

Comox Valley Naturalists Society

Wetland Restoration Project 2004

Written
by
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Courtenay River Estuary – Few Flowered Shooting Star

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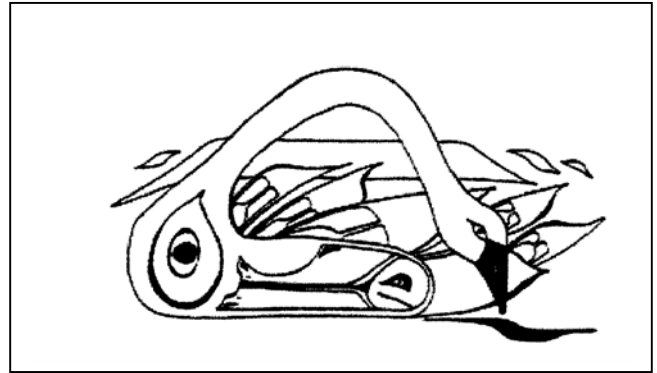
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ACKNOWLEDGEMENTS

The ongoing efforts to remove non-native invasive plants from the Courtenay River, its estuary and surrounding wetlands was made possible through the financial help and support from the following organizations:

Comox Valley Naturalists Society
 Regional District of Comox Strathcona
 International Forest Products - Field Sawmill
 Envirochem Services Inc. - Tom Finnbogason
 Shell Environmental Fund
 City of Courtenay
 Ducks Unlimited
 Federation of BC Naturalists
 Comox Valley Community Foundation
 Courtenay Airpark Association
 Project Watershed Society for Sensitive Habitat Inventory Mapping



This report was written by Ernie Sellentin with contributions from Heather West on the Grasses of the Courtenay River Estuary. All photographs by E. Sellentin. If you would like further information about the Comox Valley Naturalists Wetland Restoration Project please contact E. Sellentin via email at eselntin@shaw.ca

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Field hands - Darrin Jensen, Genevieve Sachet and Rae-Ann Bond.

Project overseer - Betty Lunam and volunteers from the Comox Valley Naturalists Society that helped out on numerous occasions.

Plant Species Identification – Mr. Fred Constable and Manivalde Vaartnou

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EXECUTIVE SUMMARY

Over the past fourteen years the Comox Valley Naturalists Society (CVNS) has spearheaded the removal of purple loosestrife (*Lythrum salicaria*) from the wetlands of the Comox Valley. Purple loosestrife is an invasive alien species that out competes native species, dries up and changes wetland ecology. Fieldwork by CVNS members, volunteers and hired employees has lead to the realization that there are other invasive species and issues threatening the ecology and biodiversity of the local wetlands.

In 2002 the CVNS moved to a holistic approach of estuary/wetland management that includes removal of other invasives, planting of native species, and working with the local sawmill to solve bark debris problems in the Courtenay River estuary. Purple loosestrife numbers have declined from a high of 24,520 in 1999 to 6,628 in 2004. Over the 2002 - 2004 field seasons, 28,100kg of sawmill debris, 11,200kg of yellow flag iris and 2,080kg of Japanese knotweed was removed from the Courtenay River estuary. The extent of Himalayan blackberry dominance has been mapped at 7150 m² with 1300m² removed in 2003 and 2,942 removed in 2004. Additionally, the eleven plant communities of the estuary were mapped in 2003 along with identification of over 170 species of vascular plants.

INTRODUCTION

The purpose of this report is to raise awareness about invasive species in the Comox Valley and document the wetland and estuary habitat restoration work done since 1999 by the CVNS. The restoration efforts include the removal of invasive species from Comox Valley wetland, riverine and estuarine habitats and replanting with the appropriate native species.

Consequences of Invasive Alien Species¹(IAS)

The following italicised paragraphs are taken from the websites of the Global Invasive Species Program² (GISP) and from statements by its associated Invasive Species Specialist Group. These paragraphs are meant for readers to familiarize themselves with the issues and the dangers associated with allowing an unchecked spread of invasive alien species.

Species suddenly taken to new environments may fail to survive but often they thrive, and they become invasive. This process, together with habitat destruction, has been a major cause of extinction of native species throughout the world in the past few hundred years. Although in the past many of these losses have gone unrecorded, today, there is an increasing realisation of the ecological costs of biological invasion in terms of irretrievable loss of native biodiversity.

Invasive species are organisms (usually transported by humans) which successfully establish themselves in, and then overcome, otherwise intact, pre-existing native ecosystems. Biologists are still trying to characterise this capability to invade... But whatever the causes, the consequences of such invasions - including alteration of habitat and disruption of natural ecosystem processes - are often catastrophic for native species.” <http://www.issg.org/> January 29, 2003

¹ *Invasive Alien species (IAS) are “introduced deliberately or unintentionally outside their natural habitats where they have the ability to establish themselves, invade, outcompete natives and take over the new environments.”*

² *International group of scientists that are laying the groundwork to address invasive alien species in science, education, management and policy through collaborative international action*

“Failure to address the underlying causes of biological invasion and mitigate the impacts of IAS (Invasive Alien Species) will result in both losses and gains. We will, for example, lose numerous species, genetic resources, and quite possibly the entire concept of “protected” areas. Poverty, malnourishment, human migration, and disease epidemics will, on the other hand, increase.”
<http://jasper.stanford.edu/gisp/home.htm> January 29, 2003

The above paragraphs highlight the very real dangers created by IAS. In particular, the last paragraph raises the possibility of losing protected areas (parks, ecological preserves) as what could be considered repositories of native species and genetic diversity. The concept of “protected” areas is especially relevant as we move to a local scale and the preservation of the remaining wetlands in the Comox Valley.

INVASIVE ALIEN SPECIES IN THE COMOX VALLEY

Background

Within weeks of the 1991 discovery of purple loosestrife (*Lythrum salicaria*) in the Courtenay River estuary, Comox Valley Naturalists Society (CVNS) members and volunteers armed with shovels began the task of removing it. By the summer of 1995 it became apparent that even a bio-control release of predatory beetles in 1994 was to prove unsuccessful. The Courtenay River estuary was now infested with loosestrife and the nearby source of contamination; a wetland was a sea of pink. CVNS member and director Betty Lunam solicited funds from donor organizations and the public to hire workers to replace volunteers suffering from burnout. In 1998 the continued efforts of Ms Lunam and the CVNS were recognized by Eco-Action with a crew and supervisor in 1998-99 seasons. With the demise of Eco-Action in 2000, funding was sought from other sources with limited success. A major breakthrough came in 2001 when an accountability strategy was adopted to measure the success of loosestrife removal. This new strategy involved counting the roots of all loosestrife plants removed and mapping locations. With the recorded hours worked in 1999 & 2000 an estimate of plants removed for these years could be derived from the 2001 plants-removed/hours worked ratio. Real numbers indicated a dramatic decline in purple loosestrife presence. The CVNS project was succeeding and this success gave funders a reason to financially support the project.

In 2004, the CVNS continued its program to eradicate alien plant species and establish diverse, healthy populations of native species in the Courtenay River and its estuary. The IAS purple loosestrife (*Lythrum salicaria*), yellow flag iris (*Iris pseudacorus*), Knotweed species (*Polygonum cuspidatum*, *P. sachalinense*), Scotch Broom (*Cytisus scoparius*) and Himalayan blackberry (*Rubus discolor*) were targeted for various degrees of removal efforts.

Purple Loosestrife (*Lythrum salicaria*)

Purple loosestrife, a tall beautiful flowering plant, invades wetlands and gradually takes them over to the exclusion of other plants. As a perennial plant, loosestrife increases its woody root mass yearly, which can result in drying out marshes, destroying native habitat and displacing wildlife. The City of Courtenay, the Town of Comox and the Regional District of Comox-Strathcona have put this invasive plant on their noxious weed list.

This is the fourteenth year that the Comox Valley Naturalists Society (CVNS) have been waging an unremitting war on purple loosestrife. Although native species have returned in greater numbers, other invasive plants have colonized the disturbed areas.



Figure 1. Purple Loosestrife

Distinguishing features include a square stock and lance shaped leaves with a leaf within a leaf pattern.



Figure 2. Purple Loosestrife in bloom

Purple Loosestrife Removal 2004

In total 6,628 purple loosestrife plants were removed from the wetlands of the Comox Valley in 2004. The 2004 removal of purple loosestrife was a very strong effort with all sites receiving a final cleanup and a later inspection. Chart 1, page 8 shows the number of purple loosestrife plants removed over the period 1999 - 2004 with a Trendline predicting less than 5,000 plants for 2005.

Appendix 1 beginning on page 21 contains aerial photographs indicating the locations where purple loosestrife was removed in 2003 & 2004. **Appendix 1 is meant to act as a guide and maps for the 2005 season and beyond.**

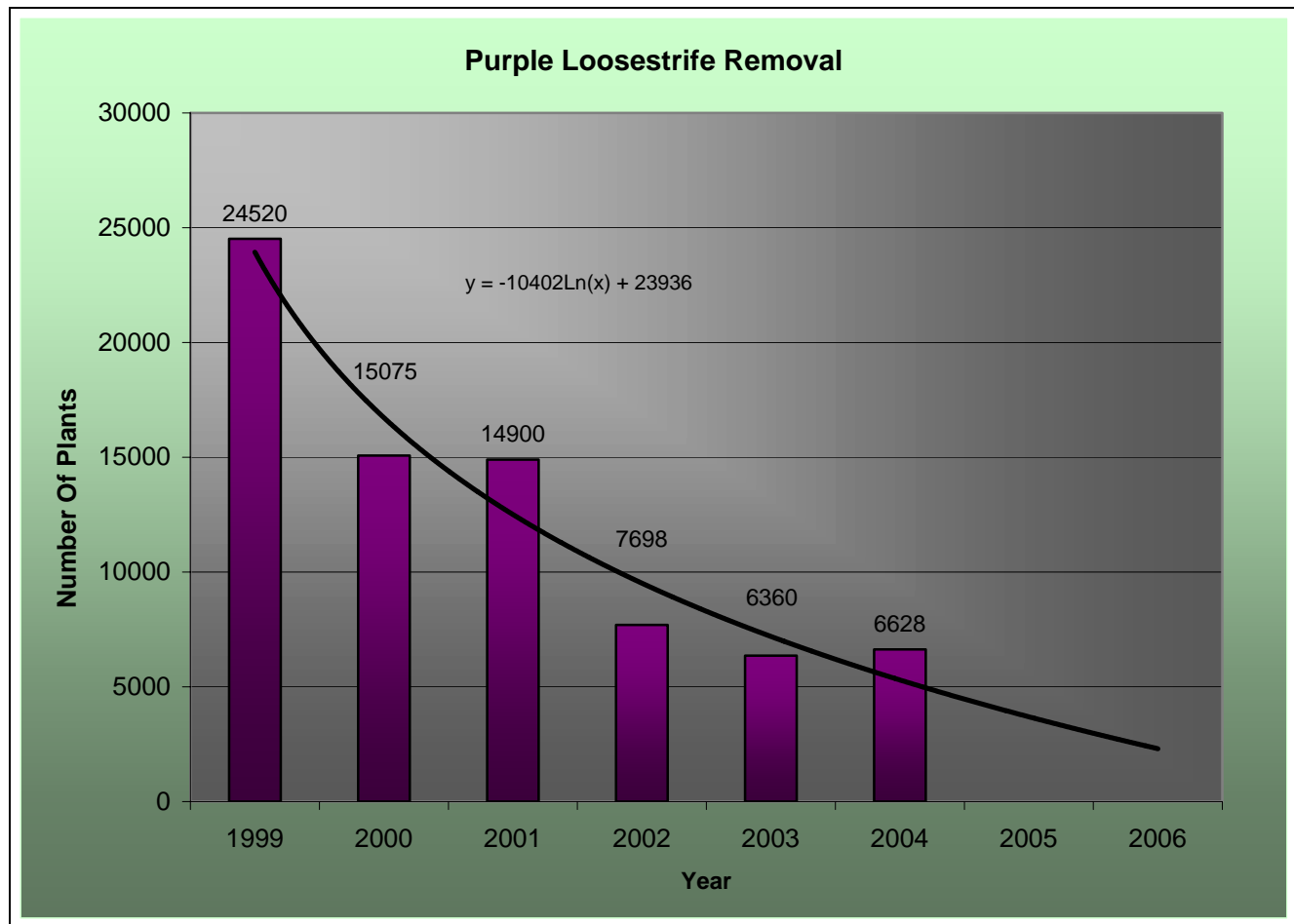


Chart 1. Purple Loosestrife Removal 1999-2004

The eight locations where purple loosestrife was removed are listed in Table 1 and displayed in Chart 2. A total of 53 days were dedicated to loosestrife removal in 2004 (58 days – 2003). Large seed bearing plants (52 plants greater than 3 years old) are still being found in numbers. One extra large plant was found at the intersection of Glen Urquhart Creek and Thorpe Drive in east Courtenay. Loosestrife seeds in the Glen Urquhart Creek system from this plant will eventually float downstream to sprout in the ditch lines of the Comox Bay Farm, Barry’s Farm or the Courtenay River estuary.

