Tod Creek Flats Integrated Management Plan

Prepared For:
The Corporation of the District of Saanich
and The Friends of Tod Creek Watershed

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introduction

The Tod Creek watershed is located primarily within the District of Saanich, with the western headwaters being in the District of Highlands and its outlet in the District of Central Saanich where it discharges into Tod Inlet. The watershed has an interesting history including being the source of water for Butchart Gardens, supporting food production for the St. Joseph's Hospital in the early 1900's, and housing a military rifle range. The stream itself supports a small resident trout population but has a fish barrier in its lower reaches that limits anadromous salmon to the first few 100 metres of stream. The main creek has been extensively channelized to facilitate land drainage and agriculture which began roughly 150 years ago.

The stream channel is in poor condition and lacks habitat complexity due to past clearing efforts. Many of the watersheds lowland wetlands have been drained or modified to support various land uses including agriculture and the military rifle range. In its existing condition it is a poorly functioning ecological system that cannot sustain salmonid populations. The Tod Flat's area (Figure 1) is one such area that has been altered by land use change.

The Tod Flat's area is part of the flood plain of Tod Creek. The creek spills its banks in the fall, flooding much of the land until June or early July. During this flooded state it becomes a major stopping place for local waterfowl. The problem is that the length of time the fields are flooding seems to be increasing such that the growing season has been significantly reduced. In efforts to increase the growing season, farmers are pumping water off the land each spring in the hopes of planting and harvesting crops.

The District of Saanich has received an Infrastructure Planning Grant to develop a framework/ concept plan with the intention to integrate the various objectives for land use of the Tod Flats. A working group—the Tod Creek Flats Working Group—has been formed to lead this community process. The overall purpose of the project is:

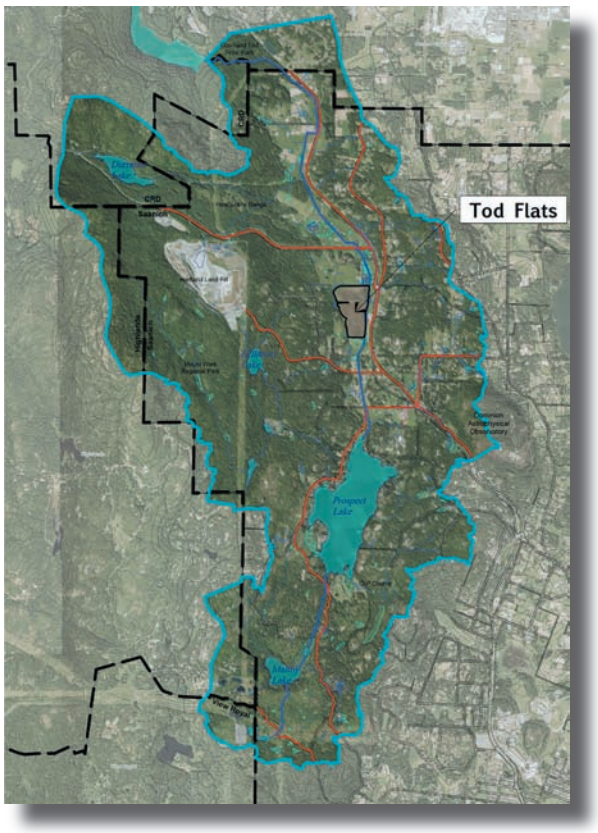


Figure 1. Tod Creek watershed and Tod Flats study area

- to identify how the Tod Creek Flats area functions presently compared to historical observations;
- to identify what the key problems/ interactions/ management issues are within the system as it relates to agriculture, wildlife habitat, flood plain function and the health and welfare of the local community; and
- to look at the site in a holistic manor and develop a framework/ concept plan that optimizes the use of the site for agriculture, flood plain function and wildlife habitat values.

the issues

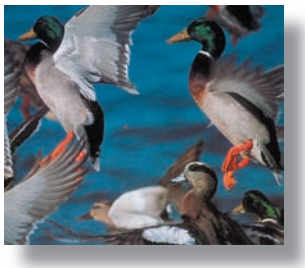
The Tod Flats site is an agricultural landscape that is encountering longer and more intensive flooding, resulting in shorter growing seasons. For the lands owners and farmers, it is getting harder to farm the land and requires significant inputs to prepare the land for farming (i.e. flood water pumping). The historic solution to this problem was to dredge the creek, lowering the water table, to facilitate faster drainage. The following points highlight that significant issues related to the flats:

Agriculture

In its present condition, that land is becoming unfarmable. The duration of flooding is increasing such that growing seasons are critically short resulting in crop losses. Mitigation measures to pump the fields dry in the late spring are becoming cost prohibitive and impact sensitive habitat values associated with the landscape. Dredging the channel is not considered an option since this will further increase the rate of soil subsidence, destroys stream habitat, and is not a sustainable cure to the problem. The peat soils are less than 30 cm deep in some areas of the flats.

Ecology

The lower reaches of Tod Creek immediately upstream of the fish barrier, do not support a significant fish population. There is potential cutthroat trout habitat between Prospect Lake and Tod Flats. The remainder of the channel, including that which flows through Tod Flats, is very low gradient (0.1 to 0.5%). The limiting factors to fish production are summer low flow conditions, high summer water temperatures and low dissolve oxygen levels. Past channel dredging and vegetation clearing of the stream/ditch negatively impacted fish habitat. Impacts include loss of riparian habitat, decreased channel complexity, low summer flows and higher summer water temperatures. On a positive note, the seasonal flooding patterns of the flats provides excellent waterfowl habitat in the fall, winter and spring as well as create microhabitat for two rare and endangered plant species (*Callitriche marginata* and *Bidens amplissima*).



Economics

Farming the Tod Flats landscape is becoming impractical from a business perspective. In order to 'work' the land in the late spring ,the land must be drained with mechanical pumps. Pumping is an unsustainable practice which is taking longer and is becoming more difficult each year. In addition, the seasonal pumping and cultivation of the land is causing subsidence of the organic soils which further risks the long term viability of the farmland.

Social

Besides agriculture, the fields provide habitat for numerous waterfowl in the fall and winter. Ducks, geese and swans use the fields in the fall as a place to feed. Predatory birds prey on these migratory populations which provide a winter food source for Bald Eagles. The new bicycle and pedestrian path adjacent to the site facilitates easy access to the site and the potential for this area as a destination for wildlife viewing. The flood plain/ farm fields also provide a significant amount of runoff storage and act as a hydrological reservoir that buffers downstream fish habitat and built environments.

the methodology

The Tod Flats landscape land use presents a complicated problem for property owners, the municipality and the steering committee. At issue are agricultural and aesthetic values, economics, fish and wildlife habitat, stormwater management, and First Nations use of the land. It is a complicated problem with linkages to land use, historical land cover changes, drainage manipulation and soil management practices. Our goal is to:

1. understand how the watershed and Tod Flats are functioning from a hydrological perspective,
2. review historical and present land use practices as it pertains to the site processes and functions,
3. identify site opportunities and constraints, and
4. develop framework plans that work with and support site processes, provide agricultural opportunities and enhance and/ or restore natural systems and associated wildlife and fish habitat.

In order to make sound and practical land use decisions about the Tod Creek Flats landscapes, land managers and owners need to understand how the site functions. The first step is to understand how this landscape has evolved into what it is today.

landscape evolution

The Tod Creek Flats landscape is a function of geophysical attributes, glacial and post glacial processes, hydrological processes and present day land use and alterations. Huntley and Bowman (2000) provide a detailed account of how the lands in the Tod Creek watershed have evolved through the interpretation of geology, surficial soils, and lake sediment information.

The following figure (derived from Huntley and Bowman) illustrates how the Tod Flats landscape may have formed. Tod Flats is at a present day relative sea level elevation of roughly 44 metres. The areas was covered by 850 metres of ice during the last glaciation period, roughly 16,000 years ago. The glaciers carved the land and deposited a layer of till over much of the land as they advanced. The till was a mix of sediment (fine silts to gravels and boulders) that was spread and compacted as the glaciers advanced over the land. The extreme weight of the glaciers resulted in the land subsiding or sinking. As the glaciers melted sea levels also increased. The net affect was a sea level that was roughly 80 metres high than it is today. In other words, the Tod Creek Flats landscape was covered by over 30 metres of sea water. During the roughly 3000 years of sea water inundation, glaciomarine sediment was deposited in the Tod Creek valley bottom. This sediment was comprised of fine silt and clay particles which drapes much of the land from sea level to the +/- 80 metre elevation band. As the ocean levels dropped, the water over the flats went from saltwater to brackish marine to freshwater. The bedrock formation that is the present day location of the old Butchart Garden's weir was and still is a significant elevation control point in the stream channel. Once ocean levels fell below this level, the Tod Creek Flats landscape would have become a shallow freshwater lake or large wetland (about 10,000 years ago).

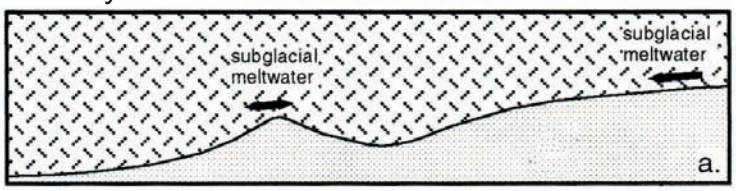
The valley bottom from Durrance Road to Hartland Avenue was probably a large shallow freshwater wetland Any sediments that were eroded from

Organic Soil Development
in the Tod Flats

the channel between Prospect Lake and the flats would have quickly dropped to the bottom of the lake. The shallow water body would have provided excellent growing conditions for aquatic and semi-aquatic plants which would thrive in this nutrient rich water. Organic matter in the form of dead plant material settled to the bottom of the depression where it accumulated over time. Since there is very little gradient in the valley bottom, very little if any material would be lost due to erosion. There was also very little lost due to decomposition since there would have been very little oxygen at the bottom of the lake/ wetland. As a result, organic matter accumulated. For close to 12,000 years, this system was built on inputs of organic matter produced by wetland and aquatic plants. The net result was that the landscape changed from a shallow waterbody, to a large wetland as more and more organic material accumulated. The channel likely would have meandered across the flats and been heavily influenced by beaver activity.

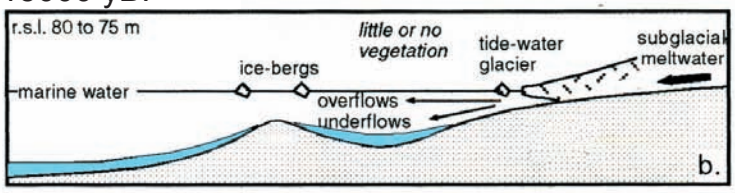
The exact depth of peat is unknown but we do know if varies from 0.3 to greater than 1.2 metres (personal observations).

