Garbage to Gardens

Reclaiming land in the Village of New Denver

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Executive Summary

The Village of New Denver, the Central Kootenay Region of British Columbia, owns an 8.84 acre plot of contaminated land. The site was previously used as a landfill from 1962 – 1983. The Village is currently interested in the potential of this site as a community garden space, and is wondering about the steps necessary to get to that point. This report is a compilation of information – including site history, soil testing, remediation method research, and community consultations – to help the Village in the process of deciding whether or not to pursue remediation of the site for community garden use. The preliminary research done here shows that although financial barriers exist, there are ways around them. There are a number of steps and expenses that will likely be involved, but agricultural potential exists, especially in the form of greenhouses or hoop houses.

Introduction

In October 2008, I came to the Village of New Denver as a part of a course through the University of British Columbia; I was with a group of students working to assess local food security. During this visit, Mayor Gary Wright introduced our group to New Denver's old landfill on Denver Siding. He indicated that there was some interest within the village to try to use this space for a community farm or garden of some sort, but there was insufficient information gathered at the time to seriously pursue this idea.

This report is the first step in gathering that information, so that the New Denver community and council can move forward to make an informed decision concerning the environmental, financial, and social suitability of this site for community agriculture purposes. In order to assess the old landfill for its community garden potential, a combination of literary research and field analysis was necessary. The project began with research into the site history, as well as government standards regarding contaminated site reclamation. Then, qualitative soil profile analyses were performed, and soil fertility tests were taken from select areas of the landfill site. A community consultation was held in the form of a community meeting, where community garden ideas could be discussed, which was followed by further research into examples of remediation methods that could be employed at the landfill.

This project was structured as a community-based research project, a long term participatory process in which researchers and various community stakeholders collaborate in a process that identifies issues important to community development and formulates strategies to move these issues forward (CCBR, n.d.). This kind of direct community involvement made it possible for local knowledge and interests to be incorporated into the project, which helped to put the project in an appropriate, realistic context.

This project focuses on only a fraction of the issues to be considered in determining this site's garden suitability, and the findings are by no means complete. However, by identifying the information gaps and synthesizing these findings with future information, the village of New Denver will be in a better position to make a decision as to whether a community garden "fits" in this site.

Site History

The New Denver Surplus Highway Site, legally known as Lot 1, D.L. 550, Plan 17712, is located in Electoral Area H, just beyond the technical boundaries of the village of New Denver. This site contains the old municipal dump in question. Throughout its past, the site has been in the ownership of a number of people, with uses ranging from an abattoir to a highways storage yard. It wasn't until 1962 that the site was first used as a municipal landfill by the Village of New Denver, under the ownership of the BC Buildings Corporation (BCBC). During this time, garbage and refuse was brought in, piled, and periodically burned down to create more room. It was later decommissioned on September 30, 1983 under the ownership of BCBC. To fulfill Ministry of Environment standards at the time, the landfill area was covered with 2 feet of fill, which was excavated from another area of the site. In 1984, the site was inspected and approved as a "rehabilitated refuse site" by the Ministry of Environment, meaning that the landfill could be officially considered "decommissioned" and left unmonitored.

The site, 8.84 acres in total, was bought for $100 by the Corporation of the Village of New Denver from BCBC on September 15, 1997 (registration # KL99048). The Village had to agree to two conditions upon purchase: firstly, that they would sign an Indemnification Clause, removing all environmental liability and responsibility from BCBC, and secondly, that they would sign a Restrictive Covenant, limiting the use of the Lands to municipal purposes only.

In the summer of 1992, an Environmental Real Estate Audit was performed on the site by JMB Research Ltd. for BCBC. This report included geological descriptions and historical site use reviews in order to identify potential environmental risks associated with the site (as a non-intrusive investigation). This led to the identification of ten environmentally sensitive areas on the site, characterized by surface refuse, stressed vegetation, and surficial staining. The covered landfill was not directly tested in this audit, but the report indicates that there is a high probability that the covered landfill contains asbestos containing materials, polychlorinated biphenols (PCB's) and PCB-containing materials, and methane producing organic materials.

Although no other formal contaminated site investigations have been completed and there has been no official Determination of contamination issued to the site, it is quite certain that the site is contaminated based on its history and the research that has been done. Consequently, it is registered in the B.C. Contaminated Site Registry. The key Suspect Land Uses of concern outlined in the Site Registry are:

- Asphalt storage

- Landfill (general use)
- Treated wood storage (hydro-pole dump)

As a result of these contamination concerns, a series of site investigations and remediation procedures must be performed and approved by the Ministry of Environment before the site can be put to municipal use. These procedures are discussed on page 10 in the *Government Policy for Contaminated Sites* section of this report.

<u>Qualitative Site Description</u>

Although the entire New Denver Surplus Highway Site is a total of 8.84 acres, only the portion most affected by the landfill has been focused on in this study (see Figures 1A and 2A in Appendix A for area map). This focal portion can be separated into four distinctly different segments, as shown below.

