ER312B –

# 203 Goward Road Covenant Property:

# Investigating a Changing Successional Trajectory

At the corner of Goward Road and Echo Drive facing into the covenant property

Edited by: Richard Hebda

Submitted by: Steven Burgess

**Abstract:**

A study was conducted to determine the cause of a reduction in canopy cover on a covenant property held by the Habitat Acquisition Trust (HAT) at 203 Goward Road, Saanich. Former baseline biophysical inventories were employed to determine possible reasons for the dieback that was later confirmed as majority Grand fir *(Abies grandis)*. Upon discovering a small stream previously undocumented and an influx of hydrophilic vegetation, it was determined that the site was receiving greater amounts of water than historically recorded. Three soil surveys were taken of the dieback zone, upstream conditions and a similar, thriving plant community to reveal the composition and function of the subsurface structures. The surveys taken near the stream were noted to be free of mycelium and containing a large content of clay. The third survey in the comparison site was found to be well-drained, sandy soil with many fungal interactions. Through use of a literature review it was hypothesized that the dieback was in response to increased runoff from local development coupled with the restricted growth of mycelium due to unfavorable summer drought conditions and poorly aerated soils from fall flooding. Soil moisture regime and soil nutrient regime were used to determine that Western Red Cedar (*Thuja plicata)* and Big Leaf Maple *(Acer macrophylum)* were the climax tree species best employed to repopulate this now saturated site.

**Introduction:**

The property at 203 Goward Road, Saanich B.C. (Figure 1, location map) has been under protection through a conservation covenant between Richard and Francis Hunter (landowners), Habitat Acquisition Trust (HAT), TLC The Land Conservancy of BC and the District of Saanich (collectively, the covenant holders) for the past seven years. This 1.55-hectare property is a beautiful segment of old growth forest located in the Prospect Lake community of Saanich, British Columbia. The property boasts an impressive mix of ecosystems types; the Garry

Oak/Arbutus at the higher well-drained sites slowly shifts to a Douglas fir salal and Western Red Cedar/Grand fir community in the lower elevation segments. A small segment of the property borders Prospect Lake to the southwest, with Goward Road and Echo Drive providing the North and East boundaries respectively (Mogenson, 2006).

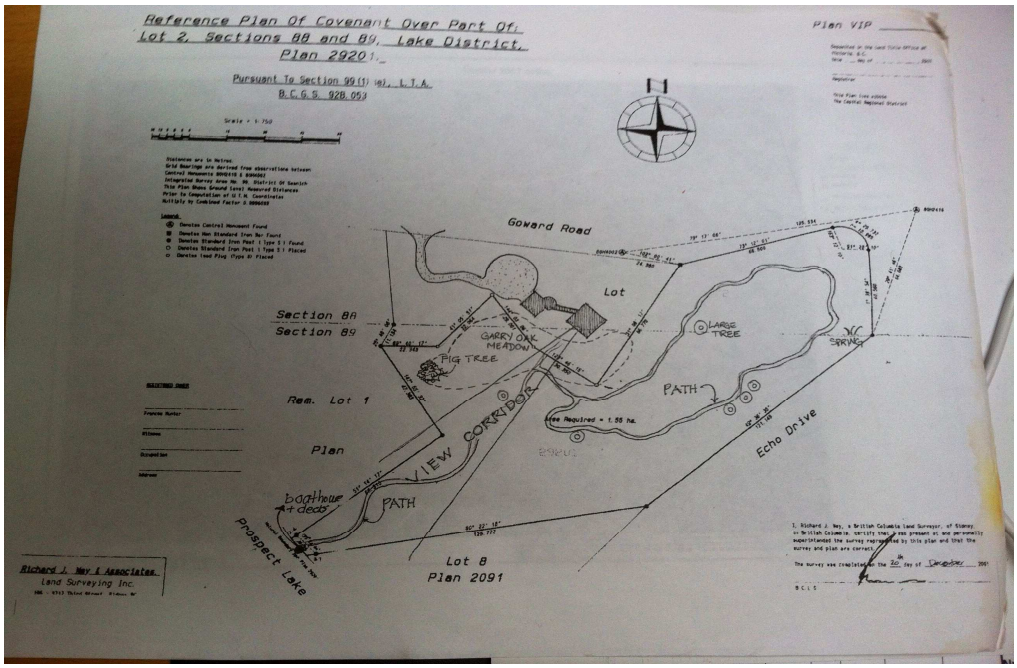


Figure 1 - UTM map made during the 2006 baseline.(Mogensen et al., 2006)