16000 yBP



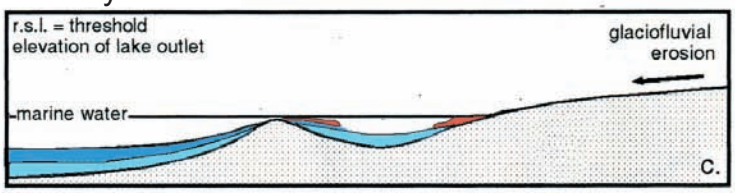
Entire watershed covered by ice during last glaciation period

15000 yBP



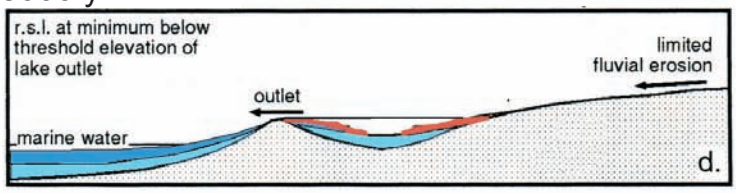
Marine clay deposition in bottom lands

12000 yBP



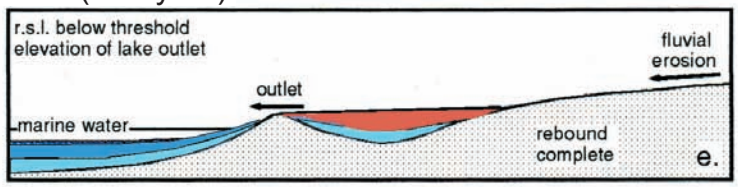
Start of peat soils development

8000 yBP

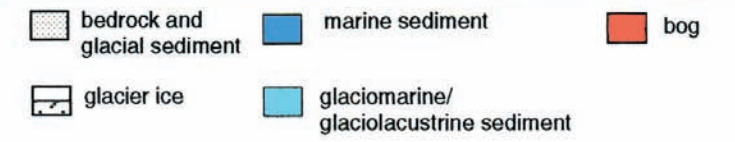


8000 years of marsh plants contributing to peat production. Minimal loss of organic matter since valley bottom was flat

1860 (150 yBP)



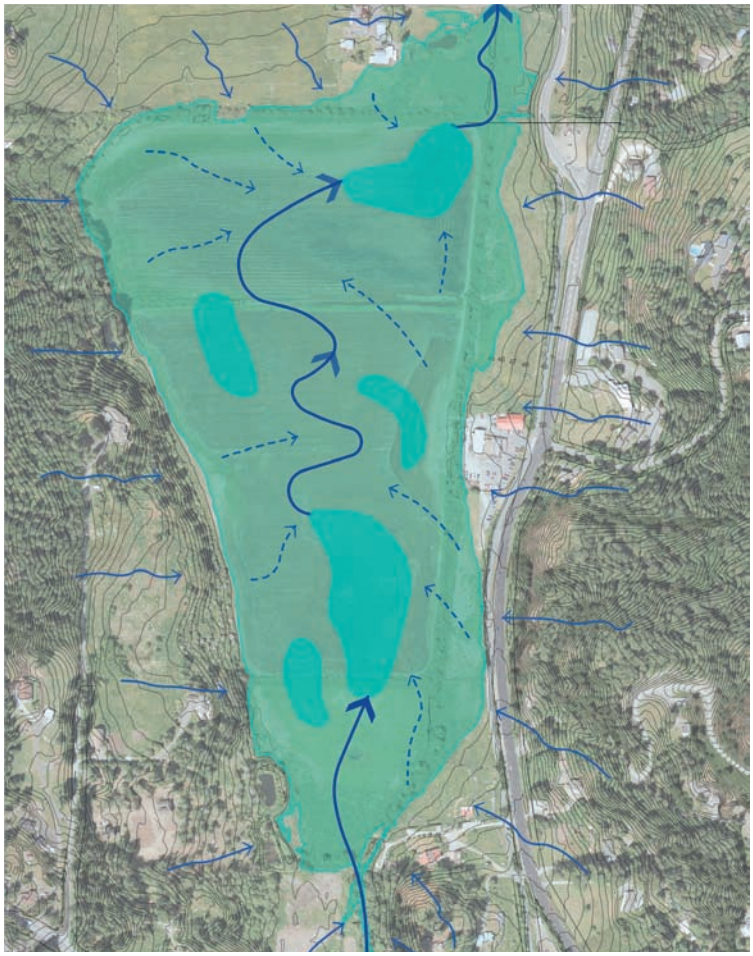
Maximum accumulation of peat soils occurred prior to drainage of wetlands, land clearing and intensive farming activity



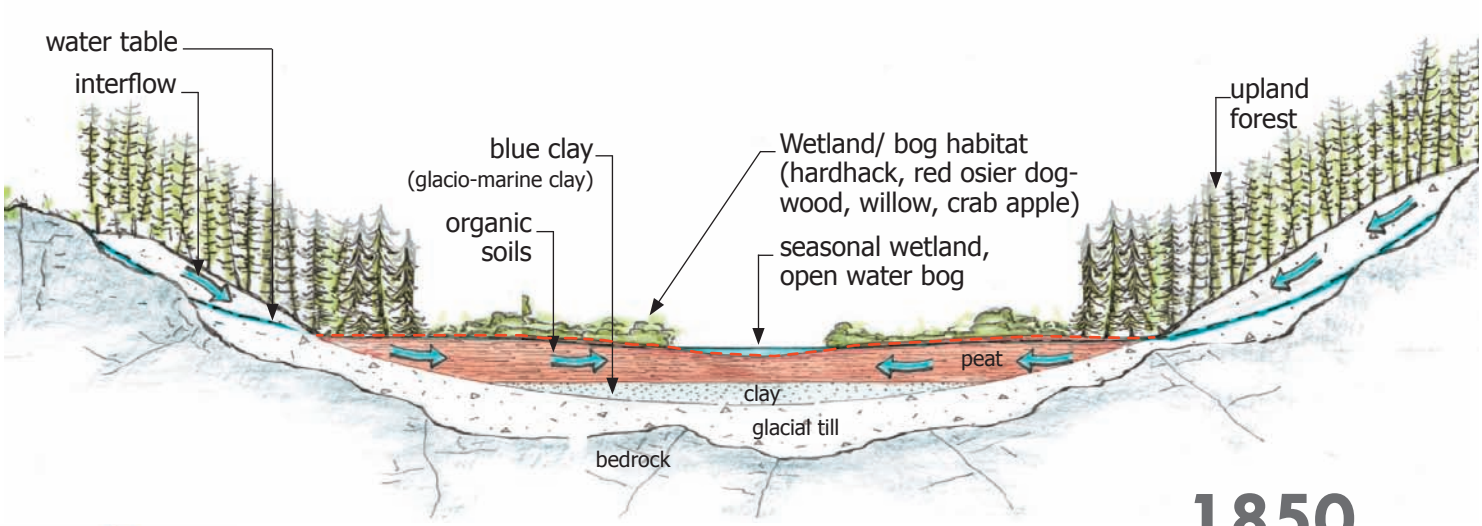
(derived from Huntley and Bowman 2000)

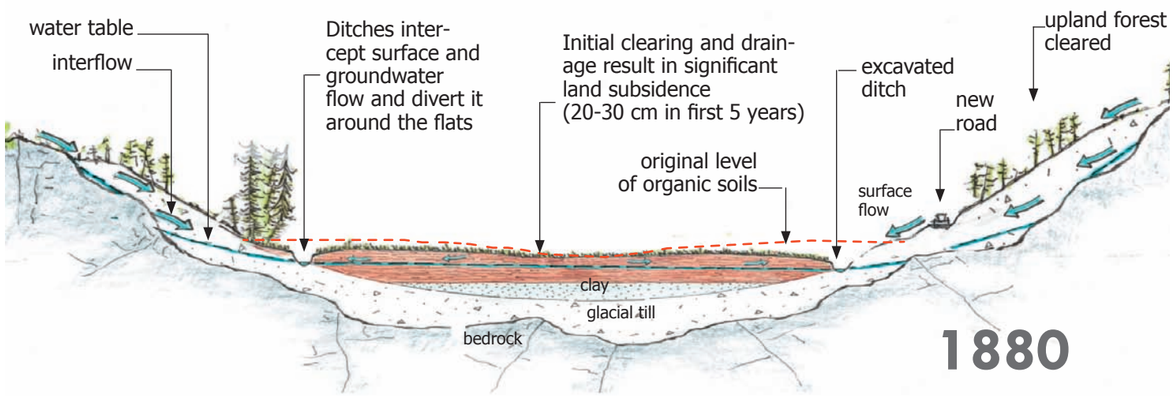
Historical Drainage Pattern

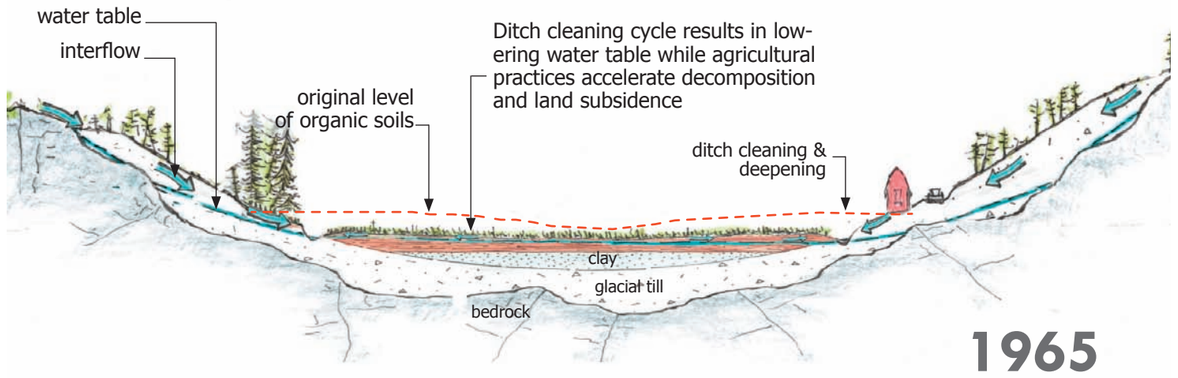
Historical survey information (Ralph, C.E. 1880) clearly indicate that the present day Tod Flats landscape was a marsh habitat dominated by dogwood, willow, hardhack and (pacific) crab apple. Prior to drainage modifications, the site was probably dominated by a slow moving stream with a strong meandering pattern. The forested hillslopes would have slowed the delivery water to the flats below. Water that seeped into the wetland would have moved slowly through the organic soils before reaching the stream. In summer months, the peat soils would have yield cool water back to the stream and sustained fish during summer drought conditions. The thick vegetation cover would have shaded the stream and helped maintain cool water temperatures. It could have supported salmonid species (rearing and adult) although it would not have supported spawning habitat. This would have been a deposition zone within the watershed and accumulated sediment from upslope areas as well as organic material produced in the wetlands. The section below illustrates the thick organic soils that developed in this area and the hydrological flow paths which supported the landscape. The most significant aspect of the site's drainage pattern was that much of the flow

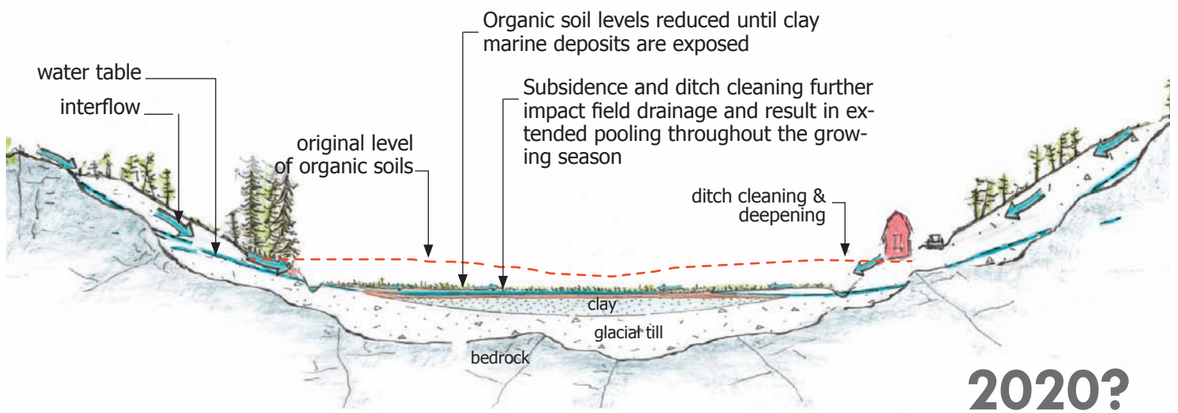


was below ground as interflow - not as surface or channel flow. The means the system would have been very slow to flood, and also slow to drain.









