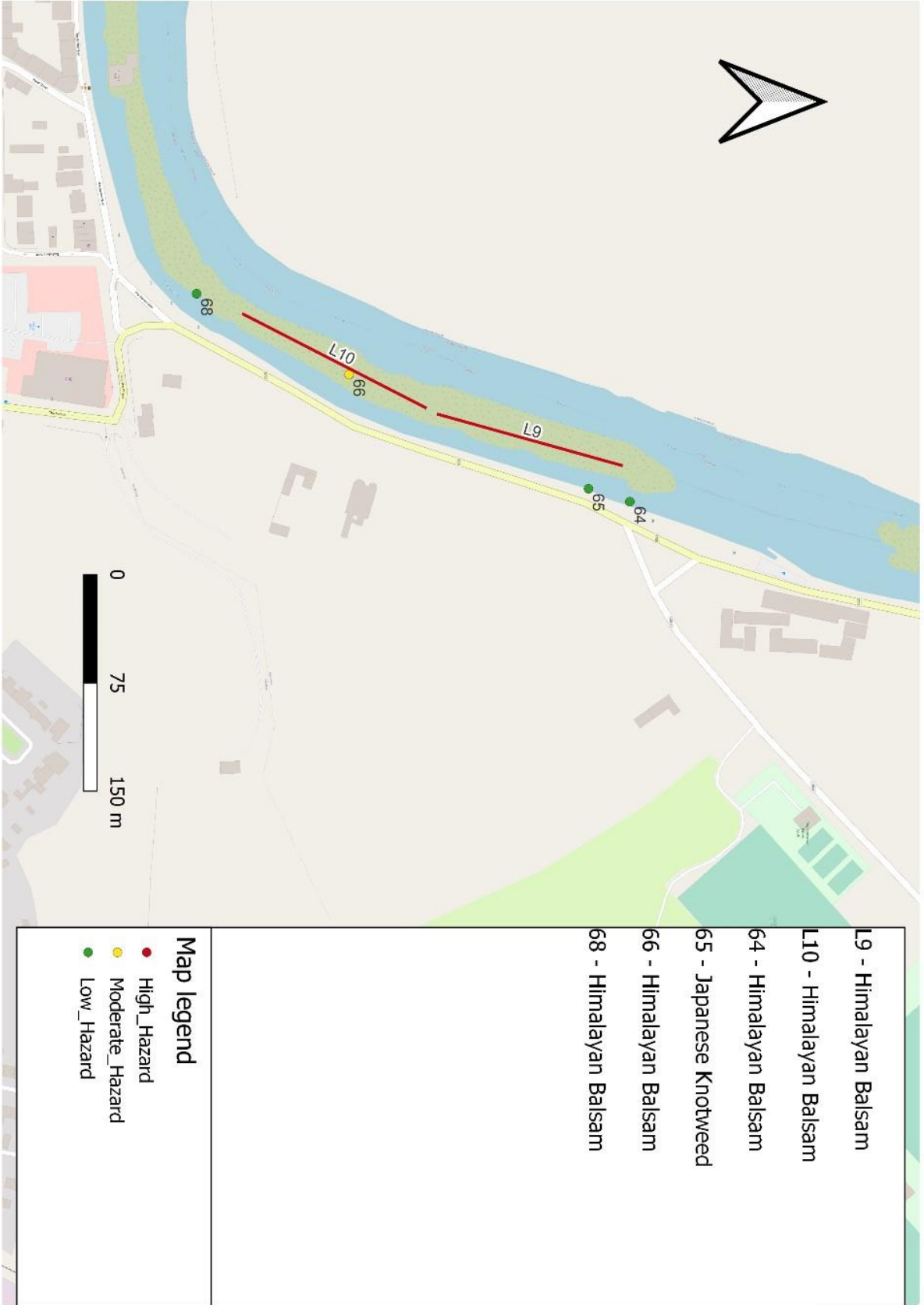


Figure 24. Section 9 detail

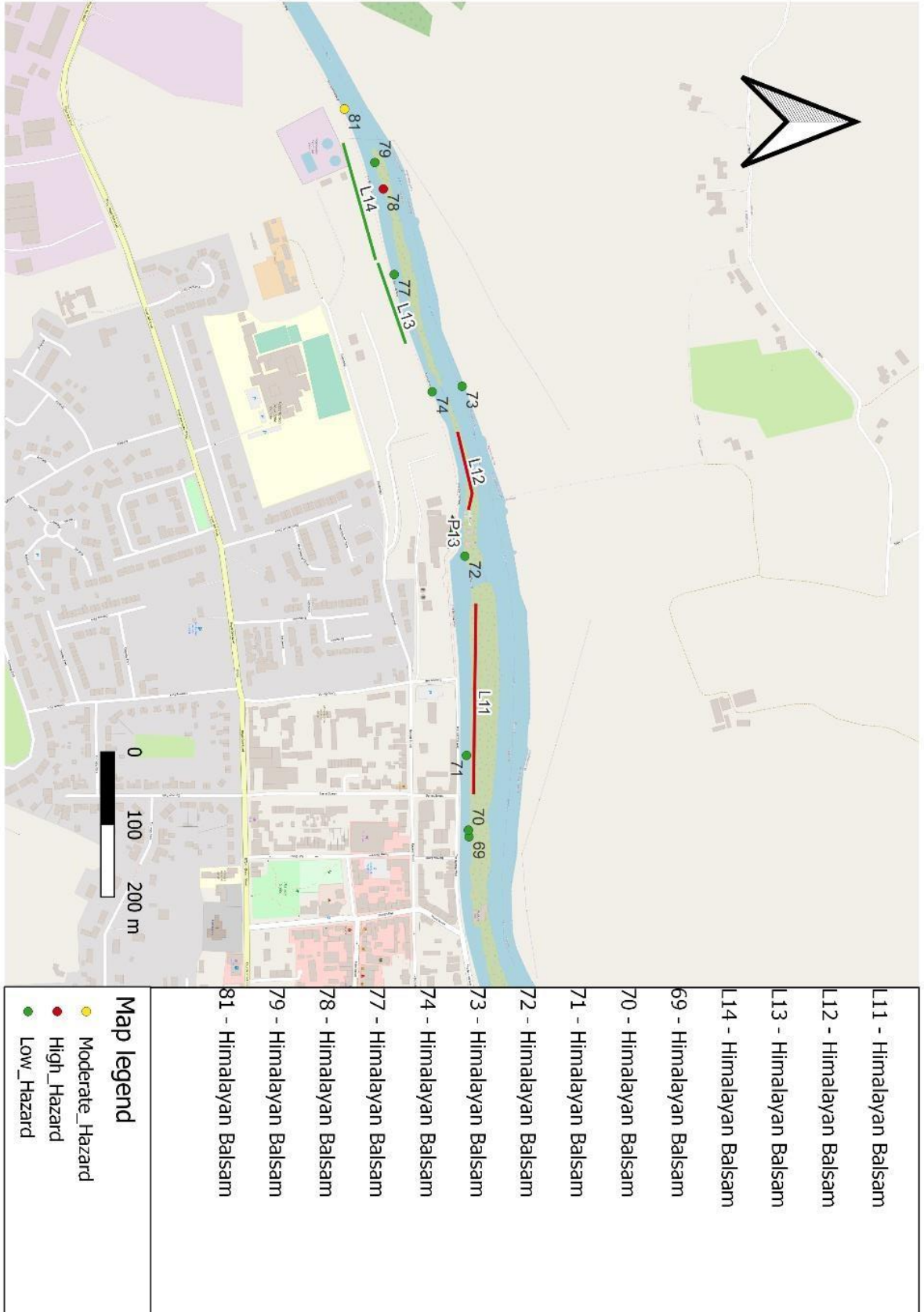


Figure 25. Section 10 detail

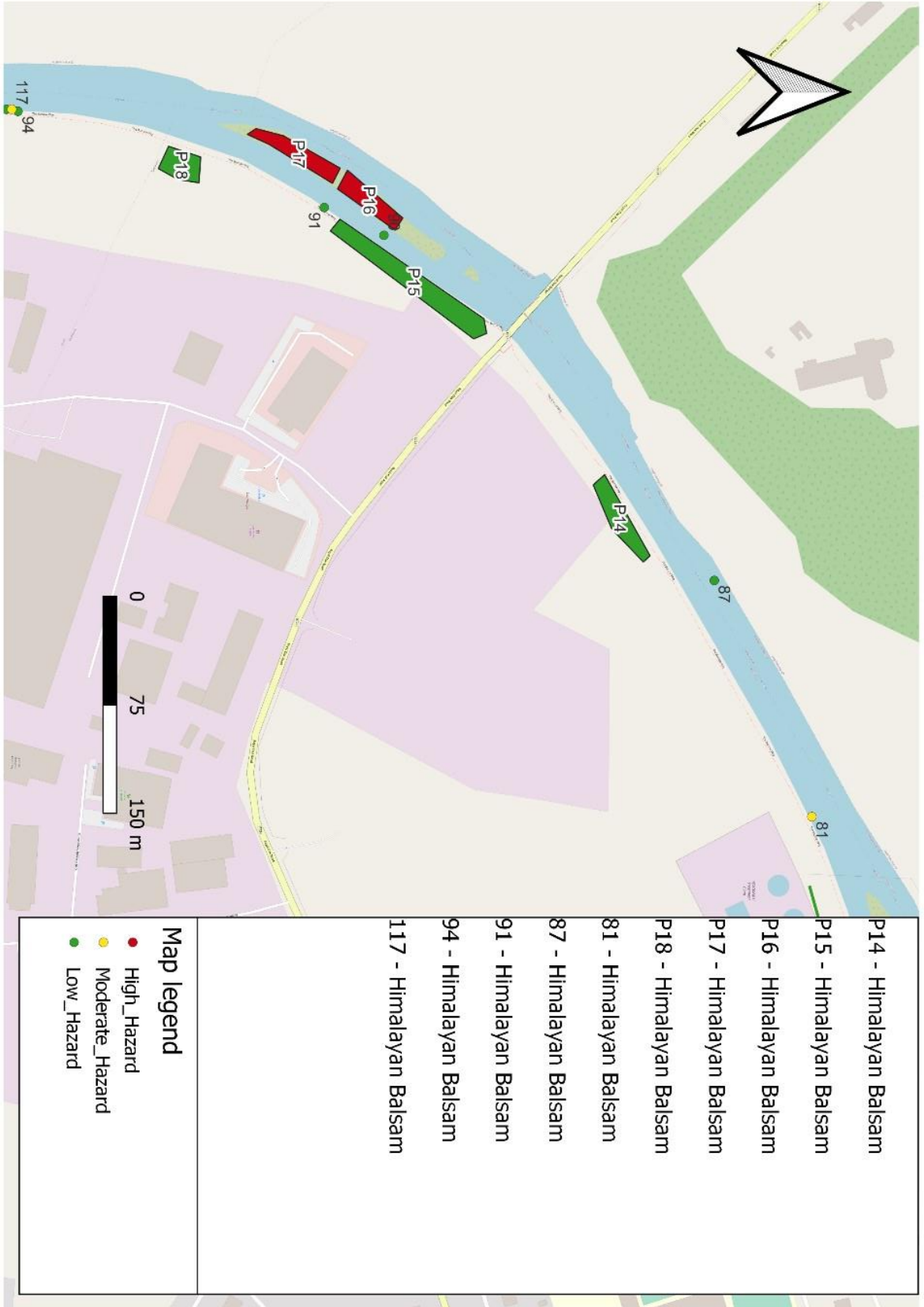


Figure 26. Section 11 detail

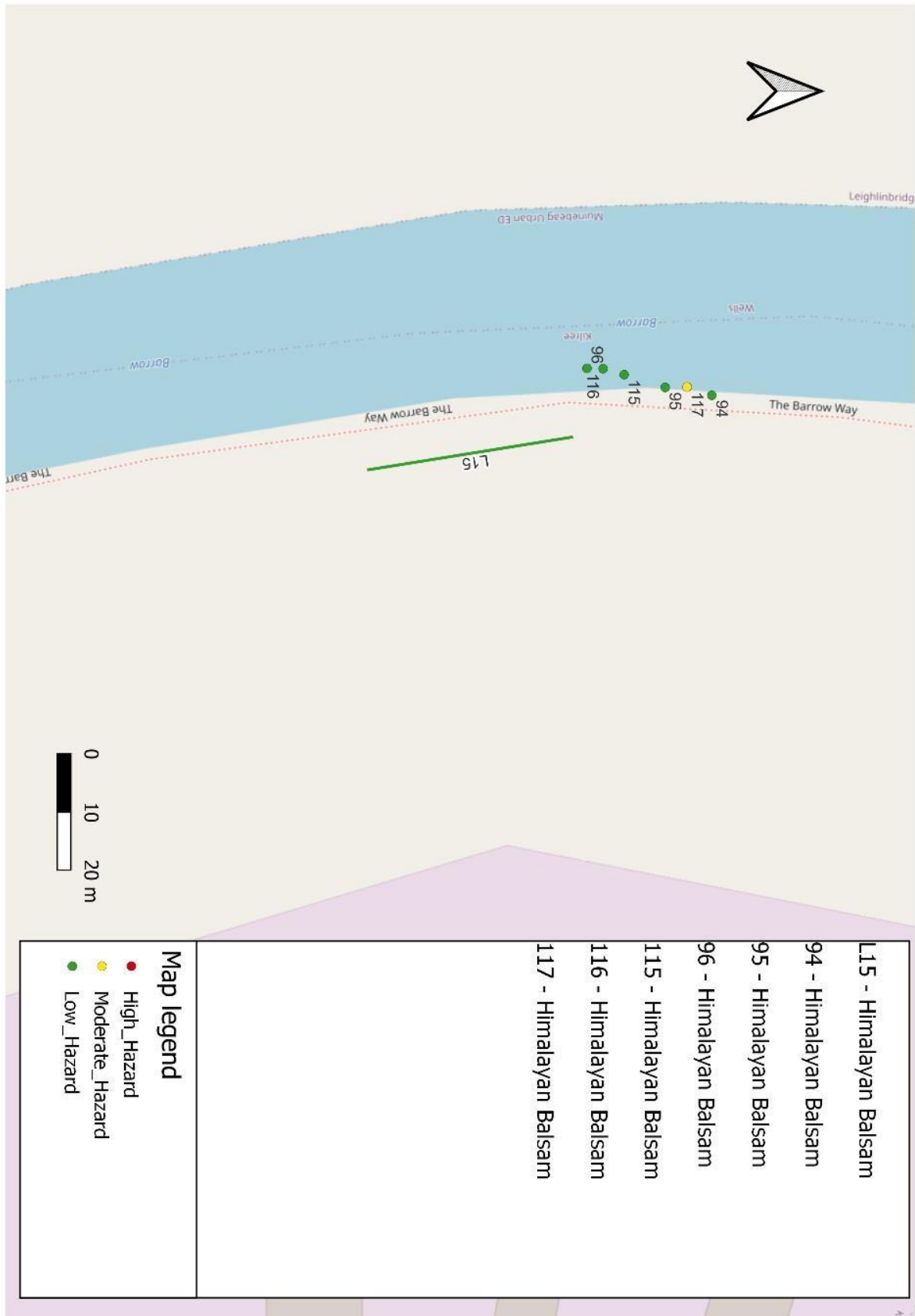


Figure 27. Section 12 detail

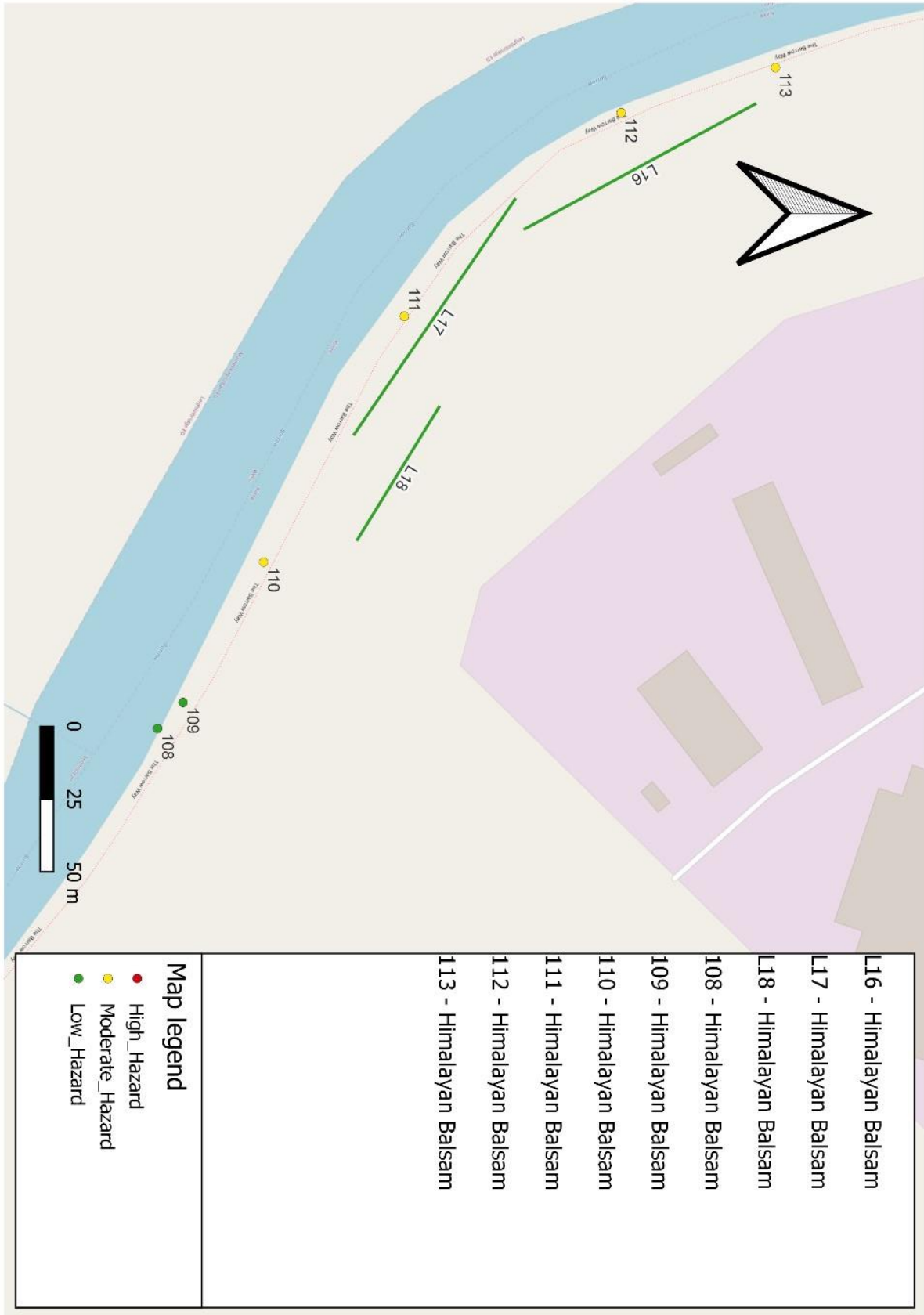


Figure 28. Section 13 detail

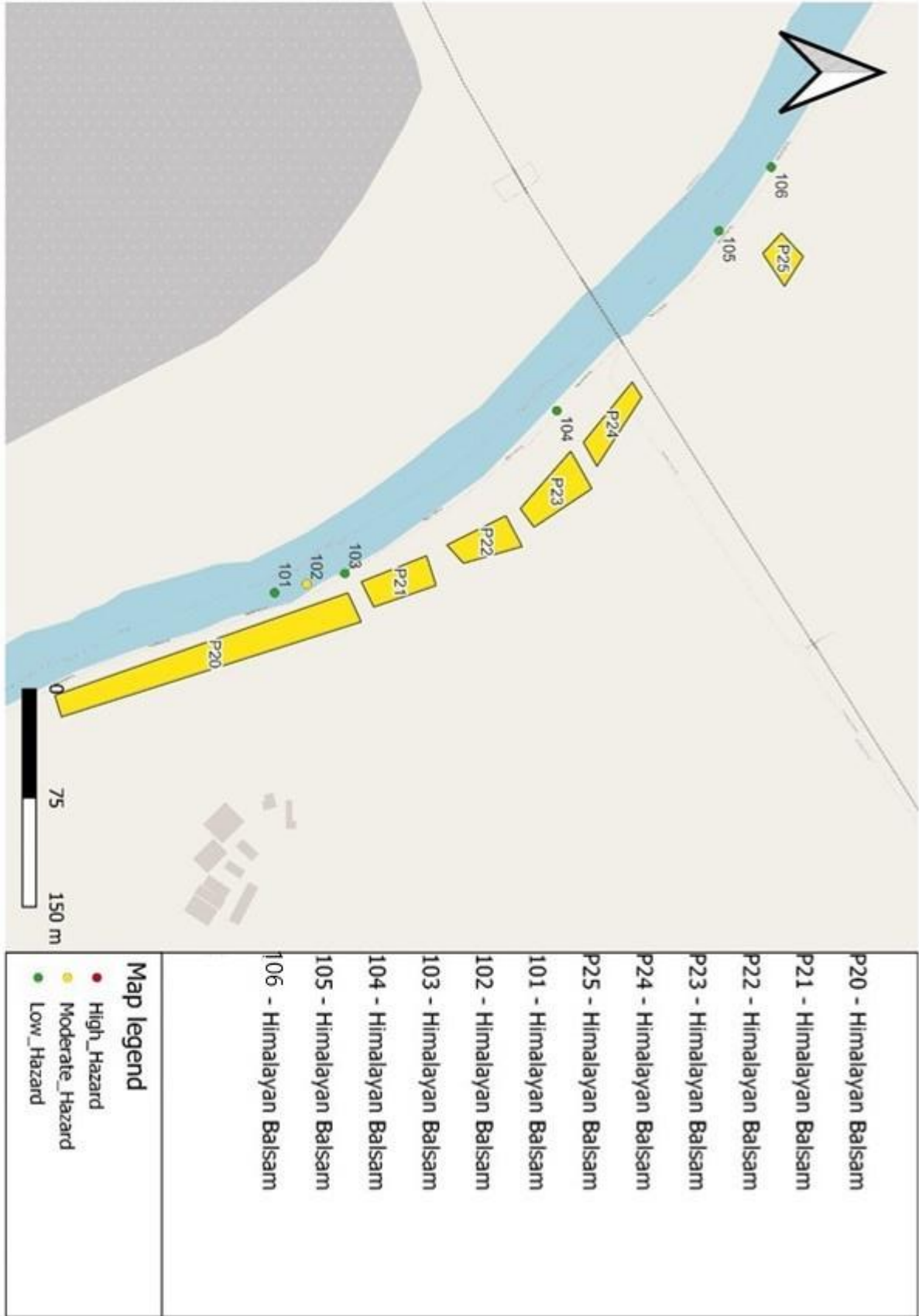


Figure 29. Section 14 detail

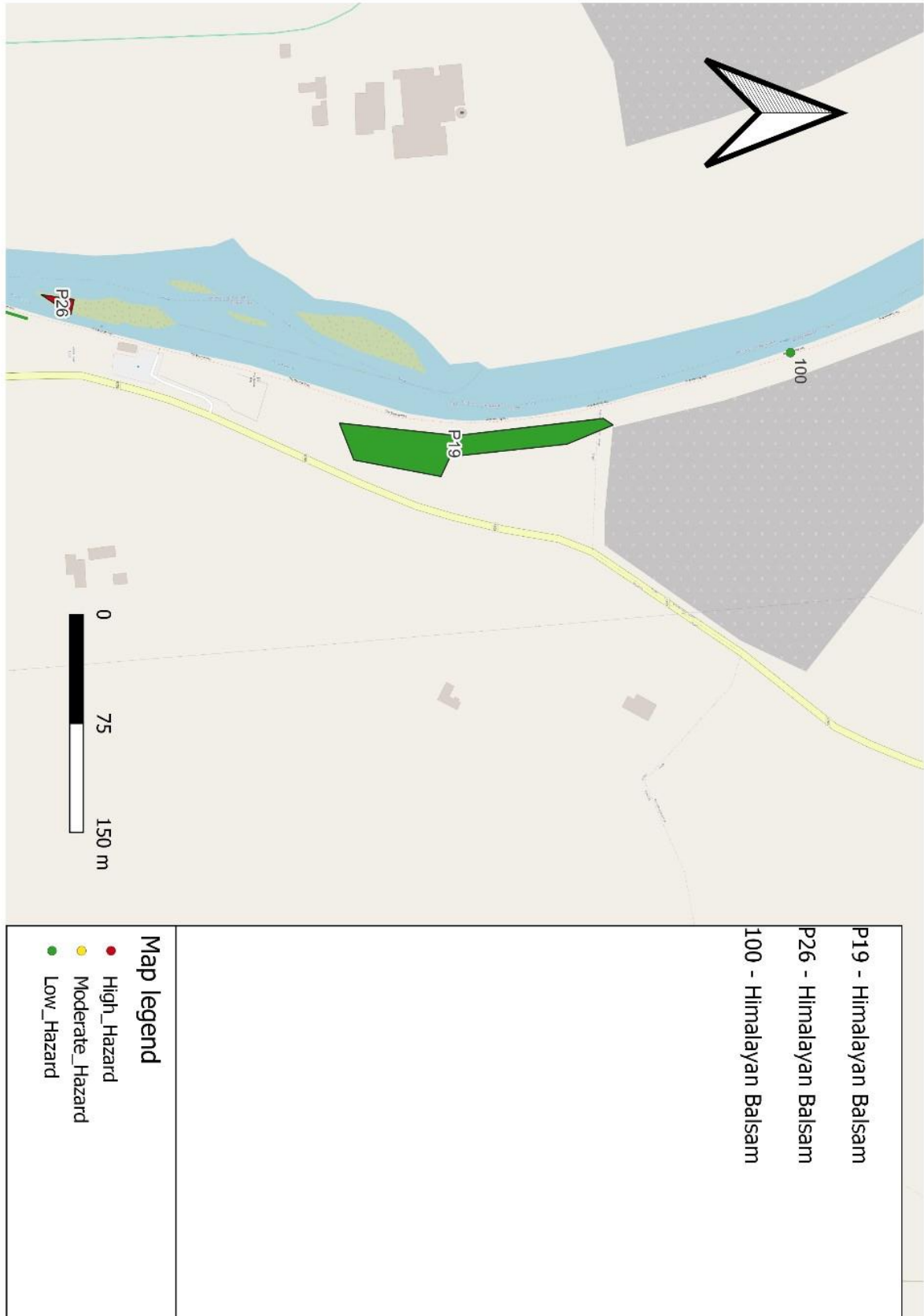


Figure 30. Section 15 detail

