SOUTH LANGLEY:
A HOLISTIC APPROACH TO EQUESTRIAN COMMUNITY DESIGN

by

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ABSTRACT

There is a need for equestrian communities to be designed holistically in order to successfully interconnect the environmental, social, and economic elements found in a healthy community. By incorporating horse related design and management principles, as well as community planning principles, equestrian communities can be designed to minimize negative environmental impacts, increase social benefits, and expand economic opportunities.

This project set out to accomplish two main goals: 1) establish Guiding Principles and Design & Management Guidelines for government, developers and individual property owners as a model to achieve the objectives stated above; and 2) use a 244 acre reclaimed gravel pit in South Langley as a site specific example of the application of these Principles and Guidelines in a holistic design of an equestrian community.
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CHAPTER I  Introduction

1.1 Project Goal

The goal of this project is to apply a more holistic approach to equestrian community design in order to lessen the negative impacts on land and water resources, improve the health and welfare of residents, and maintain the rural character of the site.

1.2 Objectives

This is a unique site in that it is designated a “Special Study Area” in the Township of Langley’s Official Community Plan (OCP). It has this designation because a development proposal for the site was underway when the Rural Plan amendment was adopted in 1992. This site is therefore the perfect opportunity to demonstrate how an area can retain a rural atmosphere while at the same time increasing density, thereby fulfilling more of the objectives set out in the OCP as well as the Greater Vancouver Regional District’s Livable Region Strategic Plan. The Livable Region Strategic Plan is based on four strategies: protect the Green Zone; build complete communities; achieve a compact metropolitan area; and increase transportation choice. This plan is a Regional Growth Strategy under the Municipal Act and aims to “promote human settlement that is economically and environmentally healthy and that makes efficient use of public facilities and services, land and other resources” (TOL, Langley 1).

This design is about combining some of the economic benefits and amenities of dense areas with the aesthetics, lifestyle, and open spaces of rural areas, while at the same time minimizing the negative aspects associated with high density, such as traffic, noise, and impervious surfaces and also taking into account the high cost of land and lack of amenities of the rural area surrounding the site.

In order to achieve these objectives, this design will promote the site as an equestrian community and showcase holistic equestrian community design by:

- preserving the rural character of the area with open spaces, wildlife habitat, park areas and horse related barns, riding rings, paddocks, and pastures;
- minimizing negative impacts, such as such as flooding, pollution, traffic, and noise on the surrounding environment and residents by designing a drainage network; devising a horse waste management strategy; developing an interconnected road and trail system; and protecting and enhancing wildlife habitat and vegetated areas;
- incorporating a mix of housing types and property sizes, including affordable housing for people who have traditionally been excluded from equestrian communities;
- including equestrian related commercial opportunities which would strengthen the sense of place, provide employment and contribute social and recreational benefits; and
- providing recreational amenities such as riding rings, parks, and a trail system for the health of people and horses, with the added benefit of reducing the impact of additional horses on Campbell Valley Regional Park.

1.3 Rationale

Holistic design for equestrian communities, facilities and properties is important as there are more than 75,000 horses living in British Columbia with about 22,000 in the Lower Mainland (BCMAFF, Horses 1). In the Township of Langley alone, there is an estimated 1100 horse properties with many housing 10 or more horses (BCMAFF, Land). “With population growth and the high cost of land not all horses can enjoy running free in large pastures” (BCMAFF, Horses 1). With less land, horses are often placed in environments contrary to their natural way of life, which may lead to a number of physical and mental health problems. There are also problems associated with noise, dust, odours, flies and water contamination (BCMAFF, Horses 1). However, “horse owners are becoming aware that rearing and maintaining horses can have a negative impact on the environment. Many of the practices in place on horse farms, from confinement areas to manure management, must be reviewed with the intent of reducing waste streams into the environment” (BCMAF, Environmentally 1).
Water Pollution
One of the most common environmental problems associated with horses is water pollution, particularly in wet areas such as the Lower Mainland. There are several factors that contribute to water pollution:

Suspended Solids
Silt, clay, and pathogens are examples of suspended solids and are often the result of "soil erosion due to poor soil management practices or horses trampling stream banks or beds" (BCMAFF, Environmental). Detrimental effects of suspended solids include: clogging fish gills, covering spawning areas and smothering eggs, destroying habitat for insects, and low water oxygen levels (BCMAFF, Environmental) and (Blickle, Healthy).

Oxygen Demand
Oxygen demand, measured as BOD (biological oxygen demand) or COD (chemical oxygen demand), refers to the reduction of oxygen levels in watercourses and is caused by an introduction of excess nutrients (BCMAFF, Environmental). "Elevated nutrient levels in surface water encourage the excessive growth of fungi and algae. When these organisms die, the organic decay process removes oxygen from water that would otherwise be available to fish and other aquatic organisms" (BCMAFF, Environmental). Low oxygen levels in watercourses can kill fish, particularly salmon and trout as they need high levels of oxygen to live (BCMAFF, Environmental).

Ammonia (NH3) and Nitrate (NO3)
Ammonia is present in urine, manure, fertilizer, and compost and when allowed into water is very toxic to fish (BCMAFF, Environmental). Nitrate forms from nitrogen when manure is applied to land. Nitrates can be used by plants. However, nitrates do not bind to soil particles and may be leached out of the shallow grass root zone before the grass has had time to use it. Once past the root zone, nitrates can continue to move downward to groundwater and into domestic water sources. Nitrates in groundwater are a health concern, particularly because of the risk of "blue-baby syndrome" in infants" (BCMAFF, Environmental).

Nutrients
When present in excess, nutrients such as nitrogen, phosphorus, and potassium can have negative impacts on soil and water (BCMAFF, Environmental). Impacts on surface water include direct toxicity to aquatic organisms and eutrophication (an increase in nutrients leads to increased productivity of aquatic organisms and therefore a depletion of oxygen), which may ultimately result in fish fatalities. Surface water impacts can be caused by: direct deposits of manure and fertilizers into watercourses; runoff from dense horse holding areas such as paddocks; and / or manure piles (BCMAFF, Environmental).

Pathogens
Manure contains bacteria, viruses, and parasites which may be pathogenic to animals and are often transmitted by water (BCMAFF, Environmental).

Miscellaneous
Wash rack wastewater, (from the area where horses are bathed and groomed), can also be a source of pollution as it typically contains manure, dirt, hair, soap, woodwaste, and / or straw (BCMAFF, Environmental).

Social, Economic and Environmental Value of Land Management
"How you manage the grass in your pastures, deal with the mud in confinement areas, and dispose of stall waste are a few examples of land management on a horse property. Good land management protects horse health and water quality. A horse property that is managed well can also prevent disputes with neighbours, attract wildlife, and make horse care more enjoyable" (Blickle, Healthy).

Blickle maintains that making improvements in land management does not need to be costly as small changes in operations can ultimately result in long-run savings. Examples of these changes include:

- eliminating mud resulting in an elimination of "horse health problems associated with mud and the vet bills they incur";
- growing a more productive pasture to reduce feed bills;
- composting manure can provide an excellent soil amendment and eliminate disposal costs; and
- "better pest management can reduce repairs around the barn" (Blickle, Healthy).
In essence, the same land management techniques that protect the environment also protect horse health, makes horse properties more attractive, and saves property owners money (Blickle, Healthy).

1.4 Design Research Method
- Linear and synthetic methods
- Literature review and precedent studies
- Campbell Valley Regional Park analysis
- Horses for Clean Water workshops and Demonstration Farm Tour

1.5 Priorities & Assumptions

Priorities
The priorities for this project were focused on community layout and design including the location of: open spaces and parks; road and trail networks; recreational amenities and social gathering spaces such as riding rings; access points and linkages; property boundaries (lot sizes and shapes); commercial opportunities; and horse related waste management strategies.

Elements that need further research:
- Marketing of the community.
- Marketing of commercial operations.
- Sewer system vs. package treatment plant.
- Groundwater and aquifers under the site, as well as potential impacts on surface water located on and / or adjacent to the site.

Elements that need further design:
- Bed & Bale.
- Tack & Feed Store and Coffee Shop.
- Community Garden.
- Park: historical reference to gravel pit, lookout point, and dog park.
• Planting plan for wildlife habitat (lists of plants toxic to horses are available in the Appendices).
• Overall grading of the site.

Assumptions
• The project is designed to be a model for government, developers and individuals. It is a site specific design meant to illustrate the Guiding Principles and Design & Management Guidelines which are transferable to other sites that have similar conditions. Differences in government policy, physical and biological conditions etc. must be taken into consideration.
• Transportation linkages are based on present and potential future routes.
• Water would be piped in as proposed by the Trademark proposal.
• The Township of Langley would assume responsibility for park, trail and public riding ring upkeep.
• There would be no offsite manure disposal. Manure pick-up and composting guidelines would be followed by members of the community.
• Hayfields were not included in the design due to the price of land needed to produce hay vs. the cost to bring hay in.

1.6 Program
• Housing: different densities and lot sizes for a range of economic groups.
• Public park / open space including an off-leash dog area.
• Vegetative buffer around the perimeter of the development, particularly at the north end, to mitigate flooding and pollution, decrease noise, provide wildlife habitat, and as a corridor for a trail system.
• Commercial activity: Tack & Feed store, Coffee Shop, Bed & Bale, and a Lesson / Boarding Barn at the center of community to serve as social gathering spaces.
• Other social spaces: communal riding rings and stables etc.
• Equestrian amenities (riding rings, boarding / lesson barn and a trail system that would be comprised of loop trails to provide excursions of varying lengths; and a connection to Campbell Valley Regional Park and the South Langley Regional Trail).
• Connect to existing neighbourhoods with all forms of transportation (car, bus, bike, pedestrian, equestrian).
• Connect to the Township of Langley Bike network.
• Connect to South Langley Regional Trail.
• Provide facilities that meet or exceed horse management standards.
• Community Garden (for humans and animals).
• Composting facilities.
• Pathway to Community Garden, as well as parking at the Community Garden.
• Access to equestrian trail and park from Bed & Bale.
• Access to stables from townhouses.
• Full board and self board at the Lesson / Boarding Barn to provide more choices in terms of time and finances.
• Internal community trail system at least 7 kilometers (~ 4 miles) in length.
• Provision of wildlife habitat.
CHAPTER II  Site Analysis

2.1 Cultural Factors
The 99 hectare (244 acre) site for this project is located on the border of Canada and the United States, and on the Surrey / Langley border between 196th and 204th Street, and 0 and 4th Avenue. It is situated at the terminus of 200th Street, which runs north from Zero Avenue through the Township of Langley, the City of Langley, across Highway 1 (TransCanada Highway) and towards the Fraser River.

Site History
The site is designated a Special Study Area as the site was subject to a development proposal at the time of zoning. It is an exhausted gravel pit with the conclusion of mining operations occurring approximately 20 years ago. Mining was focused in approximately 50% of the site, mainly in the southern and western portions (Harding Lawson). Once abandoned, the site became a popular lookout as the views from the site to the north shore mountains were spectacular. Since then, it has had numerous development proposals since the early 1980's, including: a townhouse development; a 157 home development with a 18 hole golf course, 5.5 ha (13.5 acre) municipal park, and equestrian trails incorporated throughout; and most recently, a subdivision with 99 0.8 hectare (2 acre) lots based on an equestrian theme (TOL, Report 01-236). In this latest proposal, the developer (Trademark Pacific Properties - who has optioned it from Vicwood Enterprises) was proposing to pipe water to the site, and a package treatment plant was proposed as an alternative to traditional sewage disposal. This latest development application to the Township expired in September 2002, and therefore, the developer will have to reapply.

Historical References
There are still traces of the gravel mining operations on the site, typically in the form of concrete footings of the various buildings.

Governmental Jurisdictions
The Little Campbell River (LCR) suffers a common watershed problem; it occupies more than one jurisdiction complicating management issues. In the case of the LCR, it occupies three separate governing bodies within British Columbia, Canada (Township of Langley, City of Surrey and the Semiahmoo Indian Reservation), and part of the drainage basin is in Washington State, USA (Drever and Brown 13-14). The surface water drainage divide is located approximately 1
kilometre (0.6 miles) south of the Canada / US border (Harding Lawson).

**Zoning**
The site is zoned Suburban Residential (SR2) with single family residences, agricultural and other minor uses with a minimum lot size of 0.8 hectares (2 acres). It has never been in Agricultural Land Reserve (ALR), which is in contrast with most of the Township. The lots surrounding the site are typically a minimum of 1.7 hectares (4.2 acres), however, some lots are smaller as they were subdivided before the ALR was instituted (TOL).

**Infrastructure**
The main roads that access the site include 200th Street, which connects to Highway 1, and Zero Avenue which is a major commuter road that connects the Douglas Truck Crossing border, which is located west of the site, with the Aldergrove Sumas border, which is located east of the site.

In terms of water supply, adjacent properties use domestic wells. The Trademark development proposed a 3 kilometre (1.8 mile) extension to the municipal water system and included "a pumping station in the vicinity of 18th Avenue, and a water reservoir near 0 Avenue" (TOL Report 01-236 41). For sewage disposal, adjacent properties use septic fields. With the Trademark development, a "community treatment facility", otherwise known as a package treatment plant, was proposed for sanitary servicing (TOL Report 01-236 43).

**Rural Character**

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Figure 5  Land uses within the Township of Langley. Source: TOL, Rural 20).
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Lot sizes vary in rural Langley as a result of subdivision activity prior to the adoption of the Agricultural Land Commission Act (TOL, Rural 2). Roughly half of the lots are in the 1.7 to 7.5 hectare (4.2 to 18.5 acre) range with 37% less than 1.7 hectares (4.2 acres) (TOL, Rural 2). However, approximately 40% of the rural area in Langley is still held in parcels larger than 8.1 hectares (20 acres). The majority of the land in the rural area is in the Agricultural Land Reserve (ALR), which is a provincial regulation administered by the Agricultural Land Commission (TOL, Rural 2).

"One of the distinguishing features of the Township of Langley is the rural nature of much of the Municipality. The Township has historically been a rural agricultural area, but in recent decades parts of the municipality have become urban in character as the community has shared in the rapid growth of the Vancouver region. While the Township has accommodated this urban growth and can accommodate considerably more development in designated urban growth areas, the Official Community Plan designates approximately 75% of the municipality Rural Residential / Agricultural, most of which is in the Agricultural Land Reserve" (TOL, Rural 1).
"Agricultural activities range from commercial farms, including intensive uses, to part-time or hobby farms. Rural residential development has increased dramatically due to the proximity of the Township to Metropolitan Vancouver and the demand for rural homesites" (TOL, Rural 2).

**Equestrian Character**

There is a strong equestrian character in the Township, and in fact, is one of the distinguishing features of the community. The Township is known as "The Horse Capital of BC". This character can be attributed to the following:

- Approximately 1100 horse properties in the Township (BCMAFF Land).
- South Langley Regional Trail
- Facilities such as the Thunderbird Show Park
- Boarding / lesson barns
- Pacific Riding for the Disabled
- Campbell Valley Regional Park (CVRP): a nature based 549 hectare (1370 acre) park that includes equestrian amenities:
  - 14 kilometre (~ 8.5 mile) "Shaggy Mane Trail" with year round access
  - Campbell Downs - cross country course
  - Riding ring
  - Horse trailer parking
  - Horse memorial
  - Also allows horse rental operations to use the park

**Views**

The site occupies the highest point in the Township and offers great views all the way to the north shore mountains. Although Mt. Baker is not currently visible from the site (due to tall trees), it is visible from areas surrounding the site, such as along Zero Avenue.
2.2 Physical Factors

Topography
While slopes on the site are sometimes greater than 80%, for the most part the slopes are relatively gentle. See Site Analysis map (Figure 13) for slope class mapping. The slope classes were developed based on the following criteria: 0-6% (up to 6% is good for pastures); 7-11% (reaching upper limits for road development); 12-15% (15% is the maximum recommended for horse trails); and >15% as limiting for development.

Orientation & Sun Exposure
Nearly the entire site is oriented to the north with only a small portion in the southwest facing south. Therefore, most of the site does not receive maximum sun exposure.

Precipitation
Mean annual rainfall at Abbotsford Airport, which is 19 kilometres (~12 miles) east of the site, averages 1,500 mm (59") / year, with 75% of annual precipitation occurring between October and March (Harding Lawson).

Geology and Soils
The site sits on ice-contact glacial deposits with a Lynden Gravelly Loam composed of typically variable, well-rounded cobbly gravelly soils, with silt / clay strata (Hydrographic Service).

2.3 Biological Factors

Groundwater
In response to the Trademark development, the Township of Langley remarked: "The proposed development is located above the Border Heights aquifer, which has been designated as an environmentally sensitive area and supplies drinking water for residents of Blaine, Washington. Given the proposed residential and equestrian land-use, the potential impact on the groundwater system is considered a very important issue." (TOL, Report 01-236 44).