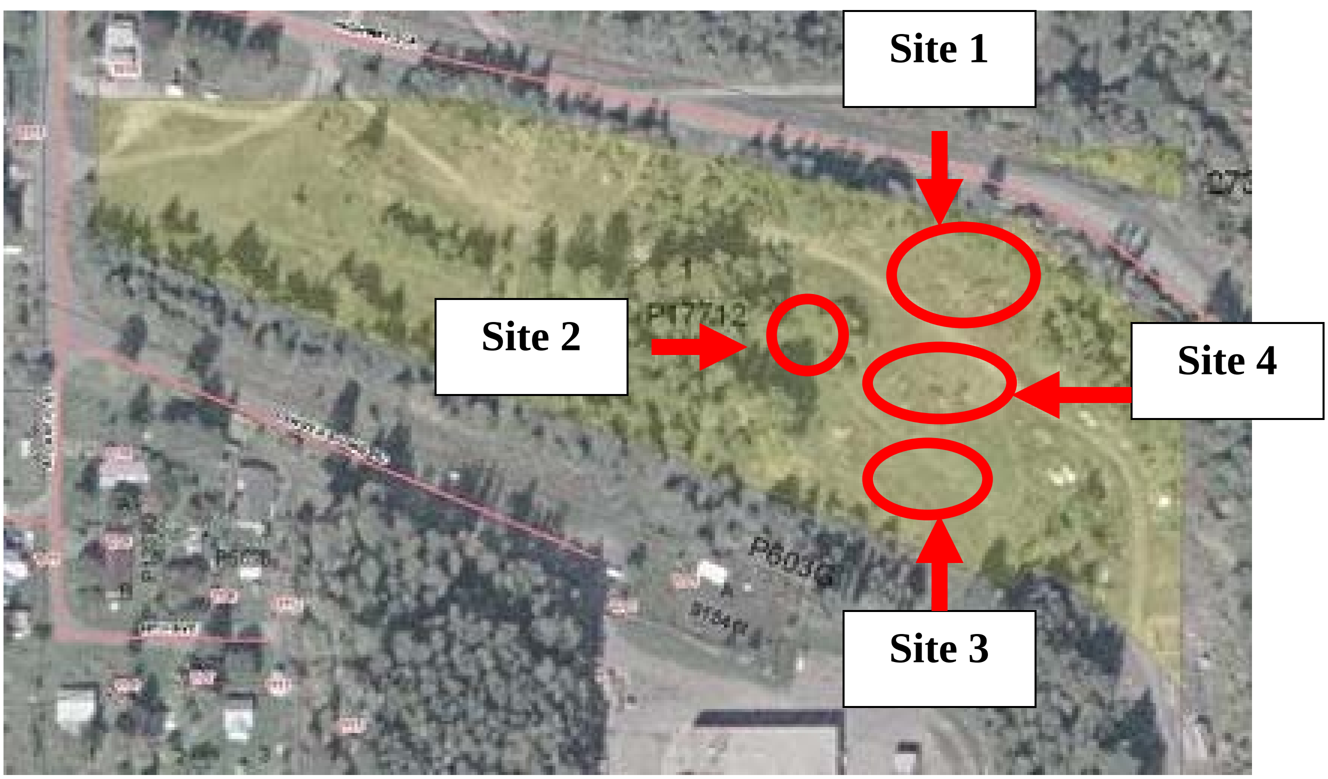

Figure 1. New Denver Highway Surplus Site map highlighted in green, red circles denoting the four main sites

Site 1 is the most flat and compact area, at the highest elevation of the site, and strewn with logs and woody debris. Most notable about this area is its stability and great exposure to the sun. Site 2 is also quite flat, but at a lower elevation and with more vegetation than Site 1. Site 3 is at the lowest elevation at the base of the covered landfill, sloping southwards with thick grass cover. Site 4 is located most directly over top of the 100 meter by 50 meter dump. It is characterized by piles of organic and inorganic debris, some of which have become grown over with grass and weeds.

In order to get a basic idea of the existing soil types, two soil pits (each 1 meter deep) were dug and soil profile descriptions done through qualitative soil pit analysis. This type of qualitative observation of the soil horizons, or layers, provides some insight into the types of soil development, soil forming processes, and disturbances are acting on the site. In addition, identifying soil texture and structure helps to indicate the nutrient holding capacity and suitability for plant growth. Sites 1 and 2 were selected for these analyses based on their apparent potential for agriculture (ex. exposure, slope, existing vegetation, accessibility).

The pit at Site 1 was difficult to dig, as the soil was very compact and coarse. The texture was largely loamy sand throughout, riddled with gravel pieces and rocks. These coarse particles are quite inert, and therefore have a low nutrient holding capacity. There were patches within the soil profile of different colours and textures, but the patches didn't extend enough to create distinctly separate horizons. The compact, granular structure reveals poor water retention, due to rapid drainage and surface runoff. The absence of a B horizon indicates a Regosolic soil order type, where soil is weakly developed for a variety of reasons (Brady & Weil, 2004). In this case, the disturbance of covering the area with coarse fill and then leveling it off with heavy machinery fits as the cause of weak soil development. Please see Appendix B, Table 1B for a detailed observation chart.

Site 2 had better soil horizon development than Site 1, as a result of soil organic matter accumulation in the top A horizon. Even so, the soil development was weak and a true B horizon was lacking, indicating Regosolic soil once again. This soil was less compact and coarse, with a sandy loam texture; however, there were still large gravel pieces embedded throughout the profile. Refuse artifacts were also littered throughout the soil profile, mostly as rusted pieces of metal or tile fragments. The soil at this site had better porosity and aggregated structure than at

Site 1, and signs of soil development were clear, it was still poorly developed due to its history of disturbances. Please see Appendix B, Table 2B for a detailed observation chart.

As a general note, the impact of the landfill use and subsequent fill covering was apparent. It was clear that the soil forming processes had been disturbed, and some areas were recovering faster than others with vegetative growth and the accumulation of soil organic matter. Work would need to be done changing the texture and structure of the soil, in order to improve the growing capacity of the site, and refuse would need to be cleared as well.

Quantitative Soil Fertility Description

In addition to the soil pit analyses, a more quantitative analysis was done in the form of soil sampling and soil fertility testing. The purpose of fertility testing was to determine the quality of the soil for crop growth, contamination concerns aside. This information will be useful in the future, should contamination investigations go forward. Then, if certain areas are discovered to be uncontaminated and direct soil access is permitted, the soil nutrient levels will be known and the correct soil amendments applied. This information will also be useful should phytoremediation (see *Remediation Overview*, page 11) be pursued as a remediation method and soil amendments become necessary for the specific plants being used. Unfortunately, contamination testing will have to be left to the professionals, as it is beyond the scope of this project. It will also be part of the official contamination investigations that will take place should the Village decide to pursue remediation.