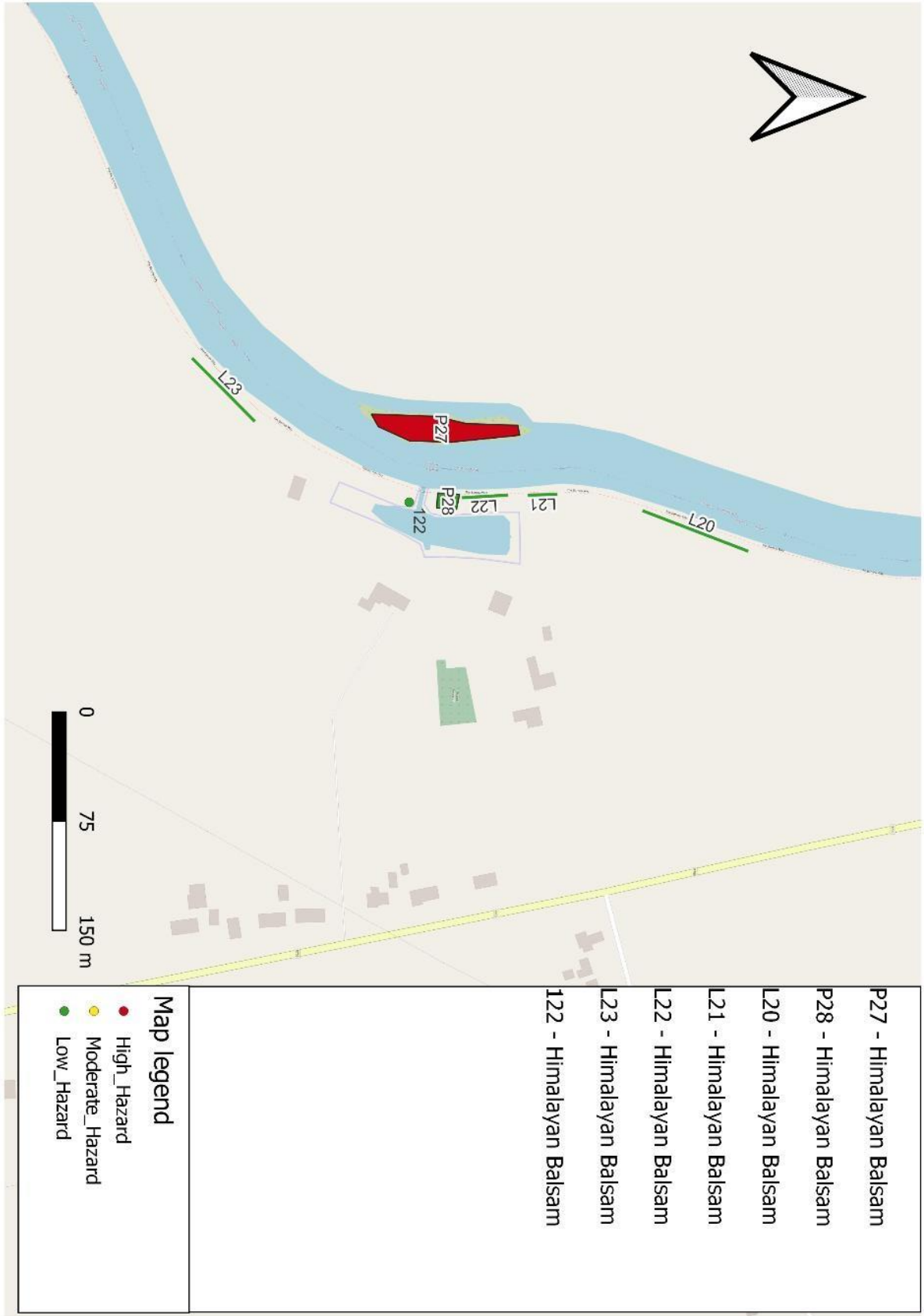


Figure 31. Section 16 detail

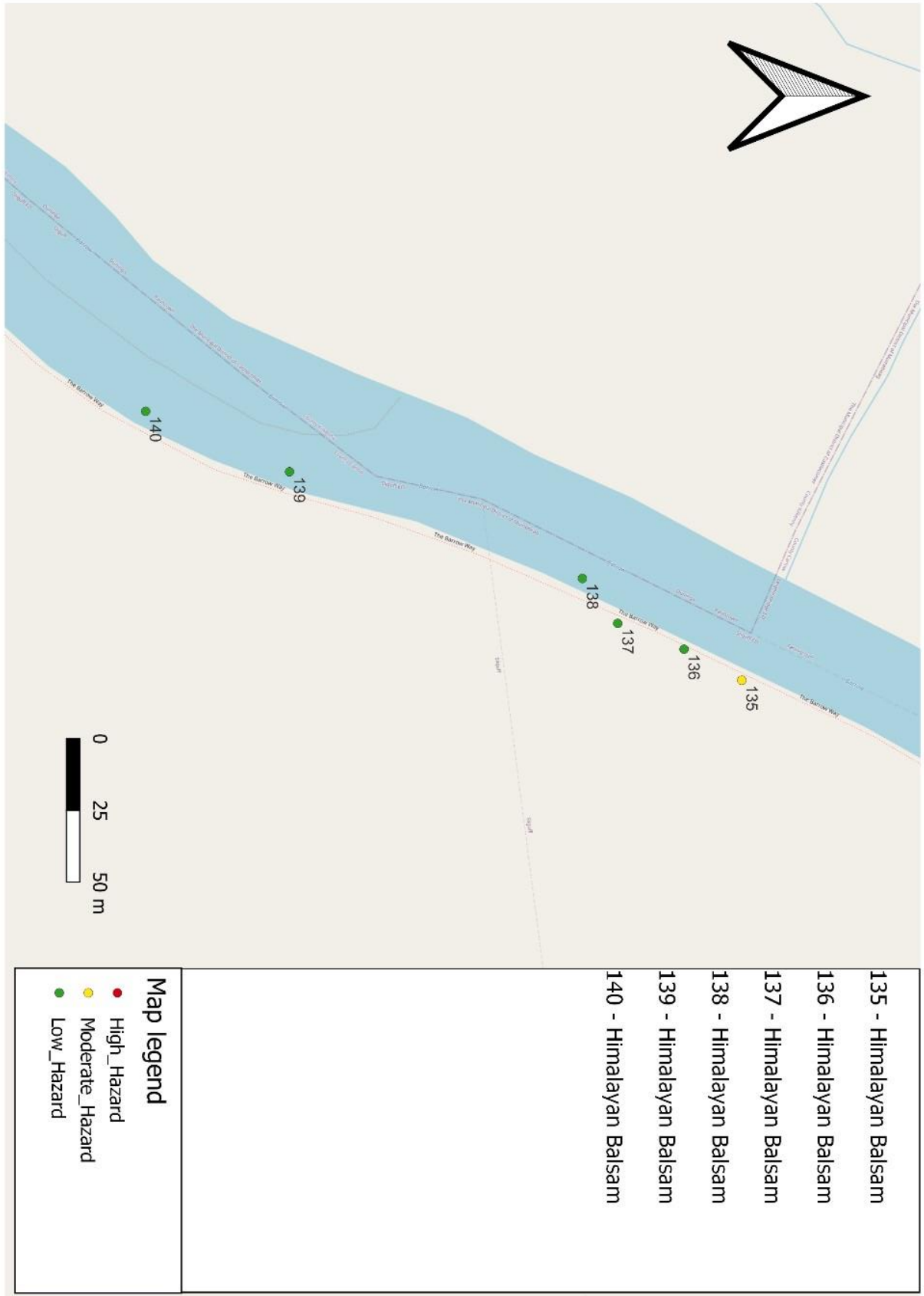


Figure 32. Section 17 detail

Appendix II

Third Schedule: Part 1 Plants

Non-native species subject to restrictions under Regulations 49 and 50

First column Common name	Second column Scientific name	Third column Geographical application
American skunk-cabbage	<i>Lysichiton americanus</i>	Throughout the State
A red alga	<i>Grateloupia doryphora</i>	Throughout the State