Surface Water
There are a number of surface water features on, or immediately adjacent to, the site including creeks, springs, ponds, marshes and other wetlands. Much of this water is supplied by groundwater flow from springs and seepage areas. Most of the ponds on the site are ephemeral, with the noted exception being the large year round pond, shown below in Figure 9 (Piteau Associates).

Figure 9 Looking north across the large, year round pond. Source: Talisman.
"Surface run-off is also an issue, including possible impacts on nearby watercourses. Jacobsen Creek near the north perimeter of the site has been a site of some flooding in the past. It is important that the proposed subdivision not aggravate the existing drainage situation" (TOL, Report 01-236 43).

**Drainage**

The site flows primarily into Jacobsen Creek which is located north and east of the site, running roughly parallel to the site (Harding Lawson). The site also drains partly into Jenkins Creek, which is located west of the site. It flows from southeast to northwest and originates in a marsh in the US. It lies in an incised, steep ravine immediately west of the site (Harding Lawson). Both creeks drain in a northwesterly direction towards the Little Campbell River (LCR) which is located approximately 2.5 kilometres (1.5 miles) to the northwest (Levelton). The Little Campbell Watershed, in which the site is located, drains approximately 74 km$^2$ (28.5 square miles) in the Fraser River Delta just north of the Canada / US border (Drever and Brown 5). The LCR is a low-gradient stream (0.02%), with low elevation watershed boundary ridges, and has its headwaters at 61 metres (~ 200 feet) above sea level in southern Langley (Drever and Brown 9). It then flows through south Surrey and empties into Semiahmoo Bay at the Semiahmoo Indian Reserve which is approximately 5 kilometres (3 miles) west of the site (Levelton).

**Vegetation**

The site is located in the Fraser Lowland area of the Coastal Western Hemlock (CWH) biogeoclimatic zone (the Very Dry Maritime CWT subzone) and has a cool mesothermic climate. The site is comprised of: portions of coniferous dominated forest; deciduous dominated forest; pasture and deciduous shrub with 10 metre (33 foot) pioneer seral successional status vegetation from the mining operations (Talisman). There are also areas of "uncultivated indigenous terrestrial vegetation of greatest ecological value" located in the southern portion of the site (Talisman).

**Habitat**

Jacobsen Creek has Class ‘A’ fish bearing reaches that are inhabited year round or have the potential for year round fish presence. It also has reaches of Class ‘A (OW)’ with intermittent water supply which may dry up in the summer months, and are inhabited by (or potentially inhabited by) fish during overwintering period when base flows are re-established (TOL, Watercourse).

Jenkins Creek has been observed to flow on an intermittent basis, with portions of the reach immediately north of Zero Avenue being dry in the late summer and early fall (Harding Lawson). This stream is a Class ‘B’ which is non-fish bearing but is a significant source of food, nutrients and / or cool water supply to the downstream fish population (TOL, Watercourse).
Both creeks provide important fish habitat. For example, both creeks have cutthroat trout occurring in the lower reaches (Drever and Brown 60) and they also support other salmonid species such as coho (Drever and Brown 52). The LCR overall is a productive system with 4 species of Pacific salmon, two trout species and a number of non-salmonid species (Drever and Brown 6).

The site itself provides wildlife habitat for 29 species of mammals, 9 species of reptiles and amphibians, and 88 species of birds (Talisman).

2.4 SWOT Analysis

A SWOT (Strengths, Weaknesses, Opportunities and Threats) Analysis for the site is as follows:

**Strengths**
- Highest location in the Township of Langley – views of north shore mountains including Golden Ears and views of the Fraser Valley. Mt. Baker is currently not visible from the site as trees block the view, but is visible from areas close to the site such as Zero Ave.
- Located in “The Horse Capital of B.C.”, with a very strong equestrian influence which the Township of Langley wants to promote.
- Ponds, springs, marshes and other wetlands.
- Provides wildlife habitat for 29 species of mammals, 9 species of reptiles and amphibians, and 88 species of birds.
- Areas of mature predominantly deciduous trees and areas of mature predominantly coniferous trees.
- Areas of already cleared grazing land.
- Some steep slopes, otherwise good grades for development.
- Good transportation access:
  - 200th Avenue
  - Zero Avenue – high traffic volume
- Availability of potable water (currently at 24th Avenue).
- Campbell Valley Regional Park
- Existing and proposed local and regional equestrian trail network.

**Weaknesses**
- Potential for contamination of groundwater.
- Predominantly north facing.
- Proximity of Jacobsen Creek.
- Who pays for amenities and upkeep?
- Traffic speed and volume on Zero Avenue.
- Wear and tear on Campbell Valley Regional Park (CVRP).
- Current lack of access to CVRP.
- Current lack of supporting community trail network.

**Opportunities**
- View properties.
- Public park lookout – take advantage of view.
- Pond area – public park.
- Connection to Township of Langley bike network.
- Link neighbourhoods with equestrian / pedestrian / bike / car routes.
- Could be part of a network of similar communities linked by a trail network. In the future, these communities that would surround CVRP could be linked by a bus route that would loop the park.
Community trail network could be an attractive alternative to CVRP resulting in no net increase in the level of use of CVRP due to the development (riders who normally ride in CVRP could also ride on the new trails).

Internal trail network that provides a minimum 1 hour workout = would need roughly 7 kilometres of trail (~ 4 miles).

Connection to Campbell Valley Regional Park and, therefore, also a connection to South Langley Regional Trail.

Use road alignments as trails where possible (low speed and volume).

Access to dog park in Campbell Valley Regional Park.

Protection of existing wildlife habitat and creation of additional habitat.

Example of more environmentally sensitive horse-keeping – composting, “sacrifice areas”, bioswales, rubber stall mats, solar charged electric fences, etc.

Human food and animal feed production – community gardens.

Commercial opportunities: Agri-tourism (Bed & Bale), Lesson / Boarding Barn, Feed & Tack shop including consignment / trade, Coffee shop.

Remnants of gravel pit operations – cultural history.

Little Campbell Watershed Society – community watershed stewardship.

The site can serve as a showcase for this kind of community.

Threats

- Surface water contamination.
- Effect of increase of impervious surfaces on the recharge of the aquifer and baseflow of adjacent watercourses.
- Flooding and erosion of adjacent watercourses.
- Groundwater contamination.
- Environmental impacts during construction (flooding, sediment runoff).
- Social impacts during construction (noise, traffic, flooding).
- Disturbance to wildlife and habitat.
- Conflict between domestic animals, wildlife and humans (i.e. opossums transferring Equine Protozoal Myelitis).
- Wetlands = mosquitoes: threat of West Nile Virus & Equine Infectious Anemia.
- Car / horse accidents.
- Increased traffic and activity negatively impacting the existing neighbourhood.
- Visual, noise and odour disturbances to existing neighbourhood.
- Introduction of a significant number of horses could compound an already serious overuse problem at Campbell Valley Regional Park if not handled properly i.e. adequate community trail system.
CHAPTER III  Precedents

3.1 Wall Equestrian Community, Township of Langley

In 1992, a proposal was made for 65 ¾ acre residential lots, an equestrian center, environmental /
parkland dedications and heritage protection amenities on a 63 ha (156 acre) property in the Township of
Langley. The Township decided that “Council indicate to the Land Reserve Commission that should the
Commission approve the Wall Financial Corporation non-farm use Equestrian Community proposal that
Council is willing to consider the subsequent rezoning application within the context of a comprehensive
rural planning process for the subject site and adjacent lands” (TOL, Report 02-215 43).

Advantages of Concept as outlined in Wall

Sustainable Agriculture
• Dwellings are clustered in the center leaving 50 of the 63 hectares (125 of 156 acres) for
agricultural use.
• Clustering consumes less open pasture than rural densities of 0.8 to 4 hectare (2 to 10 acre)
parcels and retains and enhances the viability of the land through a cooperative farm operation.
• Building density is calculated on the basis of the amount of developable land and the desire to
preserve three quarters of the site as productive agricultural open space.

Rural Design
• Rural atmosphere has been preserved by retaining the farm as a mass.
• Hamlet design reduces infrastructure of water and roads.

Social Benefits
• Hamlet design provides a community setting for families with all the advantages of farm life
without the isolation of traditional farm properties.
• Convenience of living close to other families and shared horse facilities will strengthen community
relationships.

Environmental Advantages
• Decreased infrastructure of water and roads and offers environmental advantages through using
alternatives to septic field disposal.
• Design features that could be explored including energy conservation technologies such as wind
generators and solar panels.

Public Accessibility
• Indoor arena available for public use.

Affordable Equestrian Living
• With the proposed community structure, individuals and families can actually participate in equine
industry without having to purchase their own individual 0.8 to 2 hectare (2 to 5 acre) parcel.

3.2 Silver Valley, Maple Ridge

• In a study titled “Rural Hillside Development Options in Maple Ridge's Silver Valley”, Cavens did
a comparison between 3 options for a 208 hectare site: conventional, clustering for rural
character and high-density rural village. The conclusions indicate that the rural village option is
the most beneficial overall to the community. The results are shown in Table 1:

<table>
<thead>
<tr>
<th></th>
<th>Conventional</th>
<th>Clustering</th>
<th>Rural Village</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Units</td>
<td>1329</td>
<td>1079</td>
<td>1320</td>
</tr>
<tr>
<td>Natural Vegetation Areas</td>
<td>27.2 ha 13%</td>
<td>49.6 ha 24%</td>
<td>48.7 ha 23%</td>
</tr>
<tr>
<td>Conventional Park / School Field</td>
<td>3.8 ha 2%</td>
<td>4.7 ha 2%</td>
<td>4.7 ha 2%</td>
</tr>
<tr>
<td>Horse Paddock</td>
<td>0 ha 0%</td>
<td>12.9 ha 6%</td>
<td>15 ha 7%</td>
</tr>
</tbody>
</table>
3.3 Southlands, Vancouver

Southlands, when compared to the South Langley site, is roughly the same size, approximately 1 kilometre (0.6 miles) to a Greater Vancouver Regional District (GVRD) park that allows equestrian activity, has roughly equivalent existing or proposed property parcel sizes of 0.8 hectares (2 acres), has a similar climate, and has the desire to maintain the semi-rural nature of the site.

Beneficial Elements of Southlands

- Road widths are minimal.
- Informal parking on the road edge.
- Road speeds are mitigated with speed-bumps, barriers at intersections, and horse crossing, speed limit and stop signs.
- Many of the properties have good wildlife habitat.
- Many roads have shoulder trails to increase horse and rider safety.
- Road shoulder trails provide health benefits for horse and rider in the form of exercise and stress relief.
- The Fraser River Greenway Trail provides exercise, stress relief and experiences with nature for horse and rider which has significant health benefits.
- Semi-rural feel with:
  - open space
  - large set-backs
  - distant views through the properties with visually open fences
  - pastures and paddocks
  - curbless roads
  - “rough” shoulders and informal landscaping transitions into the properties
  - drainage ditches
  - most housing styles have semi-rural characteristics

Detrimental Elements of Southlands

- Roads and many driveways are paved with impervious materials.
- Some houses are too modern in architecture and materials.
- Some properties have visual barriers that prevent views.
- The majority of the paddocks will be saturated with mud during rainy periods resulting in run-off of nutrients and sediments to the drainage ditches (there is eutrophication in many of the ditches).
- Not sure what proportion of horse property owners compost as there are large containers of uncomposted material on many properties.
- Informal erosional trails have evolved resulting in mud generation during rainy periods leading to sedimentation of adjacent drainage ditches and nutrient loading when manure is present.

Design Guidelines

There are a number of design guidelines from Southlands that can be applied to the South Langley project. These include:
• Gradual transition from public to private realm with: drainage swales, possible trails, informal landscaping, and open fences for visual penetration into properties.

Figure 15. Street treatment. Source: City of Vancouver.

• On the lots, the buildings should be clustered in order to provide large open spaces for pastures.

Figure 16. Site planning. Source: City of Vancouver.

• Configuration of buildings to maximize views and open space.

Figure 17. Building configuration. Source: City of Vancouver.
• Drainage swales and ditches
• Curbless, narrow roads – gravel for lanes, driveways and wherever else possible
• Speed limits of 30 km/hr (18 miles/hr) "enforced" with speed-bumps, intersection barriers, horse crossing signs, speed limit signs and stop signs
• Habitat creation for wildlife in open space areas
• Mudless paddock design should be incorporated
• Parking areas should be screened
• Formal trail system should be designed that does not create mud
• Trail system should be as safe as possible by limiting interaction with traffic
• Trail system should provide health benefits to horse and rider by providing exercise, stress relief and experiences with nature

3.4 Poundbury, England

Poundbury is located west of Dorchester in southern England and is an example of New Urbanism community planning. It is a 160 hectare (400 acre) mixed-use development of 2,500 houses, schools, recreation facilities and shops and is still in construction (construction began in 1993). Poundbury provides an "environmentally sensitive development model for Great Britain and other nations" (Lockwood) for the following reasons:

**Land conservation:** Poundbury is designed as a compact traditional English village. As such, large areas of land are not wasted and therefore open spaces are incorporated into the design. Houses, which are set close together along narrow streets, have rear gardens and parking (Lockwood).

**Energy efficiency:** Homes in Poundbury are extremely energy-efficient with high-efficiency condensing boilers, extra insulation and computer-controlled energy management (Lockwood).

**Fewer automobile trips:** Poundbury consists of homes, schools, workplaces, and shops which will allow people to walk or bicycle to work or school as the community completes construction (Lockwood).

**Traffic calm:** The winding roads and narrow streets of the community slow traffic to 30 km/hr (20 miles/hr) without resorting to speed bumps or stop signs (Lockwood).

**Mixed incomes:** "Of the initial 142 homes, 87 were sold at market rate and 55 were leased at subsidized rates to moderate-income households" (Lockwood). The community has been heralded as an aesthetic and financial success as "most visitors can't distinguish between the market-rate and subsidized housing" (Lockwood).

"Poundbury's advantages greatly outweigh its disadvantages. It is a real-life community, not a visionary proposal that is considered, sketched, praised and then consigned to a bookshelf. Although... still a work-in-progress, Poundbury already offers a model to Great Britain and other nations for accommodating growth and protecting the environment at the same time" (Lockwood).
CHAPTER IV Guiding Principles and Design & Management Guidelines

4.1 COMMUNITY PLANNING

4.1.1 Employ community land-use goals and policies

The Township of Langley (TOL) has experienced an annual growth rate of just more than 4% over the past 15 years. With an expected growth rate of 3%, the 2001 population of 93,000 is expected to grow to approximately 124,000 in 2011 and 165,000 in 2021 (TOL, Langley 7-8).

“The Greater Vancouver Regional District (GVRD) adopted the Livable Region Strategic Plan in 1996 and the Ministry of Municipal Affairs and Housing has deemed it to be a Regional Growth Strategy under the Municipal Act. The purpose of a Regional Growth Strategy is to promote human settlement that is economically and environmentally healthy and that makes efficient use of public facilities and services, land and other resources. The Livable Region Strategic Plan is based on four strategies:

- Protect the Green Zone;
- Build complete communities;
- Achieve a compact metropolitan area; and
- Increase transportation choice" (TOL, Langley 1-2).

The TOL Official Community Plan “conforms to the Livable Region Strategic Plan by:

- protecting lands that are in the Green Zone through appropriate land use designations and zoning;
- setting goals, objectives and principles to guide the development of complete communities in the Township;
- setting a population growth rate that is lower than the growth rate of the past two decades and employment targets that will achieve a balance between population and employment to assist in the regional goal of achieving a compact metropolitan area; and
- setting objectives and principles to encourage provision of public transit and pedestrian and cycling routes” (TOL, Langley 2).

Protect the Green Zone

“The Green Zone includes areas that are of environmental and agricultural value. Much of the Green Zone in Langley is actively farmed. Langley is a major agricultural community in the province, with approximately three-quarters of the municipality (23,784 hectares or 58,769 acres) in the Agricultural Land Reserve. This accounts for almost 40% of total agricultural land in the Fraser Valley. In 1996, Langley had 1,584 farms (more farms than any other municipality in British Columbia), 13,216 hectares (33,042 acres) of farmland and $150.3 million in farm sales (second highest in B.C.). The Township supports agricultural activity in the Green Zone, while working to resolve conflicts between farm and non-farm uses” (TOL, Langley 2). The Township also:

- sets goals for the “maintenance of the rural character and preservation of the environment”;
- includes planning and development principles that “encourage careful planning of the urban / rural boundary; efficient design of communities for efficient and convenient transportation, and protection of the environment” (TOL, Langley 2).