A composite sampling method was used to collect the soil for testing, so as to get a representative sampling of each area. To create the composite sample, multiple samples are taken, combined, and one sample then extracted from that – this is the composite sample (BCMAL, 2005). Nine composite samples, of 15-20 cm in depth, were taken from nine main areas of the dump site, differentiated by vegetation and soil characteristics. Site 1 was the most variable with 5 composites, Site 2 had 3 composites, and grassy Site 3 was highly uniform, necessitating only 1 composite. Site 4 was too uneven, variable, and cluttered with debris to be evaluated effectively, so it was excluded from this testing.

After the samples were dried and mixed, they were sent to Pacific Soil Analysts Inc. in Richmond, B.C. for macro- and micro- nutrient testing. The complete table of test results can be found in Table 1C, Appendix C. Although each area was different from each other, there are some general notes can that be made about all of the samples collectively. The soil pH was slightly acidic throughout the dump site, ranging from a pH of 5.2 to 6.4. Most crops prefer a near-neutral soil pH (Gliessman, 2007), so a lime application of 2 tonnes/ha is best for the loamy sand/sandy loam texture (Soil Test Disclosure, n.d.), except for at Logs Site 1 where the pH is high enough. Overall, total nitrogen levels were very low (all <0.3%), as well as soil organic matter (SOM, all <6.0%). Phosphorus levels, on the other hand, were very high throughout the site, and minimal or no phosphorous amendments are needed. Boron levels were all <0.7ppm, never reaching "high" levels (Soil Test Disclosure, n.d.), and soil salinity (expressed by Electrical Conductivity, or EC) was generally low with all areas at yield effect negligible levels (Soil Test Disclosure, n.d.).

Below is a list of all of the composite sample areas, with notable nutrient levels and relevant soil amendment recommendations as taken from Soil Test Disclosure (n.d.). There is a focus on amendments for potassium (K) and magnesium (MgO). Boron (B) levels are included here, but please see Table 2C, Appendix C for the guiding table for interpreting boron test results. Please note that all desired nutrient levels are completely crop dependent.

Notation Key:

(Potassium) Crop Group 3: alfalfa, red clover, field corn, sweet corn, pole beans, bush beans, spinach, peas, lettuce, small fruits
(Potassium) Crop Group 4: onions, tomatoes, potatoes, celery, cauliflower, broccoli, cabbage, root crops, cucumbers, squash, rhubarb, asparagus, hops, bulbs

(Magnesium) High Mg: celery, corn, potatoes, cole crops, pumpkin, small fruits, root crops
(Magnesium) Med Mg: alfalfa, beans, bulbs, clover, onions, peas, strawberries, turf

(Boron) Sensitive Crops, very low: beans, cucumbers
(Boron) Low Requirements, low: melons, peas, potatoes, wheat, squash, cereals, grasses
(Boron) Medium Requirements, medium: asparagus, carrots, radishes, corn, eggplant, lettuce, onion, pepper, spinach, tomatoes, small fruits
(Boron) High Requirements, high: beets, turnips, cabbage, broccoli, cauliflower, tree fruits, alfalfa, clover

Log Site 1 (within larger Site 1, see page 5):

- Highest pH, highest EC, highest %SOM, highest %N
- Grassy area, corresponds with SOM (grassland soils generally 5-6% SOM by weight)
- Group 4, 67 kg/ha of K
- Medium B

Log Site 2 (in Site 1):

- Group 3, 67 kg/ha of K; Group 4, 100 kg/ha of K
- Very low B (beans and cucumber are sensitive to B, so are suitable here without B additions)
- High, 28-56 kg/ha of MgO; Med, 17-38 kg/ha of MgO

Log Site 3 (in Site 1):

- Group 3, 45 kg/ha of K; Group 4, 90 kg/ha of K
- Very low B
- High, 28-56 kg/ha of MgO; Med, 17-38 kg/ha of MgO

Log Site 4 (in Site 1):

- Lowest Zn, low N, low SOM, low EC, low pH
- Rough area, makes sense that many nutrients are low here
- Group 3, 90 kg/ha of K; Group 4, 168 kg/ha of K
- Very low B
- High, 28-56 kg/ha of MgO; Med, 17-38 kg/ha of MgO

Log Site 5 (in Site 1):

- Highest Fe, lowest B, lowest N, lowest SOM, lowest EC, lowest pH
- Another rough area, many nutrients lowest here
- Group 3, 168 kg/ha of K; Group 4, 280 kg/ha of K
- Very low B
- High, 39-73 kg/ha of MgO; Med, 23-56 kg/ha of MgO

Willow Site 11 (within larger Site 2, see page 5):

- High, 28-56 kg/ha of MgO; Med, 17-38 kg/ha of MgO
- Low B

Willow Site 22 (in Site 2):

- High, 28-56 kg/ha of MgO; Med, 17-38 kg/ha of MgO
- Low B

Willow Site 33 (Site 2):

- Group 3, 45 kg/ha of K; Group 4, 90 kg/ha of K
- Very low B
- High, 28-56 kg/ha of MgO; Med, 17-38 kg/ha of MgO

Grass Site 100 (within large Site 3, see page 5):

- Grassy area corresponds with higher SOM
- High Ca, high Cu, high Zn, high Mn (relative to other values)
- Group 3, 45 kg/ha of K; Group 4, 90 kg/ha of K
- High, 28-56 kg/ha of MgO; Med, 17-38 kg/ha of MgO

Government Policy for Contaminated Sites

There are two key governmental documents that govern the remediation and approval for use of contaminated sites: the Environmental Management Act, particularly Part 4 (Ministry of Environment, 2003), and the Contaminated Sites Regulation (Ministry of Environment, 1996). According to the Act, the owner of a contaminated site must provide a site profile to the approving officer, outlining past and present site use and general descriptions of the land. The Act also states that a Director of Waste Management for the Ministry of Environment "may order an owner or operator of a site, at the owner's or operator's own expense, to undertake a preliminary site investigation (PSI) or a detailed site investigation (DSI)" as detailed in the Regulation, if it is suspected that "the site may be a contaminated site, or contains substances that may cause or threaten to cause adverse effects on human health or the environment."