Brazilian giant-rhubarb	<i>Gunnera manicata</i>	Throughout the State
Broad-leaved rush	<i>Juncus planifolius</i>	Throughout the State
Cape pondweed	<i>Aponogeton distachyos</i>	Throughout the State
Cord-grasses	<i>Spartina</i> (all species and hybrids)	Throughout the State
Curly waterweed	<i>Lagarosiphon major</i>	Throughout the State
Dwarf eel-grass	<i>Zostera japonica</i>	Throughout the State
Fanwort	<i>Cabomba caroliniana</i>	Throughout the State
Floating pennywort	<i>Hydrocotyle ranunculoides</i>	Throughout the State
Fringed water-lily	<i>Nymphoides peltata</i>	Throughout the State
Giant hogweed	<i>Heracleum mantegazzianum</i>	Throughout the State
Giant knotweed	<i>Fallopia sachalinensis</i>	Throughout the State
Giant-rhubarb	<i>Gunnera tinctoria</i>	Throughout the State
Giant salvinia	<i>Salvinia molesta</i>	Throughout the State
Himalayan balsam	<i>Impatiens glandulifera</i>	Throughout the State
Himalayan knotweed	<i>Persicaria wallichii</i>	Throughout the State
Hottentot-fig	<i>Carpobrotus edulis</i>	Throughout the State
Japanese knotweed	<i>Fallopia japonica</i>	Throughout the State
Large-flowered waterweed	<i>Egeria densa</i>	Throughout the State
Mile-a-minute weed	<i>Persicaria perfoliata</i>	Throughout the State
New Zealand pigmyweed	<i>Crassula helmsii</i>	Throughout the State
Parrot's feather	<i>Myriophyllum aquaticum</i>	Throughout the State
Rhododendron	<i>Rhododendron ponticum</i>	Throughout the State
Salmonberry	<i>Rubus spectabilis</i>	Throughout the State
Sea-buckthorn	<i>Hippophae rhamnoides</i>	Throughout the State
Spanish bluebell	<i>Hyacinthoides hispanica</i>	Throughout the State
Three-cornered leek	<i>Allium triquetrum</i>	Throughout the State
Wakame	<i>Undaria pinnatifida</i>	Throughout the State
Water chestnut	<i>Trapa natans</i>	Throughout the State
Water fern	<i>Azolla filiculoides</i>	Throughout the State
Water lettuce	<i>Pistia stratiotes</i>	Throughout the State
Water-primrose	<i>Ludwigia</i> (all species)	Throughout the State
Waterweeds	<i>Elodea</i> (all species)	Throughout the State