Build Complete Communities

“The Official Community Plan promotes development of complete communities and increased community diversity by:

- setting goals for attractively serviced urban areas and rational development of agricultural, industrial and commercial enterprises to provide a balance between residential and other uses;
- setting objectives to provide for an economic range of housing types, densities and sizes to provide for sufficient commercial development to meet the needs of residents;
- including planning and development principles that encourage each community to provide a mix of land uses, including housing, employment, educational and recreational opportunities, a mix of housing types, densities and tenures, provision of a full array of infrastructure and services, provision of a balance between jobs and residents, and links to other communities and larger centers in the region” (TOL, Langley 3).
Achieve a Compact Metropolitan Region

The Township focuses on:
  • “planning and development principles that emphasize providing a balance between jobs and residents” (TOL, Langley 4).

Increase Transportation Choice

Increasing transportation choice is based on the:
  • “study and development of a system of walkways and cycleways”; and
  • “linking of communities to other communities and to larger centers in the region through design that supports efficient transit service, provision of park and ride facilities and good transit, walking and cycling links” (TOL, Langley 4).

“Land use planning, community design and development regulations should protect the environment by: providing incentives, such as density bonusing, to set aside significant natural assets during the development process”; “encouraging innovative, energy-conscious design of the community and individual buildings” (TOL, Langley 10); and integrating “stream and river bank uses with flood hazard, green belt and public use policies” (TOL, Langley 18). Land use planning should also take the following into account: “reclamation and rehabilitation plans for gravel pits shall consider potential recreational uses” (TOL, Rural 27).

“A community should be designed to be safe and secure by: designing buildings to be oriented to the street, encouraging walking, neighbourhood interaction and monitoring; encouraging a mix of land use, people and activities that will contribute to on-street activity in the day and at night; and providing appropriate separation between vehicles and pedestrians” (TOL, Langley 11). “Streets should be publicly owned and publicly accessible. The use of private roads and gated housing developments should be avoided because these isolate portions of the neighbourhood and they result in inward-oriented housing developments that do not contribute to on-street activity, pedestrian safety or community interaction” (TOL, Langley 8).

A community should also incorporate cycling, equestrian and pedestrian pathways into recreation development planning (TOL). “Some communities such as those in Lexington, Kentucky, have adopted the idea that movement by the horse throughout their residential areas should be facilitated. Usually, this means the inclusion of bridle paths and hitching areas when subdivisions are laid out. Some subdivisions may also have group or individual stalls associated with the houses. In addition, some commercial or recreational areas are also accessible by horse. In Langley, one pub has hitching posts and a corral but generally, the residential areas are not designed to accept or encourage horse use. Because Langley is not yet fully developed, opportunities may exist to incorporate horse use into some subdivisions and to market these as special communities” (TOL, Langley Horse 31). “While other municipalities face the challenge of superimposing trails over developed urban areas, Langley Township has a unique opportunity to implement much of the trail system as part of community development” (TOL, Community 2).

4.1.2 Provide community access and linkages

“Each community and neighbourhood should be designed to be efficient and convenient for a variety of transportation modes including walking, bicycles, transit, trucks and private automobiles. A new community in Langley should be located and designed so that: the community is accessible by a variety of transportation methods; roads are efficient, convenient and capable of accommodating the necessary volume without harming existing communities; and the resulting travel patterns minimize impacts on rural areas” (TOL, Langley 8-9).

“Pedestrian access to neighbourhood and community parks and recreation facilities shall also be considered” (TOL, Langley 18).

“Many people want to ride to park trails, but some of the roads are not safe for horses. The speed of cars on many of the through streets in the Township’s rural areas is a concern. Fast moving cars and scared horses cause a dangerous situation which is made worse by the frequency of drivers using excessive speed” (TOL, Langley Horse 5). It is important to examine ways to “reduce interaction between motor
vehicles and horses through the development of trails away from major roadways and the location of trail-road crossings which avoid busy intersections" (TOL, *Langley Horse* 25).

"The Community Connections Network will provide for trails that are: safe, accessible, enjoyable and convenient for equestrian, pedestrian, wheelchair, bicyclist and other non-vehicular users" (TOL, *Community* i); and "oriented to the transportation and recreation functions for a broad range of local and regional interests, considering non-vehicular users of all ages and all abilities" (TOL, *Community* i).

"Langley is rich in cultural heritage. These significant historical sites offer an excellent opportunity for interpretation to promote respect for and understanding of our cultural heritage. Major historical sites should be connected to the trail system as these areas will become destinations and/or starting points for users and trails" (TOL, *Community* 38). "Trail planning considerations include vistas, cultural features, environmentally sensitive areas and interpretive signage" (TOL, *Community* iv).

"The Township shall develop plans for provision of municipal linear links consisting of equestrian, cycle and pedestrian trails in the rural area, both on and off-road.... Trails should link major parks, activity areas or communities where possible and should include areas of aesthetic landscapes and distinct and diverse topography and vegetation. The Township will consider potential conflicts among users in planning trails" (TOL, *Rural* 27).
4.2 SOCIAL - CULTURAL

4.2.1 Preserve rural character

“Rural areas serve an important role in preserving ecological and environmental values, providing fish and wildlife habitat and serving as areas for recharging groundwater and reducing runoff. In addition, rural areas provide aesthetic landscapes, open space and greenery” (TOL, Rural 3).

“Residents place a high value on the rural nature of the Township, the heritage of the community and protection of lifestyles and environment” (TOL, Rural 6). “When asked why they chose Langley as a place to live 42% of all residents and 50% of rural residents referred to the country atmosphere. Other responses such as open space and quiet/peaceful nature also relate to the rural character. When questioned about what would cause them to consider moving from Langley, the primary reason, cited by 44% of all residents and 48% of rural residents, was loss of the rural nature of the area” (TOL, Rural 7). “Responses referred to conditions which would result from over-population and over-development of the community. Both urban and rural residents indicated strong agreement on the following:

- the development process should protect the quality of groundwater, streams and rivers;
- environmentally sensitive areas should be designated and protected through restrictive zoning or purchase;
- development should be concentrated in the existing communities leaving green, rural spaces in between the developed areas to maintain the rural character;
- mountain views and rural landscapes should be preserved even if it is at the cost of potential development; and
- unique, narrow and winding country roads add to the character of the rural area and should be kept” (TOL, Rural 7).

4.2.2 Ensure a healthy environment for horses and people

The environment in which domestic horses live is often considerably different from their natural state. By trying to curb their natural instincts, there is a risk of putting a strain on both their mental and physical welfare (Bird 8). In order to reduce this strain and make their environment as healthy as possible, design and management of their environment is critical.

4.2.2.1 Public Parks and Open Spaces

“Developed parkland plays an important role as a focus for a community/neighbourhood. When the designation of sites for parkland development is made, an important consideration shall be the relationship to other foci of a community, namely educational and commercial facilities” (TOL, Langley 18).

4.2.2.2 Public Trail System

Concerns have been raised regarding the crowding of recreational riding areas such as CVRP (TOL, Langley Horse). “The Township has been working on creating a trail network, some parts of which serve horse riders. The goal is to establish a substantial trail network that connects major parks, has a link to major horse facilities, and offers a variety of riding experiences (TOL, Langley Horse 25). “Examining partnership arrangements involving pro-active individual property owners and the Township to establish public trails along the edge of private property and connecting to public right of ways” is an important factor (TOL, Langley Horse 25). “Issues for consideration could include fencing, cost sharing of trail development and maintenance, and the marking and designation of corridors” (TOL, Langley Horse 25). “Council shall encourage the development of an equestrian trailway system by securing easements or covenants from private property owners, utilizing unrequired roadway rights-of-way, and co-operating with organizations in the development of such trails” (TOL, Langley 18).

- Width
- Overhead Clearance
- Length
- Gradient
- Footing
Width & Overhead Clearance
The GVRD has found that 3 metre wide by 3 metre high (10 feet by 10 feet) trails are the most cost effective trails as they are just wide enough to allow two horses to walk side by side, or for horses in single file to pass pedestrians or other horses. For nature trails the dimensions can be reduced to 2 to 2.5 metres (6.5 to 8 feet) (TOL, Community 18).

Length
A series of loops of varying lengths is desirable as it provides options regarding the length of time for the ride (TOL, Langley Horse 25).

Gradient
While horses can climb grades at least as steep as those climbed by most pedestrians, generally a 15% maximum should be used (Quadra). If the run is less than 30 metres (~100 feet), then a maximum of 24% can be used (Quadra). Cross slopes of 2-5% are acceptable for horse trails (Quadra).

Footing
“Most surfaces can be used, but the equestrian community prefers, where not conflicting with natural trails, to use hemlock-fir hogfuel surface over a gravel sub-base. This allows for a quiet, soft ride with stable, dry footing. One other surface used successfully in Campbell Valley Regional Park is “gyrosand”, a fine dust from rock grindings; however, it is very costly to purchase due to limited sources.” (TOL, Langley Horse 18). Another option is to use 100 mm (4 inches) of 3 mm (1/8 inch) minus crusher dust over 150 mm (6 inches) of compacted coarse gravel on an undisturbed sub-base (Quadra).

Miscellaneous
Opportunities for shortcuts should be physically blocked. For switchbacks, a 2 metre by 4 metre (6.5 by 13 feet) pad at the turn with a 5% outslope should be used in conjunction with a 3 metre (~ 10 feet) long run with a 10% slope into and out of the turn. A 6 metre (~ 20 feet) long barrier and vegetation should be installed along the inside of the tread (Quadra).

4.2.2.3 Public & Communal Riding Rings – Jumping, Dressage, Western Disciplines, All-Purpose

- Siting
- Size
- Footing
- Fencing

“Constructing an outdoor riding ring with safe, clean footing that’s easy to maintain, holds up in all kinds of weather, and does not cause pollution, is an elusive goal of many horse owners” (BCMAFF, Building 1). The three key elements in building an outdoor riding ring are design, materials and maintenance (BCMAFF, Building 1).

Siting
Rings should be located in areas of good natural drainage and must be at least 45 metres (~ 150 feet) from a watercourse and 30 metres (~ 100 feet) from a domestic water supply (BCMAFF Environmental). If a riding ring is to be located closer than 30 metres (~ 100 feet) to a watercourse, footing material other than woodwaste must be used (BCMAFF, Environmental). If the riding arena is not used as a paddock or for feeding, and any manure is picked up after each use, the distance to the watercourse could be 15 metres (~ 50 feet) as long as the land is relatively flat and not sloping towards the watercourse (BCMAFF, Environmental).

Size
Table 2  Dimensions for Riding Rings  Source: Hill 111.

<table>
<thead>
<tr>
<th>Minimum recommended:</th>
<th>Small dressage ring:</th>
<th>Barrel racing:</th>
</tr>
</thead>
<tbody>
<tr>
<td>20m x 36m (65' x 120')</td>
<td>20m x 40m (66' x 132')</td>
<td>150' x 260'</td>
</tr>
<tr>
<td>Average size:</td>
<td>Large dressage ring:</td>
<td>Calf roping:</td>
</tr>
</tbody>
</table>
Footage

"The ideal footing should provide good traction, sufficient cushion to prevent excessive concussion, be nonabrasive and as free as possible of dust and odours that irritate both horse and rider" (BCMAF, Building 1). There are three major components to footing:

Sub-base: existing grade.

Base: A layer of uniform, dense graded, aggregate (known as stone dust, limestone screenings or decomposed granite) with particles no larger than 9 mm (3/8"), should provide a 100 mm x 150 mm (4 to 6 inch) base after damping and compacting (BCMAF, Building 1).

Cushion: A cushion of between 62 mm and 75 mm (2 1/4 to 3 inches) of sand or woodwaste products such as sawdust, shavings or bark mulch are most commonly used (BCMAF, Building 2). Medium coarse, washed sand is recommended as it is the most durable and able to withstand frequent use. (BCMAF, Building 2).

Fencing

Fencing is optional and should suit the type of riding done in the ring. If fencing is used, it may be angled back at a maximum slope of 2.5 : 12 to protect riders' legs (BCMAF, Building 2). To discourage horses from putting their heads over the rail when they turn near the fence, ensure your arena fence is at least 1.85 metres (6 feet) tall (Hill 110). Gates should be flush with the inside of the ring and the latch should be operable from horseback (Hill 110).

4.2.2.4 Communal Rotational Pastures

- Benefits of Pasture
- Size – Carrying Capacity
- Fencing
- Gradient for Exercise
- Field Shelter (orientation, vegetation etc)
- Water
- Management

Benefits of Pastures

"Keeping your horse on a well-maintained pasture with one or more other horses is the most natural style of management" (Hill 27). Horses on pasture are allowed free exercise, sunshine, fresh air and socialization and as a result tend to stay healthier with fewer of the respiratory diseases that are seen with stalled horses (Hill 27). Pastures also provide a mental health outlet for horses and pastured horses "seem to have a better mental attitude than many stalled horses because they are allowed "to be horses" (Hill 27).

A well-kept pasture can also offer excellent nutrition (Hill 27) and a lower yearly feed bill by providing a cheap and reliable source of feed for four to eight months of the year for most horses (BCMAFF, The Basics 1). Other benefits include: soil and erosion prevention; filtration for sediments and nutrients; and a more aesthetically pleasing property when compared with a weed infested pasture with bare spots (Blickle, Healthy).

Size - Carrying Capacity

The carrying capacity of a pasture depends on the productivity of the pasture and the requirements of the individual horses (BCMAFF, The Basics 2). "The nutrient requirements of horses vary greatly depending on their activity; e.g. lactating mares with foals require almost twice as much dry matter intake as idle
mature geldings”, while horses at medium work (2 hrs a day) are intermediate in their requirements (BCMAFF, The Basics 2).

“A well-managed, productive pasture can support one mare and a foal for 4 to 5 months on 0.6 to 0.8 hectares (1.5 to 2 acres) or three mature horses in light work on 1.2 to 1.6 hectares (3 to 4 acres)” (BCMAFF, The Basics 2). In the Environmental Guidelines for Horse Owners, the BCMAFF recommends that when feeding horses in the wetter south coastal areas of BC, plan on approximately 1 hectare (2.5 acres) of land for three to four horses. Put another way, a productive pasture in south coastal BC can support two mature horses on 0.4 hectares (1 acre) from April to September (BCMAF, Environmentally 3). “Often this amount of land is not available to the horse owner but with careful management less land can be utilized without becoming a threat to the environment” (BCMAFF, Environmental). As such, with proper pasture management, carrying capacity can become a function of time, and not necessarily in terms of numbers / area. If not managed properly, however, or if supplemental feed is provided to horses while on pasture, there is a potential for pollution. “This can happen when excess water moves downward through the soil to groundwater, or, when carried overland in runoff into watercourses” (BCMAF, Environmentally 3).

From a social standpoint, “a maximum of six ponies or four horses should be put together and this population density should always be under supervision” (Bird 16). A 0.4ha (1acre) paddock could be used for three animals for temporary turnout, while 0.6ha (1.5 acres) per animal would be required for longer periods of time (Bird 16).

Fencing

Need for Fencing
Good fencing serves many purposes as fences: keep horses separated and in a particular place, away from residences, lawns, crops, vehicles, buildings and roads; maintain boundaries and property lines; decrease liability because they lessen the chance of a horse doing damage to others’ property, decrease the chance of a horse getting onto the road and causing an accident; keep people (especially children) and animals (especially dogs and other horses) off the property; keep horses from getting hurt, whether the horses are turned out or being trained; and can set off an acreage and add to the value of the property (Hill 91).

Planning
No single type of fence will be suitable for the entire property. In fact, one acreage may have five or more fence types as each type is best suited to a particular area such as a pen, paddock, run, pasture, arena, etc (Hill 91).

When planning for fencing, the following should be considered:
- Fence and gate locations;
- Constraints such as topography, vegetation, soil type, etc;
- Permanent vs. temporary fence needs;
- Electric, nonelectric or combinations of the two; and
- Aesthetic values and material preferences (BCMAF, Pasture 1).

Pasture fence layout is important:
- Ensure good fence visibility.
- Allow adequate room for horses to run for exercise.
- Keep corners to a minimum.
- Consider “rounding” corners.
- Allow for separate pastures for “difficult” horses.
- Locate gates for good access and horse movement (BCMAF, Pasture 4).

Injury Prevention
“When laying out fence lines, avoid acute angles that can cause a horse to become cornered by other members of a herd, even if only in play” (Hill 91).
Design all gates to be flush with the fence when closed (Hill 110).

"Barbed wire or field fencing should not be used with horses, especially for confinement areas or small paddocks. Barbed wire was developed for cattle which have thick skins and react differently when caught in a fence" (BCMAFF, Environmental).