A PSI consists of two stages, as outlined by the Regulation. The first stage focuses on the site history, while the second stage focuses on determining general locations of potential contaminants. The Environmental Audit performed by JMB Research Ltd. in 1992 resembles the work that would be done in the first stage of a PSI. Based on the history of the New Denver Surplus Highway Site, it is likely that the Village will be ordered to also perform a DSI, identifying the specific locations and depths of contaminants and evaluating these values in relation to the standards of both the Contaminated Sites Regulation and the Hazardous Waste Regulation. A DSI report must also include information necessary in developing a remediation plan. A Director will then only consider an application if a written statement is provided and signed by a person with demonstrable experience in the type of remediation being applied for.

Obtaining Ministry approval generally occurs in the following basic step-wise fashion, which can be summed up as follows:

Preliminary site investigation
→ Detailed site investigation
→ Determination of contamination
→ Evaluation of remediation plan
→ Approval in Principle of a Remediation Plan
→ Confirmation of remediation
→ Certificate of Compliance

A PSI and/or a DSI must first be reviewed before a Director will issue a Determination that a site is or is not contaminated. Then, the Director must evaluate a remediation plan before issuing an Approval in Principle of a Remediation Plan. Finally, the Director evaluates a confirmation of remediation report before issuing a Certificate of Compliance with the human health and environmental protection standards (Ministry of Environment, 2008). In addition, the Act states that a Director has the right to request or rely on the recommendation of an Approved Professional. An Approved Professional is someone specializing in the field of remediation and contaminated sites and is listed in the Act under the roster of Approved Professionals. In fact, Protocol 6 for Contaminated Sites outlines that certain applications require support from an Approved Professional in order to even be considered for review (Ministry of Environment, 2008).

Remediation Overview

When considering the methods of remediation for contaminated sites, the list of options available is long and diverse. The type(s) of remediation best suited to the New Denver Surplus Highway Site will be determined by the findings in the detailed site investigation (DSI) when the contamination is quantified and identified. The information here is very general, and meant to provide the Village with a basic idea of some potential remediation options. In this remediation overview, five main methods are outlined:

- Removal/Excavation
- Capping
- Phytoremediation
- Bioremediation
- Separation

Removal/Excavation: the complete removal of contaminated soil from an area, to be replaced with clean fill. This is a very common method of remediation, because it is fast, but is often viewed negatively as an unsustainable, band-aid solution (Richardson, 2008). This is because once the contaminated soil has been excavated, it must be properly treated or disposed of in some way (Sellers, 1998). Then, the area must be refilled with “clean” soil, which can be expensive to purchase and transport. However, with this method it is possible to impact a large area of contamination and know the limits the decontamination that has been done with high certainty.

Capping: the use of gravel, rocks, soil, pavement, or other material as a fill layer to contain the contaminated area, either temporarily or permanently. Many different types of capping media can be used, and capping depths may also vary depending on the climate and the site usage (FRTR, n.d.a). It is commonly used to contain waste in landfill sites as a cost-effective, reliable way to manage hazardous wastes (FRTR, n.d.a).

Capping prevents groundwater contamination caused by water (precipitation or irrigation) flowing through the soil profile, as well as contamination of surface runoff that would otherwise come in direct contact with the contaminated soil (Sellers, 1998). It also helps to slow volatilization of contaminants and formation of contaminated dust. In certain cases, capping is used in conjunction with further isolation and containment of contamination, through the placement of walls around the area of concern. This helps to further prevent the migration of contaminants from the site through water (Ministry of Environment, 2009).

This is another fast-result method, with a high degree of certainty as to which areas have been contained, because the cap provides the boundary lines (Sellers, 1998). It can be designed to direct and control gas emissions from underlying wastes (FRTR, n.d.a). In addition, it is versatile, and can be made to suit the site through layering and specialized geosynthetics.

For example, at a former wood treatment facility in Burnaby, B.C., a number of capping materials were used in layers over one another (Ministry of Environment, 2009). First, a protective sand-gravel layer was laid down, then a low permeability layer of clay-like material called Aquablok, and then another sand-gravel layer. The cap provided a structural foundation for the creation of a marshland area on top. In New Denver’s case, the structural foundation could be used as garden space.

The difficulty is that once the cap is in place, the growing medium needs to be developed on top. Getting the topsoil to put on top of the capping could potentially be costly, and this needs to be taken into consideration.

Phytoremediation: the use of plants to decontaminate soil, water, and air based on the ability of various plants to contain, degrade, or eliminate certain pollutants and contaminants (Richardson, 2008). This remediation is relatively inexpensive and minimally disruptive as it doesn't require soil excavation disturbance. The plants are selected according to the specific contaminants they match up with, and there are many different types of plants to choose from to suit the particular site.

The main problem with phytoremediation is that decontamination is limited to the root zone of the plants, so it is only effective to a certain depth (Sellers, 1998). It is also a long process and can take years for the plants to take up the contaminants (Richardson, 2008). The other issue is that the vegetation used in the phytoremediation must be properly disposed of, because the plants contain the contaminants and become "green waste" (Richardson, 2008). Essentially, phytoremediation is a fairly limited, long-term remediation method that likely isn't suitable as the main remediation approach for the New Denver dump site; however, it has potential as a cheap, natural way to supplement another remediation process.

Bioremediation: any process that uses microorganisms or their enzymes to return the environment altered by contaminants to its original condition (Government of Canada, 2008). There are many types of bioremediation, but they all depend on the microbial metabolism of some microbial agent. Microorganisms will either use chemical contaminants as components in building cell parts through anabolism, or they will break down chemical contaminants to obtain the energy that is released through catabolism (Government of Canada, 2008). This microbial activity is particularly effective in contaminated groundwater situations (Sellers, 1998).

Bioremediation can be done "in situ" (on site), which minimized disturbances, or "ex situ" (following removal of soil from the site), which allows for the control and certainty of excavation but prevents the problem of having to dispose of the contaminated soil and bring in new fill. In either situation, bioremediation is a long-term process, but because it is using natural agents it is less expensive than its chemical treatment counterpart (Government of Canada, 2008).