Figure 33. Invasive Plants listed in the Third schedule and subjected to regulation 49 and 50 of S.I. No. 477 of 2011 (Invasive Species Ireland, n.d.).

Appendix III

Section 1 (Fig 16)

name	Species	Latitude	Longitude
WPT 1	Giant Hogweed	52.837828	-6.935998
WPT 2	Giant Hogweed	52.837733	-6.935991
WPT 5	Himalayan Balsam	52.814439	-6.953534
WPT 6	Himalayan Balsam	52.812958	-6.957098
WPT 7	Himalayan Balsam	52.814259	-6.954944
WPT 8	Himalayan Balsam	52.811956	-6.958755
WPT 10	Himalayan Balsam	52.807417	-6.966604
WPT 11	Himalayan Balsam	52.806543	-6.967313
WPT 12	Himalayan Balsam	52.806030	-6.966463

Section 2 (Fig 17)

name	Species	Latitude	Longitude
P1	Himalayan Balsam	52.788143	-6.964168
P3	Himalayan Balsam	52.781425	-6.966307
L24	Himalayan Balsam	52.7837557	-6.9668524
L25	Himalayan Balsam	52.7823921	-6.9665725
WPT 142	Himalayan Balsam	52.7811643	-6.9649881
WPT 143	Himalayan Balsam	52.7811835	-6.9652038
WPT 144	Himalayan Balsam	52.7813247	-6.9653382
WPT 145	Himalayan Balsam	52.7809996	-6.9649032
WPT 146	Himalayan Balsam	52.7810017	-6.9647370
WPT 148	Himalayan Balsam	52.7806167	-6.9640615
WPT 149	Himalayan Balsam	52.7809461	-6.9634037
WPT 150	Himalayan Balsam	52.7810210	-6.9634992

Section 3 (Fig 18)

name	Species	Latitude	Longitude
P2		52.7777844	-6.9636973
L1	Himalayan Balsam	52.7756365	-6.9632587
L26	Cherry Laurel	52.7777031	-6.9634709
WPT 20		52.7752557	-6.9632941

Section 4 (Fig 19)

name	Species	Latitude	Longitude
L2	Himalayan Balsam	52.7606261	-6.9603729
L3	Himalayan Balsam	52.7603565	-6.9604578
L4	Himalayan Balsam	52.7574458	-6.9601430
WPT 22	Himalayan Balsam	52.7669690	-6.9652215
WPT 23	Himalayan Balsam	52.7667208	-6.9649244
WPT 24	Himalayan Balsam	52.762120	-6.960737

WPT 25	Himalayan Balsam	52.761469	-6.960539
WPT 26	Himalayan Balsam	52.761093	-6.960398
WPT 28	Himalayan Balsam	52.7598814	-6.9601006
WPT 29	Himalayan Balsam	52.7595988	-6.9600582

Section 5 (Fig 20)

name	Species	Latitude	Longitude
L3	Himalayan Balsam	52.7603565	-6.9604578
L4	Himalayan Balsam	52.7574458	-6.9601430
WPT 26	Himalayan Balsam	52.761093	-6.960398
WPT 28	Himalayan Balsam	52.7598814	-6.9601006
WPT 29	Himalayan Balsam	52.7595988	-6.9600582
WPT 30	Himalayan Balsam	52.7570948	-6.9596904
WPT 31	Himalayan Balsam	52.7554852	-6.9604401
WPT 32	Himalayan Balsam	52.7551043	-6.9604189
WPT 33	Himalayan Balsam	52.7548303	-6.9608221
WPT 34	Himalayan Balsam	52.7546462	-6.9610201
WPT 35	Himalayan Balsam	52.7545991	-6.9611828
WPT 36	Himalayan Balsam	52.7534176	-6.9626611
WPT 37	Himalayan Balsam	52.7526941	-6.9640544

Section 6 (Fig 21)

name	Species	Latitude	Longitude
P4	Himalayan Balsam	52.7457825	-6.9714914
P5	Himalayan Balsam	52.7456453	-6.9713604
P6	Himalayan Balsam	52.7442837	-6.9724088
P8	Himalayan Balsam	52.7433660	-6.9727559
L27	Winter Heliotrope	52.7454009	-6.9718669
L5	Himalayan Balsam	52.7436576	-6.9725770
L6	Himalayan Balsam	52.7426230	-6.9734289
L7	Himalayan Balsam	52.7421942	-6.9738752
L8	Himalayan Balsam	52.7416945	-6.9744844
WPT 40	Himalayan Balsam	52.7456453	-6.9713604
WPT 43	Winter Heliotrope	52.7449532	-6.9721935
WPT 44	Himalayan Balsam	52.7449399	-6.9722122
WPT 47	Himalayan Balsam	52.7411316	-6.9747403

Section 7 (Fig 22)

name	Species	Latitude	Longitude
L28	Winter Heliotrope	52.7386544	-6.9773836
WPT 48	Himalayan Balsam	52.7391940	-6.9761529
WPT 49	Himalayan Balsam	52.7384617	-6.9773447
WPT 50	Winter Heliotrope	52.7377358	-6.9781369
WPT 52	Himalayan Balsam	52.7363226	-6.9778328
WPT 53	Water Fern	52.7355645	-6.9785118

WPT 152	Himalayan Honeysuckle	52.7388128	-6.9772563
----------------	-----------------------	------------	------------