Land Use Changes and Land Subsidence Process

Prior to first contact, First Nations people were thought to use the lands as a source of food (waterfowl and aquatic plants). European settlers arrived in the late 1850's and immediately began to modify the landscape. Historical records from 1874 indicate that ditching had already taken place in the watershed. During the present study, a wetland drainage specialist indicated that the present day ditches that surround the flats were intentionally designed to intercept water from upland areas (Biebighauser, pers. com. 2009). These ditches effectively cut off the water supply to the wetland such that the land would be drier for farming. The present day Tod Creek is basically part of a large scale ditch system that functions to convey stream water past the farm land as well as intercept runoff from upland areas.

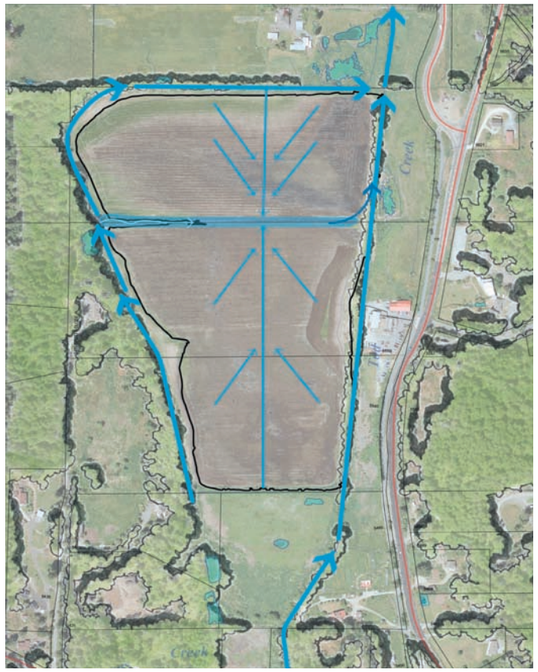
The initial ditching around the perimeter of the site would have caused an immediate reduction in the amount of water feeding the wetland. Research indicates that this action would result in 20-30 cm of subsidence in the first 5 years.

Charcoal was found in soil samples taken at the site. This could be evidence of aboriginal uses such as cooking pits or suggest that the shrub land was cleared using fire (fires could burned into the root system of existing shrubs to become buried charcoal).

Once the land was drained and cleared, more intensive agricultural practices could be initiated. When wetlands are drained and farmed, the organic soils that are present are decomposed. Decomposition results in the production of carbon dioxide (CO_2) and a lowering or subsidence of the land. Studies indicate that sustained agricultural practices on organic soils result in annual subsidence rates of 1 to 3 cm per year (Schipper and McLeod, 2002, Thompson, 1980, Hutchinson, 1980). Over the past 150 years, subsidence in the Tod Flats area could be between 1.5 to 4.5 metres! If conservative numbers were used we would be still looking a very significant loss of soil and crop growing potential.

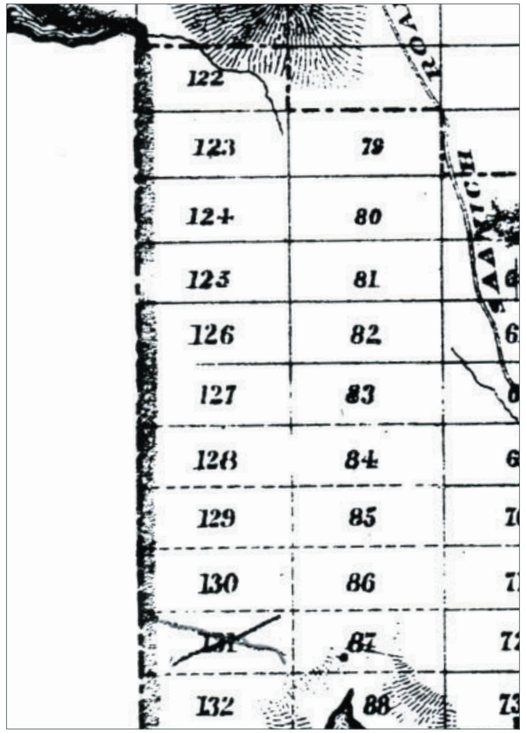
In addition, the ditches and creeks were historically dredged or 'cleaned'. The flats landscape is a deposition zone in the watershed and accumulated organic material and sediment over time. Records indicate the ditches were cleaned ever 30 years. They were often over excavated to improve drainage capacity. This would result in the lowering of the water table, more oxidation of peat soils and continued subsidence.

Peat depths were measured at various locations in the flats. Depths varied from 30 to >120 cm. Based on conservative numbers, these findings combined with known subsidence rates, areas of the flats could be down to marine clay within 30 years.

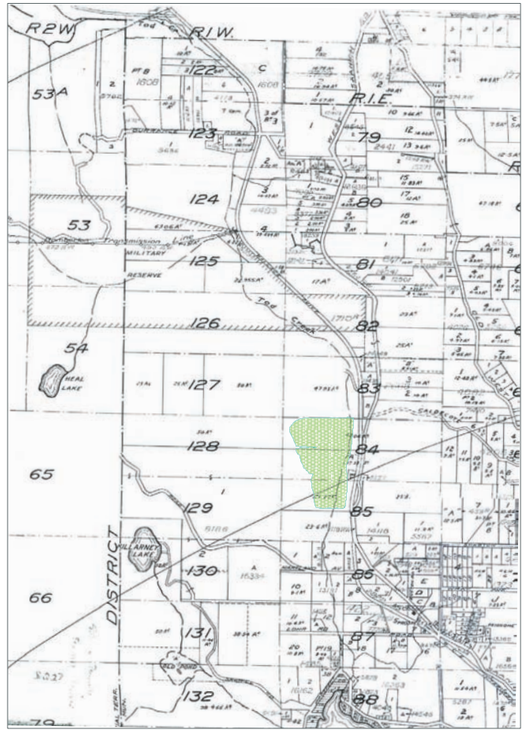


Current Drainage Patterns & Soil Subsidence

historical mapping review



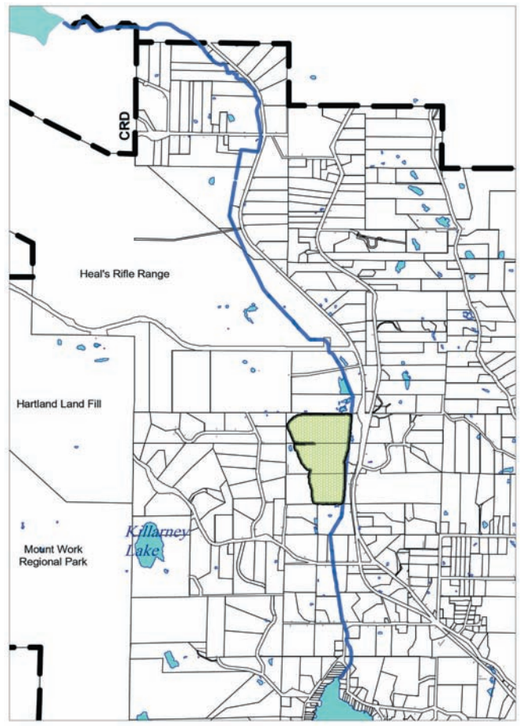
1880



1921

Present day conditions (ditching, land clearing, flooding, etc.) indicated that human activities have modified the landscape. In order to assess how it has been modified historical maps, reports and survey information was reviewed. These maps provide much information and can show old channels and streams, provide clues to drainage patterns, and indicate vegetation patterns from 150 years ago.

Early maps show a stream leaving Prospect Lake but not connecting at Tod Inlet. That suggests incomplete mapping or possibly that the stream became a large wetland that was not surveyed. In addition, early survey plans and notes indicate that the flats was considered a marsh that supported wetland species. Some of these maps area included here with the Tod Flats site indicated by the green shaded area.



present

historical highlights

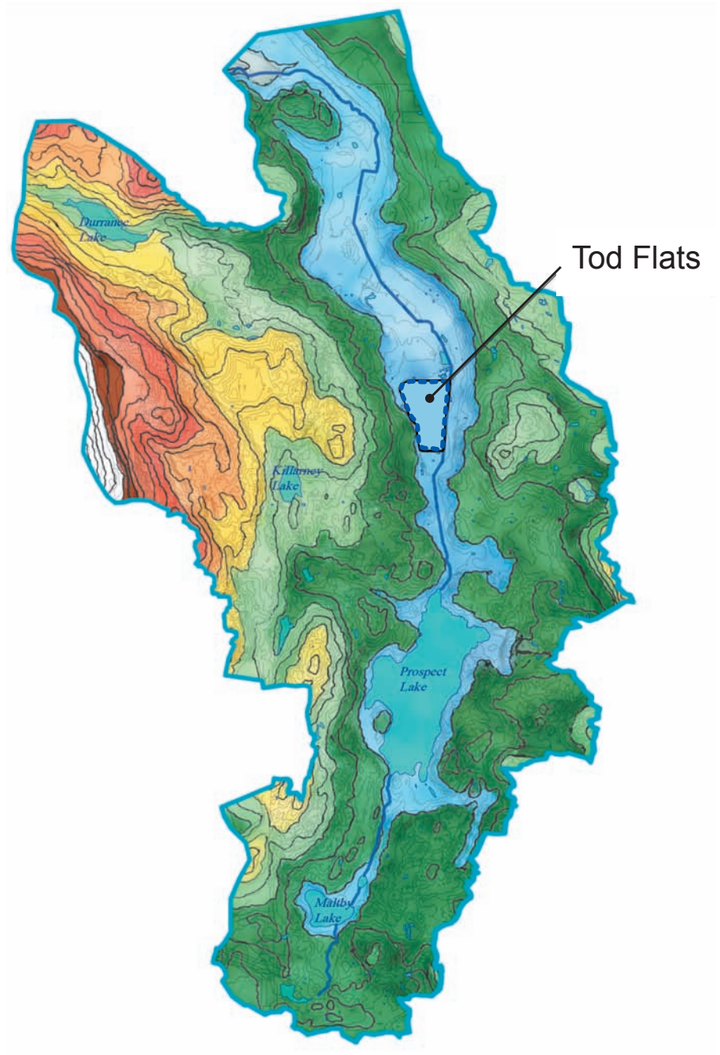
Key historical findings are outlined below:

the creek
- ditch probably dug after 1860's land grants
- 1874 surveyor identified various ditch crossings by the property owner (Kratz's Ditch, Crary's Ditch, etc.) that is present day Tod Creek