Loosestrife Removal	Days	Days	Days	Days	Days
	1999	2001	2002	2003	2004
Comox Bay Farm	18.0	8.1	5.0	5.5	2.9
Simpson & Barry Farms	5.0	1.8	1.3	5.1	3.2
Airpark & Walkway	4.0	0.9	3.1	3.3	3.5
Courtenay River	2.0	5.4	3.9	7.9	2.6
Lewis Park	15.0	27.9	14.8	12.8	16.5
Estuary	64.0	22.2	15.8	19.5	19.9
Malahat Drive	1.0	0.5	0.8	0.4	0.9
Stapley Road/Campbell River				3.9	3.6
Totals	109.0	66.8	44.6	58.3	53.0

Table 1. 1999-2004 Days Worked Per Area, Purple Loosestrife Removal

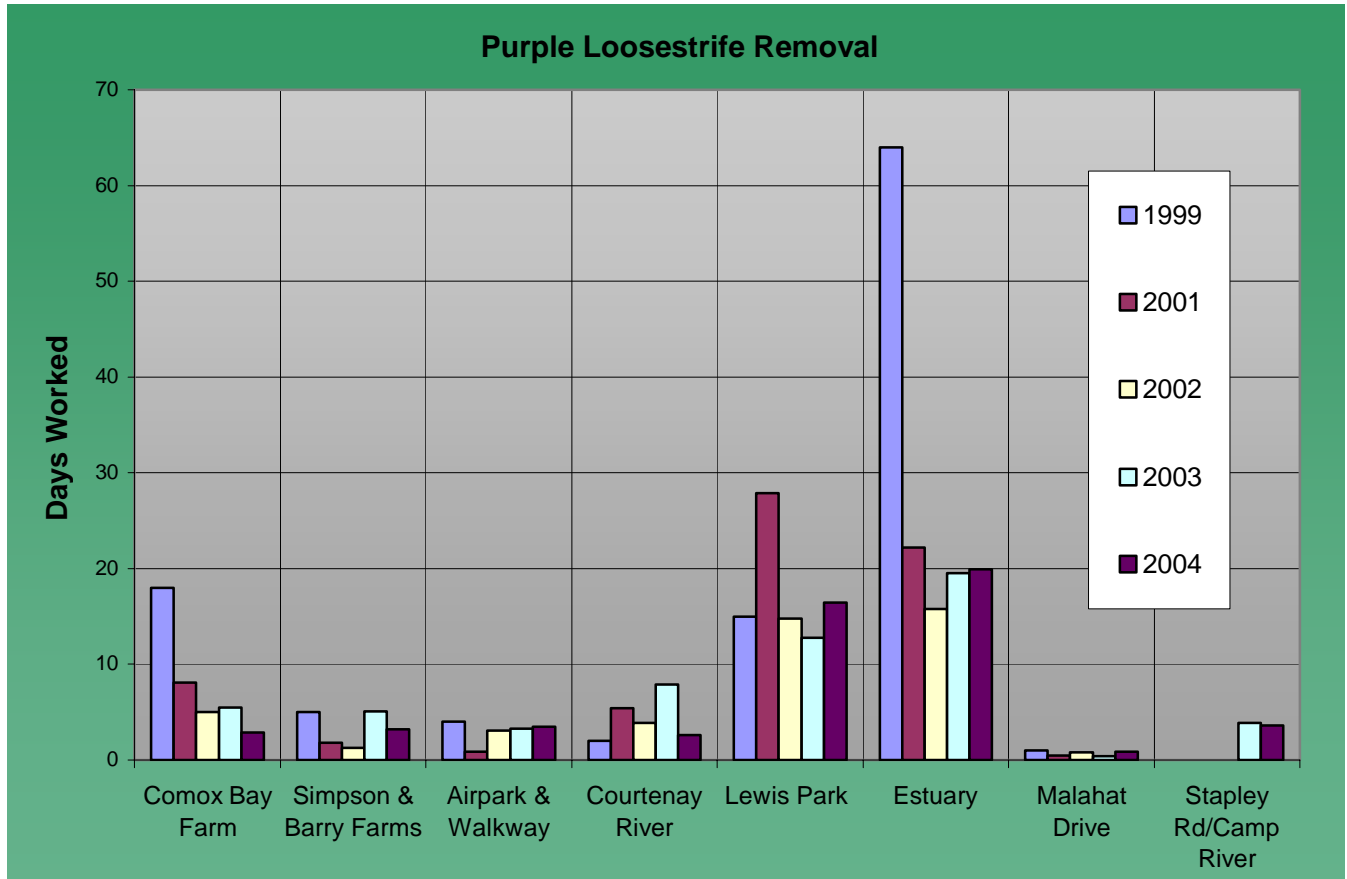


Chart 2. Days Worked Per Area, Purple Loosestrife Removal

Yellow Flag Iris (*Iris pseudacorus*)

Planted for its showy yellow spring flowers and for its erect sword like leaves it often escapes the garden to spread locally along shorelines, stream flats, and into fresh and brackish marshes. Yellow flag iris is a hearty perennial that re-grows from thick, tuberous rhizomes or corms. The rhizomes spread radially to produce large clonal populations. Rhizomes are drought tolerant.



Figure 3. Yellow Flag Iris

Both rhizomes and seeds of iris are transported downstream during winter’s high water floods to form new colonies. Yellow flag iris will grow vigorously in water or wet soil to the complete exclusion of cattails (*Typha latifolia*).

Eighteen days were spent removing, bagging and hauling yellow flag iris to the landfill in 2004. In total 11,196 kg of yellow flag were removed from the Courtenay River estuary over the 2002, 2003 & 2004 seasons. **It will be important to monitor yellow flag presence over the next few years and remove all plants as they mature and flower (easy to find) and before they can contribute to the seed bank.** Table 2 shows the dates and amounts of yellow flag iris and knotweed species that was disposed of at the Pigeon Lake Landfill in 2002-04 years.

Year	KGS	Yellow flag iris	Knotweed sps	Garbage
2004	1,040	1010		30
2003	5,460	5,176	284	
2002	6,810	5,010	1,800	
Overall total	13,410	11,196	2,084	30

Table 2. Landfilled Yellow Flag Iris and Knotweed Species

While the bulk of yellow flag iris has been removed from the Courtenay River estuary there still remains a considerable viable seed bank in the soil. Areas disturbed in the process of removing yellow flag iris corms are often re-colonized with yellow flag seedlings from the seed bank. It was necessary to hoe or weed most areas a couple of times to stop re-establishment. Additionally, areas that were removed of blackberries and replanted with native grasses and herbs required the weeding of thousands of yellow flag iris seedlings that sprouted from the ever-present seed bank.

Japanese, Giant Knotweed (*Polygonum cuspidatum*, *P. sachalinense*)

Knotweed species are present in hundreds of locations throughout the Comox Valley and thousands of locations on Vancouver Island. It is being spread to and from sites through the movement and disturbance of knotweed contaminated soils. Knotweed grows in all types of habitats from dry sand dune to wetland habitats. It forms large dense stands three metres or taller in wetlands and along streams choking out native species and endangering fish and their habitat.

Figure 4. Japanese Knotweed in Bloom



Knotweed species are members of the Buckwheat Family, herbaceous, semi-woody perennials with egg-shaped leathery leaves and greenish-white flowers that bloom in clusters along the stem. With stout hollow stems, knotweeds can grow to three metres in height forming dense clumps resembling bamboo. Soils contaminated with a rhizome piece as small as 7 grams can produce another plant. The rhizomes can penetrate concrete or asphalt, burrow into hardpan soils to a depth of 2 metres, and reach 7 metres around the base of the plant.

Along the banks of the Courtenay River and in the estuary, knotweed has grown into dense groves excluding all other plant communities.

In Europe and the UK there has been a longer history of naturalization and spread of knotweed species than in North America. The destructive potential of knotweed species has been recognized in the UK with a budget for control and legislation making it illegal to introduce knotweed into the natural environment.

Knotweed species are extremely difficult to remove in wetland habitats due to the reproductive ability of its rhizomes. Established plants should not be disturbed (rhizome contaminated soils spread infestations further) unless sufficient funding is in place to effect a complete removal within two treatments (Huckins, E. 2003).



Figure 5. Japanese Knotweed in the Courtenay River Estuary

For fear of spreading knotweed infestations further we were unwilling to target new plants for eradication in 2003 or 2004. Table 2 on page 10 shows that 284kg of knotweed roots were removed in 2003 and 1800kg in 2002. Additionally, research continues for better methods of knotweed eradication as current successful techniques rely primarily on the use of herbicides. In Canada there are no herbicides approved for use in wetlands. Figure 5 shows a small plant that was successfully removed in 2002 by hand digging and disposing of the roots in a landfill.

Himalayan Blackberries (*Rubus discolor*)

Known for their delicious berries, Himalayan blackberries are a major invasive alien species in the estuary of the Courtenay River. Blackberries spread through seeds and via vines that touch earth at their tips and sprout roots. The ability of vines to root at their tips allows blackberries to colonize areas where it would be difficult to get established with seeds alone. In this manner, blackberries have extended from roadsides and disturbed areas into the Courtenay River estuary. Once established blackberries out compete native species by sending up new vines that can reach lengths in excess of 15 meters. These vines grow up through native species such as twinberry, tip over when not supported and grow on top of the native species. Over time the dead vines press the native species down, deny them sufficient light and eventually smother native shrubs out. Figure 6 shows a twinberry plant that was pressed to the ground in just such a manner.



Figure 6. Blackberries dominating Twinberry

Blackberries dominate 4.7% of the estuary or 23.4% of the upland area of the estuary. The aerial photograph in Appendix 2 on page 33 shows the locations of the major blackberry infestations of the Courtenay River estuary that were measured in 2003. Of the 7457 m² of blackberries, 3243 were removed in 2003 and 1299 m² were removed in 2003. There remains approximately 2915 m² of blackberries in the estuary scattered over 7 different areas. .

Removal of blackberries involves cutting back the vines to access the root base of the plant and then digging out the roots. Once dug out, root wads and smaller roots that are exposed to the sun expire. Complete removal of blackberries will require continued visits to pull remaining roots as they sprout. Figure 7 to the right shows blackberries gaining a height greater than 6 metres by using the limbs of a spruce tree for support. Small amounts of Nootka rose can be seen in the left foreground of the photo.



Figure 7. Himalayan Blackberries, Courtenay River Estuary

Courtenay Estuary Invasive Species Removal and Native Plantings

The Comox Valley Naturalists Society acts as stewards of the Airpark for the City of Courtenay. As such the CVNS has a goal of naturalizing the Airpark by removing non-native species and establishing healthy populations of native species through recruitment from adjacent natural areas and plantings. A Garry Oak ecosystem will be established in drier areas and estuarine species in the wetter areas.

Approximately 2 weeks were spent removing Himalayan blackberry and Scotch broom from a section of the Courtenay Airpark. Soils along the Airpark Walkway are comprised of compacted poor quality fills and range from coarse to fine gravels, clays and debris from construction sites including concrete, asphalts and metals. The compact nature of the soils in the Airpark makes digging with hand tools physically demanding, time consuming and non-productive. For this reason, removal of invasives and planting of native species was done with the aid of a rented mini-excavator. The excavator was used to remove blackberries, dig holes for native plantings and load a track carrier with biosolids. The Regional District of Comox Strathcona donated two dump truck loads of biosolids for the Airpark Naturalization Project. The biosolids were applied directly to the soil around the native plantings to boost soil nutrients and plant health. Figure 8 below shows where removal, planting efforts and biosolids were dispersed in 2004.



Figure 8. Courtenay Airpark Naturalization, 2004

Grass Species in the Courtenay River Estuary

--Written by Heather West and E. Sellentin--

On July 2, 2003, Ernie Sellentin and Heater West of the Comox Valley Naturalists Society's Wetland Habitat Restoration Project met with Manivalde Vaartnou a native grass expert specializing in vegetation reclamation services. Mr. Vaartnou is currently test growing native grass species on a commercial scale to determine seed productivity and harvestability. The goal of Mr. Vaartnou's project is to have a native grass seed product available for all types of ecosystem reclamation work (Vaartnou, M. 2003.). Currently non-native grasses are seeded on construction and other sites to prevent erosion. The practice of seeding with non-native grasses is one reason why many ecosystems and wetland sites are losing their native grasses.

The group spent two hours touring the Courtenay River estuary and with Mr Vaartnou's expertise identified eleven species of grasses. Of the eleven grass species identified, three of the grasses, tufted hairgrass, meadow barley, and blue joint are native plant species of our region. The non-native species were reed canary grass, quack grass, tall fescue, orchard grass, colonial bentgrass, fowl bluegrass, Kentucky bluegrass, and common velvet grass. The non-native species are most likely derived from highway seeding projects and the farmlands across the Dyke Road. Kentucky bluegrass, colonial bent grass, and Canada blue grass are commonly found in seed mixes used for pastures (M. Vaartnou, 2003). The following grass species were identified within the Courtenay Estuary on July 2, 2003. The field marks and ecological notes are quoted from Pojar and MacKinnon's *Plants of Coastal British Columbia*, 1994.

1. Tufted hairgrass (*Deschampsia cespitosa* ssp. *beringensis*) is a highly variable **native species** found in many habitats; coastal salt marshes to alpine tundra. Its range extends from the Arctic to high altitudes in the tropics.
2. Meadow barley (*Hordeum brachyantherum*) is a **native species** most abundant in maritime habitats. The awned spikelets can attach to clothing or to hair and skin of animals. The spikelets can caused injury by working into the nose or mouth passages, or even through the intestines of animals eating them, but blacktail deer graze the leaves freely.
3. Blue joint (*Calamagrostis canadensis*) is a **native species** that is a very aggressive colonizer after disturbance. The seeds of blue joint are larger than those of tufted hairgrass. 'Reedgrass' is another common name for species in this genus.
4. Reed canary grass (*Phalaris arundinacea*) grows in wet places in disturbed sites. It is scattered and often locally abundant the southern half of our region especially around areas of human habitation or agricultural activity. It is not clear whether reed canary grass is entirely introduced or whether it is indigenous in parts of the coast and has extended its range through human influence.
5. Quack grass (*Elymus repens*) is an **introduced** European species that has become well established in the settled portions of our region as a vigorous, persistent weed. It is also known as 'Couchgrass'.
6. Tall fescue (*Festuca arundinacea*) is an **introduced**, large, perennial, European species that occurs in disturbed areas in our region (especially from southwestern B.C. to the south). This species has broad leaves.
7. Orchard grass (*Dactylis glomerata*) is **introduced** from Eurasia. It is cultivated for hay and is used in grass-seeding mixtures on clearings and along road cuts. One spot that the orchard grass is located in the Courtenay Estuary is along the old roadway that is now used as a trail. Orchard grass could be confused with reed canary grass, but reed canary grass usually

has wider leaves and a more narrow, pointed inflorescence and it usually grows in wetter habitats than does orchard grass.