"A large percentage of horse injuries that occur on farms are fence related and may be as a result of the fence materials, the fence design, the workmanship, or combinations of all three. ... the most successful horse fences are designed and built with specific horse habits in mind:

- The tendency to get hooves and legs caught in or through the fence or brace assembly.
- The habit of chewing wood boards.
- The need for good fence visibility" (BCMAF, Pasture 1).

"... only a fence that 'looks' substantial is likely to be a deterrent. Visibility, then, is the first criterion in making a fence safe... and when we consider visibility, we have to consider how a fence may be perceived by a horse. Colour is not a key factor in visibility, but brightness and contrast are" (Briggs, "Equine" 22).

Specifications

- 1.4 metres (4.5 feet) is the minimum fence height that will discourage horses from jumping. 1.5 to 1.8 metres (5 to 6 feet) is better, "especially for stallions, the larger breeds, or those specifically bred and trained for jumping" (Hill 91).
- "Most posts are 2.5 to 3 metres (8 to 10 feet) long and are set 0.6 to 0.9 metres (2 to 3 feet) in the ground. Wooden fence-posts should have their tops sawed off at a slant to allow water to run off" (Hill 92).
- "Posts are usually 1.85 to 3.7 metres (6 to 12 feet) apart depending on the fencing material. Most fences have either a continuous sheet of fencing (such as woven wire) or from three to five rails, pipes, or wires, the bottom element being at least 0.3 metres (1 foot) from the ground" (Hill 93).
- "Fencing material should always be put on the inside of the pen, that is, toward the horse, to prevent them from contracting the posts and from pushing the fence off" (Hill 93).
- Person / horse gates should be 1.2 metres (4 feet wide) and machinery gates between 3.7 and 4.9 metres (12 and 16 feet) wide (Hill 93).

Fence types

"Temporary or movable electric fences are used if grazing control is desired within a fence pasture. Easy to use "polywire" is used for temporary fences or standard steel smooth wire" (BCMAF, Pasture 1).

"Permanent fences should be installed only after good planning to limit future concerns especially property boundary fences" (BCMAF, Pasture 1).

"Electric fences can be used either alone or in conjunction with non-electric fences. An electric fence is a psychological rather than a physical barrier that must be constructed as both a fence and an electrical circuit. An all-electric fence may have poor visibility and be a problem with some horses" (BCMAF, Pasture 1).

An electric fence "can be temporarily by itself, as a means of training horses to stay off other types of fencing, or as a safeguard and chewing-deterrent used permanently with other types of fencing. An electric fence system consists of wire, insulators, posts and a grounded power source" (Hill 100). "Solar transformers have photovoltaic cells that charge a battery, and these can last three weeks without a sunny day" (Hill 101).

All wood fences

"All wood fences consisting of treated wood posts and round or board rails, are common in BC. With quality materials and construction, wood fences are effective. Chewing of the rails, especially the top rail,
is a problem for both fence life and horse health. An electric wire spaced away from the rail can reduce chewing. Wood fences are used in all pressure situations, but are most commonly used in high-pressure locations such as corrals" (BCMAF, Pasture 2). "Wood fences are traditional and have a certain aesthetic appeal for a horse farm. If they are properly installed and maintained, wooden fences increase the property value" (Hill 94).

- "Posts should be a minimum of 100 mm (4 inches) in diameter up to 200 mm (8 inches) in areas requiring great strength" (Hill 95).
- "Posts are usually 1.85 to 3.7 metres (6 to 12 feet) apart depending on the fencing material" (Hill 93).
- "Board fences are often made of three or four 2.5 metre (8 foot) long 2x8 pine boards as pine tends not to splinter" (Hill 95).

**Wood posts/steel strand wire**

"Wood posts with steel strand wire fences are also very common, and are most effective in low-pressure pasture situations" (BCMAF, Pasture 2).

**Wood posts/steel woven wire**

"Wood posts with steel woven wire fences are effective in horse control with various wire designs available. Woven wire options are varied but two features should be carefully selected. First, use woven wire with continuous verticals. This is important for a quality fence. Choose either:

- Knotted joint wire – one piece verticals with separate knotting wire at all the joints to horizontals, or:
- Mesh type wire – one-piece verticals that are linked or twisted at the joints to horizontals" (BCMAF, Pasture 2).

"The least desirable woven wire is the hinged joint type that has separate vertical pieces twisted together (they can come apart), or welded joint wire (no flexibility)" (BCMAF, Pasture 2).

"Secondly, select woven wire by the size of the openings. Because horses will put their hooves through openings or "walk down" the fence, choose woven wire with an opening dimension small enough to prevent this from occurring. Woven wire in a diamond mesh, a 50 mm by 100 mm (2 inch by 4 inch) rectangular opening, or a polymer grid fabric should be selected. Standard farm woven fence with larger openings is not recommended for most horse pastures" (BCMAF, Pasture 2).

**Wood posts/polymer coated steel wire**

"Wood posts with polymer coated steel wire fences are relatively new to BC. They consist of steel wire coated in a polymer (usually white) available as either a single strand (to replace single strand steel wire) or in a "rail" consisting of two or three steel wires spaced 100 to 125 mm (4 or 5 inches) apart and covered in a polymer coating (to replace wood rails or boards)" (BCMAF, Pasture 3).

"This material combines the strength of steel, the low maintenance of polymer with the visibility and the aesthetic value of white rail fences. The rail product is sold as "Centaur HTP Fencing Systems" (high-tensile polymer) and the single strand wire as "Equi-Wire." It is sometimes considered an "estate" fence rather than a common farm fence because of its high aesthetic value" (BCMAF, Pasture 3).

**Wood post/all polymer strand**

"Wood post with all polymer strand fences are recently becoming popular in BC, partly due to their low maintenance and high aesthetic value. This monofilament is a heavier gauge than most steel fence wire (8.5 gauge compared to 12.5 gauge) and has a breaking strength slightly greater than standard barbed wire but less than high-tensile wire. It is single strand solid polymer, white in colour that produces an attractive, highly visible fence" (BCMAF, Pasture 3).

"This monofilament is easy to handle and is joined by knotting. It is stapled "tight" to the fence post unlike steel wire. These fences are otherwise similar to other wood post/steel wire horse designs in the number and spacing of strands and the overall height. The monofilament is sold as "Bayco Fencing" in BC. It could also be considered an "estate" fence" (BCMAF, Pasture 3).
Wood posts/all polymer grid

“Wood posts with all polymer grid fences are relatively new to BC but are a proven product that is quite “horse safe.” This polymer is produced in a grid format that has 50 mm by 50 mm (2 by 2 inch) openings (5 ft height typical for horses). It is stretched and attached with nailing strips to wood posts. Horses are said not to chew the poly-grid, but a wood top rail or an electric wire can be used. The polymer grid products are available in various qualities depending on the type of material and whether the fabric was “stretched” during manufacture (producing greater web strength) and whether it was stretched in two directions (greatest strength). Generally, cost is proportional to strength. As with other polymer fence products, low maintenance, good visibility, horse safe, aesthetic value and durable colour (usually black or white) are advantages” (BCMAF, Pasture 3).

Brace assemblies

“Brace assemblies are required for all horse fence types except the all wood rail and all PVC rail designs. A brace is the anchor point for the wire strands, woven wire or grid that forms the fence. Braces must be constructed to withstand the loads due to the material tension as well as loads due to the horse pressure against the fence. While this design is structurally sound, problems can occur where space between the brace wire and the fence wire can trap a horse’s leg. To prevent this, block off this space on all braces accessible to a horse’s leg. If using woven or grid wire, wrap the brace on both sides” (BCMAF, Pasture 4).

All polyvinyl chloride (PVC)

“PVC fences are relatively new to BC. This product is designed to imitate the wood post/wood rail traditional horse fence using long lasting, low-maintenance PVC. These fences have high aesthetic value and could also be considered an “estate” fence. Used in traditional white, it makes a very handsome fence that never needs painting. [It] has elastic action and is highly visible it results in less injury and veterinary bills than many other types of fencing” (BCMAF, Pasture 4).

<table>
<thead>
<tr>
<th>TABLE 3</th>
<th>TYPES OF HORSE FENCES (PERMANENT, NONELECTRIC)</th>
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<tbody>
<tr>
<td>(Refer to text for detailed information)</td>
<td>RAIL FENCE</td>
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<td></td>
<td>WOOD POST</td>
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<td></td>
<td>WOOD RAIL</td>
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<td>Chew?</td>
<td>Yes</td>
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<tr>
<td>Catch hooves?</td>
<td>No</td>
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<td>Catch legs?</td>
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<tr>
<td>Visibility</td>
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<td>Colour</td>
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<td>Maintenance</td>
<td>High</td>
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<td>Aesthetics⁴</td>
<td>medium to high</td>
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<td>Relative Cost</td>
<td>Low</td>
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1. Choose small opening woven wire.
2. All separate wire fences have the possibility of tangling horse legs.
3. Steel wire strands (12.5 gauge commonly used) have the least visibility.
4. This factor is, of course, personal and subjective.

Source: BCMAF, Pasture 6.
Gradient
"Moderate rolling grassy hills are desirable as they usually drain well and provide a good environment for the exercise and development of horses. A slope of 2-6 percent is ideal" (Hill 34).

Field Shelter
Horses on pasture will need a place to stay dry and out of the wind. "Wooded areas, slopes, or ledges will provide good natural shelter. On flat land, one of the best ways to provide protection is with an in-and-out shelter or a three-sided shed" (Hill 77). When it is wet and cold or windy, a 3.7 by 6 metre (12 by 20 foot) steel walled three-sided shed on well-drained site with an eight foot back wall set to prevailing winds is ideal (Hill 78). During the summer, the shed may also be used as protection from the sun or flies (Hill 77).

Water
"Have a source of water for each pasture. You can have separate water sources for each pasture or a single water source that is accessible from more than one pasture. Also try to divide pastures in such a way that horses can have access to shade or shelter especially if they will be confined to these areas for more than a few hours" (BCMAFF, Environmental).

Management
"Pasture management includes the following basic steps: seeding suitable species; fertilizing with manure and an application of commercial fertilizer; rotating horses out of the pasture before it becomes overgrazed; mowing to prevent weeds from gaining a hold; and harrowing to break up manure and expose parasites to the sun" (BCMAFF, The Basics 1).

Toxic Weeds
See Appendix I for a list of toxic weeds. Many landscaping shrubs and trees can also be toxic to horses. See Appendix II for an example listing of these plants.

No Wet Season Grazing
"First, state-of-the-art horsekeeping no longer includes allowing horses on pasture year around" (Blickle, Summer, 1). If horses grazed that much most would be overweight, risking laminitis issues and pastures would also end up being destroyed" (Blickle, Summer 1).

"In the winter keeping horses off saturated and rain soaked soils and dormant or frozen pasture plants is critical if you want to maintain a healthy pasture next summer. Soggy soils or dormant plants simply cannot survive continuous grazing and trampling in winter months. Horses are particularly hard on pastures — the pounding of their hooves compacts the soil which suffocates plant roots. In addition, when the soils are wet horse hooves act like plungers by loosening fine particles of topsoil that are washed away by the rain" (Blickle, Mud 2).

"When horses are allowed access to wet pastures they compact the soil, damage vegetation, and can destroy a wetland's ability to act as a filter. Allowing horses to graze in wet areas will also eventually turn your green field into a muddy pasture. The end result is the loss of a valuable resource in exchange for a muddy mess that isn't much use as a grazing area and is a breeding ground for insects and disease. To avoid this, keep horses off pastures whenever the soil is soggy—this may be for most or all of the year for wetland areas" (Blickle, Healthy).

Rotation
"Try fencing pastures areas according to how wet they are. That way, in the spring you can let your horses onto the higher, dry areas first. Save the wetter areas until later in the summer when they dry out. The golden rule for pasture management is don't graze below 75 to 100 mm (3 to 4 inches) and avoid bare spots. A bare spot in the summer is mud in the winter and weeds next spring" (Blickle, Mud 2).

"Poor pasture management results in reduced quality and quantity of grass, soil erosion, nitrogen runoff, increased weeds and increased feed costs" (Blickle, Win 2).
“In a small way, by using a rotation system, we are mimicking nature by allowing our animals to move on to a fresh area. The delight they display when a gate is opened to new pasture is all too apparent” (Bird 88).

Pollution Prevention
To prevent pollution, the following measures are recommended:

- Ensure no contaminated runoff from the pasture is allowed to enter any watercourse. Consider harrowing pastures to break up manure piles (BCMAFF, Environmental).
- When irrigating pastures, apply water at a rate suitable for the soil and local climate to ensure no nutrient leaching (BCMAFF, Environmental).
- Do not exceed the recommended number of horses for your pasture (BCMAF, Environmentally 3).
- Do not supplement feed or locate salt licks within 30 metres (100 feet) of a watercourse or domestic water sources (wells) (BCMAF, Environmentally 3).
- Rotate supplemental feeding areas where possible and provide stock waterers (BCMAF, Environmentally 3).
- Harrow fields to break up manure (BCMAF, Environmentally 3).
- Fence horses away from domestic water sources (wells) (BCMAF, Environmentally 3). “The direct input of animal waste and sediment into streams degrades water quality and destroys the aquatic environment. Horses and other livestock tend to trample down streamside vegetation. Trees and undergrowth are nature’s system for filtering contaminants from runoff. They also help prevent soil erosion and provide food and shelter for fish and other aquatic wildlife. The overhead canopy that trees provide keeps the water cool. When these natural elements are destroyed a toxic environment is created for fish and other streamlife since cool water is able to carry more oxygen than warm water, which benefits fish” (Blickle, Win 2).

4.2.2.5 Exercise Paddocks – “Sacrifice Areas”

- What is a “Sacrifice Area”?
- Uses of Sacrifice Areas
- Siting
- Dimensions
- Footing
- Fencing
- Gradient for Exercise
- Chore Efficiency
- Access
- Safety

What is a Sacrifice Area?
“A sacrifice area is a small enclosure, such as a corral, run, or pen, which is meant to be your horse’s outdoor living quarters. It is called a sacrifice area because you are giving up the use of that small portion of land as a grassy area for the benefit of the rest of your pastures. Your horses should be confined to the sacrifice area during the winter and early spring and in the summer before your pastures become overgrazed” (Blickle, Mud 2).

Uses of Sacrifice Areas
“The main reason to use a sacrifice area is to maintain a healthy pasture for the following summer and avoid a muddy mess (fewer plants in a pasture means more mud in the winter and dust in the summer). It is also useful for separating or confining animals, for controlling the amount of grass or feed your horse consumes on a daily basis and for caring for sick or injured individuals” (Blickle, Creating 1).

“All horses of all ages need exercise every day – either a daily ride or a minimum turn-out of two hours in a large pen or pasture. A regular exercise program invigorates the appetite, tones muscles, increases lung and heart capacity, and helps develop reflexes and coordination. Exercise increases circulation
which increases the activity of the skin and lungs, which in turn helps remove body heat and the waste products (lactic acid) of exercise. Exercise aids in the development and repair of tissue and improves the quality and strength of bones, tendons, ligaments, and hoofs. Exercise also conditions and stretches muscles and tendons, resulting in less chance of injury and lameness. Allowing horses to play in moderately soft footing can help develop elasticity in tendons. Horses that are allowed ample exercise rarely develop vices such as pawing, stall kicking and wood chewing, which are often the result of boredom. Adult horses take in the largest portion of their exercise at the walk but young horses, testing their physical limits, have explosive outbursts at all gaits" (Hill 21). "Horse need space to run and paddocks should be designed with this in mind. Long rectangular paddocks are preferable" (BCMAFF, The Basics 2).

Location
"The location of the sacrifice area is an important consideration for reducing mud. Choose an area on higher ground, away from wetlands or surface water flows. Don't choose a bowl or depression that will gather water. Well drained, gravely soils work best for buildings and confinement" (Blickle, Creating 3).

• “Site confinement areas and corrals a minimum of 30 metres (100 feet) away from any watercourse” (BCMAFF, Environmental).

Dimensions
• “The size of a sacrifice area can range from a double box stall about 3.7 by 7.4 metres (12 by 24 feet) attached to a stall, to a long, narrow enclosure that allows horses to run and play. You may just have several turnout paddocks that you rotate stalled horses through during the day to give them a chance to move about” (Blickle, Horses).

• “Approximately 6 by 9 metres (20 or 30 feet) wide by 30 metres (100 feet) in length will allow a horse to trot, 60 metres (200 feet) in length to gallop. Keep in mind that the larger the sacrifice area, the larger the area you’ll have to clean and the more footing you’ll need to purchase. A good option is to have one sacrifice area per horse set up like a run off each stall” (Blickle, Creating 1).