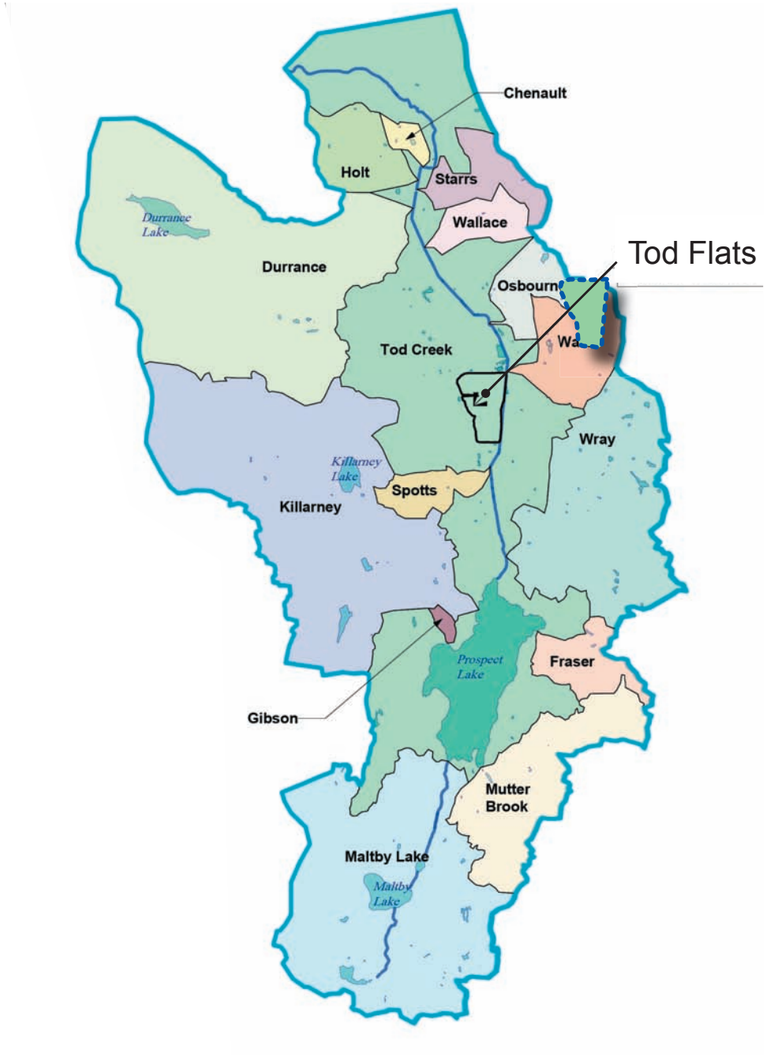
the ditch
- ditch cleaning occurred in 1947 and 1979, a 30 year interval
- discussions indicate that it is due to be clean again, roughly 30 years since last efforts

the grades
- historical 1979 survey and plans illustrate existing and proposed grades for ditch excavations
- similar data collected in 1947 but it has since been destroyed
- present day replication of similar survey indicates that material is accumulating in the ditch.

the flats
- Tod Flats and the 'Tod Creek' lowland were a significant wetland/ marsh in the watershed that probably started downstream of present day Hartland Road and continued to present day Durrance Road
- 1874 surveyor identified vegetation as 'crab, hardhack, willow, and dogwood-very thick'
- 1880 surveyor identified the Tod Flats area as a willow swamp



contour banding plan



subdrainage areas

watershed analysis

Tod Creek flows from south to north and discharges into Tod Inlet. The diverse watershed comprises flat seasonally flooded valley bottom with shallow lakes, gently rolling landscapes to the east and steeply sloping hills to the west. Tod Creek is confined to a ditch from just below Hartland Road to Durrance Road. The creek is more or less flat in this zone with a gradient of 01. to 0.5%. The last 400 to 500 metres are more steeply sloped as the creek drops into Tod inlet. The contour banding map graphically illustrates the watershed topography.

The watershed was divided up into sub-drainage units to assess potential drainage problems related to the flats. The flats is located in the valley bottom and has two main water input sources. The first is the upstream discharge from Tod Creek. The second is water from the surrounding landscape and valley walls.

The watershed area that contributes water to the Tod Creek Flats landscape is roughly 15.3 square kilometres. Not all of the rain that falls in this area will make it to Tod Flats however. Rain water is intercept by plant leaves and evaporated, taken up by plant material and evapotransporated, or stored in aquifers. The remaining water will travel via interflow (water movement through the soil), overland, and channel flow to the Tod Flats area.

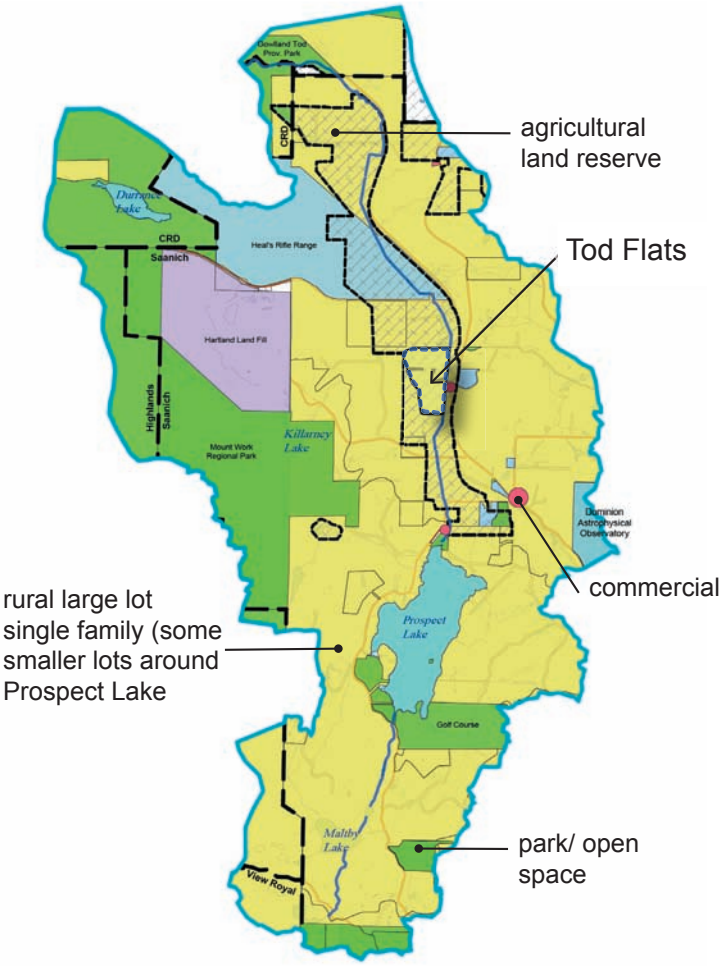
Prospect Lake is a significant hydrological buffer for the Tod Flats landscape. Its combine sub-drainages represent 68% of the Tod Flats catchment area. The remaining 32% of the drainage area will probably have more potential to affect the flats given that there is not significant buffering between these drainages and the flats.

land use analysis & implications

Development in the watershed has altered the land cover and hydrology of the watershed. Presently, land cover consists of forested lands, lakes and wetlands, small to mid-sized agriculture operations, hobby farms, rural residential, industrial uses in the form of the Hartland Landfill in the upper reaches of Durrance Creek and small commercial areas. Historic land clearing, draining of wetlands, road construction, tilling of fields and development and its associated infrastructure has impacted the hydrologic performance of the watershed and negatively impacted fish habitat. These impacts include increased stream temperatures, decreased oxygen levels, loss of riparian cover, increased sediment levels, and overall reduced water quality.

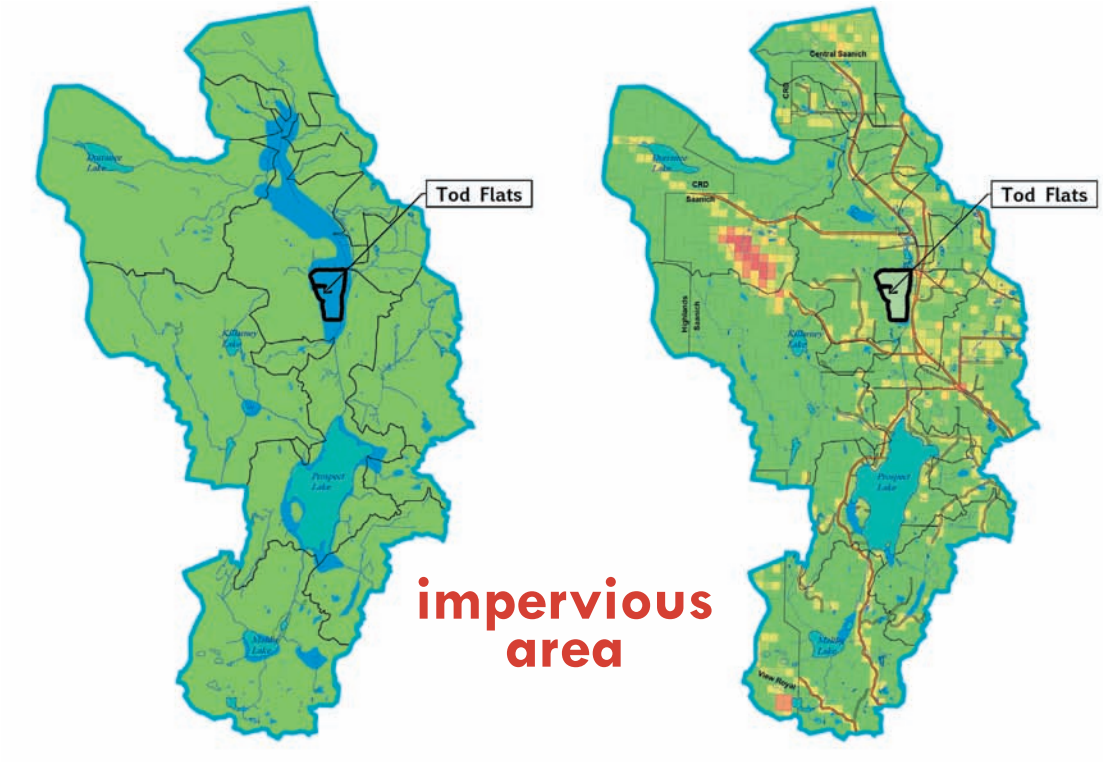
To assess potential impacts from land use changes we analyzed impervious area (built areas that produce stormwater runoff), channel density (amount of channel/ pipes per unit area) and wetland areas at the watershed. Pre-development land conditions were compared to existing conditions for these three variables. The purpose of this exercise was to help determine whether land use change was having a major impact on stream health and flooding in the flats study site and to identify the problem(s).