Figure 2 – Aerial map of the 203 Goward property. The dieback zone is in the northwest portion of the property near the corner of Goward Road and Echo Drive. The map is oriented so that north is up.

The representative for HAT is Wendy Tyrrell, the Covenants and Acquisitions Coordinator. The concern expressed by both Wendy and the Hunters were the aggressive encroachment of invasive species and a crown reduction in the low-lying basin due to die back in the Grand fir population. The goal of the study was to map the development of the invasive populations and present theories for the reduction in the Grand firs. The focus of this specific report is to account for the reduction in crown closure, determine the key features that have lead to the marked reduction of the crown tree species and make recommendations for remediation of the site.

Through referencing previous soil surveys, this property is shown to possess two different soil series types: Saanichton and Sprucebark (Jungen, 1985). The Saanichton soil series

is describes as marine deposit in origin with very little to no coarse fragment. All sediment layers are described as ranging from a sand clay loam to heavy clay and therefore poorly drained. Sprucebark on the other hand has its parent material comprised of glaciofluvial sediment. The soil in this range is said to be well drained and with far higher coarse fragment content (20 to 30%), in comparison to the Saanichton soil series. All soils in and around the Prospect Lake property are shallow (within a depth of 1m) with bedrock intrusions as commonplace (Jungen, 1985).