8. Colonial bent grass (*Agrostis capillaris*) is **introduced** from Europe for pastures and lawns. It is scattered throughout our region. Also known as *A. tenuis*, colonial Bentgrass is called 'colonial' because it grows in dense masses. The species name *capillaris* alludes to the thin leaves.
9. Fowl bluegrass (*Poa palustris*) is an **introduced** Eurasian species (Mani argues that fowl bluegrass is a native species). Bulbous bluegrass is common in disturbed, relatively dry habitats at low elevations in the southern half of our region (especially in the Strait of Georgia-Puget Sound area and south). Fowl bluegrass is more delicate than Kentucky bluegrass and is located on the point in the Courtenay Estuary.
10. Kentucky bluegrass (*Poa pratensis*) is an **introduced** and widely established species that is extensively used in lawn and pasture grass mixes. It is found in meadows, pastures, clearings, roadsides, thickets, and open forest sites from low to middle elevations (especially those near settlements).
11. Common velvet-grass (*Holcus lanatus*) is an **introduced** meadow grass from Europe. It is commonly found growing in and around human settlements at low elevations.

Reed Canary Grass (*Phalaris arundinacea*)

Reed canary grass was not present in the eastern part of the estuary in 1974. By 2003 reed canary grass has become the dominant grass throughout the entire estuary and is displacing Lyngby's sedge at its upper regions. On the western portion of the estuary where it was present in 1974 it has formed large clonal stands. A late August 2003 inspection of a stand of reed canary grass shown in figure 9 revealed no other plant species present.



Figure 9. Reed Canary Grass as a Dominant Species

By identifying the grass species and plant communities that presently exist in the estuary, changes may be compared to the plant communities identified in a 1974 Master's Thesis completed by K. Kennedy. Twelve grass species were identified in the 1974 thesis, three of which have yet to be identified in the estuary; seashore saltgrass (*Distichlis spicata*), western mannagrass (*Glyceria occidentalis*) and sweet vernalgrass (*Anthoxanthum odoratum*). Three species that have emerged since the 1974 thesis (tall fescue, bluejoint grass, and fowl bluegrass) may have been identified as another species with very similar characteristics.

Bluejoint grass is native to Vancouver Island but has recently adapted to growing in estuarine habitat. Perhaps this vigorous species is pushing out some of the weaker competitors and changing the species found in the Courtenay River estuary (Vaartnou, M. 2003). The general conclusion from the 2003 inventory was that the grass species currently in the Courtenay River estuary are mostly non-native introduced grasses. Mr Vaartnou recommended the following planting prescriptions:

1. Sandy Beaches- Tufted hairgrass, Nootka alkali grass, spiked bentgrass, and meadow barley.
2. Estuary meadow- Tufted hairgrass, mannagrass species, and meadow barley. Plant one kilogram of seed in a small plot and monitor germination success.

Removing the large amount of invasive alien grasses in the Courtenay River estuary is neither physically possible nor desirable. In 2003 1kg of mannagrass was purchased and planted in an area that was cleared of blackberries. Mr. Vaartnou identified a few stands of native mannagrass in 2003 and since that time it has been found present in numerous locations most notably in the Old Tsolum River channel just north of Lewis Park. Approximately 2kgs of mannagrass was harvested in 2004 and planted in locations where invasive species were removed.

It is hoped that re-introducing native grasses will keep them present and help preserve the historical biodiversity and food webs of the Courtenay River estuary.

Summary of Plant Communities in the Courtenay River Estuary

In 1974, Kathryn Kennedy a Masters student at the University of British Columbia identified the plant communities and plant species of the Courtenay River estuary. Kennedy's Thesis gives a baseline study of the plant communities and species that were present at that time. During the 2003 field season and 29 years after Ms Kennedy's work the plant communities and species were once again identified.

Comparison of the 1974 and 2003 plant communities and species list shows that the estuary is a place of change. The ever-present invasive species purple loosestrife, yellow flag iris and Japanese knotweed were not found in the estuary in 1974. In 2004, reed canary grass is a dominant grass in the eastern part of the estuary whereas in 1974 it was listed as present only in the western most part of the estuary.

Nine days were devoted to identifying, recording and mapping the locations of 11 plant communities and presence of over 170 species of plants in the Courtenay River estuary. Mr. Fred Constable volunteered a week of his time and was the key force in identifying individual species of plants in the estuary. In the 2005 an ongoing inventory of seasonal plants will be conducted in an effort to complete a comprehensive list of plants not easily discovered when in small numbers or unless in bloom.

Appendix 3 starting on page 36 contains a list of the plant communities and species found in the Courtenay River estuary. Aerial photographs of the estuary on page 45 & 46 diagram the general locations where communities and their associated species may be found.

SUMMARY OF WORK COMPLETED

A total of 1726.5 hours or 230.2 days were spent on the project in 2004. This includes everything from fieldwork to bookkeeping and the production of this report. Of the 1726.5 hours of work, 115.5 were volunteer hours. Hours of work were broken down into twelve categories by 7.5-hour days. These categories with a detailed job description are as follows:

1. Loosestrife – 55 days
 - Removal, bagging and hauling of purple loosestrife to composting facility
2. Yellow Flag – 17.9 days
 - Removal, bagging and hauling of yellow flag iris to Pigeon Lake landfill
3. Blackberry species – 48.3 days
 - Cutting of canes away from native species, removal of roots and exposure to sun
4. Books and Writing – 7.7 days
 - Funding proposals, budgeting, payroll calculations, remittances to Canada Customs and Revenue Agency, Records of Employment, T4's, and year end report
5. Plant maintenance, Seed Collection – 48.8 days
 - Watering, weeding, mulching of current and previous plantings. Collection and cleaning of native plant seeds for planting in rehabilitated areas
6. Knotweed – 12.7 days
 - Removal bagging and hauling of knotweed roots to Pigeon Lake landfill.
7. Work preparations – 5.0 days
 - Boat maintenance, tool maintenance (sharpening, handle replacement), tool allocation, daily work planning and vehicle cleanup.
8. Holiday pay – 8.5 days
 - Government regulated mandatory paid holidays
9. Plant communities – 0.5 days
 - Delineating and mapping plant communities, species identification and data entry
10. Public relations and other – 15.0 days
 - Presentation preparations, public speaking engagements and presentation
 - Meeting with partnership groups (City of Courtenay and Field Sawmill)
11. Broom – 9.6 days
 - Pulling and cutting of broom
12. Scouting – 0.6days
 - Checking of new areas for invasive non-native species

The summary of work allocation with a comparison between 2003 & 2004 is displayed graphically in the Chart 3 below. Expectations for the 2005-year and budgetary considerations should see approximately the same allocation of time per job description. With the removal of 1,010kgs of yellow flag iris from the Courtenay River estuary in 2004 there remains few if any large plants to deal with in 2005. However, a considerable bank of yellow flag iris seed is present in the soil that quickly sprouts when blackberries are removed. These sprouts are dealt with via hand weeding/hoeing and expire easily in the sun. Time not allocated to yellow flag removal will be needed for maintenance in the form of planting and weeding until the native species are well established and the soil becomes exhausted of invasive species seeds.

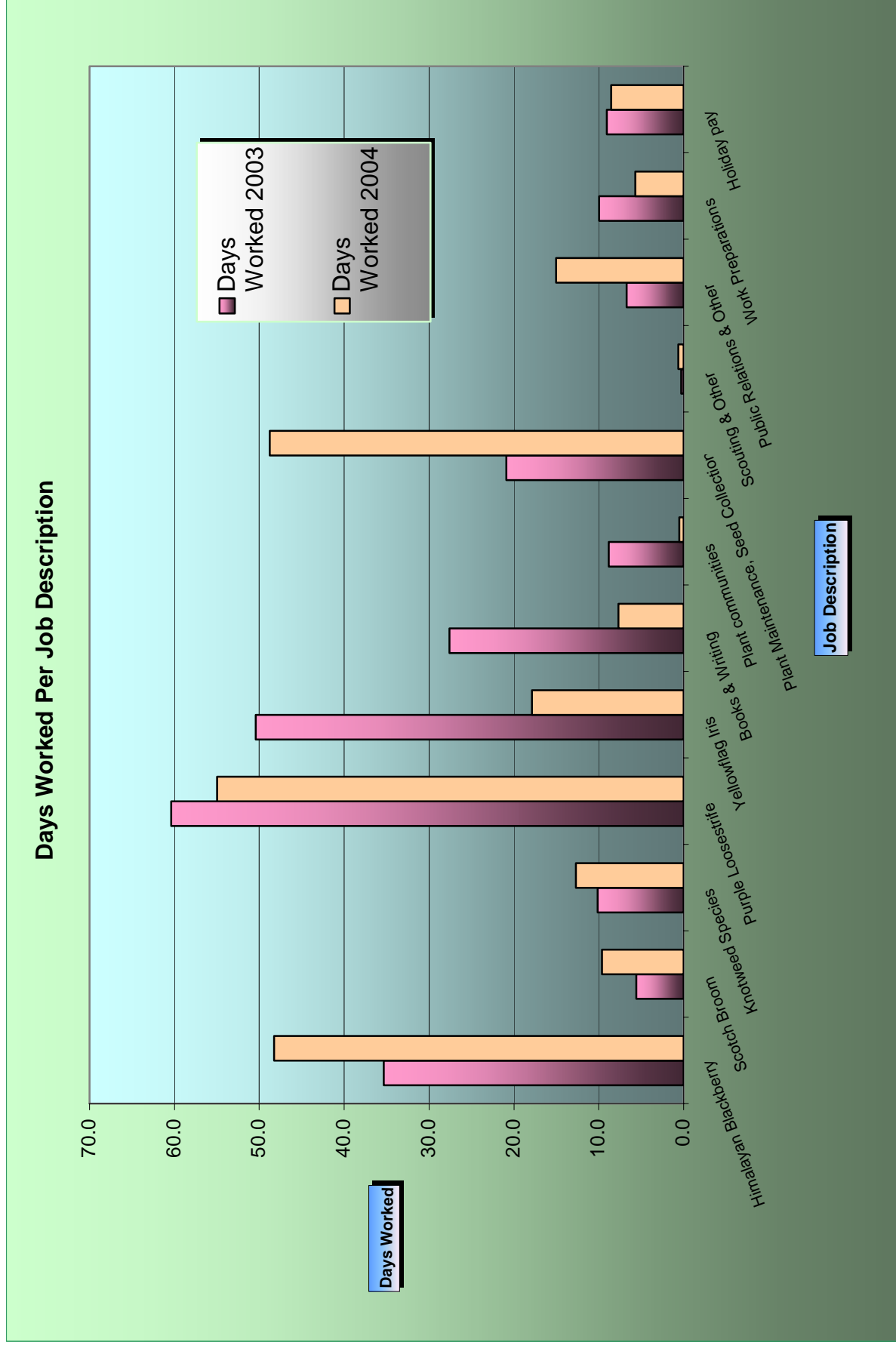


Chart 3. Days Worked per Job Description, 2003 & 2004

Recommendations

The 2005-year needs a continued focus on the eradication of purple loosestrife. The strong effort in 2003 & 2004 has left few large loosestrife plants able to contribute to the seed bank for the 2005 season. Of all the infested areas only the Simms farm/slough area is of concern. A thorough effort was put forth in the Simms/Slough area in 2004 with less than 500 plants discovered. Due to the mucky nature of this area it requires extreme caution and determination to ensure the area is covered adequately.

There remains a number of immature non-flowering yellow flag iris plants and a considerable yellow flag iris seedbank in the estuary. The plants should be removed early in 2004 with a summer long follow-up and weeding of seedbank sprouts. All areas where plants were removed in 2002-2004 years should also be checked for seedlings. Where blackberries were removed in the past and the soil exposed to sunlight a heavy crop of yellow flag iris sprouted. Continued weeding in areas where blackberries are removed will be necessary to control the establishment of yellow flag iris.

Efforts to remove Himalayan blackberries should continue in 2005. There remains 2915m² of the original 7457 m² of blackberries that dominated 23% of the upland area of the estuary. An ongoing check for blackberry shoots in restored areas will reveal roots missed in previous eradication efforts. Areas cleared of blackberries are ideal for the planting of desirable native grasses, herbs and shrubs.

Japanese knotweed continues to expand its presence along the banks of the Courtenay River and upland areas of the Comox Valley. Knotweed has been successfully removed from one location with ongoing removal efforts at another location. Mapping the location and measuring the size of the Japanese knotweed patches would give a baseline point to measure future control/eradication efforts. With a much heavier rate of knotweed infestation, the state of Oregon may be able to provide valuable information on control and eradication methods (Huckins, E. 2003). The Nature Conservancy of Oregon is currently trial testing stem injection of herbicides to control knotweed. Preliminary tests show promising results with further tests and final analysis available in the summer of 2004 (Soll, J., 2003).