This study did not measure impervious surfaces but impervious cover data from the CRD (Natural Areas Atlas mapping, 2009) does show impervious areas (roads and buildings). Given the nature of urban development, most runoff from the roads is conveyed by ditches to the nearest stream. Although damaging, urban development remains scattered throughout the watershed and tends to be large lot, rural hobby farms with relatively low density and low effective impact area. These tend to have simple drainage systems that often spill onto the land rather than be connected to large piped infrastructure systems. In simple terms they, are disconnected from the downstream receiving waters and therefore do not contribute much in the way of stormwater to the system. Hydrological



land use

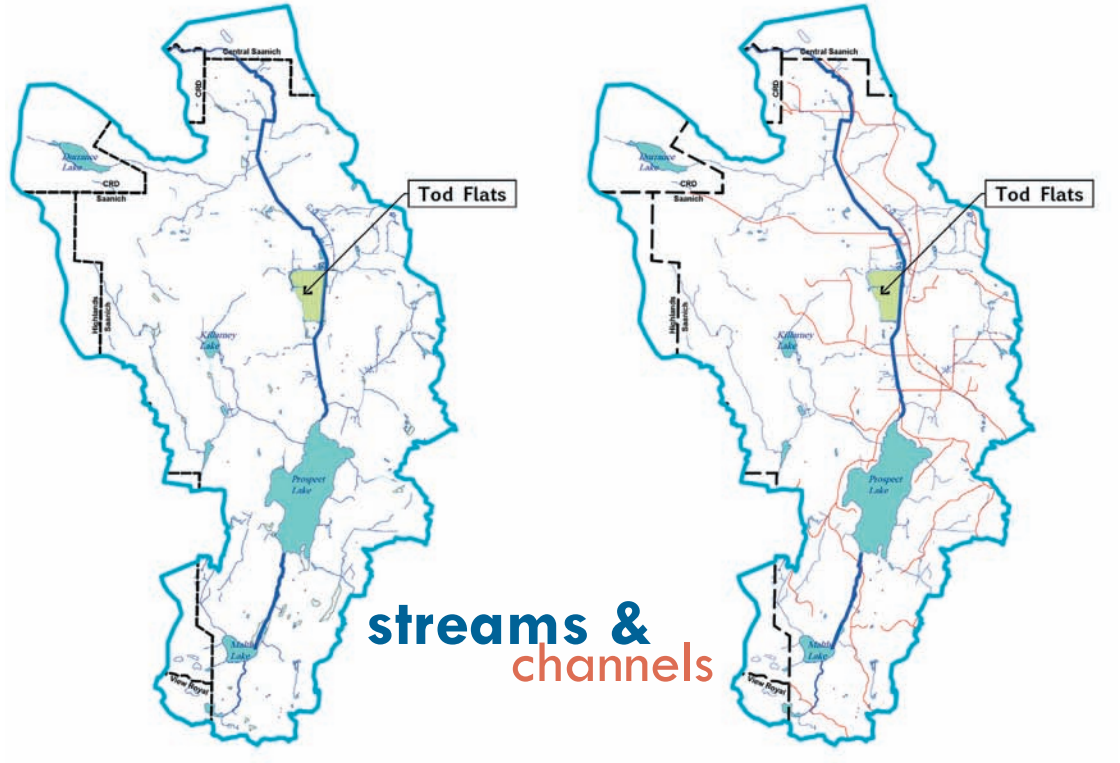
impacts are typically noted when effective impervious area is greater than 10% in a watershed or sub-basin area. That level has not been reached in the Tod Creek watershed. From a development perspective, care should be taken with regard to future development within the non-basin drainage areas that contribute to the flats along with the Ward and Wray sub-basins areas that feed the stream adjacent to the flats. Low Impact Development (LID) planning and design practices should be applied in these areas and elsewhere in the watershed. Drainage practices that disconnect impervious areas from streams and ditches should be encouraged.



impervious area

predevelopment

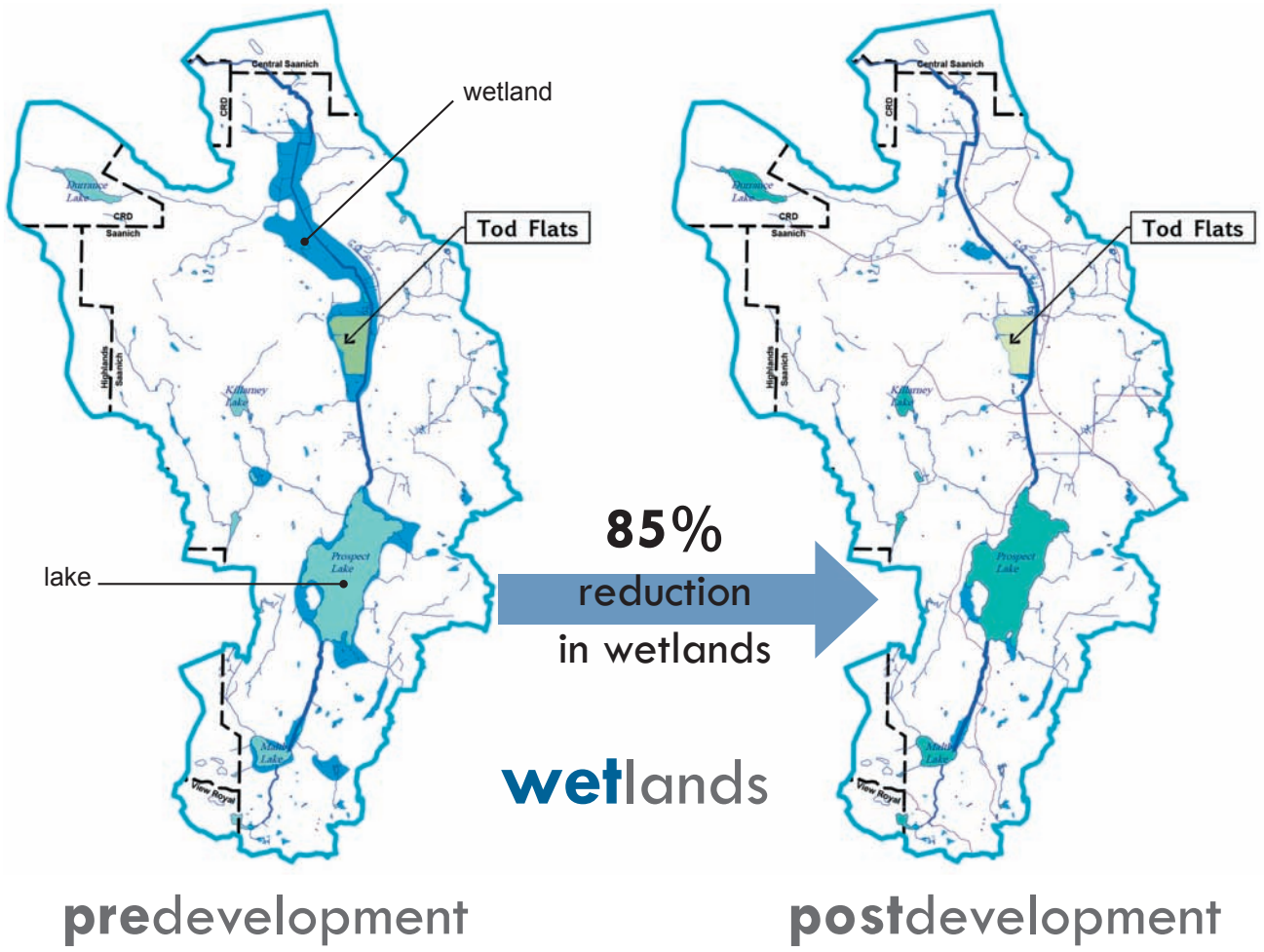
postdevelopment



streams & channels

predevelopment
channel density **2.9**

postdevelopment
channel density **4.5**



Stream flows through Tod Flats are highly dependant on the control of water exiting the dam at Prospect Lake. Care must be taken with the operation of this outlet dam to ensure winter flows are retained but more importantly, that summer base flows are sustained.

The lakes and wetlands within the watershed perform a significant buffering affect on hydrological changes due to development. This is not to say that development won't alter stream hydrology, rather that the lakes and wetlands will help to moderate peak flows and release water more slowly to downstream receiving areas. Typically in this part of Vancouver Island, winter rains fill the lakes, wetlands and soils which then slowly release that water back to the stream during the dry summer months.

At the watershed scale, the most significant change is the loss of wetland habitat. It is estimated that 85% of the wetlands have been drained or modified over the last 150 years. This loss would account for a significant loss of hydrological buffering in the watershed.

impervious area

- some increase mostly due to roads and buildings
- not a significant impact to Tod Flats hydrology

channel density

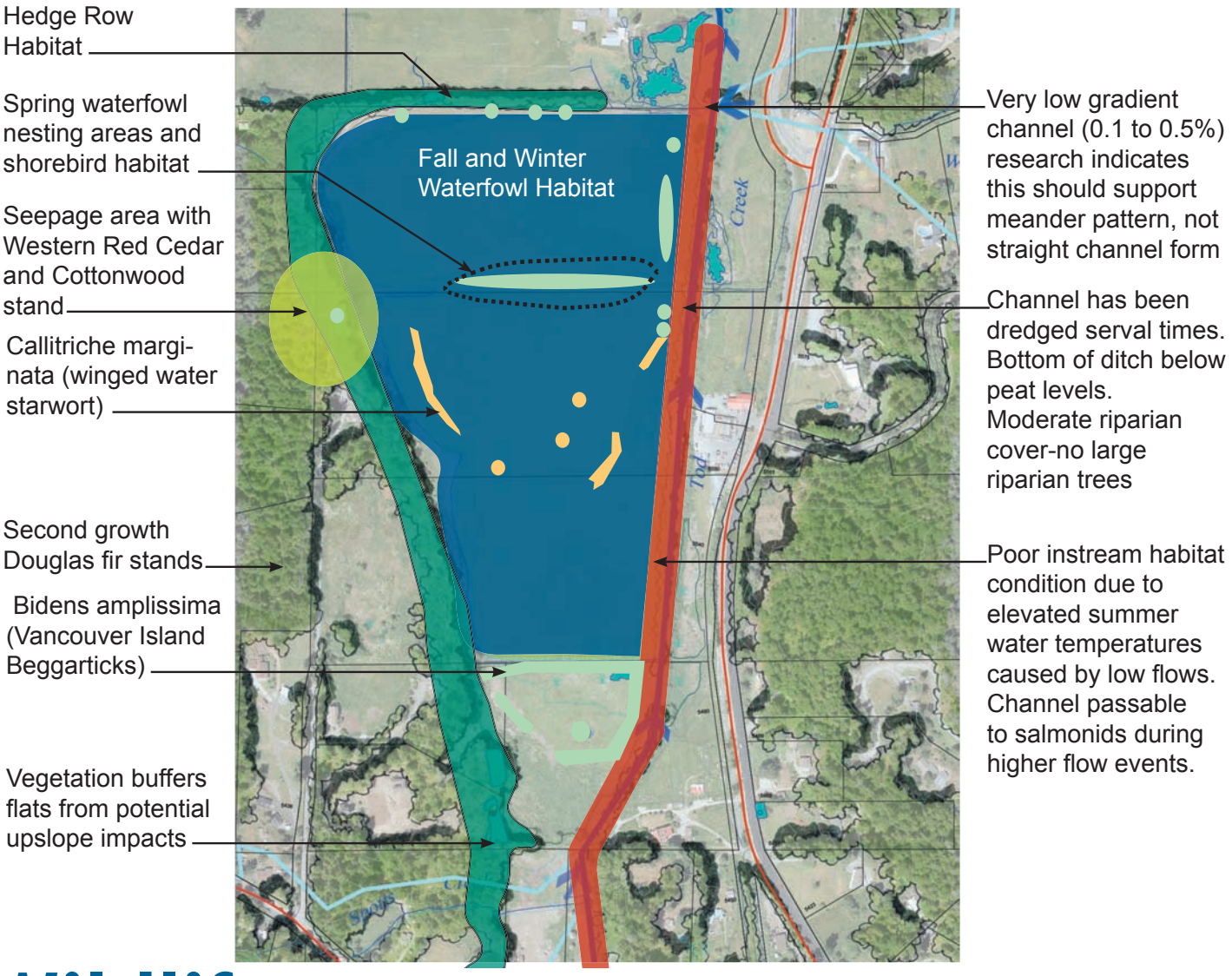
- roughly 1.5 fold increase in channel density
- relatively small amount compared to urban watersheds which often have 25 to 30 fold increase in channel density

wetlands

- ditching and conversion of marsh to agricultural lands is probably the most significant factor affecting the watershed and the Tod Flats area
- watershed has seen roughly 85% of its wetlands disappear in the last 150 years.
- the watershed has lost a significant hydrological buffer

land use

- land use changes have significantly altered the landscape and how it performs and functions
- ditching and vegetation removal have had a significant negative impact on watershed hydrology
- loss of forest cover was probably more significant in the late 1880's after much of the land and forests were cleared.
- historical ditching and land drainage have resulted in greater flow fluctuations and negatively impacted summer low flow conditions