Footing
“Hogfuel: Install 0.3 metres to 0.45 metres (1 to 1.5 feet) deep, will pack down to approximately 150 mm (6 inches).

• Pros Least expensive footing material; animals like to lie on it; relatively easy to pick manure out of it; incidental wood pieces removed with manure will be composted. Through the natural composting process they contribute to the break-down of the nitrogen in the horse’s urine and manure. This process eliminates the urine smell often present in outdoor confinement areas. Hogfuel or wood chips can provide an excellent footing.

• Cons Material life is 2-3 years; when material starts to break down it must be removed and replaced; can cause thrush in feet. Poses environmental hazard from leaching. (Blickle, Footing 1). (Note: See Mud Management section for information on potential water contamination from woodwaste).

Gravel: Install 100 mm to 150 mm (4 to 6 inches) with non-woven geotextile material to prevent rock from sinking into the soil. You can use 3/8 minus, 5/8 minus, reject rock, or pea gravel; it is relatively easy to pick manure out of it.

• Pros Material life is indefinite with minimal addition of gravel as needed; crushed rock breaks down to make a firm surface.

• Cons Requires meticulous manure removal or manure particles will form a barrier; materials are expensive; many animals do not like to lie on it, so an alternate area to lie down will probably be necessary (Blickle, Footing 1).
Sand: Install 100 mm to 150 mm (4 to 6 inches) over a layer of drain rock 100 mm to 150 mm (4 to 6 inches) deep. Installing non-woven geotextile material will prevent rock from sinking into the soil. A second layer of geotextile is recommended between the sand and gravel to prevent mixing of materials and filtering of sand down into the rock. Washed (coarse) sand recommended for best drainage.

- **Pros** Material life is indefinite with minimal addition of sand as needed; animals like to lie on it; is relatively easy to pick manure out of it; any material removed with manure and placed on pastures with compost will not be noticed.

- **Cons** Most expensive to install; requires meticulous manure removal or manure particles will form a barrier to water percolation” (Blickle, Footing 1). “Ingesting sand (do not feed on sand) or mud with hay can result in serious sand colic problems and expensive vet bills” (Blickle, Mud 3).

“You might want to try a combination of footing types” (Blickle, Mud 3).

Fencing
“Choose the very safest fencing you can for your sacrifice area. Whatever type of fencing you choose, you may want to reinforce it with some type of electric tape or hot wire - a good “psychological barrier”. Horses are hard on fences and will test most types. They tend to have more respect for electric fencing” (Blickle, Creating 2).

Chore Efficiency
“Will sacrifice areas be near your manure pile and hay storage for ease of daily chores? Can deliveries be made without moving horses—will people have to drive through a pasture to get to your sacrifice area? Do your horses have easy access to fresh water? Can horses be fed without walking through sacrifice areas? This is especially important if you ever plan to have inexperienced people feeding—you may not want them in with your horses. Can you move horses to pasture areas or elsewhere with ease? Are alleys and paths wide enough for wheelbarrows or any other equipment? A good option is to have one sacrifice area per horse set up like a run off of each stall. This chore efficient arrangement gives the horse free access to the stall, and you’ll have a clean, dry, convenient place to feed” (Blickle, Healthy).

Accessibility
“Keep in mind that gates need to be wide enough for delivery trucks - about 3.7 metres (12 feet) wide. It is also important to have a road or driveway leading into your sacrifice area that will be accessible year-round. Remember that the vet, farrier, and delivery vehicles will need easy access even in the winter months. Be sure that your road or driveway won’t be too muddy or narrow, that you’ll be able to clear it of snow if necessary, and that there aren’t any low-hanging wires or tree branches” (Blickle, Healthy).

Safety
“Be sure that there are no protruding objects like bolt ends, nails, boards, or the tops of metal T-posts in your sacrifice area. Also watch out for the corners of roofs and the bottom edges of metal building materials. Look for any hanging wires or cords and remove any garbage or machinery in the paddock” (Blickle, Healthy).

4.2.2.6 Barns and Shelters
- Facility Components and Goals
- Siting
- Barn Construction
  - Materials
  - Dimensions
  - Ventilation
- Stall Bedding
- Wash Racks
- Food & Water
- Chore Efficiency / Access
• Safety
• Living Quarters in Barns

Facility Components
• "barn(s) with stalls;
• runs, pens, paddocks, pastures;
• storage for feed, bedding, machinery, tack, and other equipment;
• training areas: round pen, arena, track, walker, tread mill, pool;
• work areas: grooming area, wash rack, shoeing and veterinary area, breeding shed, laboratory, office, tack room; driveways, walkways, parking areas;
• shelter belts, wind breaks, wildlife areas;
• water and other utilities" (Hill 38).

Siting:
• “Plan for maximum sun in the winter and maximum shade and breeze in the summer” (Hill 38).
• “Locate your buildings on dry ground, preferably high ground. Ideally there should be a 2 to 6 percent slope away from the building. The building floor should be eight to ten inches above the outside ground level” (Hill 38).
• “Ensure that there will be good subsurface drainage, especially for stall areas and runs. For a building location, a sandy or gravelly subsoil is preferred over clay” (Hill 39).
• “Plan for ample space to turn large trucks and/or trailers around. Assure that routine chores are possible without a great hardship during all seasons” (Hill 39).
• “Make the appearance as nice as possible without sacrificing the functional aspects of your layout. Remember, plan for safety, efficiency, and convenience” (Hill 39).
• “The importance of planning structures to reduce environmental impacts cannot be over emphasized” (BCMAFF, Environmental).

Safety:
• “Facilities should be strong and well designed with horse behaviour principles in mind” (Hill 38).

Convenience:
• “Everyday activities should flow efficiently. Buildings should be placed so as to save labour and time. Locate water within easy access to the places it is needed” (Hill 38).

Protection:
• “Keep horse comfort in mind and provide protection from sun, wind, wet, cold, and insects” (Hill 38).

Barn Construction

Materials
“A barn should provide a safe, comfortable, and healthy home for your horses” (Hill 51). “The overall shape of your barn is usually decided by the roof type and whether you plan to have a loft in your barn” (Hill 52). Storing hay or bedding in a loft over the stalls is considered a fire hazard, therefore, “it is strongly recommended to locate your hay storage in a building separate from the stable” (Hill 52).

“Wood buildings are traditional, attractive and provide good insulation. Metal buildings are quick to put up, less expensive than wood, and require minimum maintenance. They can be noisy, however, during windy or rainy weather, they can be cold in the winter and hot in the summer, and although they are neat in appearance they may not be thought as aesthetically attractive as other choices” (Hill 54).
"The physical and social aspects of collecting, storing, handling, transporting, and disposing of manure can be a major problem to horse owners. Clean bedding as well as manure may require separate storage structures. Wide work alleys with a full-width sliding door at one end permit loading manure directly from the stalls into storage, or a trailer, spreader, or truck box" (BCMAFF, *Environmental*).

**Dimensions**

**Feed and Tack Rooms**
"Your feed-room priorities are to keep your food fresh, safe from insects, rodents, and moisture, and out of reach of your horses. A separate tack room will help keep your valuable equipment from getting dusty and/or mouldy" (Briggs, "Design" 33).

**Aisles**
- "Aisles should be a minimum of 2.5 metres (8 feet) wide, but 3 to 3.7 metres (10 to 12 feet) is better" (Hill 74).
- "Blanket racks on every stall door help keep winter blankets and summer sheets easily at hand. Collapsible saddle racks, placed at intervals along the aisle, will help simplify tacking up. If you intend to have boarders, it may be useful to install individual tack lockers" (Briggs, "Design" 35).
- Keep halters and lead ropes outside each stall in case of emergency and for efficiency (TOL, *Barn*).
- Install several sets of cross ties in your aisle, "perhaps with rubber matting underfoot for your horse’s security" (Briggs, "Design" 34).

**Stalls**
"Typical stablebarns are designed to be human friendly rather than horse friendly. However, if we understand the horse’s behavioural needs, we can endeavor to make his stabled time as stress free as possible" (Bird 63).

"Many people get upset seeing zoo animals confined in small cages, but amazingly few worry about stabled horses. The argument that horses have been domesticated and so are happy with their contrived lifestyles does not stand up – would you ever consider keeping your dog or cat in a cage the size of a fridge?!" (Bird 58). "Keeping a horse in a stall or small pen is contrary to its desire to roam and have regular exercise. Prolonged confinement is one of the leading causes of such vices as pawing, pacing, weaving, and stall walking" (Hill 12).

Stalls are convenient when the weather is bad, for stall rest during recovery from injury or illness, and for keeping horses clean and ready when you have time to ride or before a show.

- Tie stalls prohibit exercise. A 3.7 by 3.7 metre (12 by 12 foot) box stall is appropriate for most horses and seems to be "optimal when considering the horse's comfort and the stall's maintenance" (Hill 63). "Foaling stalls should be a minimum of 4.3 by 4.3 metres (14 by 14 feet), and many people use this size for stallions as well" (Briggs, "Design" 32).
- "Sliding doors are convenient and space-efficient because when open they fit closely along the front of the stall wall" (Hill 66).
- "Plan on stall doors at least 1.2 metres (4 feet) wide "(Briggs, "Design" 32).
- "To discourage fighting between stalls, the dividing partition can be solid and a minimum of 2.5 metres (8 feet) high. The ceiling of a stall should be somewhere between 2.5 and 3.7 metres (8 and 12 feet) high" (Hill 65).
- "In an ideal world, a stable would lead directly into a field, paddock or at least some kind of courtyard" (Bird 63).
Hay Barn
"The hay barn should be located separately from the stable yet close enough for convenience in
transporting weekly supplies of hay, grain and bedding to the feed room in the barn" (Hill 75). "Hay or
straw storage can be done fairly simply by building a separate shelter with a roof only, no sides" (Briggs,
"Design" 35).

• "Between 3 to 4 tons per horse per year is needed if not relying on pasture for supplemental feed.
  A ton of hay, 2,000 pounds, is usually comprised of about thirty 65-pound bales. A ton of hay
  requires approximately 200 cubic feet of storage space. For example, this would require a space
  3 by 3 metres (10 by 10 feet) and 0.6 metres (2 feet) high, or 1.5 by 1.5 metres (5 by 5 feet) and
  2.5 metres (8 feet) high; or 1.85 by 1.85 metres (6 by 6 feet) and 1.85 metres (6 feet) high" (Hill
  75).

Ventilation
"Good ventilation is critical as it allows fresh air to circulate and stale air to be expelled, so apex roofs are
desirable with ventilation gaps under the eaves. Most stables tend to have door and window openings on
the same side" (Bird 66).

• "A 454 kilogram (1,000 pound) horse releases 9 litres (2 gallons) of moisture into the air each day
  through respiration. If part of the stall front is fitted with bars or mesh and a 0.6 by 0.6 metre (2
  by 2 foot) window is located on the back wall of the stall, the stall will be set up to take advantage
  of additional light and warmth from the sun or cool breezes, depending on the season and time of
day" (Hill 67).

• "0.3 metres (1 foot) of space between the top of the wall and the ceiling will allow for air
  movement and good ventilation. Also, walls should extend to the ground so that a horse cannot
  get its legs caught under them" (Blickle, Basic 1).

• "Ideally, another opening, such as a sliding window or half-door opening at the horse’s
  chest/head height on a side or back wall, helps to create better air movement and a lighter
  environment. Additionally, it offers an extra view, giving the horse twice as may sights and
  sounds to keep him amused. As a prey animal, a horse needs to see all around the horizon to
  feel secure, so several viewpoints are beneficial" (Bird 66).

Stall Bedding
"Insects are annoying at best and at worst carry disease, bite, and can cause allergic reactions. Use of
rubber mats is an excellent manure management technique. It allows for ease of cleaning and offers a
firm, level surface that makes chore time simpler – you can easily scoop up manure and soiled bedding
and leave the clean bedding behind" (Blickle, Rubber 1).

• "Rubber mats are a pricey investment initially, but they pay for themselves in stall cleaning
  convenience, reduced bedding costs and comfort for your horse. Flooring should be dry and
  level — rubber mats on top of 150 millimetres (6 inches) of gravel are excellent and reduce the
  amount of shavings needed" (Blickle, Rubber 1).

Wash Racks
Ideally, wash racks should be located outside (condensation can be a problem in barns) surrounded by
grass and / or plants. Roughed up concrete can be used, although rubber stall mats are likely better as
they provide more secure footing (Blickle, Healthy).

Food & Water
"The preferable location for a horse to be fed is in a clean, well-ventilated stall or shelter. It is most
natural for a horse to eat with its head lowered — this helps clear their respiratory system. Never feed in
mud — feeding on sand or muddy ground leads to ingestion of dirt and serious digestion problems. Good
feeding options for hay and grain include flat, open grain pans or boxes, rubber mats, or firm, dry sod" (Blickle, Basic 1).
A horse drinks 36 to 55 litres (8 to 12 gallons) of water per day. Water should be fresh and available at all times. Be sure your horse’s water container is free of rough edges and rust” (Blickle, Basic 1). “We live in a selenium deficient part of the world, therefore selenium should be supplemented. Salt should be available free-choice at all times” (Blickle, Basic 2).

**Freedom from competition**

“Separate horses to feed them. This prevents fights, injuries and weight loss problems. Don’t over stock your pastures or crowd horses together” (Blickle, Basic 2).

**Chore Efficiency / Accessibility**

Horse properties typically need year round accessibility for trucks.

**Safety**

In the Barn Safety Checklist from the Langley Township Fire Department, the following is recommended:

- Maintain a defensible space around the barn.
- Keep the area around the barn clear (no bushes, woodpiles etc.).
- Ensure that there is vehicle access to the barn and at least 8 meters (25 feet) of space for a firetruck. Fire vehicles will park between 23 to 30 metres (75 to 100 feet) away.
- Clear the area to and around your water source.
- Mark the route of escape from each stall with a Red or Yellow line on the floor or wall from the stall to the nearest door.
- Enclose all wiring in metal conduits to protect against rodents and to reduce exposure to moisture (Bryant).

**Living Quarters in Barns**

“The installation of living quarters might at first seem an extravagance, but there are many advantages to having an on-site caretaker - guaranteed access to the horses (a plus in bad weather), the ability to respond immediately to suspicious goings-on (a ruckus in one of the stalls, headlights in the dead of night), and comfort and convenience while awaiting the birth of a foal, to name a few” (Bryant).

**4.2.3 Provide social meeting places and a sense of community**

“Individual communities should have distinctive characters and identities. Community design and community services should support the development of strong community spirit” (TOL, Langley 9). “Langley’s rural landscapes and environment are integral to its character. The landscape is diverse in terms of physical features and vegetation, ranging from level cleared fields to sloped wooded areas to watercourses winding through the countryside. Corridors throughout the rural area provide attractive vistas of the countryside. Views of landmark mountains (Mount Baker and Golden Ears) are visible from many areas. Heritage buildings contribute an important man-made element to the environment and the landscape of rural Langley” (TOL, Rural 9).

“There area a number of buildings of heritage value in the rural area, including original farmsteads, barns and churches. In addition, there are roads of historic and scenic significance as well as landscapes and view corridors that provide a characteristic visual impression of rural Langley. Policies of this plan encourage the maintenance of these elements of the rural landscape” (TOL, Rural 28).
4.3 SOCIAL - ECONOMIC

4.3.1 Supply a range of housing / property options to include those traditionally excluded from equestrian communities

“A community should include a mix of housing types, including a variety of housing densities (single detached lots of various sizes, duplex, townhouse, apartment), a variety of tenures (fee simple, strata title, rental) and mixed forms such as secondary rental suites in houses to provide a wide variety and price of units to meet the needs of all members of the community” (TOL, Langley 8).

4.3.2 Include commercial opportunities to provide some employment and services

“In 1990, the B.C. Ministry of Agriculture, Fisheries and Food (BCMAFF) undertook a province-wide horse industry survey... The profile estimated the economic impact of the horse industry in Langley to be $40 million annually, providing 320 full-time equivalent jobs directly on farms and an additional 190 full-time jobs in support services” (TOL, Rural 5). “The horse industry in Langley has grown rapidly over the past decade. In addition to people keeping horses for their own recreational purposes, the Township has numerous farms devoted to breeding, boarding and training of horses as well as several equestrian centers” (TOL).

“The strength of the local horse industry is directly affected by the horse population and the people involved with horses. Concern has been expressed over the high cost of land in the Township which restricts the ability of Langley horse owners and farm operators in recent years, to locations further up the Valley and to the Interior. Together these factors decrease the local population of horses, affect the local market for recreational horses, and remove some of the energy and vitality from the industry” (TOL, Langley Horse 3).

“It is the elite competitive riders which promote the image of the industry, but it is the recreational riders and horse owners which buy the bulk of the products and services. The base of recreational riders is therefore, a critical factor in the Langley horse industry’s health” (TOL, Langley Horse 4).