Conclusion/Discussion

The ongoing effort of the CVNS at removing purple loosestrife is showing a promising decline in the occurrence of this destructive wetland plant. The potential exists for a dramatic decline in purple loosestrife in the next few years. The removal of loosestrife has evolved into a holistic project of wetland management that monitors the health of the estuary through a yearly presence in the field. For example, this continued presence has led to the recognition of the destructiveness of Himalayan blackberries and yellow flag iris to the ecology and food webs of the estuary.

The 2003 mapping of plant communities in the estuary gives a good baseline account of invasive species presence. Removal efforts of blackberries and the domination by non-native grass species can now be measured from this baseline study. Additionally, vigilance of threats by new invasive species, combined with field identification can get an early start to prohibiting the establishment of undesirable alien plant species. Early detection and rapid response (eradication) are the keys to success and cost control when removing an invasive alien species.

Reference:

Hitchcock, C.L., and A. Cronquist. 1973. *Flora of the Pacific Northwest*. University of Washington Press, Seattle, Washington.

Huckins, E. 2003. Watershed Technical Specialist, Lincoln Soil and Water Conservation District, Newport, Oregon. Personal communication with E. Sellentin.

Pojar, J., and A. MacKinnon. 1994. *Plants of Coastal British Columbia including Washington, Oregon & Alaska*. Lone Pine Publishing, Vancouver, B.C.

Soll, J. 2003. The Nature Conservancy and Metro Parks and Greenspaces, Stem injection of Japanese and giant knotweed, Preliminary Results Report 1. The Nature Conservancy, Portland Oregon.

Vaartnou, M., 2003. *Establishment of a Native Seed Industry for the West Coast of Vancouver Island, Final Report 2002/03*. Unpublished.

APPENDIX 1.

Location of Purple Loosestrife Removal - 2004

The areas are as follows:

1. Area 1 – Comox Bay Farms ditch lines and constructed ponds
2. Area 2 – Simpson & Barry Farms to CBF
3. Area 3 – Airpark Walkway
4. Area 4 – Courtenay River from Lewis park to Airpark Marina
5. Area 5 – Courtenay River north of Lewis Park
6. Area 6 – Estuary on East side of Comox Road and south of Interfor’s sawmill
7. Area 7. – Detention Pond, Malahat Drive and Glen Urquhart Creek

Area 1 – Comox Bay Farms (CBF) - Ditch lines and ponds on DU Lands

- A total of 2.9 (5.5 days 2003, 5 days 2002) days was spent on removing purple loosestrife from this area. It was visited on four different occasions with flowering plants being discovered on two occasions.
- This area covers the ponds and all the ditch lines to Barry’s farm

This area is owned by Ducks Unlimited and is accessed through the farm or more often through the south side of the Superstore parking lot. Purple loosestrife was found and removed along the ditch lines and around the ponds. In August of 2003 the ditches behind Superstore were cleaned and alders were thinned. **The soil removed during ditching was contaminated with purple loosestrife and dumped in a location denoted on Figure 10.** The site indicated in Figure 10 will have to be checked on an annual basis. By August of 2004 purple loosestrife had sprouted from seed to mature flowering plants in the areas ditched in 2003. Approximately 60m² of Himalayan blackberry canes and roots were removed from an area indicated on Figure 10.

Denotes purple loosestrife presence and removal



Black circle denotes dominance by Himalayan blackberries



Yellow Flag presence: removed and not removed



Knotweed (Japanese, Giant & Himalayan)



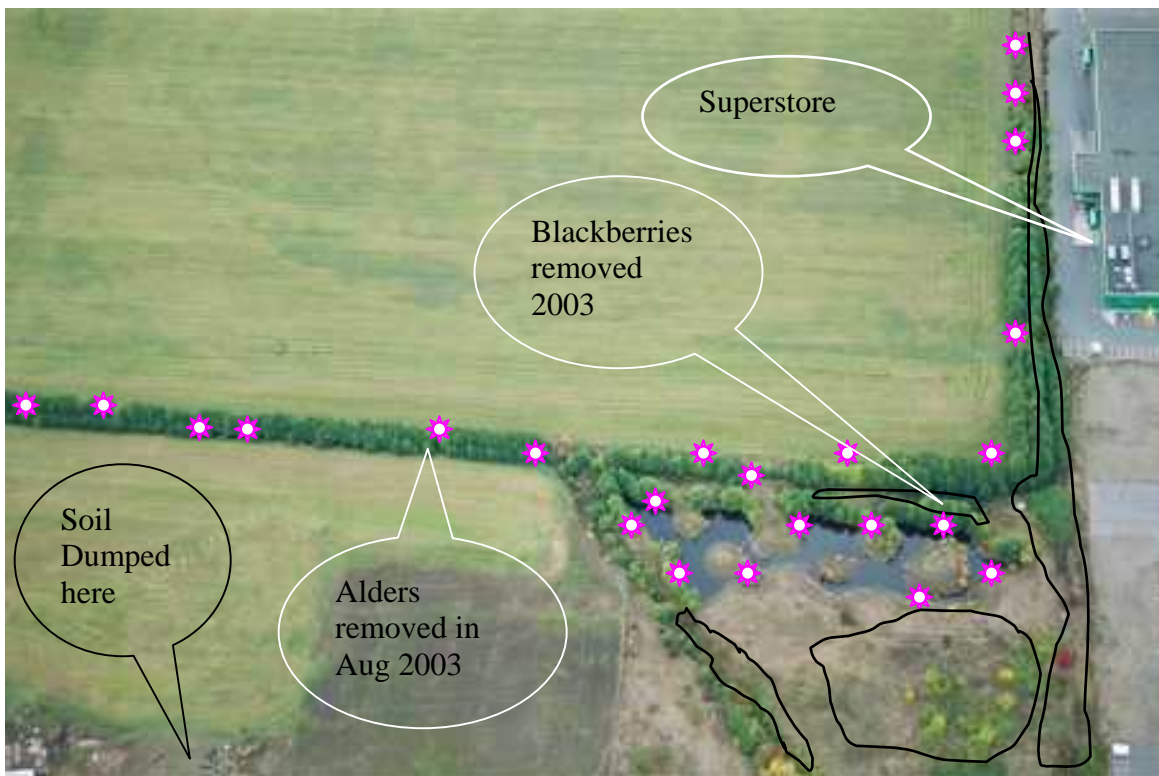


Figure 10, Area 1. Comox Bay Farm Ponds



Figure 11, Area 1. Comox Bay Farm to Barry's Farm

Area 2 – Slough through Simpson & Barry Farms to CBF

- 3.2 days 2004 (2003, 5.1 days scouting for and removing purple loosestrife 1.5 days 2002, 1 day 2001, 1 day 1999)
- This area is downstream from a seed source and upstream from a tidal seed source

The largest plant discovered in 2002 came from Barry's farm just upstream from the newfound 2003 infestations. The location of this plant is marked in Figures 12 & 13. Large plants that would have seeded in 2002 & 2003 were also found in the constructed wetland shown in Figure 13. Hundreds of plants were removed from the locations in Figure 12. Area 2 is very difficult to cover thoroughly. **Extreme caution is necessary when working in this area as in places the bottom has over 60 cm of soft mud.** Using a canoe along with a 14-foot tide allows reasonable access to this area.

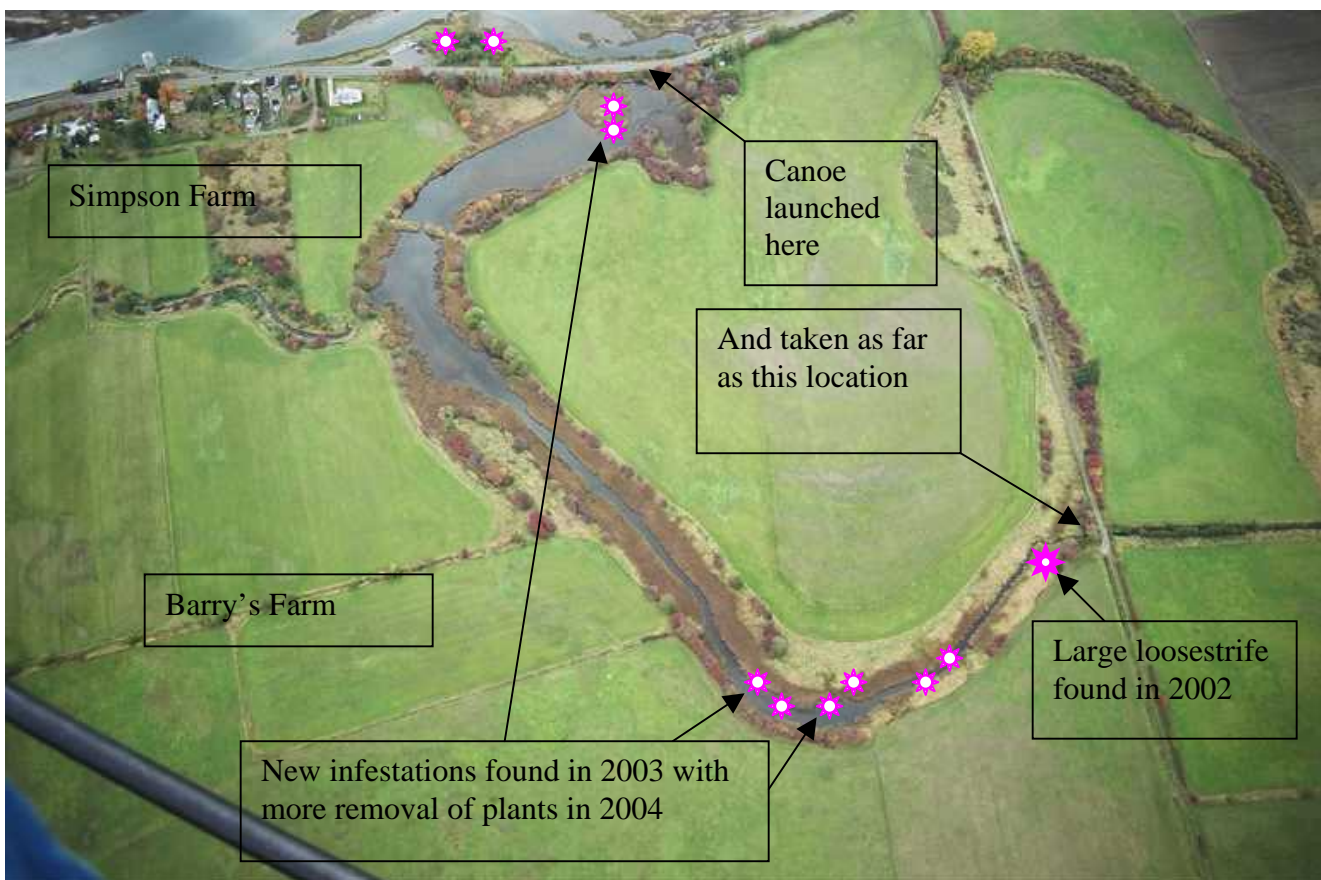


Figure 12, Area 2. Slough through Simpson & Barry Farms

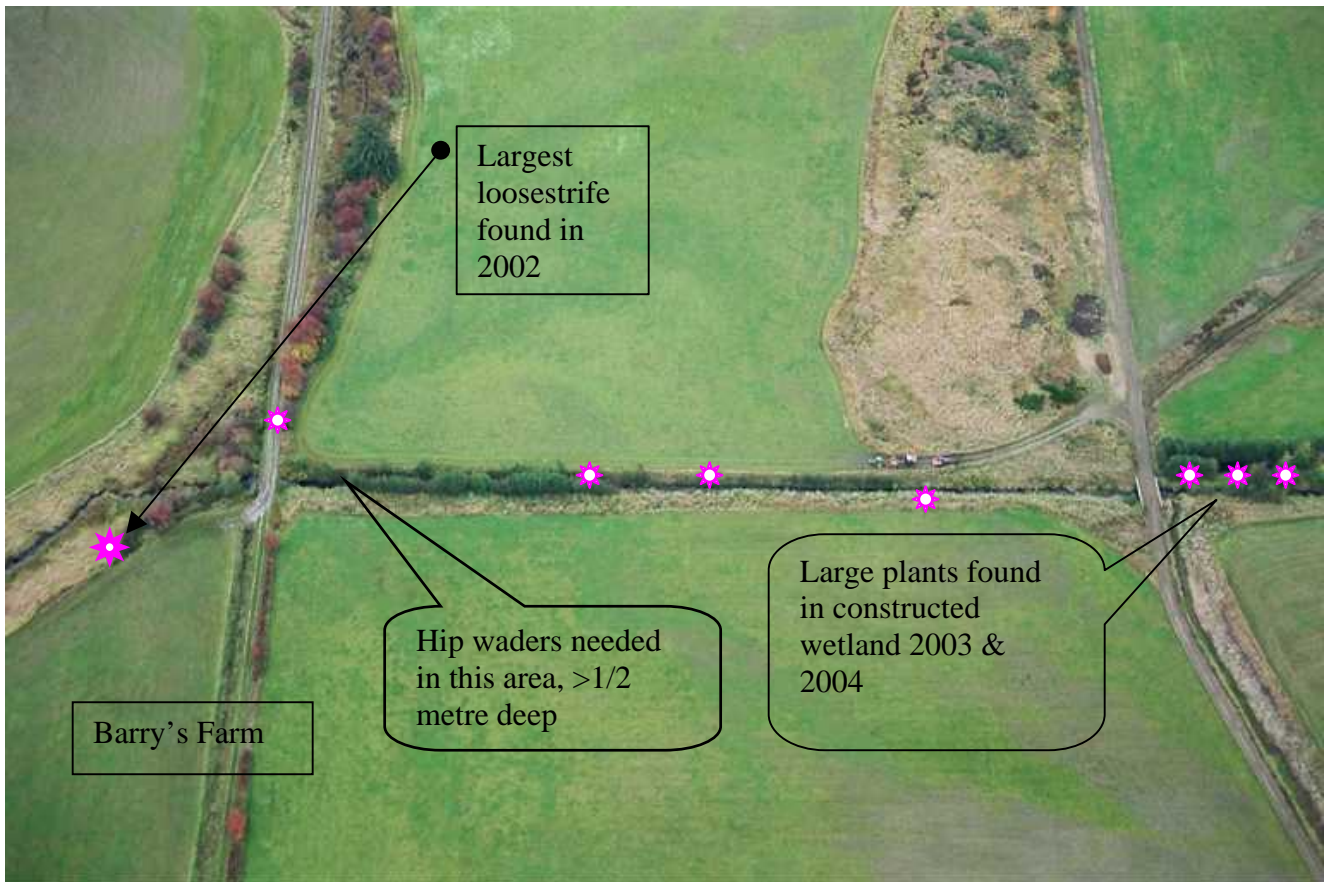


Figure 13, Area 2. Slough and Barry's Farm ditch line

Area 3 – Airpark Walkway

This is a large area extending from the freshwater marina to 31st Street. There are scattered patches of loosestrife and knotweed from one end to the other. Himalayan blackberries are a major concern along the length of the walkway.