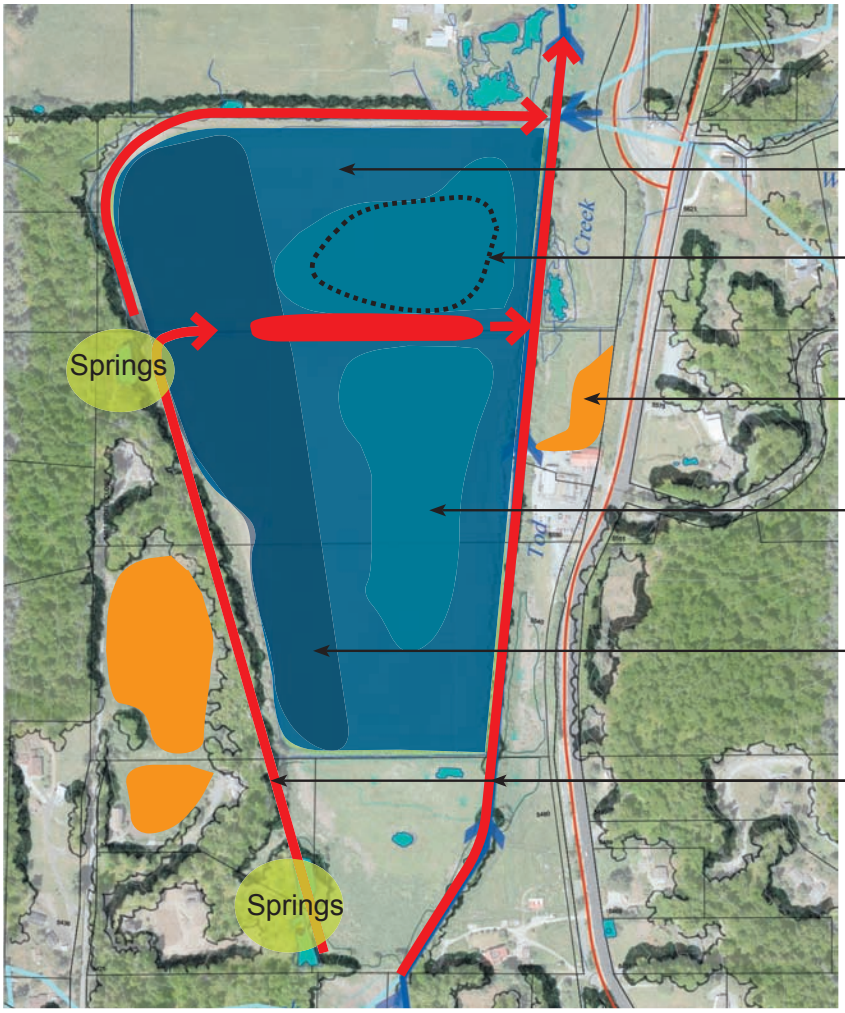


Wildlife Habitat

Tod Flats supports a variety of unique habitat types ranging from seasonally flooded fields to hedge row thickets. Fish habitat in Tod Creek is poor due to water quality issues and poor habitat characteristics.

The north and east edges of the flats support good hedge row and upland forest transition zones respectively. Of interest are populations of Winged Water Starwort and Vancouver Island Beggarticks. Currently Callitriche marginata is not protected under any BC or federal laws, however, it is considered S1 (Critically imperilled) and Red-listed by the Conservation Data Centre (CDC). Bidens amplissima is considered S3 (Vulnerable) and Blue-listed. The winged-wart starwort (Callitriche marginata) normally occur in coastal bluff vernal pools but were recently found (since 2007) at Tod creek flats (Costanzo et.al. 2009). This species appears to do well under the farming regime of 2007 and 2008 where the water was pumped for ploughing and planting in mid June.

Migratory birds use the flooded fields for food and many species nest along the dugout area in the middle of the flats. Bald Eagles also frequent the area in the winter, preying on the abundant waterfowl.



Opportunities and Constraints Plan

The flooding patterns, topography, soil type and wildlife species present many site planning and design opportunities and constraints. These have been outlined in the graphic above.

Site Constraints

- Fields flooded mid-October to mid to late July
- West side of field shaded by steep hillslope
- Saanich flood plain mapping states all development to occur at elevations greater than 46.88 m geodetic elevation
- Flood waters trapped in 'bowl' extends inundation period
- Springs/ seeps along west bank of flats
- Landscape depressions result in extended duration of inundation.
- Ditches intercept cool groundwater and divert it around flats
- Peat soils less than 30 cm deep in certain zones

Site Opportunities

- East side of properties have excellent access to West Saanich Road and Bicycle/ Pedestrian path
- East side of fields is sunny-less impacted by steep western hillslopes.
- Good forested and hedgerow habitat on west and north sides respectively
- Peat soils >1 m deep on west side of fields
- Commercial node (Red Barn Market) attracts people to the site

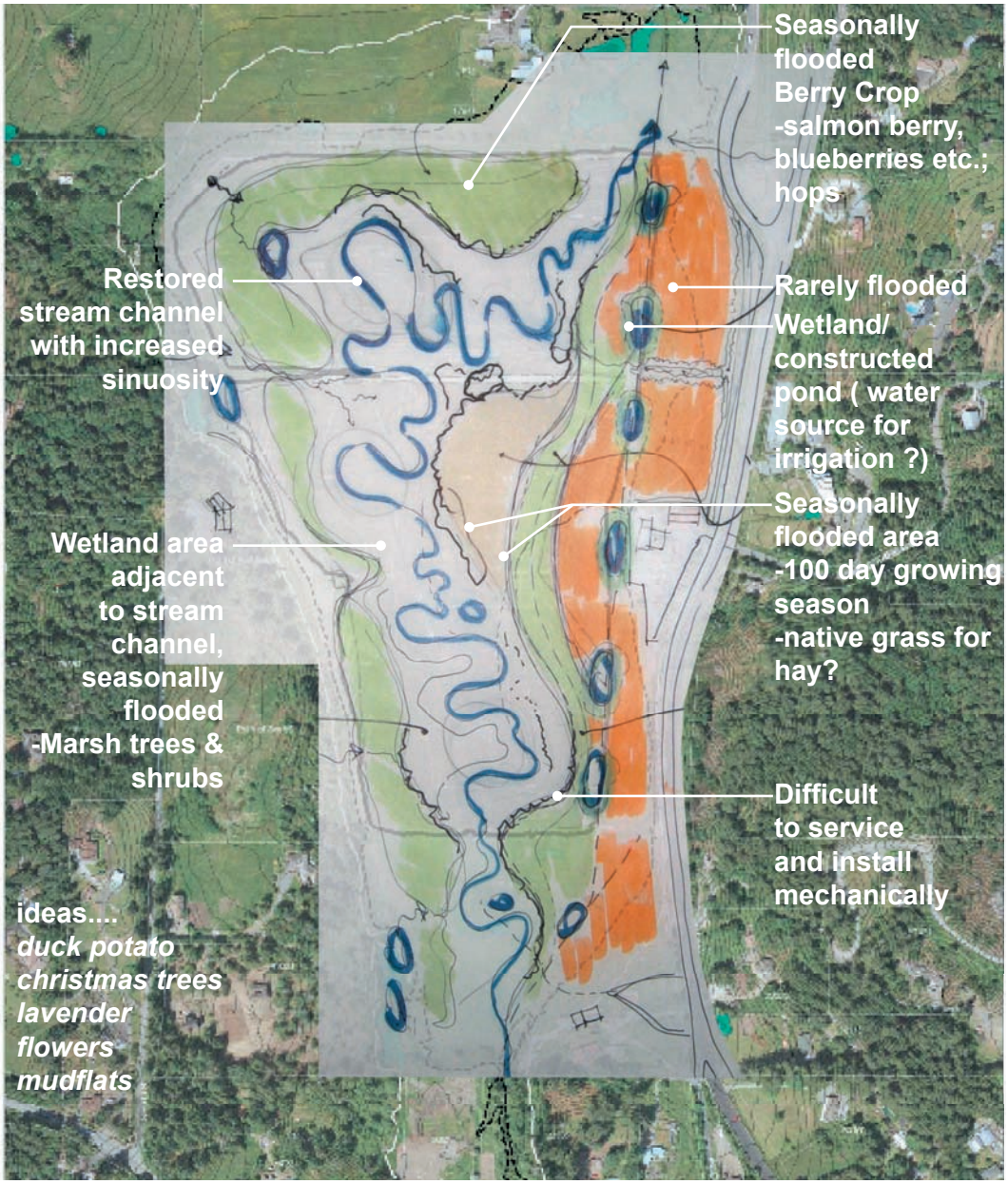
Framework Plan
and Charrette Designs

The goal of the project was to look at the site in a holistic manor and develop a framework/ concept plan that optimizes the use of the site for agriculture, flood plain function and wildlife habitat values. On June 30, 2008, a group including land owners, a wetland specialists, landscape architects, a stream biologists, a soil scientist and municipal staff conducted a one day planning and design charrette. Landscape architects from MDI along with Tom Biebighauser (wetland specialist) guided the 1-day planning and design charrette. The day will be broken into a morning site review and education session and an afternoon planning and design charrette. The morning session included a field review and discussions about the current status of the land and possible options for future work on the land. Discussions centred around how the site functioned and the identification of sites opportunities and constraints.

In the afternoon, the group was divided into two design teams guided by the design staff of MDI. The goal was to develop Framework Design Options for the Tod Flats landscape. Two framework plans were developed that took into consideration site opportunities and constraints. The framework options were used to test various program elements including:

- enhancing agriculture productivity,
- maintaining/ enhancing flood plain capacity,
- enhancing wildlife and fish habitat values,
- providing wildlife viewing opportunities,
- identifying an irrigation supply source, and
- managing pollution loads from West Saanich Road runoff.