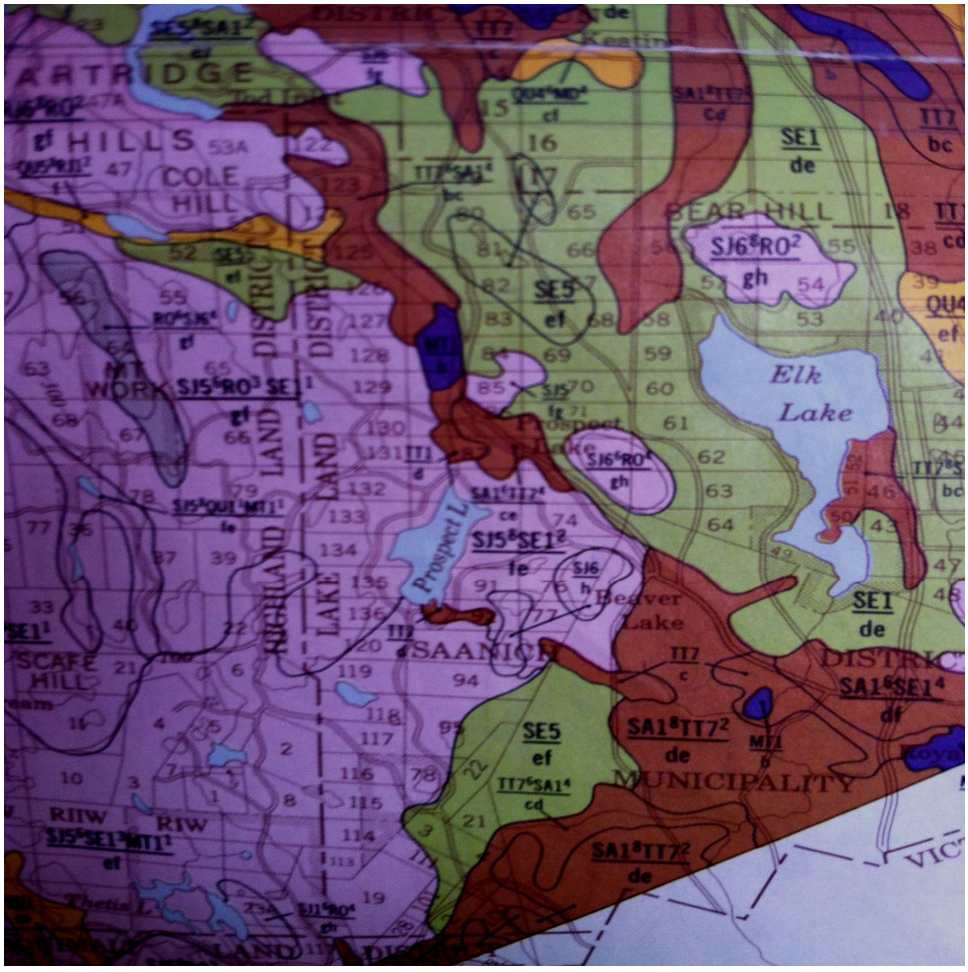


Figure 3 – Soil Survey Map of Southern Vancouver Island. The pink is the Sprucebark soil site and the brown is the Saanichton soil site. The property is located at the Northeast tip of Prospect Lake (Jungen, 1985).

The bulk of the crown dieback is in the Grand fir population of the low elevation zone in the south east of the property. Grand fir is traditionally abundant in dry cool sites with

precipitation between 600mm and 2500mm and long growing seasons from 5 to 7 months. The Grand fir has a very high nutrient demand and therefore, does quite poorly in wet, leached soils (Ministry of Forests, Land and Resource Management, 2011).

Figure 4 – Canopy view in the dieback zone

**Methods and Materials:**

For the purpose of this project all fieldwork was conducted with the assistance of Teren Sunstrum and Wendy Tyrrell. Also all research was done on the University of Victoria library's journal search engine.

Field research was done on October 24th and 26th, November 2nd and 6th.

Soil profile descriptions were conducted at three points in the study area: in the valley beside the stream parallel to the development driveway, at the top of the stream and in a similar

community to that of the dieback area slightly uphill from the stream. The purpose of the soil pits was to conduct texturing of the soil to determine drainage capabilities, the depth of the water table and the any differences between these two Grand fir communities.

Research was conducted with:

- Shovel
- 30m Plumb measuring tape
- Garmin etrex Legend HGx GPS system - NAD 28 10U
- Soil Surveys of Southern Vancouver Island Map (Jungen, 1985)
- Apple Iphone camera 4Gs
- Ground Inspection Forms from "Field Manual for Describing Terrestrial Ecosystems – 2nd Edition"

## Results:

| Waypoint # | Description | UTM (m) |
|---|---|---|
| 1 | First Soil Survey in dieback study area just north of the free flowing water | E 0468119<br>N 5374013 |
| 2 | Second soil pit to determine upstream conditions | E 0468170<br>N 5374054 |
| 3 | Third soil pit in similar but health Douglas fir/Grand fir community | E 0468105<br>N 5374029 |
| 4 | Location of fire hydrant and under ground culvert | E 0474619<br>N 5363868 |
| 5 | Termination of winding stream and connection with already existing ditch | E 0468067<br>N 5373936 |

The first soil pit dug in the dieback zone proved to be stereotypical of the Saanichton soil series. The Ah layer was a clayey silt loam and about 25cms thick. At about 45cm the B horizon starts as a thick heavy clay layer. It was difficult to break up and came up in thick aggregates. There was no coarse material found in this area at all. The high clay content

suggests that drainage is quite poor. The soil was fairly wet and suggested that the trajectory of this soil type is the CwBg – foamflower. The dominant species in this soil type are Western Red Cedar *(Thuja plicata),* Douglas fir *(Pseudotsuga menziesii),* Big Leaf Maple *(Acer macrophyllum),* and Grand fir with dull Oregon-grape *(Mahonia nervosa)* and sword fern *(Polystichum munitum)* as the dominant understory species, all of which are abundant on the property uphill from the site.