When performing in situ bioremediation, it is important to be aware of bioaccumulation problems. Should there be any contaminants remaining in the microorganisms there can be negative food chain impacts as the contaminants are accumulated in higher order consumers (). Because of this, heavy metals are not suitable targets for bioremediation and require alternate remediation approaches (Government of Canada, 2008).

Separation: technologies employed to separate concentrated contaminants from the soil, due to variation in volatility, solubility, or electrical charge (Sellers, 1998). As identified in the 1992 Environmental Audit done by JMB Research Ltd., methane gas emissions from the covered landfill are a potential concern, so gas release and venting methods will likely be relevant in the future. There are many ways to vent the soil, but a common method is soil vapor extraction (SVE). This system separates contaminants from the soil based on their volatility using a series of extraction wells. Air can be blown into the soil wells, inducing air flow through what is known as "air sparging" (FRTR, n.d.b). The idea is that the contaminants will then volatilize into the air and a vacuum in the wells will suck in the vapors to holding tanks at the surface (Sellers, 1998). The vapors must then be treated before they are released into the atmosphere.

Separation systems can be costly to install, but if gas venting is going to be an issue it will be necessary to pursue some sort of SVE or sparging apparatus.

Community Garden

When beginning any sort of project, it is advisable to have an end goal in mind so as to effectively focus the work done along the way. For this project, having an idea of what a community garden at the old New Denver landfill might look like would provide some context for further research into potential remediation methods for this site. A small community discussion was held in Knox Hall on June 13, 2009, for residents to voice their concerns and discuss their ideas about a community garden. I have narrowed down the food production structures of greatest interest based on information from the AGSC 350 food security project in 2008, my own observations at the site, and feedback from the Community Meeting held to discuss community gardens.

During the AGSC 350 food security project in October 2008, it was discovered that one of the main food security concerns in the village is the dependence on external food sources during the winter months. Winters in New Denver are generally long and cold, leaving the ground covered in snow and cutting the summer growing season rather short. Due to the small population of the village, turnover of produce is very slow in the small local grocery stores, resulting in generally poor quality, expensive produce that travels many miles before it is sold. This indicates that some form of food production in these winter months would be especially valuable to improving food security in New Denver.

Within the dump site, there is a large, flat area with excellent exposure and a very solid, gravelly-fill texture (referring to Site 1, see Figure 1 on page 5 of this report). This would likely be an excellent area for some type of season extension structure, such as a greenhouse or hoop house arrangement. That said, this area could also be simply filled in with top soil and be suitable for a raised bed situation (without the greenhouse structure). However, other areas that appear to have more fertile soils also have refuse and artifacts in their upper horizons, and perhaps these areas could be covered with fill and then used as the greenhouse areas. Either way, these seasonal extension facilities especially suit the Site 1 area of the landfill, and could be arranged as best fits the site layout.

The residents at the Community Meeting also voiced their opinion that season extension would be an important thing to incorporate in a community garden for the area, and the idea of greenhouses/hoop houses was well supported. What was unclear was how the garden would be administered and structured, such that it would remain financially viable. Another popular idea at the Community Meeting was to have a large, industrial composting facility and municipal composting program. There was discussion as to how this could be the first step in the process, and the compost could be used to build up the top soil for the garden, which would be developed later. People at the meeting raised concerns about gas emissions from the buried landfill, and many seemed wary of directly using the existing soil.

See Appendix D for full summary of the Community Meeting.

Recommendations

Based on the information gathered, some conclusions can be drawn regarding the suitability of the site as a community garden. Both the qualitative and quantitative soil analyses indicate that the soil quality is relatively poor, and will require some amendment work, without taking into consideration the risk of contamination. However, this does not mean that the site has no potential for agriculture. Site 1 (Figure 1, page 5) is of particular interest, as it is compact, stable, level, and has excellent exposure to the sun. These characteristics add up to form an area suited to greenhouse or hoop house operations. This theme of season extension is also in line with the food security limitations in the Village during the winter months.

In terms of remediation, it is difficult to predict which method will be most suitable without specific contamination information, but at this point it appears that capping is a valid option. Capping is both timely and cost-effective, and provides the assurance of having a protective barrier between contamination and – in this case – the garden. Examples of capping for community gardens exist as reference points for this method of remediation, most notably the Cottonwood Community Garden in Vancouver, where the majority of the garden spaces have been developed on top of sand that was initially dumped there for playfield construction (Dr. Art Bomke, personal communication, June 7, 2009). Although, depending on the contamination levels and if the greenhouse areas are raised enough, capping may not be necessary at the New Denver dump site.

Whether or not the capping is necessary, it is probable that a clean topsoil layer is going to need to be built-up or brought in, so as to avoid the contaminated soil and/or improve the fertility of the soil. It would be much cheaper for the Village to build up the soil on its own, rather than buying and transporting a topsoil layer for the dump site. This fits in with an idea raised during the Community Meeting in June, of having a composting facility as part of the community garden. The composter could be the first stage of the garden project, and then some of the compost generated there could be saved as topsoil for the community garden. Another idea was to have a community wood chipper combined with a mushroom-growing operation; the wood chips would serve as food and substrate for the fungi, the fungi could be sold to finance the community garden project, and the products of fungal decomposition would be set aside as topsoil for the garden.

Self-creating organically enriched soil as a growing medium will be a multi-step, long-term process, but it would cut down on input costs. Also, it may be necessary to split the garden development up into phases like this in order to better account for the many remediation expenses that will come.

When this site was purchased in 1997, the Village accepted some heavy financial responsibilities, and these expenses are prominent barriers to bringing the site back into municipal use of any kind. The steps that need to be taken by the Village to fully reclaim the site and be awarded a Certificate of Compliance are going to be expensive, and it is going to take some planning and hard work to fund the site remediation. There are costs for having professionals come in to perform the site investigations, and again later to complete the remediation. Then there is the cost of implementing and running the community garden at the end of it all. On top of this, there are administrative fees to have documents and plans approved by the Ministry of Environment. For the New Denver dump site to go through all of the necessary administrative procedures, the total cost from the Ministry alone would be over $50,000 (Ministry of Environment, 1996).