- 3.5 days removing purple loosestrife in 2004, 3.3 in 2003, 3.1 days 2002, 1 day 2001, 4 days 1999
- Blackberries and broom removed from area between walkway and lagoon. Thirty six native species planted and mulched by the CVNS, then watered by the City of Courtenay
- Japanese knotweed plant disturbed and spread when new walkway constructed north of the Courtenay Airpark in 2003. Knotweed was hand removed in 2004 but still present
- Watering and mulching of plantings from 2002

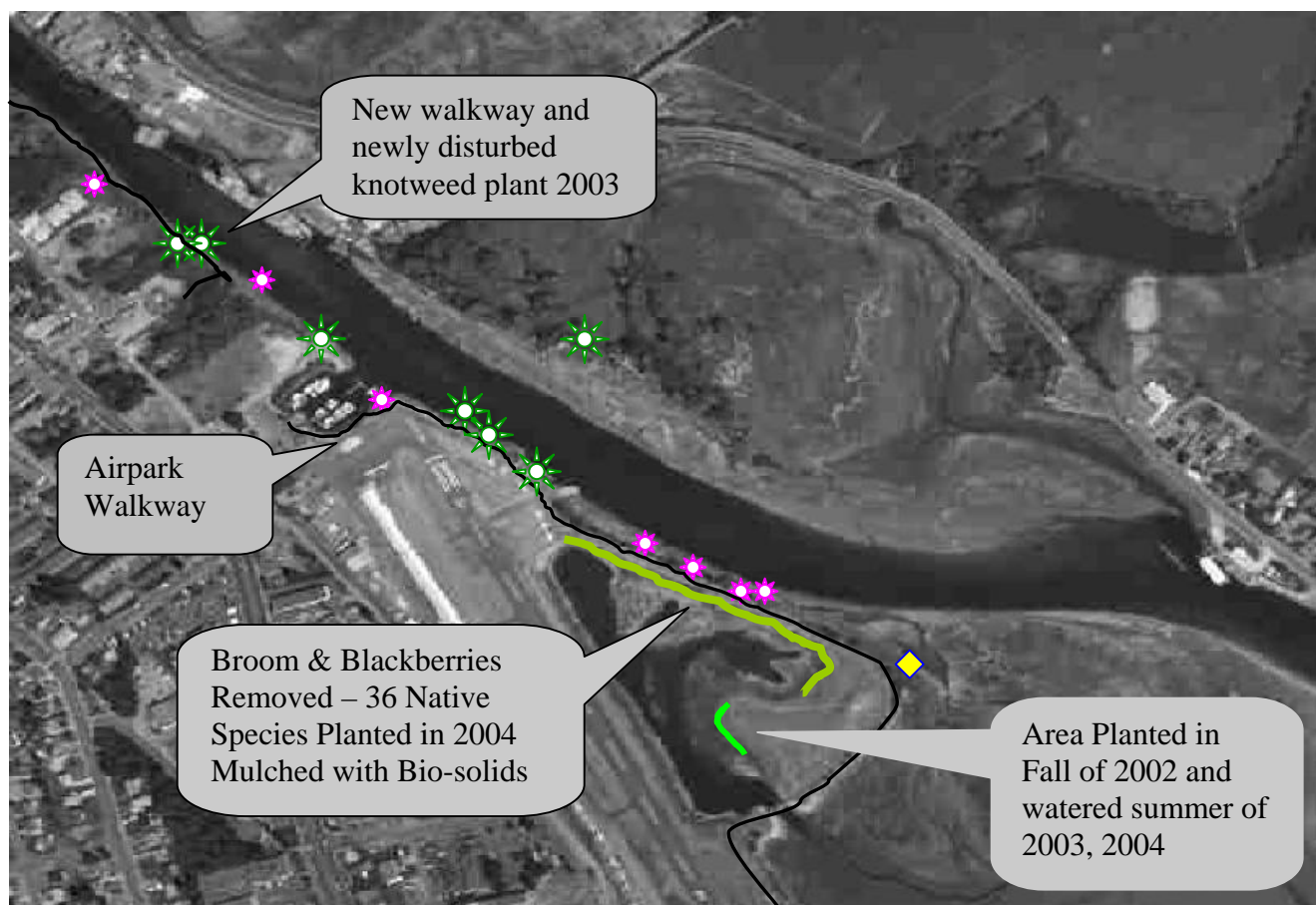


Figure 14, Area 3. Airpark Walkway

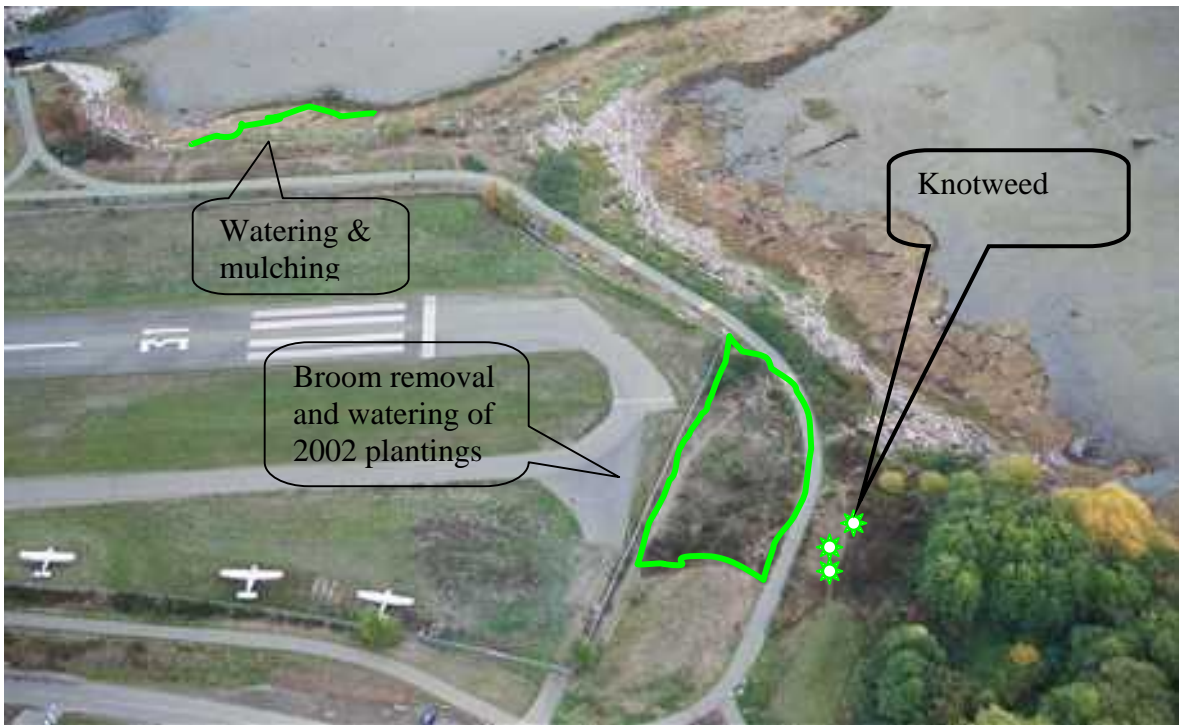


Figure 15, Area 3. Airpark Walkway

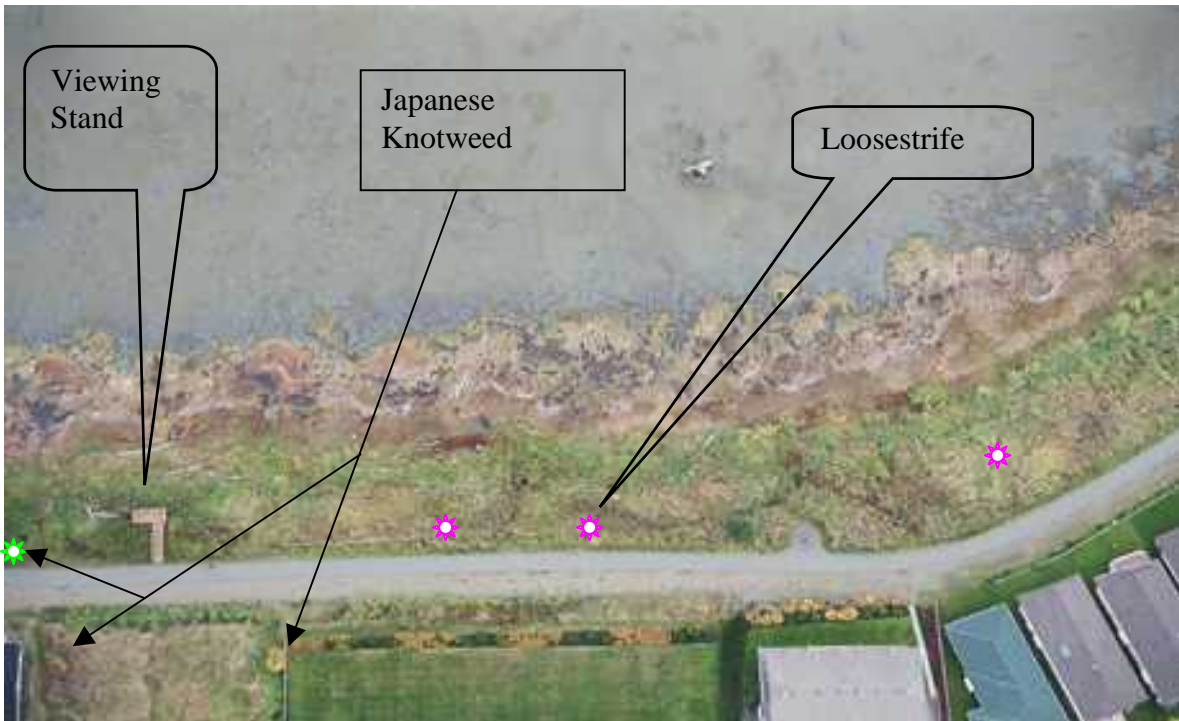


Figure 16, Area 3. Airpark Walkway

Knotweed indicated in Figure 16 is growing amongst Nootka rose. This makes it very difficult to remove without destroying a significant amount of Nootka rose. Further work will be needed to get at all the knotweed roots. It may be necessary to remove some Nootka rose in this area and replant it after knotweed is removed.

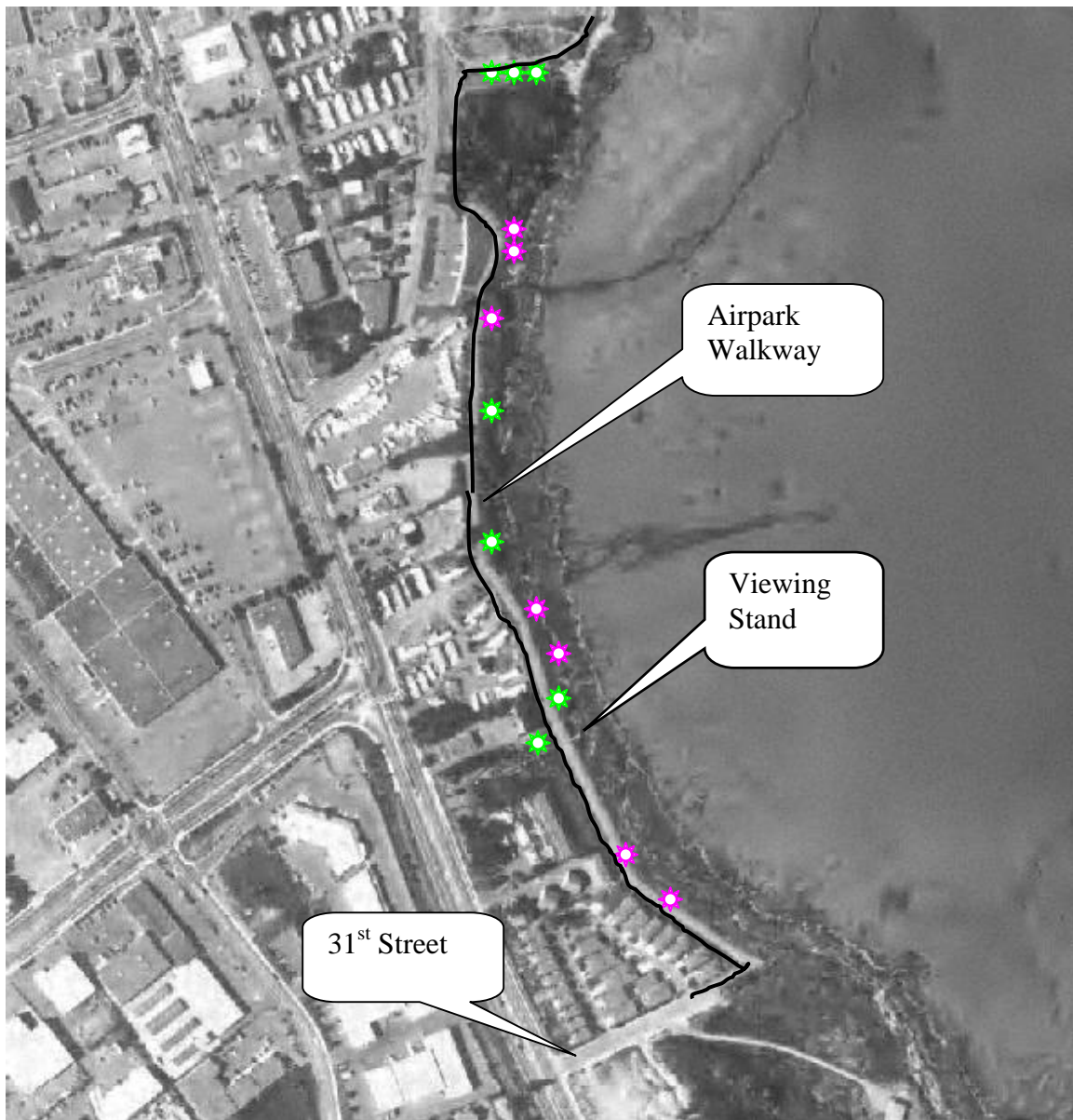


Figure 17, Area 3. Airpark Walkway

Area 4 – Courtenay River from Lewis Park to Airpark Marina

This area was searched on six different occasions using the boat and outboard motor. Purple loosestrife plants were found along the entire section of the river and in the Federal Government freshwater marina. Purple loosestrife was found in the constructed wetland at Simms Park in 2003 but not in 2004.