“The aim of the Horse Industry Strategy is two-fold:
- to strengthen Langley as the horse capital of British Columbia, and
- to develop a world class horse industry” (TOL, Langley Horse).

“It is intended that Langley should become recognized as being the place within British Columbia to locate an equestrian business, to buy stock, to train horses and riders, and to compete. ... Langley should also become a community in which the horse plays a major role in recreation and in the retention of the pastoral landscape (TOL, Langley Horse). Important goals of the Langley Horse Industry Strategy include:
- improving the growth and profitability of the local industry;
- providing economic benefits for the Township;
- enhancing the image of the industry and the Township; and
- encouraging the growth of horse ownership and ridership in the Township (TOL, Langley Horse 6).

“The Township may wish to identify areas within the community plan that could more reasonably lend themselves to a horse themed development. This approach could ensure that such areas are compatible with surrounding uses and with the Township’s developing trail network. If areas were designated for this type of development, the concept could possibly include a horse right-of-way or a dedicated horse trail. If communal facilities were permitted along a trail area, policies would be needed covering ownership and the cost of facility maintenance” (TOL, Langley Horse 31).

“The creation of horse themed communities will need the interest of the land development industry. They will have to feel comfortable with the level of demand for this type of subdivision development. It will also be important to learn from other jurisdictions where this type of concept has worked, as well as those where problems have occurred” (TOL, Langley Horse 31).
"Industry growth requires the expansion of the number of horses and the number of recreational riders. This implies the need for the industry to support initiatives which increase the recreational riding opportunities; provide better access to existing trails; and enhance the quality of the recreational riding experience" (TOL, Langley Horse 25).

4.3.2.1 Lesson / Boarding Barn
The Township states that: "More horse related recreational facilities are needed to serve the Township's large segment of recreational riders" (TOL, Langley Horse). A facility such as a lesson / boarding barn would help satisfy this need.

The Township also encourages "the development of commercial recreation facilities where demand is sufficient and the land resource is suitable for such development" (TOL).

4.3.2.2 Tack & Feed Store
"Development of an equestrian service center to provide for a variety of services for the equestrian industry and recreational horse owners (e.g. Farrier, tack store) may be considered in the Small Farms / Country Estates area in southwest Langley in an appropriate location that has access from a major road. This development shall be very limited in scale. A special zone shall be developed for such use" (TOL, Rural 22).

"Development in Rural Commercial Centres shall conform to the following criteria:
- development shall be limited in scale to reflect a rural character;
- safe access shall be provided to and from adjacent roads;
- development shall be confined to a small area as determined in rural area plans; and
- commercial areas shall be designated as a development permit area" (TOL).

4.3.2.3 Bed & Bale
The Township also encourages "bed and bale" operations in the rural area of Langley. "Bed and breakfast establishments are a common form of small scale tourist accommodation. The "bed and bale" concept offers a similar service and adds horse stabling or pasture to a country bed and breakfast operation. Langley's rural setting, attractive vistas, and developing horse trail network create an appealing riding experience. When combined with a "bed and bale" service, Langley could attract horse related tourism. Non-local competitors at Langley's many horse shows would also provide a good source of "bed and bale" clients. The intent is to establish a network of "bed and bale" operations" (TOL, Langley Horse 17).

"Council and the Economic Development Commission shall develop a marketing program to promote the tourism potential of rural Langley, including the equestrian industry (riding trails, stables, horse shows, etc.), golf courses, hiking and cycling trails, scenic and heritage drives....etc." (TOL, Rural 16).
4.4 ENVIRONMENTAL

4.4.1 Protect surface and groundwater resources

4.4.1.1 Riparian Buffers

"The Township encourages physical barriers, including fencing and appropriate vegetation, to restrict access by farm animals to watercourses" (TOL).

"Development permit areas shall include land within 30m (100 feet) of the natural boundary of the Fraser, Nicomekl, Salmon or Campbell Rivers, ... and within 15m (50 feet) of the natural boundary of any other watercourse" (TOL, Rural 31). The following guidelines are outlined in TOL Rural:

a) "Watercourses, ravines and steep bluff areas shall be retained in a natural state and kept free of development, other than roads, walkways, trails or other public facilities. They shall be protected by restrictive covenant or dedicated for conservation use. The area to be protected shall be defined by the Township in consultation with the Ministry of Environment and the Department of Fisheries and Oceans. Where it is not practicable to preserve all important natural features on a site, compensation should be provided by the developer through dedicating or restoring a natural area nearby.

b) Development shall be designed to provide leave strips adjacent to watercourses and minimize their disturbance.

c) Existing vegetation along watercourses and bluff areas shall be retained. Where additional plantings are required to control erosion or protect fish or wildlife habitat, a landscaping plan will be required showing the location of the vegetation or trees to be retained or planted and the type and size of materials to be used.

d) Development should not unduly increase storm water runoff and should not alter the natural drainage patterns of adjacent properties. Design and construction practices should minimize erosion and sedimentation.

e) Areas subject to hazard shall be kept free of development, except in accordance with conditions recommended in an engineering evaluation.

f) Development shall be required to be set back from watercourses or the top of ravines or bluffs to protect the development and the ecological value of the area. Potentially polluting activities should be set back and buffered from watercourses" (TOL, Rural 31-32).

4.4.1.2 Manure Management

"A unique set of conditions exist in the Fraser Valley with mild temperatures and heavy precipitation in the winter months combined with the highest animal density in the country and urban/rural interface conflicts. These circumstances result in problems with waste disposal, especially manure. Nitrogen from wastes can result in lower quality of groundwater and eutrophication of surface water. Use of fertilizers and spraying of pesticides are also concerns in the rural area because of potential adverse impacts on ground and surface water and proximity of residential development" (TOL, Rural 4).

- The Importance of Manure Management
- Uses and Benefits of Manure
- Composting
- Manure Storage and Application

The Importance of Manure Management

"Manure management is often overlooked when planning for horses" (Blickle, Mud). "Manure management systems consist of various components including manure collection, storage, transport, and land application" (BCMAFF, Environmental). "Managing manure—pick up, storage, and disposal—is an issue for every horse property owner. A good manure management system benefits horse health and the environment as well as the general aesthetics of your property. A regular, convenient manure pick-up system will go a long way in preventing mud and worm reinfection in your horses. An effective storage system prevents manure piles from turning into a soggy mess that can result in mud and water pollution.
And a good disposal system can turn manure into an asset instead of an expensive hassle, eyesore, odor problem, and fly magnet" (Blickle, Healthy).

"In B.C., horse manure is currently viewed as an ‘agricultural waste’. What this means is, “like other farmers”, agricultural wastes including manure and bedding must be handled as an organic fertilizer for the promotion of crops” (BCMAFF, Environmentally).

**Detrimental Effects on the Environment**

"Runoff from soggy manure piles can cause serious surface water contamination problems" (Blickle, How 1). "If manure is applied outside of the growing season, or above the rate of pasture use, nutrients from the manure can be carried in the rainwater, and may cause pollution to streams or rivers. These nutrients can move through the soil and pollute groundwater” (BCMAF, Environmentally 1).

**Detrimental Effects on Horses**

"Horse manure can contain parasites, eggs, and larvae. Manure either spread or deposited on the ground directly from the horse can contain eggs that could live for some time. Larval development and subsequent migration onto the grass stalk could occur at a time when a grazing horse could ingest the eggs or larvae with the grass” (Blickle, Healthy).

**Uses and Benefits of Manure**

"There are many solutions to existing waste management problems that can be solved with little or no money. Preventing pollution from horse farms should not be synonymous with extreme costs. Manure accumulation is a particular problem for small horse farms with insufficient acreage to support spreading, but lack of land is a problem to any size operation. The natural decomposition process produces good quality top soil, and as such, manure should be viewed as a resource” (TOL, Langley Horse 29).

**Uses**

Manure can be used as organic fertilizer and a soil amendment for: cropland, pasture, hayland, vegetable fields, topsoil companies, greenhouse or container growers, mushroom farms, or home gardeners. It can also be shared with horseless neighbours (Blickle).

**Economic Benefits**

"Horse manure is an excellent fertilizer. The manure as excreted by a 455-kilogram (1000 pound) horse in one year totals 45 kilograms (100 pounds) of nitrogen, 8 kilograms (17 pounds) of phosphorus and 28 kilograms (62 pounds) of potassium” (BCMAFF, Environment). “This can translate into $150 US in fertilizer value / year” (Blickle, Healthy).

**Environmental Benefits**

"Maximizing the fertilizer value of manure also has positive environmental implications. Soil characteristics are improved by the addition of the organic matter in the manure. The decomposition of manure by bacteria contributes to improved aeration, improved permeability, and increased water-holding capacity of the soil. Other soil conditioning benefits include pH buffering and an improvement to soils having high salt levels. Applying manure to soil can also improve the physical structure of soil” (BCMAFF, Environment).

"Animal manure is a valuable source of plant nutrients and organic matter. The main nutrients that can be supplied by manure are nitrogen, phosphorus, and potassium” (BCMAFF, Environment).

**Value of Nitrogen (N) in Manure**

"Nitrogen in manure exists in two forms: inorganic and organic. Inorganic nitrogen (ammonia) is the simple, soluble form that plants can use. After application to land, ammonia is converted by soil bacteria to a nitrate (NO3) form. Nitrate can be lost from the root zone through leaching or denitrification (loss to the atmosphere). Manure solids also contain nitrogen in the organic form. Until the organic matter is biologically decomposed in the soil, the nitrogen remains unavailable for plant use. Nitrogen in the organic form is desirable since it acts as a reserve in the soil and is slowly released for plant use. While in storage, horse manure loses much of the ammonia to the atmosphere (volatilization). When manure is eventually spread onto land for crop production, most of the remaining nitrogen is in the organic form and
not subject to volatilization. Because of the lack of inorganic forms, the nitrogen compounds in horse manure must be decomposed by soil microbes before they are available to plants. It can be assumed, as a general rule, that 40 percent of the nitrogen in the manure when applied is available during the year of application. The rest of the nitrogen becomes available over the next three to five years. If manure is applied during the fall or winter, it is estimated that up to one third of the nitrogen may be lost. The losses are due to leaching, denitrification, and surface runoff" (BCMAFF, Environmental).

Value of Phosphorus (P) in Manure
"50 percent of total applied phosphorus in manure is available to the crop in the year it is applied. Most of the phosphorus contained in manure is in the organic form. Its availability depends on the rate at which soil organisms break down the organic material (mineralization) and release phosphorus. Excess phosphorus which enters surface waters via runoff can cause eutrophication" (BCMAFF, Environmental).

Value of Potassium (K) in Manure
"All potassium in manure is available to the current crop. Soil that regularly receives manure is not often lacking in this nutrient" (BCMAFF, Environmental).

Trace Element Value
"Manure also contains the secondary nutrients sulphur, magnesium, and calcium, as well as the micronutrients iron, manganese, boron, chlorine, zinc, copper, and molybdenum" (BCMAFF, Environmental).

Composting
Composting converts one form of organic matter into a more uniform and relatively odourless substance called "humus" or "compost." "Compost is a rich soil enhancement which improves the health of both plants and soil and helps to retain moisture. Compost is a valuable soil amendment: adds micronutrients, microbial life. The optimum carbon-to-nitrogen ratio is roughly 30:1, while manure has a carbon: nitrogen ratio of 14:1 and sawdust has a 400:1 ratio" (Hill 135).

"Composting reduces the possibility of parasite reinfection in your horse as the heat generated in the composting process kills worm eggs as well as pathogens and weed seeds by eliminating their breeding ground. It also decreases the volume of material you have piled up: the composting process will reduce the size of the pile by about 50%" (Blickle, How 1). "Composting also makes your property more pleasing for you and your neighbors to look at and enjoy and reduces odours" (Blickle, How 1).

How to Compost
Larger Operations
"The "Aerated Static Pile Method" is one composting solution for a medium to large horse operation. This method uses an aeration system—usually a system of perforated pipes connected to a blower—placed under the compost pile to periodically blow or draw air into the pile" (Blickle, Healthy).

- For larger composting systems (five horses or more) where heavy equipment will be used, you may want to consider two three-sided cement bins approximately 5 by 5 metres (16 by 16 feet) or 10.5 by 10.5 metres (35 by 35 feet) (Blickle, Healthy).

Smaller Operations
- "For a backyard composting system with one to five horses, without the use of a tractor or heavy equipment, use two to three 2.5 by 2.5 metre by 1.2 metre (8 by 8 by 4 foot) bins. If you are going to use a tractor to turn your compost piles, plan on two to three 2.5 by 2.5 metre by 1.2 metre (8 by 8 by 4 foot) piles for one to five horses. When using a tractor, it helps to place the piles on a cement pad. This makes it easier for the bucket to scrape the surface and keeps the tractor tires from tearing up the ground. A 9 by 9 metre (30 by 30 foot) area will house three piles with some room to move" (Blickle, Healthy).

- "First, select a site for your composter. Look for a high, level area on your property, don't put your composter in a low lying area or it will turn into a soggy mess. Choose an area away from property lines to avoid zoning issues and problems with neighbors. A location that's convenient
to your stall and paddock areas will make the chore of cleaning up easier and less time consuming" (Blickle, How 2).

- “Next, decide on the number of bins you’ll need; at least two bins, maybe a third for convenience. A two-bin system works by piling manure and stall wastes in one bin. When that bin is full allow it to compost and start filling the second bin. Once the first bin is done composting you can start using the composted material. For convenience or if you have 3 or more horses you may want to consider going to three-bins. This allows for one bin for daily wastes, another bin which is full and in the composting stage and the third for the finished compost to be removed and used at your leisure" (Blickle, How 2).

- “Compost management includes tarping, turning and watering. Like all living things, the micro-organisms which break down the manure and bedding require air and water. Too much or too little of each can cause problems. Cover each of your bins with a tarp to prevent your pile from becoming a soggy mess in the winter and too dried out in the summer. A tarp also prevents the nutrients you’re saving for the garden from being washed out into the surface water and causing other problems” (Blickle, How 2).

- “Turning the compost-to-be allows oxygen to get to the bacteria and organisms which break down the material into dirt-like structures. How often you turn it determines how quickly your compost will be ready. An easy way to get air to the center and avoid turning the pile as frequently is to insert a couple of 5 foot PVC pipes into the center of the pile. Use a drill to put holes along pipes. The pile will still need to be turned occasionally to get the manure on the outside into the center so the heat from the composting process can kill parasites and weeds” (Blickle, How 2).

- “To ensure that pollution is not created at the composting site, ensure that:
  - The site is located a minimum of 15 metres (50 feet) from a watercourse, and 30 metres (100 feet) from wells used for domestic purposes" (BCMAFF, Environment). (Put on concrete pad and use lip so leaching does not happen).

### Manure and Bedding

“Selective removal of manure when mucking out and removal of less bedding will help to reduce the C:N ratio. Less bedding will also mean fewer trips to the field to spread manure, smaller storage facilities, and less cost to remove the manure pile" (BCMAFF, Environment). “Consider straw bedding which can be utilized by mushroom farms” (BCMAF, Environmentally 2).

### Manure Storage and Application

#### Amount of Waste Produced

- “A horse produces 36 to 45 litres (8 to 10 gallons) of urine a day” (Blickle).

- “A 454 kilogram (1,000 pound) horse produces about 20 kilograms (45 pounds) of manure per day, equating about 1 cubic foot per day. With bedding that comes to 2 cubic feet per day” (Blickle, Basic 3).

- “If you use your farm manure as fertilizer, then it must be stored to prevent rain from washing out the nutrients that may cause pollution. The size of the storage facility must be able to accommodate six months of manure production: a minimum of 360 cubic feet of storage per horse. Six months storage for 5 horses would require a covered area of 6 by 6 metres (20 by 20 feet) stacked 1.35 metres (4.5 feet) high. This is approximately the size of a two car garage” (BCMAF, Environmentally 2).

### Storage Facilities

“The Waste Management Act requires that at a minimum, these piles are to be covered with a tarp form October to April. Spread it as a fertilizer or plan to have it removed by the end of September. The
storage facility can then be planned and sized to house six months of accumulated manure / bedding for those that must store it on the farm" (BCMAFF, Environmental).