The second soil pit at the top of the stream was quite illuminating. Upon initial inspection it became apparent to the team that there was a culvert allowing the water to run from the property located uphill from the covenanted land. Furthermore, just above the culvert was a fire hydrant indicating that municipal water mains run underground in the area as well. The area selected for digging was quite loose and gravelly at its surface. Once digging commenced it became apparent that this gravelly material was eroded content. There was 15cm of eroded material above the original humic layer. The Ah horizon again was textured and also proved to be a clayey loam, potentially at least 50% clay. There were few if any naturally occurring coarse fragments, aside from some unidentified glass material that was most likely discarded human artifacts. At 50 cm deep (35cm not including the upper eroded layer) the water table was hit, at the beginning of the B horizon. Thus proving that there is an additional source of groundwater adding to the accumulation at the dieback area.


Figure 5 – Boundary of the covenant property and points of interest.

Initial speculation and hypothesizing predicted that the dieback was caused by increase runoff associated with a housing development to the Southeast of Echo Drive. A former baseline report done on the property, conducted by Mogensen et al. 2006 (Figure 1), included a riparian area in the northwest of the property that they concluded originated from a spring slightly uphill. Upon inspection of the property it became apparent that there was indeed running water present and it coincided neatly with the dieback zone. However, the origin of the stream cannot be confirmed as the spring. Runoff channels leading off to the newly added driveway would agree with the adjacent development theory; however, free flowing water is apparent in abundance farther upstream of the property. Therefore, the inundated soil cannot be blamed

solely on one new development in the area. Chemicals associated with parked cars and construction machinery can hypothetically be transferring heavy metals and dissolved pollutants into the soil, which may be speeding up the rate of dieback (McKenzie et al., 2009).

Figure 6 – The profile of the first soil pit just outside the waterlogged section of the dieback zone.

Figure 7 – The gravelly eroded material found above the organic layer in the second survey site

The third and final soil analysis was preformed in a nearby Grand fir community. The soil survey here was quite helpful as it painted a very different picture than the first soil pit. First off, the humic layer was roughly 5cm thicker than that of the of the dieback zone. This is most likely due to the decreased erosion and leaching rate caused by the inundated soil and the free moving water in the dieback zone. The humic layer was also very rich in mycelium, far greater than either of the other two soil survey sites. The Ah horizon was still a loam but with a far greater sand content. The B horizon had an even greater sand content with little to no clay. Furthermore, there was about a 30% coarse fragment content with the majority being stones or cobbles. As expected being slightly uphill from the stream and with a far better drainage potential the site was rich and fairly dry and seemed to represent the Sprucebark site series. As mentioned before Grand fir thrives in rich dry to rich moist soils and does poorly in very wet

conditions. Therefore, it seems intuitive that the Grand fir population located at this point is doing quite well.