Luckily, there are a number of grant opportunities, ranging from federal to regional programs, which could be accessed by the Village. Just this past year, in April 2009, a new program was launched in B.C. by the Ministry of Agriculture and Lands called the "Brownfield Renewal Funding Program". This grant offers financial assistance for contamination investigations in three different ways:

- Preliminary Site Investigations, up to 85% of eligible project costs or $40,000
- Detailed Site Investigations, up to 70% of eligible project costs or $125,000
- other environmental investigations or related environmental activities, up to 50%,or $125,000

Maximum funding provided for each application is based on the lesser of either the maximum dollar amount or the maximum percentage of the activity for which funding is requested (BCBR, 2009). This is a great funding opportunity to pursue; however, it only applies to the site investigations, which are the first steps of the remediation process. As a result, more funding needs to be pursued and used in a piece-meal fashion. For example, there is an Environmental Initiatives Program through the Columbia Basin Trust of a $20,000 maximum for community initiated and supported ecosystem restoration (CBT, 2009). The Regional District of the Central

Kootenays (RDCK) also offers a Community Development Grant for projects that provide social, economic and environmental wellbeing.

In addition, New Denver's partnership with the Rural B.C. Secretariat could be useful in obtaining funding for remediation. The Secretariat is part of the Ministry of Community Development, and functions to link rural communities in B.C. with provincial/federal governments and provide communities with tools to diversify and strengthen their local economies (RuralBC, n.d.). The Secretariat has already identified the old landfill site as a prominent opportunity for New Denver, and they have already identified some grants through the Western Economic Diversification Canada. The remediation process will be expensive, but with help, this barrier can be overcome.

The other main issue to be dealt with is to determine what the final product will look like – how will the community garden be structured? At the Community Meeting on June 13th, it became apparent that there were many ideas as to how the garden could be administered and managed, and how food could be distributed. The difficulty will be to find a financially viable and self-sufficient structure that fits in with the Restrictive Covenant that limits the site to municipal-purposes only. Based on the discussions held with community members, it seems that the best general way to manage a community garden in this situation would be to have the garden run by municipal workers, paid by the Village. The main variables would then be:

- how much responsibility these workers would have for garden maintenance,
- how exactly community members would be involved in the garden, and
- how will the food be distributed so that the garden can pay its operating fees

There is a lot of potential, and need, for further research into types of community gardens. Case studies of other community situations would provide valuable insight into what structures exist and what would best suit New Denver. It will also be important to get further input from residents to know what people would like to have in a community garden space, and as more information comes available about the site through contamination investigations the capabilities of the site will become clearer.

What would really be valuable to evaluate the financial viability of a community garden and to get a better idea of what the end goal might look like would be to complete a business plan. Having a community garden business plan would allow for a snapshot into the expenses and inputs that might be required, and operating details would be brought up as a part of the business plan writing process. Then, the Village can better plan for funding, and even formulate a timeline of expenses. Of course, it is likely that the final community garden vision will change over time, but the business plan provides a starting point and can be changed accordingly. Currently, the project is at the stage where there are a lot of ideas and speculations flying around, but the next step will be to pin an idea down and take a serious look at the way the community garden might function. A business plan would be an effective way to do this.

Conclusions

Many questions remain, and there is no simple answer as to what should or shouldn't be done on this site. As this report outlines, a community garden is feasible as long as the food production structure is chosen to suit the strengths of the site. Although the remediation process will not come without its barriers, there are ways around it. It is going to be expensive to remediate the site, but there are funding options available to help with this. Approaching the garden development in a series of stages will help to make the project more manageable, and developing a business plan will help to identify the best way to structure the garden.

There are many options and opportunities for this site, making the dump site ownership an investment into the future. There will be costs, but there is great potential for the old dump site in New Denver to become a model in food security action. The next steps are to get a better idea of what the final garden vision and create a funding plan to see the project through, the information compiled in this report should help in making these next steps move forward.

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Soil Test Disclosure. (n.d.) (incomplete citation, to be reviewed)