"Under the Code of Agricultural Practice for Waste Management, manure must be stored in a manner that prevents pollution. Manure storage facilities should receive as much attention and planning as any other aspect of a horse operation" (BCMAFF, Environmental). “According to the Code, manure can be stored in a storage facility or in a field storage. Uncovered manure piles allow rain to saturate the pile resulting in the formation of leachate” (BCMAFF, Environmental). “Manure leachate can flow overland to a watercourse and its components can move down through the soil to enter groundwater and ultimately drinking water wells. A small farm may need only a well-selected prepared site and a means to keep rain out of the manure. A larger operation will require an improved method of waste management due to the increased risk of pollution occurring” (BCMAFF, Environmental). “Storage facilities are permanent structures designed and operated to contain all manure until it can be applied as a fertilizer or removed for use elsewhere. All storage structures, including reinforced concrete tanks and simple earthen basins, require similar siting and sizing considerations. These structures should be:

- Located at least 15 metres (50 feet) from any watercourse and at least 30 metres (100 feet) from wells or domestic water sources" (BCMAFF, Environmental).
- “Located so that clean surface runoff from adjacent areas is excluded” (BCMAFF, Environmental).
- “Sized to provide enough storage to prevent having to spread manure during the fall and winter or at any time runoff is likely to occur” (BCMAFF, Environmental).
- “Covered in areas of the province receiving more than 600 millimetres (24 inches) of rainfall between October and April. This includes the Fraser Valley and Vancouver Island” (BCMAFF, Environmental).

**Manure Application Rates**

"In general, in the south coastal area of BC, each acre of a well-managed productive pasture can use up 2500 cubic feet of manure bedding per year. As a general guideline, manure or manure/bedding mixture from 3 to 4 horses can be spread on 0.4 hectares (1 acre) of productive pasture” (BCMAF, Environmentally 1).

The acceptable minimum area required to spread manure from horses can be calculated following this example: “Balance the nitrogen in manure with the nitrogen in the harvested portion of the crop produced. Typically, an 8-tonne/hectare (3.6 ton/acre) grass crop (pasture) requires approximately 190 kilograms/hectare (170 pounds/acre) of nitrogen. This translates into the annual waste production from 5 horses (5 horses per hectare = 2.1 horses per acre). For a 12-tonne/hectare (5.3 ton/acre) grass (a reasonable hay field), the requirement is approximately 288 kilograms/hectare (260 tons/acre) of nitrogen in manure. This would come from the waste produced by 8 horses in one year (8 horses per hectare = 3.2 horses per acre)” (BCMAFF, Environmental).

“The ratio of horses versus land area for feed purposes changes drastically when you look at horse versus land area manure utilization only. For example, a well-managed pasture will utilize the manure and bedding from eight horses on one hectare (three horses per acre). This rate is approximate and must be adjusted where horses are grazed on the pasture only part time” (BCMAFF, Environmental).

**When to Apply Manure**

“Maximum benefit is derived from manure when it is spread on the land in spring or summer. At this time leaching and runoff risks are low and crop growth and nutrient uptake is high. Adequate storage makes this possible by allowing more flexibility in choosing the correct time to apply the manure” (BCMAFF, Environmental).

**4.4.1.3 Drainage Network**

- Why Mud is a Problem
Why Mud is a Problem

Unhealthy Environment for Horses
- "Harbors bacteria and fungal organisms which cause diseases such as abscesses, Scratches, Rain Scald, and Thrush.
- Breeding ground for insects such as Cullicoides (no-see-ums), filth flies, and mosquitoes. Insects are annoying at best and at worse carry diseases, bite, and can cause allergic reactions for both you and your horse.
- If fed on the ground horse can ingest mud/sand with hay = sand colic a very serious digestive disorder.
- Standing in mud can lower body temperature, cause unthriftyness and hypothermia.
- Slick / unsafe footing, can slip & cause injuries.
- Mud in the winter is dust in the summer's dry season – a potential health risk for your horse’s fragile respiratory system, a potential problem for you (especially if you or a family member has allergy or respiratory issues) and it may be a concern for your neighbors as well" (Blickle, Mud 1).

Inconvenient and Unpleasant for People
"Mud is very inconvenient for owners. It makes chores difficult and unpleasant, bordering on impossible. It’s also not much fun to catch a horse to go for a quick ride when he’s knee deep in mud and filthy from head to tail" (Blickle, Mud 1). “It is also unsightly for the neighbourhood and community in general and can also cause odours and attract flies” (Blickle, Mud 1).

Negatively Impacts the Environment
- “Causes runoff of sediment & nutrients (from manure).
- Contaminates surface water, possibly ground water.
- Detrimental to fish & aquatic wildlife.
- Once soil and manure has mixed with water to make mud, it can easily be carried into nearby streams or lakes. Sediment can smother trout and salmon eggs, destroy habitat for insects (a food source for fish), and cover prime spawning areas. Many pollutants, like the nutrients in manure, are also likely to attach to soil particles and be carried into the water" (Blickle, Healthy).

How Mud is Created
- "Increase of surface water
- High organic soil
- Build-up of manure
- Decomposed organic material such as stall waste, shavings, old hogfuel, hay
- High traffic area pulverizes surface material
- Compaction causes an impervious surface
- Excessive hoof and foot traffic breaks down and often eliminates vegetation that helps stabilize soil” (Blickle, Healthy).
“Perimeter drainage using drainage pipes may be required to reduce soil saturation around the ring. Water should be encouraged to run off the surface of the ring into the perimeter ditch or swale rather than move down through the ring surface” (BCMAF, Building 1).

- “A well-compacted, properly tapered sub-base is critical to good drainage. A 1.2 by 1.8 metre (4 to 6 foot) wide swale, 25 cm (10 inch) deep, can be dug around the perimeter to carry away the runoff” (BCMAF, Building 1).

- “To allow water to run off, crown the ring with a 2% slope and compact the clay. All arenas should be either crowned at the center or sloped gradually from one side to another” (BCMAF, Building 1).

Sacrifice Area Drainage

“In coastal areas of BC, and those areas having greater than 600 millimetres (24 inches) of annual precipitation, uncovered confined livestock areas must be properly managed to prevent polluted runoff. To overcome these pollution and runoff problems, horses in high precipitation locations are often fed in stables” (BCMAFF, Environmental).

Drainage System – Mud Prevention Techniques

Install Gutters & Downspouts on All Buildings

“A 250 mm (1 inch) rainstorm produces 409 litres (90 gallons) of water running off a 3.7 by 3.7 metre (12 by 12 foot) roof” (Hackett 1). “In an area that gets 975 mm (39 inches) of rain annually, 63,644 litres (14,000 gallons) of rainwater would run off a double stalled run-in shed in one year!” (Blickle, Creating 2).

“Installing rain gutters and a roof runoff system on your barns and shelters to divert rainwater away from your horse’s confinement areas is another consideration. This technique will seriously reduce mud and will prevent manure and urine from being washed out of the paddock” (Blickle, Creating 2).

“Runoff from each confined area should be directed to a collection basin for complete control. This will ensure that no contamination of the surface water or groundwater supply occurs” (BCMAFF, Environmental).

Good sites to divert clean rainwater to include a dry well, drain field, woods, corner of pasture, stock watering tanks, ditch, pond, creek, wetlands, rain barrel, or undisturbed area of your pasture. “Protect downspouts so animals don’t destroy them. This can be done with heavy PVC, hot wire or by simply making the down-spout area inaccessible to horses” (Blickle, Healthy).

Divert Water with Perimeter Swales

“All off-site runoff should be directed away from the confined area wherever possible (perimeter diversion ditches are the most common way of achieving this)” (BCMAFF, Environmental).

Buffers

- “Surround sacrifice areas with at least 7.5 to 15 metres (25 to 50 feet) of lawn, pasture, garden, trees, or bushes. This vegetative buffer will act as a mud manager for surrounding areas and naturally filter contaminated water running off” (Blickle, Healthy).

- “Trees drink a huge amount of water and they can significantly reduce the amount of water around your horse facility. A mature Douglas fir can drink approximately 450 to 1,100 litres (100 to 250 gallons) per day. Evergreens have the added advantage that they keep on using water in the winter when deciduous trees are dormant” (Blickle, Healthy). “Planting water-loving natives like willow, cottonwood, red osier dogwood, and hybrid poplars along the outside of sacrifice areas can help keep the area drier. Trees planted inside pastures and paddocks will need protection from chewing and root compaction. Fence off these trees along their drip zones. Consider planting new trees where horses can’t reach them such as outside fencelines. By planting trees you will also provide shade for horses and habitat for wildlife. Be aware that some fruit trees and ornamental landscaping trees may be toxic to horses. Surround your paddock with
grassy areas for a natural filtration effect. Pastures, lawns, gardens or other vegetative areas work well for this" (Blickle, Healthy). See Appendix I and II as well as examples of those not to use as they are toxic to horses.

Footing: Riding Rings

- "The type of material used should not have a high potential for leachate run-off that can cause pollution. Woodwaste use must not exceed a total depth of 450 mm (18 inches) and the maximum application rate must not exceed 150 mm (6 inches). Woodwaste in general, and cedar shavings and hogfuel in particular, are not recommended as they produce toxic leachate. Sawdust rings can also be quite slippery when dry" (BCMAF, Building 2).

- "Sand, combinations of sand and woodwaste, ground up rubber from tires and a host of products are intended to improve the riding arena footing" (BCMAF, Building 2). "The layer over the base can be a mixture of materials, such as sand, topsoil, sawdust, wood chips, and rubber or fiber additives" (Bird 65).

- "An inexpensive and environmentally safe option is a mixture of sand and an organic material such as sawdust, peat moss or composted manure. The sand provides the traction necessary to prevent slipping and the organic material retains moisture" (BCMAF, Building 2).

Footing: Sacrifice Areas

Woodwaste

"Woodwaste includes hogfuel, woodchips, bark, shavings, and sawdust. Horse owners use woodwaste extensively for riding arenas, stable bedding, turnout paddocks, high traffic areas and for footing on riding trails or paths" (BCMAF, Woodwaste 1).

"It is currently acceptable for horse owners to use woodwaste on horse operations but water contamination must be prevented" (BCMAFF). "All woodwaste, particularly woodwaste that contains softwood residues from western red cedar, will produce leachate when exposed to rainfall or irrigation" (BCMAF, Woodwaste 1). "Although woodwaste is a natural product, if handled improperly, it can become a serious source of pollution. All woodwaste, regardless of the tree species or form is capable of producing a toxic leachate. Leachate can destroy fish habitat and spawning grounds if allowed to enter a ditch, creek or stream" (BCMAFF, Environmental).

"Woodwaste leachate is typically a black, strong smelling, foamy liquid with a high chemical and biological oxygen demand and a high toxicity to fish when it enters water. It usually contains lignins, tannins and tropolones which are toxic compounds. The leachate is generally acidic and has a high reserve acidity (buffering capacity). It creates an iridescent (oily) slick on water it enters into. Due to its colour, which is black rather than the tea brown colour of peat water, woodwaste leachate screens the passage of light into water. Light and oxygen are essential to the production of aquatic plant production and fish rearing" (BCMAF, Woodwaste 2). "The application of woodwaste to soil can also cause shifts in soil microbial populations and the carbon to nitrogen ratio (C:N ratio). Most soils have a C:N ratio in the order of 12:1 to 15:1. Woodwaste, with a C:N ratio of 300:1, can upset this balance, causing free nitrogen to be tied up and made unavailable for crop growth" (BCMAF, Environmental).

"The impact of woodwaste leachate is more severe on watercourses such as small streams and ditches that are distant from main water bodies like the Fraser River. These small watercourses often have low flow levels and are critical fish habitat for rearing and growth of fry" (BCMAF, Woodwaste 2).

"Because leachate can be a health hazard, it must not enter any source of water used for domestic purposes. As good stewards of the land, horse owners must handle woodwaste in a manner that minimizes the impact on the environment' (BCMAF, Woodwaste 2). "Take the following precautions:

- Depth of application maximum of 150 mm (6 inches) / year. Maximum of 450 mm (18 inches) total depth (BCMAF, Woodwaste 2).

- Only use woodwaste for animal bedding, ground cover, equestrian facilities, on-farm access ways, as plant mulch or soil conditioner. Never use woodwaste for landfill (BCMAF, Woodwaste 2).
Never deposit woodwaste directly into a watercourse (BCMAF, Woodwaste 2).

Do not use woodwaste products within 30 metres (100 feet) of a domestic water intake including a well (BCMAF, Woodwaste 2).

Although minimum setback distances are not presented in any regulations or codes of practice, a setback of 15 meters has been suggested as being potentially acceptable, where practical, based on site conditions (BCMAF, Woodwaste 2).

Do not utilize woodwaste within 10 meters (30 feet) of the property boundary (BCMAF, Woodwaste 2).

Do not deposit woodwaste within 1 meter (39 inches) of the highest groundwater level (BCMAF, Woodwaste 2).

When storing fresh shavings or hogfuel, tarp woodwaste or store in a shed (BCMAF, Woodwaste 2).

Do not use woodwaste in place of drain rock for subsurface drainage (BCMAF, Woodwaste 2).

Prevent the release of leachate into surface water or groundwater. Leachate must be contained (BCMAF, Woodwaste 2).

Alternatives include gravel and sand and combinations with rubber and fiber additives. Compost also works well as it retains moisture.

Other High Traffic Areas

"In high-traffic areas (such as paddocks or stall entryways), horse hooves loosen topsoil and compact the soil below. As the soil becomes more and more compacted with the constant pounding of heavy horse hooves, rainwater is not able to percolate through the soil and instead pools on top, mixing with the loose topsoil to create mud. Possible problem sites: barn/stall entrances; storage areas (compost or manure storage sites, shavings bins); parking areas and driveways; watering points/feeding stations; gates/along fences" (Blickle, Healthy). "Ideas and options for footings in these areas include gravel or crushed rock. A little more pricey, but very useful are rubber stall mats" (Blickle, Creating).

4.4.1.4 Infiltration Enhancement

- Road Width and Surfacing
- Sidewalk / Trail Width and Material
- Infiltration Swales

One of the goals of the Township is to ensure “that infrastructure standards and design minimize negative impacts on the environment, cultural resources and agricultural lands” (TOL).

Road Width & Surfacing

The James Taylor Chair recommends the following:

- There are many variations on road widths and surfing. Roads can be 6 metres (20 feet) wide with two 3 metre (10 feet) lanes and with optional parking on one or both sides at 2.3 metres (8 feet) wide.
- Driving lanes may be surfaced with asphalt, while parking lanes may be surfaced with crushed stone.
- Back lanes can be 4 metres (13 feet) wide with 1 metre (39 inches) on either side for vegetation (112).
- Back lanes can be surfaced with 20 centimetre deep crushed stone to aid in stormwater infiltration (112).

Sidewalk / Trail Width & Material

Sidewalks for pedestrians should be 1.5 metres (5 feet) wide; trails that accommodate both pedestrians and bicycles should be a minimum of 1.5 metres (5 feet) but better if at least 2 metres (6.5 feet) wide (TOL, Community 23).

Trails should be made of pervious materials to aid in stormwater infiltration.
Roadside Infiltration Swales
Runoff from roads can be directed into infiltration swales as part of a stormwater management system. As the water moves downwards to the level of the water table, it is filtered through the grass and soil (The James Taylor Chair 108). 3.25 metres (10.5 feet) wide should be adequate to provide infiltration as well as including the planting of street trees (The James Taylor Chair 65).

4.4.2 Promote resource use reduction
"Land use planning, community design and development regulations should protect the environment by: facilitating lifestyles that minimize energy consumption (e.g., encourage walking, support composting and recycling and encourage transit use)" (TOL, Langley 10).

- Composting (Communal Garden & Horse Properties)
- Alternative Transportation
- Solar Powered Electric Fence
- Recycled Materials: Stall Mats, Feeding Tubs, Riding Ring Footing, and Bedding

4.4.3 Protect and enhance wildlife habitat
"Land use planning, community design and development regulations should protect the environment by: protecting wildlife habitat" (TOL, Langley 10).

- Importance of Enhancing Wildlife Habitat on Horse Properties
- Wildlife habitat enhancement options
- Importance of protecting wetlands
- Importance of vegetation along streams

Importance of Enhancing Wildlife Habitat on Horse Properties
"Pastures do not provide good habitat for most wildlife. Farm owners can help offset this loss of habitat by planting or growing a diversity of vegetation that provides food and cover for wildlife. Consider incorporating native plants for landscaping and planting projects" (Blickle, Healthy).

Natural Pest Control
"By attracting insect-eating birds and using other natural pest controls, you can make a huge dent in the numbers of insects around your property. For example, one swallow consumes about 6,000 soft-bodied insects per day while bats can eat 600 mosquitoes an hour, more than 5,000 a night! Bats also eat agricultural pests such as corn borers, cutworm moths, potato beetles, and grasshoppers. By attracting hawks and owls, you'll also have a natural form of rodent control" (Blickle, Healthy).

Low-cost, Low-maintenance Landscaping
"Many people believe that native plants are the best kind for wildlife and they also cost less money and require less maintenance than non-natives. Because they are suited to our climate and have developed natural resistance, they are much more disease tolerant and require less watering" (Blickle, Healthy). Non-native, non-invasive species can also be great sources of food and shelter, just ensure they are not toxic to horses (See Appendix II for an example of plants that are toxic).