Section 8 (Fig 23)

name	Species	Latitude	Longitude
P9	Himalayan Balsam	52.715033	-6.960992
WPT 54	Water Fern	52.729770	-6.978745
WPT 59	Himalayan Balsam	52.715813	-6.961742
WPT 60	Giant Rhubarb	52.715744	-6.961770
WPT 61	Water Fern	52.713842	-6.959987
WPT 62	Japanese Knotweed	52.711605	-6.955503

Section 9 (Fig 24)

name	Species	Latitude	Longitude
L9	Himalayan Balsam	52.706385	-6.955390
L10	Himalayan Balsam	52.704800	-6.956507
WPT 64	Himalayan Balsam	52.7067303	-6.9549196
WPT 65	Japanese Knotweed	52.7064689	-6.9550151
WPT 66	Himalayan Balsam	52.7049946	-6.9562069
WPT 68	Himalayan Balsam	52.7040903	-6.9570344

Section 10 (Fig 25)

name	Species	Latitude	Longitude
L1	Himalayan Balsam	52.703512	-6.963938,
L12	Himalayan Balsam	52.703469	-6.968111
L13	Himalayan Balsam	52.7024917	-6.9718101
L14	Himalayan Balsam	52.7020588	-6.9740734
P13	Himalayan Balsam	52.7032717	-6.9670888
WPT 69	Himalayan Balsam	52.7034517	-6.9612570
WPT 70	Himalayan Balsam	52.7034474	-6.9609458
WPT 71	Himalayan Balsam	52.7034646	-6.9623180,
WPT 72	Himalayan Balsam	52.7034474	-6.9665229
WPT 73	Himalayan Balsam	52.7033639	-6.9702787
WPT 74	Himalayan Balsam	52.7030274	-6.9698826
WPT 77	Himalayan Balsam	52.7024510	-6.9725457
WPT 78	Himalayan Balsam	52.7024006	-6.9741530
WPT 79	Himalayan Balsam	52.7022688	-6.9748020
WPT 81	Himalayan Balsam	52.7019559	-6.9753784

Section 11 (Fig 26)

name	Species	Latitude	Longitude
P14	Himalayan Balsam	52.7006648	-6.9789238
P15	Himalayan Balsam	52.6994244	-6.9812270
P16	Himalayan Balsam	52.6990802	-6.9821266
P17	Himalayan Balsam	52.6987480	-6.9825333
P18	Himalayan Balsam	52.6979845	-6.9823785

WPT 81	Himalayan Balsam	52.7019559	-6.9753784
WPT 87	Himalayan Balsam	52.7012019	-6.9782717
WPT 90	Himalayan Balsam	52.6992758	-6.9817420
WPT 91	Himalayan Balsam	52.6988820	-6.9819939
WPT 94	Himalayan Balsam	52.6969665	-6.9830461
WPT 117	Himalayan Balsam	52.6968272	-6.9829444

Section 12 (Fig 27)

name	Species	Latitude	Longitude
L15	Himalayan Balsam	52.6966075	-6.9828339
WPT 94	Himalayan Balsam	52.6969665	-6.9830461
WPT 95	Himalayan Balsam	52.6969772	-6.9830284
WPT 96	Himalayan Balsam	52.6968124	-6.9830903
WPT 115	Himalayan Balsam	52.6968459	-6.9830726
WPT 116	Himalayan Balsam	52.6967856	-6.9830903
WPT 117	Himalayan Balsam	52.6968272	-6.9829444

Section 13 (Fig 28)

name	Species	Latitude	Longitude
L16	Himalayan Balsam	52.6949062	-6.9820094
L17	Himalayan Balsam	52.6942163	-6.9812645
L18	Himalayan Balsam	52.6940422	-6.9802964
WPT 108	Himalayan Balsam	52.6932960	-6.9789459
WPT 109	Himalayan Balsam	52.6933817	-6.9791271
WPT 110	Himalayan Balsam	52.6936671	-6.9799251
WPT 111	Himalayan Balsam	52.6940315	-6.9810391
WPT 112	Himalayan Balsam	52.6947522	-6.9822061
WPT 113	Himalayan Balsam	52.6952264	-6.9824183

Section 14 (Fig 29)

name	Species	Latitude	Longitude
P20	Himalayan Balsam	52.6888093	-6.9704759
P21	Himalayan Balsam	52.6895274	-6.9710683
P22	Himalayan Balsam	52.6900044	-6.9713777
P23	Himalayan Balsam	52.6904063	-6.9719878
P24	Himalayan Balsam	52.6907278	-6.9726243
P25	Himalayan Balsam	52.6918184	-6.9743794
WPT 101	Himalayan Balsam	52.6887504	-6.9708296
WPT 102	Himalayan Balsam	52.6889353	-6.9709312
WPT 103	Himalayan Balsam	52.6891684	-6.9710948
WPT 104	Himalayan Balsam	52.6904706	-6.9727128
WPT 105	Himalayan Balsam	52.6914942	-6.9744722
WPT 106	Himalayan Balsam	52.6917969	-6.9750955

Section 15 (Fig 30)

name	Species	Latitude	Longitude
P19	Himalayan Balsam	52.6833802	-6.9676467
P26	Himalayan Balsam	52.6811982	-6.9692202
WPT 100	Himalayan Balsam	52.6857185	-6.9687006

Section 16 (Fig 31)

name	Species	Latitude	Longitude
P27	Himalayan Balsam	52.6737181	-6.9712320
P28	Himalayan Balsam	52.6738742	-6.9705214
L20	Himalayan Balsam	52.6753687	-6.9702683
L21	Himalayan Balsam	52.6744990	-6.9706235
L22	Himalayan Balsam	52.6741597	-6.9706013
L23	Himalayan Balsam	52.6725682	-6.9716183
WPT 122	Himalayan Balsam	52.6736023	-6.9705436

Section 17 (Fig 32)

name	Species	Latitude	Longitude
WPT 135	Himalayan Balsam	52.6689676	-6.9795845
WPT 136	Himalayan Balsam	52.6687979	-6.9797222
WPT 137	Himalayan Balsam	52.6685609	-6.9798710
WPT 138	Himalayan Balsam	52.6685111	-6.9800042
WPT 139	Himalayan Balsam	52.6675429	-6.9805615
WPT 140	Himalayan Balsam	52.6670487	-6.9809368