Appendix A

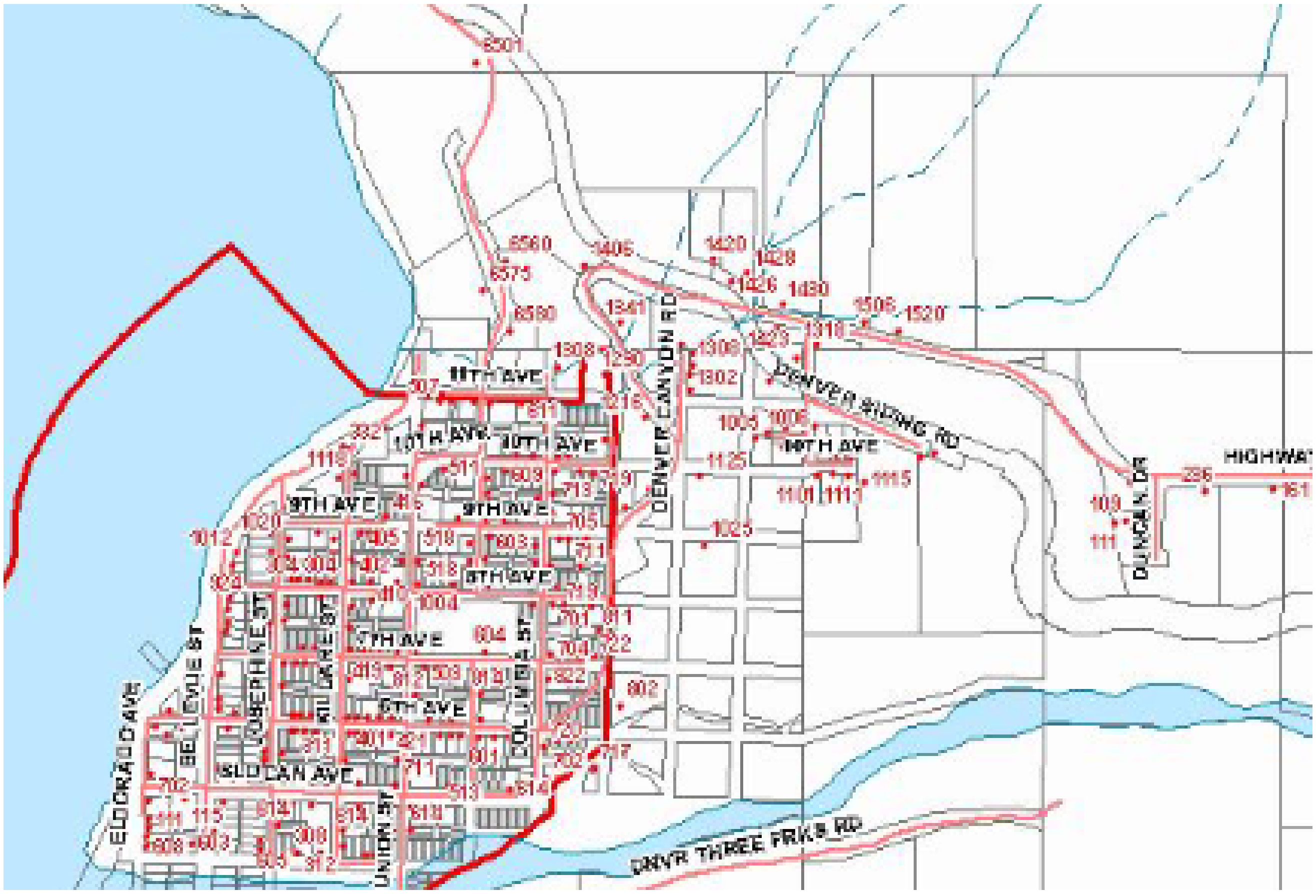

Figure 1A. New Denver area map with the New Denver Surplus Highway Site on Denver Siding circled in red.

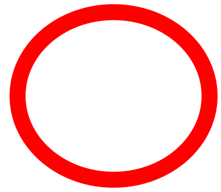

Figure 2A. New Denver Surplus Highway Site highlighted in green, and general location of decommissioned landfill area.

Appendix B

Table 1B. Qualitative soil profile description for Site 1.

Soil Profile Description – Site #1				
Horizon	Depth (cm)	Colour*	Texture	Structure
Difficult to apply horizons here, as it was all quite clearly rough fill that was brought in to cover the landfill	Different horizon types mixed together, varying depths	Brown to mixture of dark brown (humic-looking) patches and reddy-brown patches *Munsell	Loamy sand, mostly Darker segments, silty loam Very surface, quite gravelly	Granular, very compact with rocks and gravel throughout

		colour reference sheets unavailable		
Location	Northern segment of decommissioned landfill (northern, upper ledge)			
Parent Material	Mesozoic Slocan Group (slate, argillite, limestone, quartzite, and tuffaceous sedimentary rocks)			
Elevation	n/a			
Aspect	Slight south-western slope, relatively flat			
Vegetation	Logs (dumped), burs and weeds, some sparse grass			
Soil Classification	Regosolic - unsure of presence of B horizon, as I couldn't really dig down to the true parent material (felt like I was digging through pure fill) - based on site history (of excavated fill disturbance)			
Factors and processes of soil formation	- in 1983, fill was excavated from the asphalt storage area of the site to cover the landfill with 2ft of compacted fill - black and red patches indicate mixture of other horizons and substances from fill - disturbance very obvious, little/no build up of SOM			
Other comments	- took a couple of feet before any refuse was uncovered (not as shallow as in Site #1), and less garbage here as well - very compact, couldn't even dig a full meter down			

<u>Table 2B.</u> Qualitative soil profile description for Site 2.

Soil Profile Description – Site #2				
Horizon	Depth (cm)	Colour*	Texture	Structure
Ajh C	0 - 5 (highly variable around rim of pit) 6 – 100 (although, didn't really dig to parent material)	Dark brown (organic influence) Grey brown *Munsell colour reference sheets unavailable	Sandy loam Sandy loam	granular (held together by roots of grass) granular, compacted, large rocks and gravel pieces throughout
Location	Lower level of decommissioned landfill (western, lower ledge)			

Parent Material	Mesozoic Slocan Group (slate, argillite, limestone, quartzite, and tuffaceous sedimentary rocks)
Elevation	n/a
Aspect	Slight south-western slope, relatively flat
Vegetation	Grass, moss, mature cottonwood and pine nearby, burs, ferns
Soil Classification	Regosolic - unsure of presence of B horizon, as I couldn't really dig down to the true parent material - some evidence of organic matter accumulation, could indicate Brunisol instead - based on site history (of excavated fill disturbance), matches Regosol classification
Factors and processes of soil formation	- in 1983, fill was excavated from the asphalt storage area of the site to cover the landfill with 2ft of compacted fill - growth of vegetation brings development of humus on surface
Other comments	- many large gravel pieces, rocks, metallic refuse, glass, and some plastic bag material - "C horizon" is likely the gravel fill brought in to cover the landfill - over the years, portions of the site were leveled out as more fill and vegetative debris were dumped there, creating a high ledge to the east of this particular area