- 2.6 days removing purple loosestrife in 2004, 7.9 days 2003, 3.5 days – 2002, 5 days – 2001, and 2 days in 1999

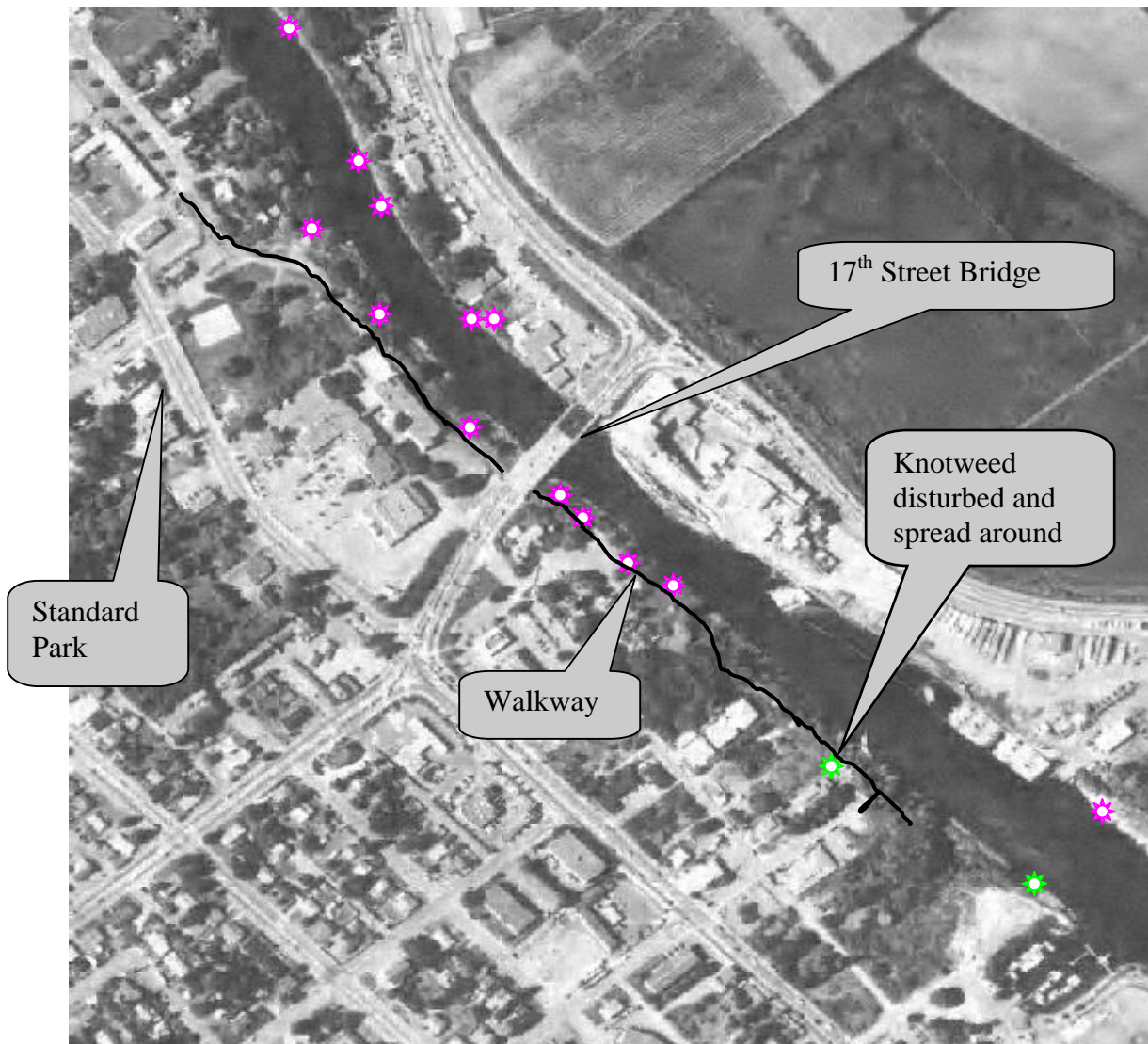


Figure 18, Area 4. Courtenay River from Airpark to Millennium Park

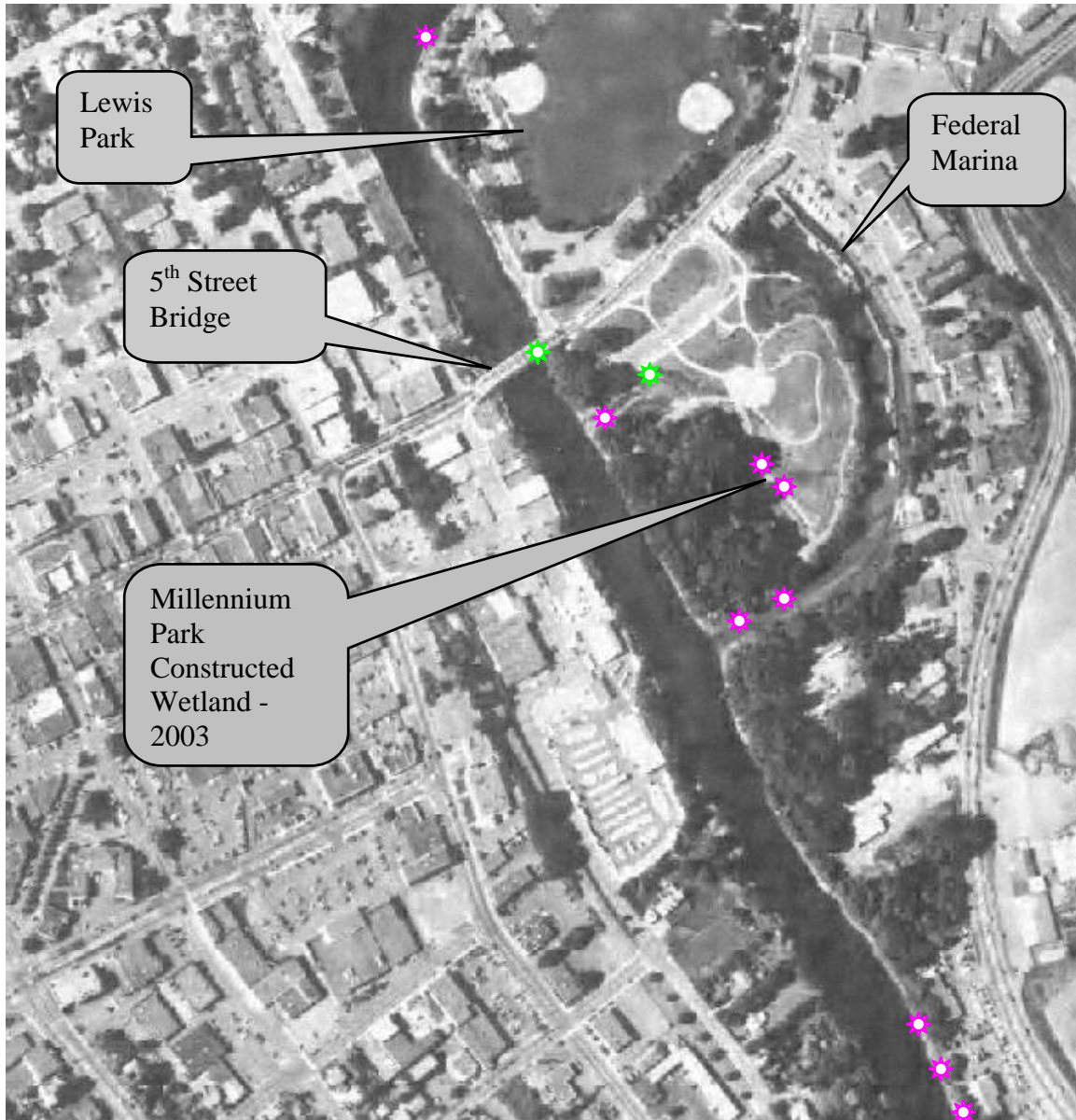


Figure 19, Area 4. Courtenay River from Standard to Lewis Parks

Area 5- Courtenay River north of Lewis Park including Tsolum River and Old Tsolum River channel and wetlands.

The old Tsolum River Back channel was dramatically altered in 1981 when the Tsolum River changed course and cut this channel off from its flow. As such this channels flow is now mainly tidal with rapid infilling via silt deposition and is an area under constant change. The yearly infilling with silt makes the channel ideal habitat for the colonization by invasive species. In addition to purple loosestrife an annual plant of the impatiens family has become well established in a large part of the grass habitat.

- 16.5 days removing purple loosestrife in 2004, 12.8 days in 2003, 14 days 2002, 28 days 2001, 14 days 1999

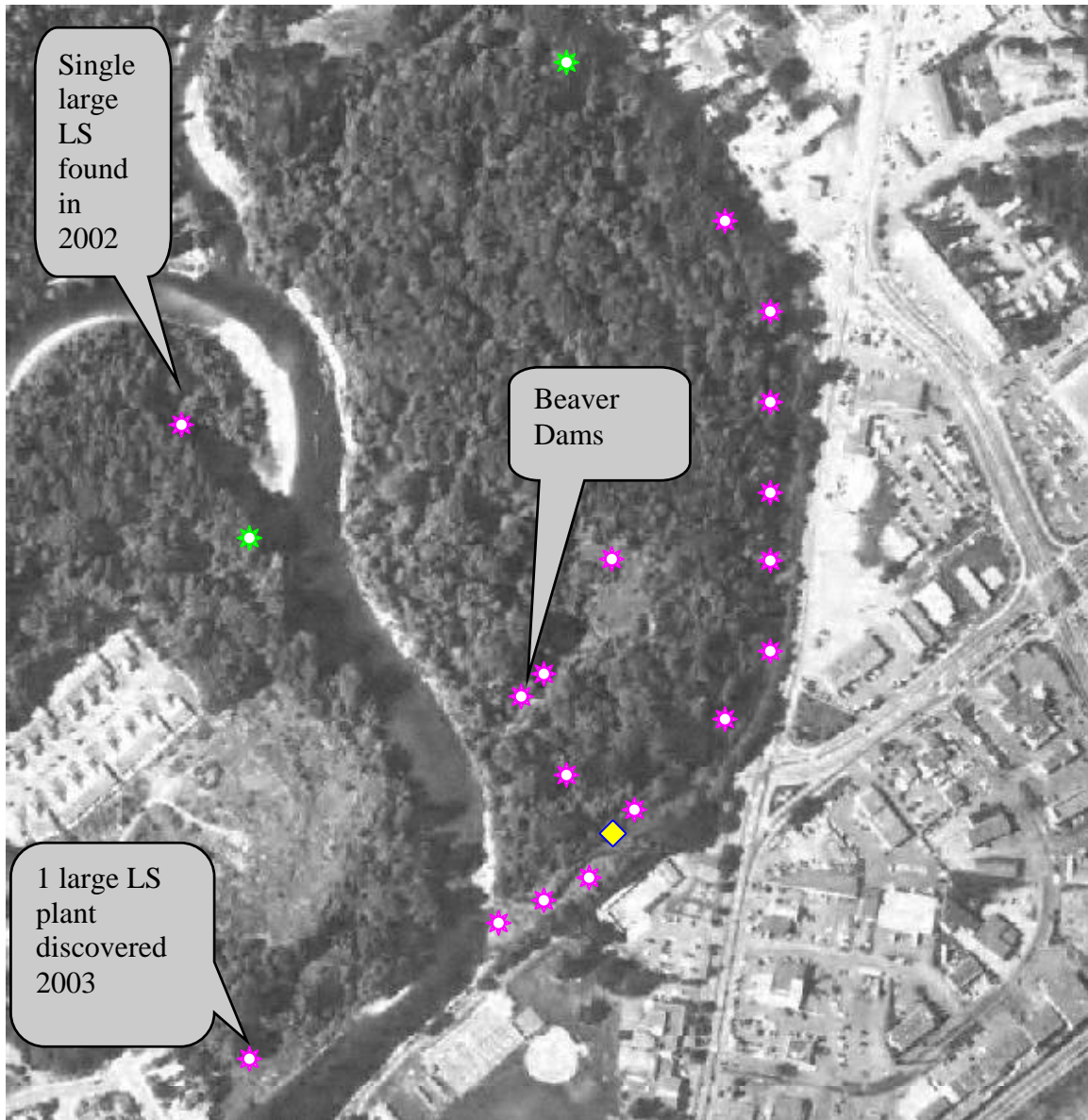


Figure 20, Area 5. Old Tsolum River Channel and Courtenay River

- The Knotweed shown in Figure 22 is growing in riprap making it difficult to remove without major expense or by using chemical herbicides.
- Two different species of Knotweed can be observed growing side by side in Figure 22. One has much smaller leaves than the other.