The two framework plans that were developed are illustrated on the following pages.



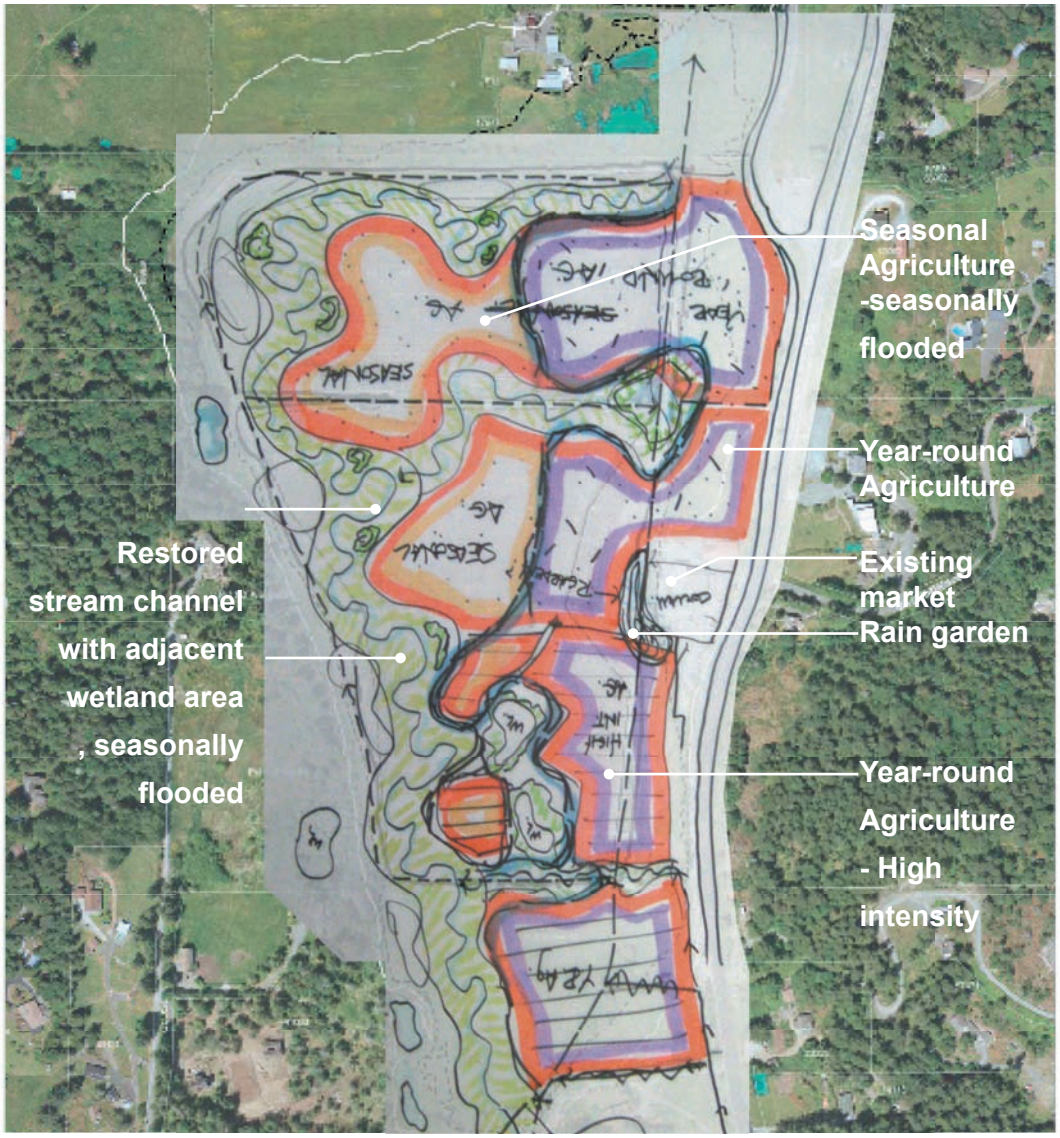
Concept One

High Lights

- Restore stream to middle of Tod Flats,
- Restore channel, creek flood plain and riparian habitat zones,
- Maximize grades above 45.38 m geodetic for agriculture-organic farm plots outside of flooded areas,
- maintain flood plain requirements, as per Saanich bylaw.

Pros and Cons

- Moving stream to middle of valley bottom consumes the most land and signficantly reduces the amount of seasonally flooded field,
- Small 'pocket' fields are difficult to farm (too small to be practical),
- Moving intensive agriculture activity to east side moves all production to the sunny side of site and closer to roads/infrastructure,
- Utilize abandoned ditch for possible irrigation ponds or stormwater management facilities.



Concept Two

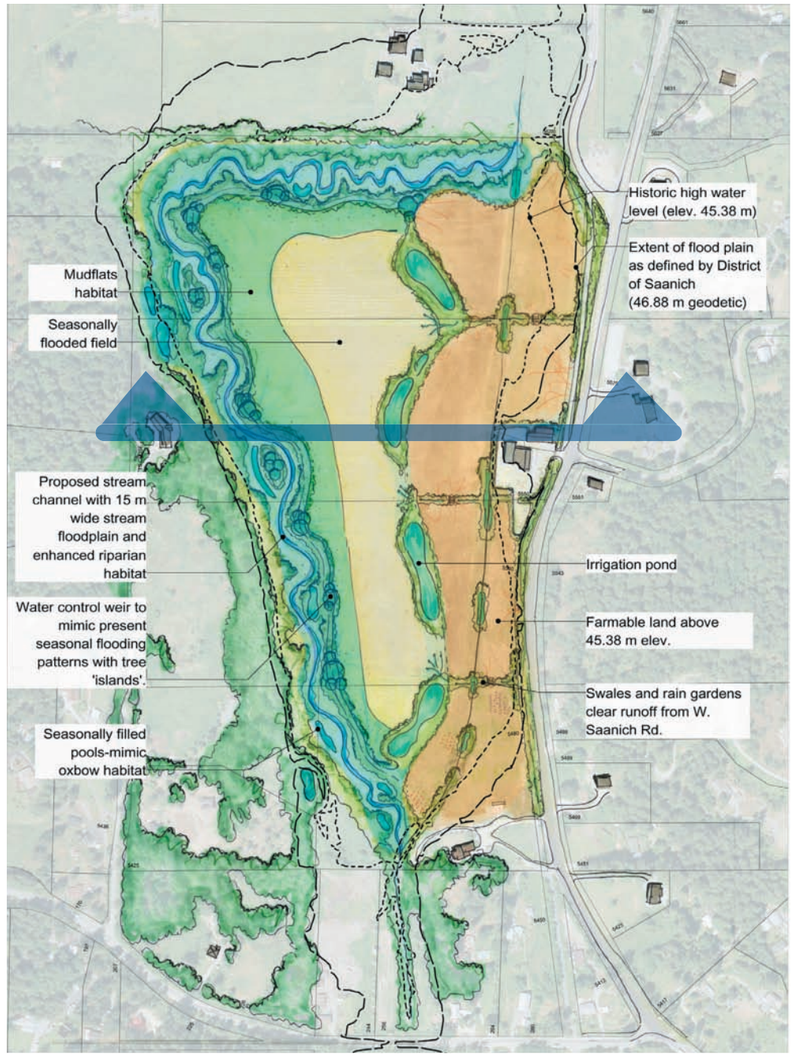
High Lights

- Restore stream moved to east side of Flats,
- Restores channel, creek flood plain and riparian habitat,
- Maximize grades above 45.38 m geodetic for agriculture-organic farm plots outside of flooded areas,
- maintain flood plain requirements as per Saanich bylaw,
- provides high diversity of habitat types including seasonal wetlands, edge habitat and forested hummocks.

Pros and Cons

- Patches of seasonally flooded land impractical to farm.
- Diverse channel forms maximize habitat diversity but reduce size of seasonally flooded fields.
- Moving stream to eastern edge of field minimizes the amount of land consumed, places stream in shadow of hillslope (cooler habitat) and links stream to cool groundwater fed springs on east side.
- Moving intensive agriculture activity to east (sunny) side moves intensive activity areas closer to infrastructure (roads/ access)
- Rain gardens manage pollutants from W. Saanich Road.

framework plan
option 1

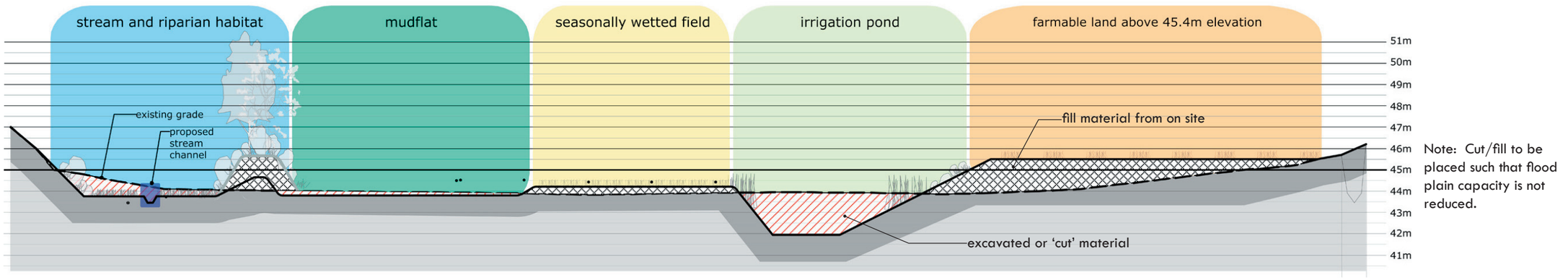


Program Elements

- 15 to 30 m wide stream with flood plain on east side
- Excavated material moved to west side to increase land height to 45.38 m (above max. recorded water elevations).
- Create mudflats habitat and seasonally flooded field areas suitable for *Callitriche marginata* (winged water starwort) and *Bidens amplissima* (Vancouver Island Beggarticks).
- Mudflats inundated from early fall to late July
- Seasonally flooded fields inundated November to May.
- Mudflats inundated from early fall to late July.
- Irrigation ponds developed for each property.
- Stormwater from West Saanich Road diverted into vegetated swales and rain gardens developed in abandoned Tod Creek ditch. Swales to follow existing property lines. This will act to clean runoff but also to separate agricultural crops for road runoff.
- Seeps and springs from western slope tied into new channel

Design Critic

- See Habitat Analysis Fact Sheet Chart for habitat created
- Mud flats will provide unique habitat presently lacking in CRD for migratory birds.
- Over 1.4 km of functional stream habitat
- Create 6 ha of functional riparian habitat
- Create 6-7 ha of aerable farm land