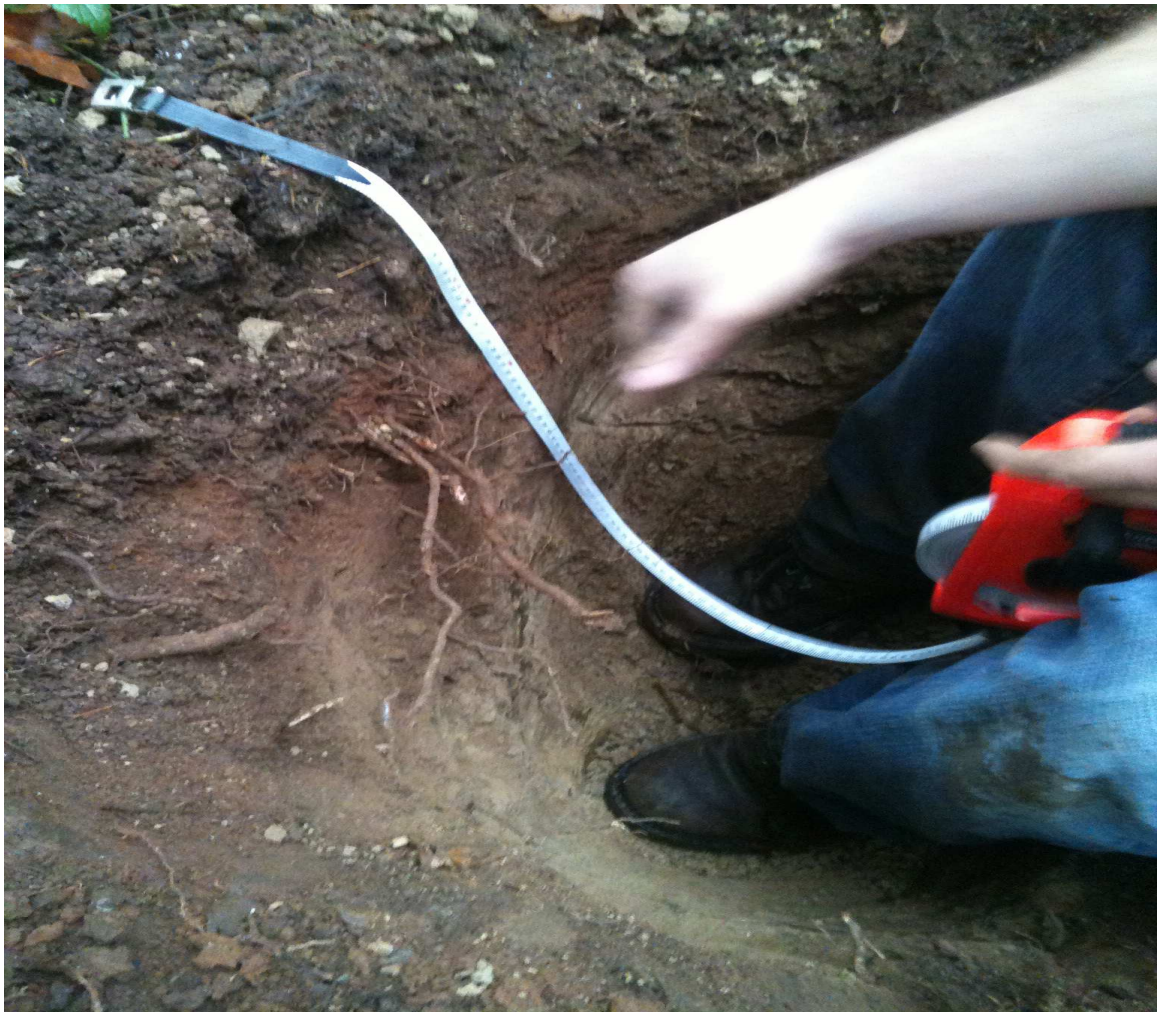

Figure 8 – Analyzing the third soil pit. Majority sand with a high amount of mycelium in the organic layer

**Discussion and Conclusions**

There are several implications to this study. Firstly, that the high clay content in the stream area is preventing proper drainage of the now waterlogged dieback zone. Previously this may not have been a problem as the percentage of impermeable soil barriers in the Prospect Lake subdivision has increased as the population and interest of the area increase over the last

decade (District of Saanich Department of Housing, 2012). This should also be compared to dry season sites to get a fuller feel of the site's hydrology. The adjacent development is obviously a point source of increase water into the dieback zone but there are contributions from the entire neighborhood. From other developments in the community to the compaction that comes from near by foot trails, there are several potential sources for the observed increased water flow through the property.