Appendix C

07/08/2009 15:00 2738082 PACIFIC SOIL ANAL PAGE 01/01

PSAI

Attn: Art Bomke UBC   Dru Yates   July 7/09

SAMPLE	pH	Buffered pH				Salts (mmhos/cm) E.C.	Organic Matter (%) O.M.	Total Nitrogen (%) N	AVAILABLE NUTRIENTS (ppm) Phosphorus P	Potassium K	Calcium Ca	Magnesium Mg	Copper Cu	Zinc Zn	Iron Fe	Manganese Mn	Boron B	Sulfate-Sulfur S
Logs Site 1 x8	6.4					0.52	6.0	0.24	215	170	2600	210	0.4	42	21	88	0.7	
2 x10	5.5	6.5				.30	4.9	.12	108	110	1100	95	.6	10	60	46	.2	
3 x 11	5.6	6.8				.30	3.1	.09	103	135	1050	75	.9	9.0	75	54	.2	
4 x 18	5.3	6.5				.18	1.9	.06	108	85	700	50	1.2	5.0	125	39	.1	
5 x 15	5.2	6.4				.16	1.3	.04	77	60	600	45	1.4	5.5	135	33	.1	
11 x10	5.6	6.6				.22	5.3	.17	159	190	1150	75	10.5	63	100	59	.3	
22x 8	5.7	6.8				.24	5.1	.15	190	230	1000	95	2.3	45	50	55	.3	
33 x17	5.5	6.7				.22	3.3	.12	133	135	900	60	11.0	60	75	51	.2	
100 x 9	5.5	6.6				.28	5.7	.18	87	130	1250	80	11.5	78	70	85	.4	

COMMENTS:

#5 – 11720 Voyageur Way, Richmond, B.C. V6X 3G9 273-8226

Table 1C. Macro- and micro- nutrient test results from Pacific Soil Analysts Inc.

Amount of Boron to Apply (kg/ha)			
ppm of boron in the soil	<0.20	0.21 – 0.50	0.51 – 1.0
Soil Test Rating	Very low	Low	Medium
High Requirements	4.5 – 5.6	3.4 – 4.5	2.2 – 3.4
Medium Requirements	2.2 – 3.4	1.1 – 2.2	1.1
Low Requirements	1.1	1.1	0
Sensitive Crops	0	0	0

Table 2C. Guide for Interpreting Boron Test Results (taken from: Soil Test Disclosure. (n.d.) (incomplete citation, to be reviewed)

Appendix D

Disclosure from Dru Yates, re: Community Meeting on Community Gardens

To the Village Council of the Village of New Denver,

As you know, on Saturday June 13th a small community discussion was held in Knox Hall, for me to inform residents about the project I am doing on the decommissioned landfill on Denver Siding and to hear people's ideas on community gardens. First of all, I would like to thank you so much for allowing me to use Knox Hall for this event. There were 12 people in attendance, and everyone there was very interested and keen. It was a great group, and the discussion we had was very natural and relaxed. I had prepared a discussion outline, with prompting questions and rough time limits; however, I quickly realized that it was unnecessary and discarded the structured discussion plan so as to let the conversation flow.

I started by introducing myself and explaining the purpose of my project. I described how my original project plans had evolved during the first couple weeks; I had realized that it wasn't realistic or feasible for me to do soil testing for contamination, and so I was instead doing more basic soil fertility testing to assess the site for its agricultural potential in that way. There were many questions about the site history, ownership, and land use restrictions. Some of the residents had insight into the site history that I was unaware of, which was very useful to me. After the project and the situation of the site were clarified, the conversation bounced around. The following are the main topics that were discussed:

Season Extension

It was quite important to the group that a community garden have some sort of facility to extend the growing season into the winter months, when local produce becomes rare to non-existent. The consensus seemed to be that the produce available in the grocery stores is of poor quality, and knowing where their food was coming from would be really valuable. They expressed interest in having a ***greenhouse system***, although the associated heat and energy challenges were also quickly brought up in response. ***Hoop houses*** were then considered as a less heat-demanding operation. Water sources were also brought into question, and people were wondering where the water would be coming from, regardless of the way the food was being grown.

The other community garden feature that was briefly mentioned was a large ***composting facility***. We didn't really discuss this in any detail, but it received a very positive response when it was mentioned.

This was good feedback to receive, and I will look further into these types of growing systems to try to understand how remediation may differ for these particular structures.

Contamination Concerns

Another component of having greenhouses that appealed to the group was that it provided a way to keep the plants from directly accessing the ground. There were some fears and misconceptions surrounding growing food on previously contaminated sites. We talked about the Strathcona and Cottonwood community gardens in Vancouver, both developed on dump site areas. I used these as examples of how contaminated areas can be first covered over with fill and top soil so as to make a safe growing medium for gardens. The reality is, though, that some people are going to have misgivings. This is important to consider, as it is likely going to take some time and education for them to feel comfortable with eating food from a previously contaminated site.

There were some concerns about water and runoff contamination from irrigation, but I explained that if there is a sufficient layer of fill, it is going to take a lot of over-watering to saturate it and create runoff problems. The other worry that came up had to do with gas emissions leaking from the buried landfill. People were then wondering if there was any safe way to trap these gases for our own purposes of heating a greenhouse, for example. This is something I currently know very little about and is certainly a valid concern that I need to follow up on.

Garden Management and Financing

We also talked about how the community garden could be structured, and who would manage the plots. There were a lot of different ideas, ranging from having plots that people could harvest from "for free" (given that these people also tended the plots) to having everything cared for by municipally-hired workers and then selling the produce to people based on "shares" they had in the garden (like a cooperative, or a twist on the traditional Community Supported Agriculture program). We discovered that each idea had its own set of barriers and possible restrictions to consider. The main one was maintaining the financial viability of the community garden, while adhering to the Restrictive Covenant of "municipal-use-only" that exists on the site. Other concerns raised were: the potential of detracting from existing local food businesses and producers, and ways of making the produce available and accessible to everyone (low income families, the physically unfit, etc.).

Please keep in mind, this is just a basic summary of the main points of interest that were most focused on during the discussion. In addition, some of these discussion topics are beyond the scope of my own project in terms of what I will be researching and reporting on, but they are certainly relevant to the overarching objective of finding a community garden space for the village. I think the meeting – though small – was successful, and it at least got people together to throw around some ideas and concerns that they might not yet have put voice to. It was also very important for me to make some form of contact with community members and learn from their experiences and questions. I will be at the council meeting on June 23rd to provide further details and answer any questions you may have about what happened at the community discussion, or about how my project is progressing in general. Thank you for your time!

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