Figure 21, Area 5. Courtenay River and Old Tsolum River Channel



Figure 22, Area 5. Tsolum River showing location of Knotweed species.

Area 6 – Estuary on East side of Comox Road and south of Field Sawmill

Area 6 is the last remnant of natural, significantly treed, wild estuary habitat that remains of the Courtenay River. This area is vital to the preservation of a healthy stock of native plant species and thus the ecological diversity of the area.

- 19.9 days removing purple loosestrife in 2004, 19.5 days 2003, 15.8 days 2002, 22.2 days 2001 and 64 days in 1999



Figure 23, Area 6. Courtenay River Estuary Purple Loosestrife

Figure 23 shows the location of purple loosestrife removed in 2003 and 2004. The marks indicate the approximate areas where loosestrife is most prevalent. These areas are generally the same year to year but the entire area should be checked annually.

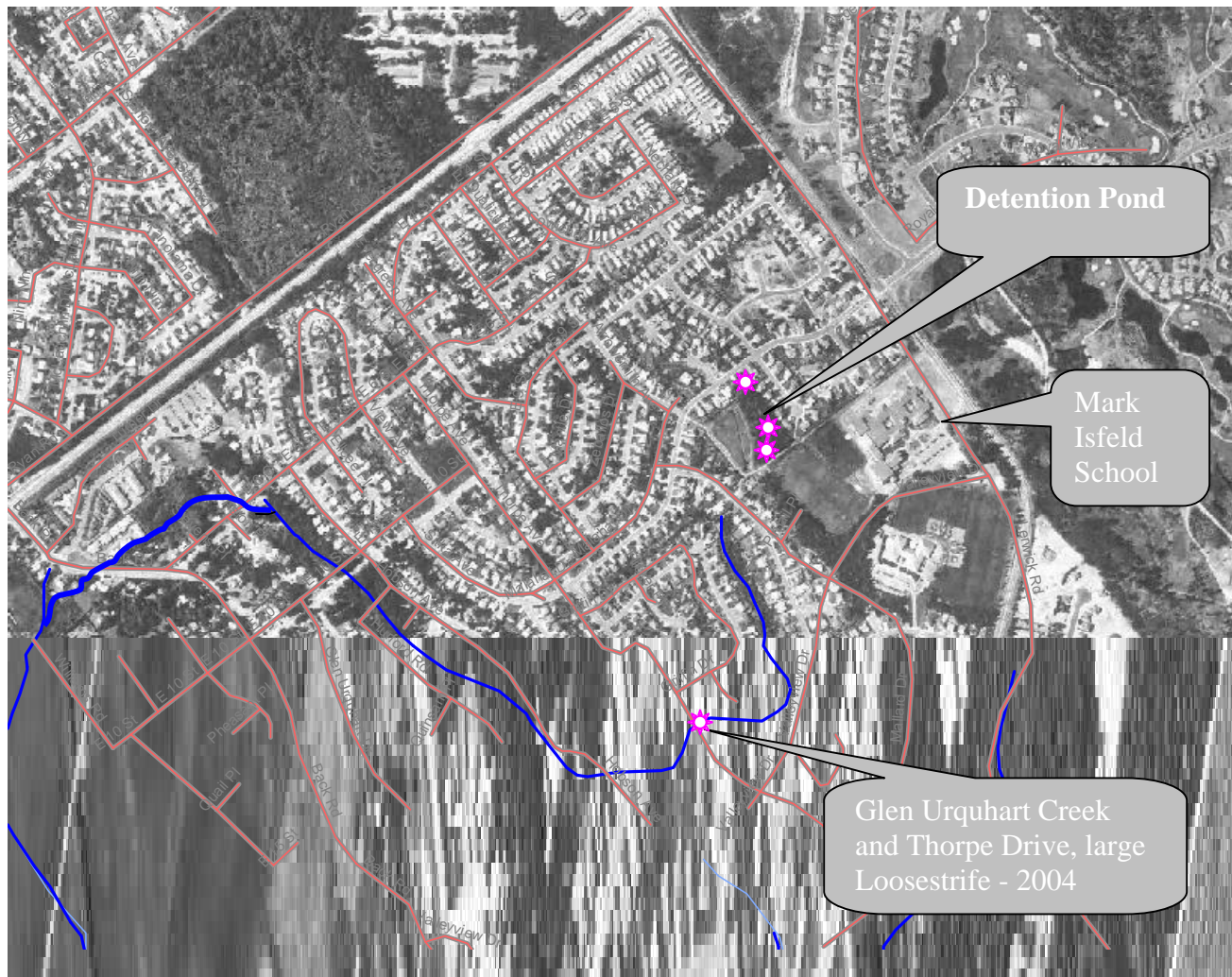


Figure 24, Area 7. Detention Pond at Malahat Drive and Glen Urquhart Creek

A large loosestrife plant was found at the upstream side of the intersection of Glen Urquhart Creek and Thorpe Drive in east Courtenay. This plant was growing in riprap and it was not possible to remove the roots. **This loosestrife plant will be alive and well in 2005.** Additionally, the area is heavy to Himalayan blackberries making access to the site difficult. The discovery of this plant in 2004 emphasizes the importance of covering previously infested areas with diligence on a yearly basis.



Figure 25, Area 6. Courtenay River Estuary Yellow Flag Iris & Knotweed Species

This was the third year that yellow flag iris (*Iris pseudacorus*) and knotweed species were targeted for removal. Eighteen days were spent removing iris, much of which was scattered throughout the estuary or buried in bark debris. This required more hours of work per kilogram of iris removed than in 2002 or 2003.

- ◊ Yellow flag iris removed in 2002
- ⊛ Yellow flag removed in 2003
- ◈ Yellow flag removed in 2004
- ★ Knotweed species initial removal 2002 follow up in 2003 & 2004
- ☆ Knotweed infestation

APPENDIX 2.

Location of Himalayan Blackberry Dominance



Figure 26, Courtenay River Estuary, Dominance by Himalayan Blackberries

Area #	Square metres	Percent coverage	Percent removed	m ² removed
1	61	50.00%	100%	61
2	98	50.00%	100%	98
3	299	70.00%	100%	299
4	266	80.00%	0%	0
5	843	60.00%	100%	843
6	484	95.00%	100%	484
7	763	75.00%	95%	725
8	256	90.00%	90%	230
9	89	60.00%	50%	45
10	935	50.00%	100%	935
11	2308	60.00%	20%	462
12	60	75.00%	100%	60
13	291	60.00%	0%	0
14	403	50.00%	0%	0
15	301	75.00%	100%	301
Total Blackberries 2002	7,457			4542
Removed 2003	1,299			
Removed 2004	3,243			
Remaining	2,915			

Table 3. 2003-04 Blackberry Species Measurements and Removal

APPENDIX 3. COURTENAY RIVER ESTUARY PLANT COMMUNITIES

The list of plants below is not complete; many more are waiting to be discovered. Some plants listed were entered from an earlier inventory but not placed in communities thus they have no location entries. Other plants listed but also with no location may be from Kennedy's list and as yet have not been found or identified. Plants are listed as One = only one found, F = few, C = commonly occur, CD = co-dominant with one or two other species, and D = dominant species of that plant community. Each plant community is outlined on the aerial photographs and given a number corresponding to the plant community on the list.

For user's convenience the page numbers for each plant are given from the Plants of Coastal British Columbia by Pojar and MacKinnon. When not listed in Plants of Coastal BC, the page numbers from the Flora of the Pacific Northwest by Hitchcock and Cronquist are given in bold type.

Species name	Common name	Area	1	2	3	4	5	6	7	8	9	9A	10	11	12
		Pojar Hitch	Spruce Cotton wood	Roadside	Typha Reed canary	Carex lyngbei	Tidal Flats	Reed Canary	Impoundment zone	Typha Reed Canary Aster	Blue Joint Aster	Blue Joint Micro climate	Tufted Hairgrass	Typha Reed canary grass	21 st Street
<i>Abies grandis</i>	Grand fir	34													
<i>Achillea millefolium</i>	Yarrow	279		F	F			F	F	C	C	F	C	C	
<i>Agrostis tenuis</i>	colonial bentgrass	367	C	C	F										
<i>Allisma plantago-aquatica</i>	Water plantain	337							F			F			
<i>Alnus rubra</i>	Red Alder	44	C	F	ONE			F	F	1		F		ONE	C
<i>Ambrosia chamissonis</i>	Silver burweed	278		C											
<i>Amelanchier alnifolia</i>	Saskatoon	72	C												
<i>Anaphalis margaritacea</i>	Pearly everlasting	304		F											
<i>Angelica genuflexa</i>	Kneeling angelica	218	F					F			C	F	F	F	
<i>Anthroxanthum odoratum</i>	sweet vernal grass	370													
<i>Aster foliaceus</i>	Leafy Aster	288		F	F			C	C	CD	D	F	C	C	
<i>Athyrium filix-femina</i>	Lady fern	422	F	ONE	F						F			F	F
<i>Atriplex patula</i>	Common orache, saltbush	310													
<i>Barbarea orthoceras</i>	American winter cress	149													

Species name	Common name	Area	1	2	3	4	5	6	7	8	9	9A	10	11	12
		Pojar Hitch	Spruce Cotton wood	Roadside	Typha Reed canary	Carex lyngbei	Tidal Flats	Reed Canary	Impoundment zone	Typha Reed Canary Aster	Blue Joint Aster	Blue Joint Micro climate	Tufted Hairgrass	Typha Reed canary grass	21 st Street
<i>Bidens amplissima</i>	Beggar ticks	290			F				F			F			
<i>Brodiaea hyacinthina</i>	Fool's onion	107						F							
<i>Calamagrostis canadensis</i>	blue joint	365			F			F		C	D	C	C	F	
<i>Camassia quamash</i>	common camas	108						C	F	C	C	C	C	C	
<i>Carex lyngbei</i>	Lyngby's sedge	400			C	D	C	C	D	C	C		C	C	
<i>Castilleja miniata</i>	Common Red paintbrush	258	F					F	F	F					
<i>Castilleja unalascensis</i>	Unalaska paintbrush	257						F							
<i>Chenopodium rubrum</i>	Red goosefoot	311		F											
<i>Cichorium intybus</i>	Chicory	227		F											
<i>Cicuta douglasii</i>	Douglas' water hemlock	215			F			C	F				F		
<i>Cirsium arvense</i>	Canada thistle	306	C	F	F			C		C	C	C	F	F	
<i>Claytonia sibirica</i>	Siberian Miner's Lettuce	133													F
<i>Convolvulus sepium</i>	Morning glory	326		F	F						F	C			
<i>Cornus stolonifera</i>	Red-osier dogwood	90	C	F				F			F				
<i>Crataegus douglasii</i>	black hawthorn	73	C	F				F			F			ONE	C
<i>Crataegus monogyna</i>	Common Hawthorn	73		F											
<i>Cystifolus scoparis</i>	Scotch broom	83		F											C
<i>Dactylis glomerata</i>	orchard grass	371													C
<i>Daucus carota</i>	Queen Anne's Lace	221		F	F			F							
<i>Deschampsiaespitosa</i>	tufted hairgrass	384		F				C	F	C	C		D	F	
<i>Dicentra formosa</i>	Bleeding Heart	313													F
<i>Disporum hookeri</i>	Hooker's fairbells	102	F												F
<i>Distichlis spicata</i>	seashore salt grass	381													

Species name	Common name	Area	1	2	3	4	5	6	7	8	9	9A	10	11	12
		Pojar Hitch	Spruce Cotton wood	Roadside	Typha Reed canary	Carex lyngbei	Tidal Flats	Reed Canary	Impoundment zone	Typha Reed Canary Aster	Blue Joint Aster	Blue Joint Micro climate	Tufted Hairgrass	Typha Reed canary grass	21 st Street
<i>Dodecatheon pulchellum</i>	Few flowered shooting star	324			F			C	F	C	F	F	C	F	
<i>Elocharis palustris</i>	Creeping spike-rush	406					F		F						
<i>Elymus mollis</i>	dunegrass	364													F
<i>Elymus repens</i>	quackgrass, couch grass	362													
<i>Epilobium angustifolium</i>	fireweed	206													
<i>Epilobium watsonii</i>	Watson's willow herb	207		F	C			F	C		C			C	
<i>Equisetum arvense</i>	Comon horsetail	430	F		C				C			F	F		
<i>Eriogon philadelphicus</i>	Philadelphia fleabane	284		ONE											
<i>Erythronium oregonum</i>	White Fawn Lilly	104	C												
<i>Festuca arundinaceae</i>	Tall fescue	376			F				F						
<i>Festuca pratensis</i>	Meadow fescue	376						C	C						
<i>Fritillaria camschatcensis</i>	Northern rice root	110	F					C		C	F		C		
<i>Fritillaria lanceolata</i>	chocolat lily	110													
<i>Galium aparine</i>	Bedstraw	330			F								C		
<i>Galium asperium</i>	Rough bedstraw	449													
<i>Galium trifidum</i>	small bedstraw	331	F						C	F	C		C	C	
<i>Galium triflorum</i>	Sweet-scented bedstraw	330		F				F	C		C	C		C	
<i>Geranium molle</i>	Dovevoot geranium	316													
<i>Geranium robertianum</i>	herb Robert	316		F											C
<i>Glaux maritima</i>	sea-milkwort	321					C								
<i>Glyceria occidentalis</i>	western managrass	379													
<i>Grindelia integrifolia</i>	Gumweed	291													
<i>Heracleum lanatum</i>	Cow parsnip	213	C								F		F		