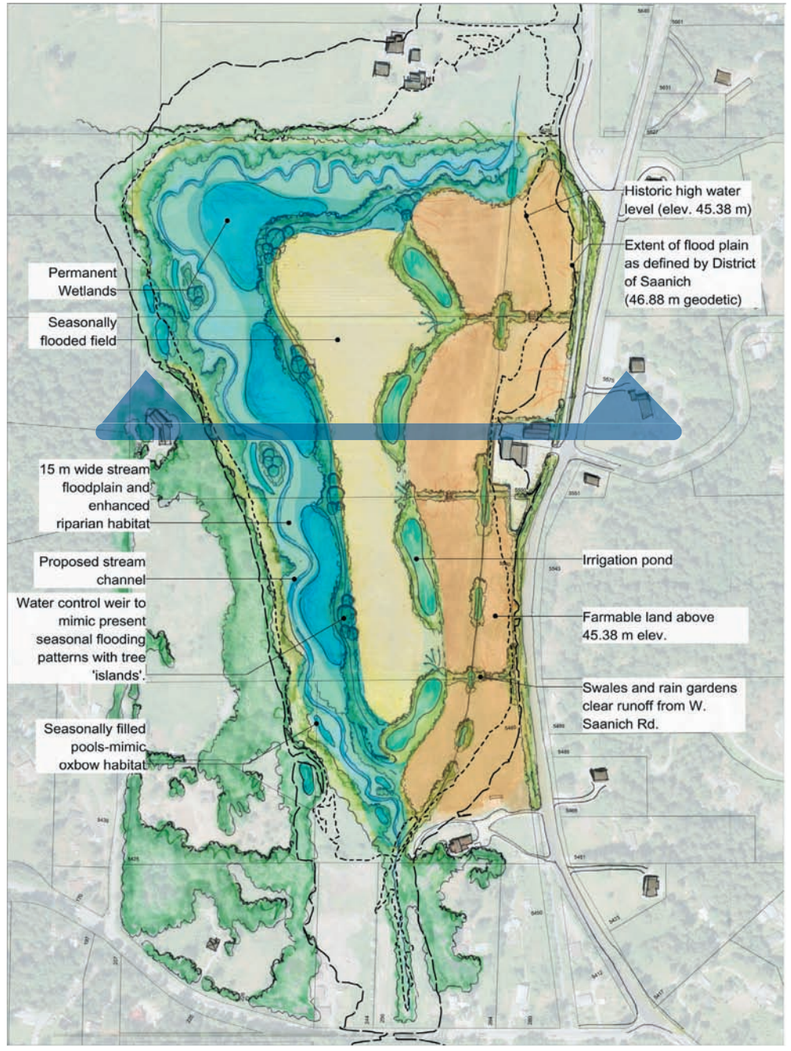


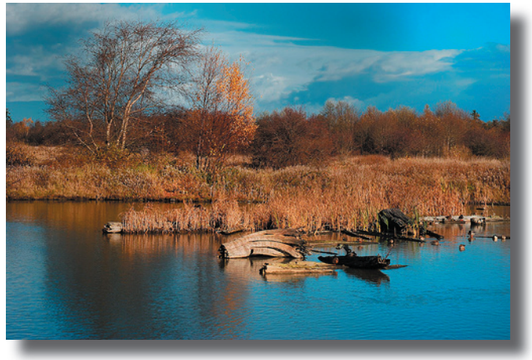
Note: Cut/fill to be placed such that flood plain capacity is not reduced.

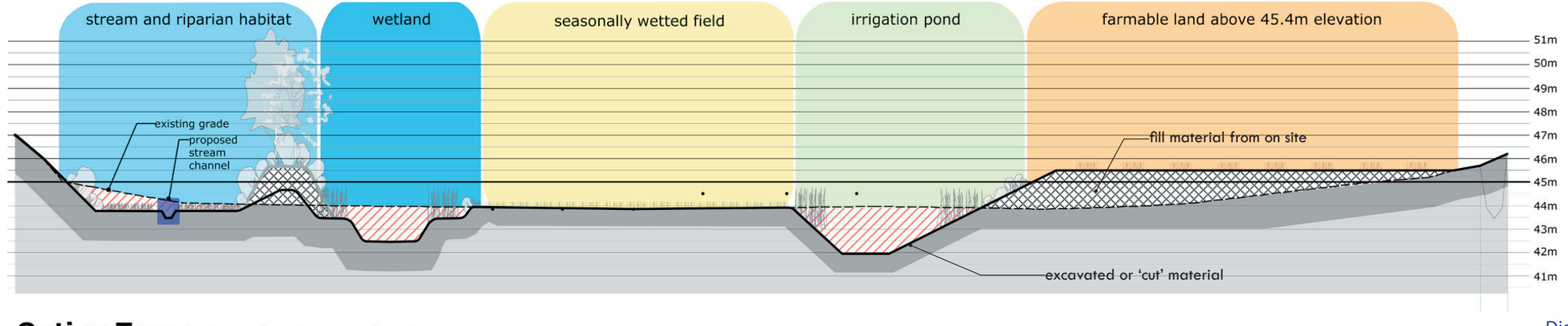
Option One horizontal scale:vertical scale = 1:5

Assumptions: All material/fill must remain on the property that it is taken from.

framework plan
option 2







Note: Cut/fill to be placed such that flood plain capacity is not reduced.

Program Elements

The program elements are the same as option 1 with the following exceptions:

- Large permanent wetlands will be created within the riparian area of the stream. These would be deep, water bodies that would remain wetted year-round.
- Mudflat habitat would be limited to the margins of the seasonally wetted fields (as is presently the case)

Design Critic

- Similar habitat benefits to option 1
- Large wetlands would create additional habitat diversity for fish and waterfowl
- Large wetlands would be a significant aesthetic feature and provide year round water views for visitors and residents of the area
- Permanent wetlands/ irrigation ponds could support populations of invasive bullfrogs (life cycle requires 2 years of standing water)
- Reduced mudflat habitat to margins of seasonally wetted fields

Option Two horizontal scale:vertical scale = 1:5

Assumptions: All material/fill must remain on the property that it is taken from.

habitat fact sheet

The comparison table below indicates the lack of permanent, high quality habitat presently in the Tod Flats landscape. The area seasonally supports large populations of waterfowl but the stream and riparian habitat are in very poor condition. In addition, seasonal changes to the land (draining, tilling, planting, etc.) negatively affect the existing rare species plant communities. The proposed plan increase the amount and quality of stream, riparian, and mudflat habitat. In the proposed plan, these become permanent habitat types.

Habitat and land cover comparison of existing and the proposed plans for Tod Flats

	Existing	Proposed
High Quality Stream Habitat	0 m	1400 m
Seasonally Flooded Fields	17.1 ha	4.5 ha
Non-Flooded Fields	0 ha	7.1 ha
Irrigation Ponds and assoc. Riparian Edge	0.4 ha	1.9 ha
Scrub Brush	6.8 ha	1.0 ha
High Quality Riparian/ Wetland Habitat	0 ha[1]	6.8 ha
Mud Flat (option 1) Wetland Ponds (option 2)	0 ha[2]	3.0 ha
Hedgerow/Forest Edge Habitat	0.9 ha	0.9 ha
Total	25.2 ha	25.2 ha

1 The existing Tod Creek does support riparian habitat but it is in poor functional condition and has therefore not been included. In addition there is no stream floodplain associated with the ditch. The channel is confined to the ditch.

2 The seasonally flooded fields presently support two rare plant species and do function as mudflats. However, in any given year these areas could be cultivated and planted such that they do not provide year round mud flat habitat.

agriculture fact sheet

Much of Tod Flats is farmed using industrial agricultural practices, which requires large inputs of energy and large machinery to cultivate, plant and harvest the field. It has been farmed as one large field rather than as individual fields. This type of farming is based on large inputs of energy and equipment and contributes to green house gas production. The land is approaching a time when areas of it will be unsustainable to continue farming. Continued subsidence will result in prolonged flooding, shorter growing seasons, and the exposure of clay sub-soils.

The proposed plan would see the land better managed to fit the natural conditions of the site. The creation of a stable land base above the 45.38 m high water elevation would create opportunities to develop organic farm plots. Organic farming is intensive in terms of people inputs not chemical or petroleum inputs. In can be managed as a significant sink for green house gases. Both proposed options retain some of the seasonally flood fields that could still be used for production of potatoes, which has been the crop of choice on this land. These options also present the agriculture industry with a significant opportunity to educate the population about organic farming, integrated farm management plans, water resources, and natural systems.

Agricultural comparison of existing uses and the Option 1 proposed plan for Tod Flats

	Existing	Proposed
Agriculture Type	Large Scale Industrial	Organic Intensive
Seasonally Flooded Fields	17.1 ha	4.5 ha
Non-Flooded Fields	0 ha	7.1 ha
Rate of return per ha	low to mod.	very high
Production Cost per ha	high (mechanical)	mod.-high (labour)
Greenhouse Gas Production	Very High (carbon source)	Very Low (carbon sink)
Education Opportunities	low	high

information gaps

The following items outline missing information that need to be gathered, or areas of study that need to be addressed:

- Site survey information to pick up missing ditches on west and north side of flats
- Ground water levels during the course of the year for site specific locations. Simple soil sampling devices could be used periodically in the summer to determine summer groundwater level.
- Complete peat depth surveys (presently on third of the site has been surveyed). This information combined with site topography could be used to better locate ponds.
- Review soil information and determine best way to build soil depth. For example should peat soils be excavated and used to build soil height (to 45.38 m elev..), should clays be used or some combination of these materials.
- Funding opportunities for detail designs, implementation planning, and construction.
- Crop suitability analysis of seasonally flooded landscape.
- Review design options that will discourage nuisance wildlife such as Canada Geese.
- Alternative means to replenish/ build peat soils (add compost from large scale composting programs, re-flooding the land and growing specific crops that would add peat production, etc.
- Review options to expand the study site to include the entire valley bottom to north of Durrance Road. The implications are that the entire system has been modified, and future flooding of areas downstream of the flats will continue since these lands were derived in much the same way. They presently rely on ditch cleaning and water table lower to maintain flow and drainage.
- Review Prospect Lake dam flow control operations to ensure summer base-flow levels are met.

conclusions

The Tod Flats landscape was historically a source of food for local aboriginal populations. In the past 150 years the land supported more intensive agricultural uses ranging from local market gardens to industrial potatoe farming. Modern farming practices have required that water be drained from the site in order to work the land. The single, most important issue pertaining to the agricultural use of this site is water management.

The Tod Flats landscape was created by a combination of geological processes, organic accumulation over time and the modification of the land cover and drainage practices by modern civilization. It is a landscape that was built by inputs of organic material over a 12,000 year period. Water played a key role in the site as the slow movement of water resulted in the accumulation of organic matter (peat) which did not decompose due to the high water table.

Drainage and agricultural practices of the day lead to draining of the land and the implementaiton of intensive agricultural practices. In the 1860's food production was of major importance. Issues related to fish habitat were not. For 150 years drainage and agricultural practices have had a significant affect on the condition of the flats and how it functions. What was historically a system built on inputs (water/organics) was instantly converted to a system or removals (water/carbon/crops). A thick organic soil which was built over a period of 12,000 years has been depleted by 150 years of land use change and drainage manipulation.

The plans presented in this report are not detailed plans, rather they are working concepts based on our knowledge of the site, historical records, and the desire of the present land owners to work with the land and do something positive. Rather than being a landscape dominated by agriculture with wildlife habitat as an aside, the future plans take a holistic view where agriculture, wildlife habitat, aesthetic and social values and flood control all have equal weight. The designs work with and restore the natural systems of site rather than over ride them. The plans illustrate a vision for the Tod Flats landscape that best approximate a sustainable landscape for the future.

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