It has become apparent that in the last 5 years or so the maximum amount of water this clay heavy Saanichton soil type can properly manage has been exceeded. This needs remediation as soil saturation can lead to acidification, decreases in aeration and organic nitrogen loss (Brady and Weil, 2008 & Zhu, 2008). Secondly, the dieback of the Grand fir is indicating that there is a shift in the successional trajectory of this site. With increased moisture the CwBg – foamflower classification shifts to a Cw – skunk cabbage community. The expected vegetation of the Cw – Skunk Cabbage community type is dominantly Western Red Cedar and Big Leaf Maple. The expected understory is Salmonberry (*Oemleria cerasiformis),* Red Elderberry *(Rubus spectabilis),* Salal *(Gaultheria shallon)* and Sword Fern. The Cw – Skunk Cabbage is not known to support Grand fir as the moisture regime is too high. Young Western Red Cedar and Big Leaf Maple are observed in abundance in the dieback zone along with salal, sword fern and red elderberry, again supporting the shifting successional trajectory theory. Finally, if there is in fact a trajectory shift occurring and it is resulting in a crown thinning, then now more than ever the invasive population needs to be kept in check. All along the stream Himalayan blackberry, English Ivy, and Holly were observed. The increased sun to the forest floor is sparking abundant understory development and unfortunately the invasive species, especially the Himalayan blackberry, have a leg up on the native species that traditionally occupy those niches.

The symbiotic fungal associations also need to be addressed in determining the dieback catalyst. Mycelium aid in increasing the total water uptake by trees through accessing water in

organic material restricted to pockets protected by clay particles (Brady and Weil, 2008). This becomes especially important in periods of either excess water or drought. Drought, inundation, heavy metals, excessive nitrates, and acid rain byproducts all restrict the development of mycelium (Newbound, 2010). Runoff from nearby developments coupled with the drought/inundation stress experienced in the past year has appeared to impede the fungal lifecycle. This would support why little to no hyphae were observed in the first two soil surveys (Newbound et al., 2010). Also possible but less likely is that the fire hydrant at the head of the stream could be leaking. It is not definitive; however, it cannot be excluded as a potential point source of increased water. Poor aeration and loss of mycelium can be a death sentence for the already sensitive Grand fir.

Figure 9 – Hydrophilic vegetation in the dieback zone. The development's drive way is in the top left of the picture with a workers truck parked on the curb.

There are several potential remediating steps that can be taken in light of this information. However, before any work commences it has to be decided which vegetation is desired on the site. The Grand firs may hold a special place in the stakeholder's hearts. There may also be more of an emphasis on maintaining a natural adaptive community. Either way these are questions that need to be addressed before any remediation steps can take place.

Figure 10– The fire hydrant at the mouth of the culvert. The free water can be seen heading down the property.

Two possible courses of action have been determined from this study. First, an invasive plant removal plan of this area is suggested as a precursor to any other remediation work (please see Teren Sunstrum's report). If retention of the Grand firs that are desired, then the digging of a trench to divert the water draining through the culvert is suggested. This can follow the property line and connect with another already existing culvert paralleling Echo Road

further downhill (Figure 5). This could intercept some of the water that runs off the new development and hopefully reduce water in the dieback zone back to a manageable amount for the soil to process. The only issue with this is that there is no guarantee that this will reduce the moisture level below soil saturation. Small increases in impermeable surface greatly influence runoff levels and percolation ability (Schafer, 2004 & Newbound et al., 2010). Furthermore, if it did work it may only be a temporary solution, as further development in the subdivision would only lead to this problem reoccurring in the future.

The second option would be to embrace the increased water level and aid the community in its transition. This would entail protecting the young Western Red Cedar saplings as browsing is exceptionally high in this species in thinned stands (Mass-Hebner et al., 2005). Further on if the condition of the Grand fir does not improve then eventually topping for use as wildlife trees may be required. Native hydrophilic vegetation can be planted, such as skunk cabbage. As the novel community develops and the saturation of the soil decreases, dormant mycelium spores should develop and aid young Western Red Cedar and Big Leaf Maple. The opinion of this study is to assist the natural transition process as continuing development in the community is imminent.

Figure 11_– Thriving Western Red Cedar and Big leaf Maple saplings dominate the understory in the riparian zone.

**Acknowledgments:**

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