Species name	Common name	Area	1	2	3	4	5	6	7	8	9	9A	10	11	12
		Pojar Hitch	Spruce Cotton wood	Roadside	Typha Reed canary	Carex lyngbei	Tidal Flats	Reed Canary	Impoundment zone	Typha Reed Canary Aster	Blue Joint Aster	Blue Joint Micro climate	Tufted Hairgrass	Typha Reed canary grass	21 st Street
<i>Hesperis matronalis</i>	Dame's violet, sweet rocket	169													
<i>Holcus lanatum</i>	common velvet grass	385	C												F
<i>Holidiscus discolor</i>	Oceanspray creambush	71													F
<i>Hordeum brachyantherum</i>	meadow barley	362											F		
<i>Hypericum formosum</i>	Western St John's-wort	319		F	F		C	C	F		F		C	F	
<i>Hypochaeris radicata</i>	Hairy Cat's-ear	274		F			F	F			1	1		1	
<i>Ilex aquifolium</i>	Holly		F												F
<i>Impatiens noli tangere</i>	touch-me-not	314		F											
<i>Iris pseudacorus</i>	yellow-flag	116			F				F		F	F	F	F	
<i>Juncus acuminatus</i>	tapered rush	414		F					C						
<i>Juncus balticus</i>	Baltic rush	410													
<i>Juncus effusus</i>	common rush	410		C			C	C	C		F?			F	
<i>Lactuca biennis</i>	Tall Blue Lettuce	276	F									F			
<i>Lathyrus japonicus</i>	beach pea	191		ONE				F							
<i>Lathyrus palustris</i>	marsh peavine	191		F	F			F	C	C	C	C	F-C	C	
<i>Lemma minor</i>	duckweed	677													
<i>Leucanthemum vulgare</i>	Oxeye daisy	281													
<i>Lilaeopsis occidentalis</i>	Western lillaeopsis	213													
<i>Lilium columbianum</i>	tiger lily, Columbia lily	111	F								C				
<i>Lolium perenne</i>	Ryegrass	363		F											
<i>Lonicera involucrata</i>	Black twinberry	69	C		ONE			F		F	F	F	F	F	
<i>Lupinus sp</i>	lupin	194	F												
<i>Lycopus uniflorus</i>	bugleweed	243							C			C	F	F	

Species name	Common name	Area	1	2	3	4	5	6	7	8	9	9A	10	11	12
		Pojar Hitch	Spruce Cotton wood	Roadside	Typha Reed canary	Carex lyngbei	Tidal Flats	Reed Canary	Impoundment zone	Typha Reed Canary Aster	Blue Joint Aster	Blue Joint Micro climate	Tufted Hairgrass	Typha Reed canary grass	21 st Street
<i>Lysichiton americanum</i>	Skunk cabbage	334	F												
<i>Lysimachia thyrsoiflora</i>	Tufted loosestrife	321			F										
<i>Lythrum salicaria</i>	purple loosestrife	318	F	F	F		F	F	F	F	F	F	F	F	F
<i>Maianthemum dilatatum</i>	false lily-of-the-valley	103	C								F				C
<i>Malus fusca</i>	Pacific crab apple	48	C	F	ONE			F			F				
<i>Malus species</i>	Crabapple xsps		F												
<i>Malus species</i>	Domestic apple sps			F											
<i>Meiblotus alba</i>	white sweet-clover	199													
<i>Mentha arvensis</i>	field mint	244	C		F					F	F		F	F	
<i>Mentha spicata</i>	spearmint	404													
<i>Mimulus guttatus</i>	monkey flower	264			F				C						
<i>Monti (Claytonia) cordifolia</i>	heart leaved spring-beauty	133													
<i>Monti (Claytonia) parvifolia</i>	streambank spring-beauty	132													
<i>Monti (Claytonia) sibirica</i>	Miners' lettuce	133													
<i>Myosotis scorpioides</i>	Marsh forget-me-not	240													
<i>Myrica gale</i>	sweet gale	81	F					F		1	F		F	F	
<i>Oenanthe sarmentosa</i>	Pacific water-parsley	216	C		F			F	C		F	C			F
<i>Petasites palmatus</i>	Palmate Coltsfoot	294													
<i>Phalaris arundinaceae</i>	reed canary grass	370	F	C	D			D	C	CD	F	F	C	D	F
<i>Phleum pratense</i>	timothy	368		F				F							
<i>Physocarpus capitatus</i>	ninebark	73	F	F										F	
<i>Picea sitchensis</i>	Sitka spruce	37	D												F
<i>Plantago lanceolata</i>	ribwort, narrow-leaved plantain	329		F	F			C	F			F			

Species name	Common name	Area	1	2	3	4	5	6	7	8	9	9A	10	11	12
		Pojar Hitch	Spruce Cotton wood	Roadside	Typha Reed canary	Carex lyngbei	Tidal Flats	Reed Canary	Impoundment zone	Typha Reed Canary Aster	Blue Joint Aster	Blue Joint Micro climate	Tufted Hairgrass	Typha Reed canary grass	21 st Street
<i>Plantago macrocarpa</i>	Alaskan plantain	329											C		
<i>Plantago major</i>	common, broad-leaved plantain	329						F		F	F				
<i>Plantago maritima</i>	seaside plantain	328													
<i>Platanthera dilatata</i>	white bog orchid	122								F	F	F	C		
<i>Poa pratensis</i>	Kentucky bluegrass	378		F											
<i>Polygonum douglasii</i>	Douglas' knotweed	127										F			
<i>Polygonum lapathifolium</i>	willoweed	127							one						
<i>Polystichum munitum</i>	sword fern	421			ONE										C
<i>Polygonum persicaria</i>	Lady's thumb	127			F										C
<i>Populus tremuloides</i>	Trembling Aspen	46													
<i>Populus trichocarpa</i>	black cottonwood	46	C								ONE				
<i>Potentilla pacifica</i>	Pacific silver weed	186	C	C	C		C	F	C	C	C	C	C	C	
<i>Prunella vulgaris</i>	self-heal	246		F	C			F	F				F		
<i>Prunus emarginata</i>	Bitter cherry	48	F												
<i>Pteridium aquilinum</i>	bracken	420													
<i>Ranunculus occidentalis</i>	western buttercup	176	F?						F						
<i>Ranunculus repens</i>	Creeping buttercup	176	C		F					C	C	C			
<i>Rhamnus purshiana</i>	casca	90	F												F
<i>Ribes lacustre</i>	Black swamp gooseberry	85	F												
<i>Ribes sanguineum</i>	Red flowering current	84	F												F
<i>Rosa gymnocarpa</i>	dwarf woodland rose	74													F
<i>Rosa nootkana</i>	Nootka rose	74	C	F							F				C
<i>Rubus discolor</i>	Himalayan blackberry	78	C	F				F						F	C

Species name	Common name	Area	1	2	3	4	5	6	7	8	9	9A	10	11	12
		Pojar Hitch	Spruce Cotton wood	Roadside	Typha Reed canary	Carex lyngbei	Tidal Flats	Reed Canary	Impoundment zone	Typha Reed Canary Aster	Blue Joint Aster	Blue Joint Microclimate	Tufted Hairgrass	Typha Reed canary grass	21 st Street
<i>Rubus laciniatus</i>	Evergreen blackberry	78	F	ONE				F							
<i>Rubus spectabilis</i>	salmonberry	76	C	F				F						C	C
<i>Rubus ursinus</i>	trailing blackberry	78		F	ONE						F				C
<i>Rumex acetosella</i>	Sheep sorel	129		F											
<i>Rumex conglomeratus</i>	Clustered dock	130										F			
<i>Rumex crispus</i>	Curled dock	130													
<i>Rumex occidentalis</i>	Western dock	130	F	F	F			F	F	F	C	F	F	C	
<i>Rumex salicifolius</i>	Willow dock	130			F			C							
<i>Sagittaria latifolia</i>	Wapato or arrowhead	337												F	
<i>Salix lucida</i>	Pacific willow	88			ONE										
<i>Salix</i> sps	Willow species	88			F			F	F		F				
<i>Sambucus caerulea</i>	Blue elderberry	70	F												
<i>Sambucus racemosa</i>	Red elderberry	70	C	ONE	F										F
<i>Scirpus americanus</i>	American bulrush	405													
<i>Scirpus lacustris</i>	Hard-stemmed bulrush	404							F			F	F		
<i>Scirpus microcarpus</i>	Small-flowered bulrush	405						F	C		C			C	
<i>Scutellaria galericulata</i>	marsh skullcap	243						F	C					F	
<i>Sidalcea hendersonii</i>	marsh hollyhock	318		F	C			C	C	C	C	D	C	C	
<i>Sisyrinchium littorale?</i>	blue-eyed grass	114													
<i>Sium suave</i>	Water parsnip	215													
<i>Solidago canadensis</i>	Goldenrod	289		C											
<i>Sonchus asper</i>	Prickly sow thistle	275	F	F	F			F		F	C	C	F	C	
<i>Sorbus scopulina</i>	western mountain ash	71	F	ONE	F				ONE						

Courtney River Estuary October 2002 Plant communities as delineated August 2003



Figure 27. Plant Communities from the East



Figure 28. Plant Communities from the West

APPENDIX 4. NATIVE SPECIES PLANTINGS, 2004

Airpark Naturalization			21st Street Naturalization		
Quantity	Size	Latin & Common Name	Quantity	Size	Latin & Common Name
41 gal		Acer glabrum - Douglas Maple	41 gal		Acer circinatum - Vine Maple
121 gal		Amelanchier alnifolia - Saskatoon Berry	101 gal		Amelanchier alnifolia - Saskatoon Berry
21 gal		Arbutus menziesii - Arbutus	31 gal		Cornus nuttallii - Western Flowering Dogwood
3610cm		Arctostaphylos uva-ursi - Kinnikinnick	51 gal		Corylus cornuta - Beaked Hazelnut
1810 cm		Balsamorhiza deltoidea - Deltoid Balsamroot	41 gal		Crataegus douglasii - Black Hawthorn
61 gal		Cornus nuttallii - Western Flowering Dogwood	61 gal		Holodiscus discolor - Ocean Spray
121 gal		Cornus stolonifera - Red Osier Dogwood	5410 cm		Lythyrus japonicus - Beach Pea
11 gal		Corylus cornuta - Beaked Hazelnut	61 gal		Manhonia aquifolium - Tall Oregon Grape
52 gal		Corylus cornuta - Beaked Hazelnut	101 gal		Oemleria cerasiformis - Indian Plum
241 gal		Crataegus douglasii - Black Hawthorn	41 gal		Populus tremuloides - Trembling Aspen
121 gal		Elymus molis - Dune Grass	61 gal		Philadelphus lewisii - Mock Orange
121 gal		Holodiscus discolor - Ocean Spray Creambush	12 gal		Quercus garryana
1810 cm		Lathyrus japonicus - Beach Pea	21 gal		Rhamnus purshiana - Cascara
61 gal		Lonicera involucrata - Black Twinberry	41 gal		Rhododendron macrophyllum - Pacific Rhododendron
61 gal		Mahonia aquifolium - Tall Oregon Grape	61 gal		Ribes sanguineum - Red Flowering Currant
121 gal		Malus fusca - Pacific Crabapple	61 gal		Rosa gymnocarpa - Baldhip Rose
61 gal		Myrica Gale - Sweet Gale	121 gal		Rosa pisocarpa - Clustered Wild Rose
61 gal		Oemleria cerasiformis - Indian Plum	41 gal		Rubus parviflorus - Thimbleberry
61 gal		Philadelphus lewisii - Mock Orange	21 gal		Sorbus sitchensis - Sitka Mountain Ash
121 gal		Physocarpus capitatus - Ninebark	21 gal		Spiraea douglasii - Hardhack
6RCB		Populus tremuloides - Trembling Aspen	61 gal		Symphoricarpos mollis - Trailing Snowberry
01 gal		Prunus emarginata - Bitter Cherry - Not Available	61 gal		Symphoricarpos albus - Snowberry
22 gal		Quercus garryana - Garry Oak	149		Total Plantings for 21st Street
61 gal		Rhamnus purshiana - Cascara			
41 gal		Ribes sanguineum - Red Flowering Currant			
61 gal		Rosa gymnocarpa - Baldhip Rose			
121 gal		Rosa nootkana - Nootka Rose			

121 gal	Rosa pisocarpa - Clustered Wild Rose
121 gal	Rubus parviflorus - Thimbleberry
121 gal	Rubus spectabilis - Salmon Berry
121 gal	Salix sps
61 gal	Salix lucida - Pacific Willow
61 gal	Sambucus racemosa - Red Elderberry
41 gal	Sorbus sitchensis - Sitka Mountain Ash
41 gal	Spirea douglasii - Hardhack
61 gal	Symphoricarpos albus - Snowberry
41 gal	Symphoricarpos mollis - Trailing Snowberry
330	Total Plantings Airport
149	Total Plantings 21st Street
479	Total Plantings for 2004

Courtenay River Estuary, Camas and Red Osier Dogwood in Bloom