A Renewable Resource
"Trees can provide you with wind breaks, dust barriers, shelter and shade for horses, mud control (since they soak up so much water), and a buffer between neighbors. When properly placed, trees can also help save on heating and cooling costs for your buildings" (Blickle, Healthy).
Wildlife Habitat Enhancement Options

Water
"Water is essential for all wildlife and can be supplied in a stock tank, birdbath, small pond, or a shallow dish. Simply placing a half-barrel under your roof downspout can do the job. Place a floating board as a “dock” in your water source to allow safe exit for birds or small animals. If you’re lucky enough to have a natural pond, stream, or wetland on your property, make sure to preserve or restore these areas” (Blickle, Healthy).

Vegetation
"Provide a variety of vegetation types of varying heights, such as tall grasses, groundcovers, shrubs, and trees. The different heights and varieties of plants will provide habitat for the varying needs of birds and other wildlife. Make sure to include at least one good clump of evergreen trees and shrubs to provide year-round protective cover from weather and predators. Trees planted inside pastures and paddocks will probably need protection from chewing and root compaction. Fence off trees outside their drip zone—the area at the ends of the branches where raindrops roll off. Consider planting new trees where horses can’t reach them such as outside paddocks or pastures; use hot wire; wrap & tie chicken wire around tree trunks, paint with crib halt; pile downed brush &/or rocks around base of tree to drip zone (to create a physical barrier)” (Blickle, Healthy).

Brush Piles
"When gathering downed branches from storms, stack them in a corner or unused area of your pasture. Brush piles make excellent homes for small mammals, amphibians, reptiles, and small birds. You can also create rock piles with the rocks removed from paddocks and pastures. Rock piles provide great habitat for toads, field mice, snakes, and weasels. Locate brush and rock piles away from any of your buildings to prevent these structures from becoming wildlife habitat!” (Blickle, Healthy).

Snags and Fallen Trees
"Woodpeckers, owls, chickadees, nuthatches, swallows, and wrens all use dead or dying trees (called “snags”) for nesting. Creatures such as salamanders and beneficial insects depend on downed trees in their lifecycle. Like brush and rock piles, keep dead trees away from your buildings to avoid attracting insects and rodents and for fire prevention. Consider leaving snags and downed trees in the corners of pastures, outside of paddocks or fence lines, and in wooded areas” (Blickle, Healthy).

Hedgerows
Plant shrubs or bushes along fence lines, in corners of pastures, along driveways, and in clumps in your pastures. Small animals and birds travel along these protected areas and use them for food and shelter. Native plants like hawthorn, serviceberry, oregon grape, and native roses can be planted to form good hedgerows (Blickle, Healthy).

Feeders and Nesting Boxes
"Hang bird feeders and nesting boxes throughout your property: bird, bat, bee (mason & bumble bee) & butterfly; collect horse and dog hair as spring nesting material for birds and set out in tufts. Feeders can provide nectar for hummingbirds in the summer months and a variety of seed for other birds year round. Bat houses can be placed up high on a barn, pole, tree, or house. The best habitat for bats is within a half mile of a stream, lake, or wetland” (Blickle, Healthy).

The Importance of Wetlands
“Although they were once regarded as mucky swamps with little value, we now know that wetlands are a vital resource. Wetlands act like a giant sponge, soaking up water and slowly releasing it, reducing flooding and erosion. Wetlands also filter the water, removing pollutants as it passes through the vegetation” (Blickle, Healthy).

“Since wetlands often connect to streams or ground-water sources, their ability to filter pollutants is important to water quality throughout the watershed. The water that soaks through wetlands often recharges aquifers, a source of water for many rural wells. Wetlands also provide important habitat for wildlife” (Blickle, Healthy).
The Importance of Vegetation Along Streams

"Horses often spend a lot of time near their water source, and if their water source is a stream they can cause a lot of damage. Besides contaminating streams with manure and urine, horses will tend to overgraze these areas and trample the roots of trees and the plants living along the stream bank" (Blickle, Healthy).

"The loss of vegetation leads to a muddy mess in winter but it also harms the environment in a number of ways. Trees and shrubs along streams provide shade and keep water temperatures cool. Fish need oxygen in the water to survive and when water temperatures rise, oxygen levels decrease—the warmer the water, the less oxygen there is. Warm water also leads to excessive growth of algae. Decaying algae use the oxygen fish need and turn water scummy and smelly. The roots of vegetation stabilize stream banks and prevent erosion. When soil erodes into streams, it can clog fish gills, cover spawning beds, smother fish eggs, and make it hard for fish to see their prey" (Blickle, Healthy).

"Plants along stream banks help filter pollutants from manure and urine out of water before it reaches the stream. Nutrients from manure accelerate the growth of algae and even tiny amounts of ammonia from urine can be toxic to fish. Vegetation provides food, nesting, and hiding places for fish and wildlife such as turtles, beaver, river otter, eagles, frogs, and waterfowl" (Blickle, Healthy).

4.4.3.2 Maintain Existing Vegetation of Greatest Ecological Value

"Land use planning, community design and development regulations should protect the environment by: retaining existing trees and requiring the planting of new trees" (TOL, Langley 10).

"The Township recognizes the importance of maintaining tree cover and shall encourage retention of significant tree cover and planting of new trees in reviewing development applications" (TOL, Rural 13).

4.4.3.3 Protect Pond / Wetland Areas as Open Space / Parks

"Land use planning, community design and development regulations should protect the environment by: protecting sensitive environments and incorporating environmentally sensitive areas within the overall park system" and "providing significant green spaces and, where appropriate, linking these green spaces" (TOL, Langley 10).
CHAPTER V  Evaluation of Trademark Proposal

The Trademark Development as proposed is illustrated in Figure 20. The proposal has both positive and negative elements, and concerns were expressed by the Township of Langley, the Little Campbell Watershed Society and the general community. A public open house also gathered valuable public input regarding the proposal.

Positive Elements
- "The applicant is currently proposing the provision of a trail system incorporating mixed-use (pedestrian / bicycle / equestrian) trails along roadways, and through a trail corridor, as shown on the proposed subdivision layout. In addition, a pond area in the southern portion of the property is to be protected as an open space feature" (TOL Report 01-236 38). Proposed sewage treatment plant effluent – effect on environment (Jacobsen Creek).

Negative Elements
- There is no hierarchy of lot size, resulting in very similar property prices which accommodates only a specific economic and social group.
- There does not seem to be a focus to the community – no center.
- The proposed trail system is mainly along roadways, which is not as safe as off-road trails.
- The development proposal does not seem to take into account site characteristics. Vegetation of greatest ecological value does not seem to be protected. What about water bodies other than the pond area in the southern portion of the property? What about buffering Jacobsen Creek in particular (in terms of pollution and run-off volume)? What about buffering the new development from existing neighbours?

Concerns Expressed by the Township of Langley
- The proposal does not connect 200th Street to Zero Avenue. "The Township Engineering and Planning Divisions have indicated to the applicant that provisions must be made for the connection of 200th Street to 0 Avenue".

Concerns Expressed by Little Campbell Watershed Society
- "We are concerned that Trademark (Vicwood) may be considering asking for permission to dump water into ditches on their property that lead to tributaries of the Little Campbell River. We feel in this day and age, dumping large quantities of water into a stream in a short period is an out-dated solution to a problem that they are responsible for creating in the first place....Our watershed is relatively undeveloped considering its location. It has an effective impervious area of less than 9% and presents a wonderful opportunity to test new and innovative technology to deal with drainage rather than just dumping the water into the nearest ditch and transferring the problem downstream" (TOL Report 01-236 38).

Issues Raised by Existing Residents (TOL Report 01-236 38)
- Proposed sewage treatment plant effluent – effect on environment (Jacobsen Creek).
- Long term maintenance of the proposed sewage treatment plant.
- Increased flooding and erosion of Jacobsen Creek.
- Effect of increase of impervious surfaces on the recharge of the aquifer and baseflow of Jacobsen Creek.
- Negative environmental effects of discharge of chlorinated water into Jacobsen Creek.
- Effect on underlying aquifer.
- Negative effects of a concentration of horses on relatively small parcels.
- Proposal out of character / inconsistent with larger 2 hectare (5 acre) surrounding properties.
- Introduction of 100-150 horses could compound an already serious overuse problem at Campbell Valley Regional Park.
- Proposed internal horse trail system not adequate for user needs.
- Responsibility for long term maintenance of horse trails.
- Effect on schools.
- Traffic (i.e. 200th Street, 0 Avenue).
• Noise.
• Effect of construction traffic on existing residents.
• Surrounding infrastructure unable to support proposed development (i.e. 200th Street).
• Proposal lacks amenities.

• "...we as residents can't see any positive additions to the area resulting from this project. There are no additional amenities that have any benefit to the existing residents, no playgrounds, no open public green space or park, no tennis courts, no public horse facilities" (TOL, Report 01-236 38).

• "We would want to see more green space in the plan between the development and existing residences. The previous development plan called for a much more substantive buffer zone around the project with a riding trail and green space, trees etc. We would want to see the same type of zone in this plan. In general we were very negatively surprised by the lack of green space and actual horse facilities proposed. The promo line for the development was equestrian oriented development yet the plan allows for minimal park and open land and an absence of trails for horses and separation from existing land owners" (TOL, Report 01-236 38).

• "Have you considered the option of having the entrance to the subdivision off 202 Street, which is not a through road? We note that there are other streets that also would provide access to the development (i.e. 3A Ave.) that should be considered in the overall traffic flow and access planning such that one street alone does not bear the full weight of the increased traffic load in the area" (TOL, Report 01-236 38).

• "...we would like to suggest there be a restrictive covenant of two horses per parcel or that there be a variety of parcel sizes (two acres) to allow for flexibility in the amount of horses per family" (TOL, Report 01-236 38).

Public Open House Results, held January 25, 2001 (TOL, Report 01-236)

• Of 21 respondents, 13 said that if they purchased a lot, they would keep horses on it, with 1 wanting 1-2 horses, 7 wanting 2 horses, 1 wanting 2-3 horses, 2 wanting 3 horses, and 2 wanting 5-6 horses.

• Of 18 respondents, 9 said they would build a riding ring on their property with 1 saying they would not if a public ring was close, 8 said they would not, and 1 was not sure, if there are trails nearby.

• Of 21 respondents, all felt that separation of rider and road are required, with 13 wanting fencing (1 mentioned it is safest for young riders), 5 said a swale or ditch, and 3 said swale or fencing.

• Of 15 respondents, 6 felt that the proposed equestrian / pedestrian trail system was the best layout, or that it was ok (2 wanted links to CVRP), 6 felt they could do a better job as there is a need to separate riders and cars, 2 said there should be a communal riding ring and/or pasture, 1 said improvements needed to be made to 200th to make it a feature entrance to the development for riders, and 1 thought the trail needed to mingle through the lots.

• To the question of what other equestrian amenities could be provided in the community, 10 respondents did not want any special facilities on the project. 11 wanted an outdoor riding ring, with 1 wanting separate rings –one for jumping and a second for dressage, 2 wanted stables (also noted that 2 people stated no to this question), 2 wanted a tack shop and 1 also wanted a feed store (also noted that 2 people stated no to this question), 12 wanted an indoor riding ring (also suggested in discussion that this facility does not need to be walled, just covered.

• Other ideas included a track, a stand for ride-by viewing and more access trails.

• There were also concerns regarding: waste disposal; the possibility of people running a trail riding business on their site; and “free-ridership” as people will come to use the trails but not help pay for upkeep.
Figure 19  Plan of the latest development proposal by Trademark showing the road layout and property lines for the 99 sites that are a minimum 0.8 hectares (2 acres).
CHAPTER VI  Application of Guiding Principles and Design & Management Guidelines

6.1 Master Plan
6.2 Lesson / Boarding Barn
6.3 Townhouse Stables
6.4 Individual 2 Acre Property
Section - Elevation C - C'

Section - Elevation D - D'

FIGURE 23 Section - elevations of lesson / boarding barn

N↑ 1 : 500
FIGURE 25 Section - elevations of townhouse stables
Section - Elevation K - K'

Section - Elevation L - L'

FIGURE 27 Section - elevations of the individual 2 acre property
CHAPTER VII Confirmation of Applied Principles and Guidelines

7.1 Community Planning: Employ community land-use goals and policies
7.2 Community Planning: Provide community access and linkages
7.3 Social - Cultural: Preserve rural character
7.4 Social - Cultural: Ensure a healthy environment for people and horses
7.5 Social - Cultural: Provide social gathering places and a sense of community
7.6 Social - Economic: Supply a range of housing options to include those traditionally excluded from equestrian communities
7.7 Social - Economic: Include commercial opportunities to provide some employment and services
7.8 Environmental: Protect surface and groundwater resources
7.9 Environmental: Promote a reduction in resource use
7.10 Environmental: Protect and enhance wildlife habitat
CONFIRMATION OF APPLIED GUIDING PRINCIPLES

Design & Management Guidelines:
Community Planning

7.1 Employ community land-use goals and policies

FIGURE 28

- mix of land uses
- access to recreational amenities: public park; pedestrian & cycling trail; equestrian trail; riding rings and boarding / lesson barn
- access to coffee shop, tack & feed store
- community garden
- communal stables & riding rings

RURAL PLAN

Land Use Concept

Source: TOL, Langley 20.
CONFIRMATION OF APPLIED GUIDING PRINCIPLES
Design & Management Guidelines:
Community Planning

7.2 Provide community access and linkages

FIGURE 29

EQUESTRIAN
- linkage provided from the new trail to CVRP through easements between 200th and 202nd St
- access to lesson / boarding barn, coffee shop, and tack & feed store from equestrian trail (hitching post available)

PEDESTRIAN
- roadside trail
- pedestrians may also use the equestrian trail

BIKE
- TOL cycling route is connected from 200th St to 0 Ave
- roadside trail shared with pedestrians

AUTOMOBILE
- 6 access points into new community, interconnected street layout within community
Figure 30 Township of Langley Adopted Equestrian Trail System (1989). Map source: TOL, Community 9.
CONFIRMATION OF APPLIED GUIDING PRINCIPLES

Design & Management Guidelines:
Social - Cultural

7.3 Preserve rural character

FIGURE 31

- 4 public riding rings, 2 communal riding rings
- lesson / boarding barn with riding arena
- stables
- sacrifice area paddocks
- pastures
- equestrian trail
- open riding area in park
- views
- park / open space
- wildlife habitat
CONFIRMATION OF APPLIED GUIDING PRINCIPLES

Design & Management Guidelines:  
Social - Cultural 

7.4 Ensure a healthy environment for people and horses

FIGURE 32

- 4 public riding rings
- lesson / boarding barn
- stables: box stalls are either 12x12 feet or 12x14 feet
- horses have free access to sacrifice area paddocks
- rotational pastures
- 8 kms of equestrian trails: 5.8 km perimeter loop; 1.4 km park loop; 0.8 kms of connecting trails
- open riding area in park
- park: off-leash dog area, lookout and picnic area, all wheelchair accessible
- park: riding ring, riding area (can go off the trail), equestrian trail
- roadside trail
CONFIRMATION OF APPLIED GUIDING PRINCIPLES

Design & Management Guidelines:
Social - Cultural

7.5 Provide social gathering places and a sense of community

FIGURE 33

- coffee shop, tack & feed store: access is provided from bike / pedestrian trails, vehicles, and equestrian trail (hitching post available)
- communal stables
- lesson / boarding barn
- communal and public riding rings
- equestrian trail
- open riding area in park
- park: off-leash dog area, lookout and picnic area
- park: riding ring, riding area (can go off the trail), equestrian trail
- community garden
CONFIRMATION OF APPLIED GUIDING PRINCIPLES

Design & Management Guidelines:
Social - Economic

7.6 Supply a range of housing options to include those traditionally excluded from equestrian communities

FIGURE 34

- properties larger than 2 acres
- properties between 1 and 2 acres
- properties between 1/4 and 1 acre
- properties less than 1/4 acre
- single family residences
- townhouses
- carriage houses
- apartment loft in lesson / boarding barn
- apartment above tack & feed store and coffee shop
CONFIRMATION OF APPLIED GUIDING PRINCIPLES

Design & Management Guidelines:
Social - Economic

7.7 Include commercial opportunities to provide some employment and services

FIGURE 35

- bed & bale: facilities for up to 4 horses; direct access to equestrian trail and park
- coffee shop
- tack & feed store: could also have tack consignment
- lesson / boarding barn: full-board for 10 horses; self-board for 8 horses; lessons. Also, horse shows could be held at this facility.
CONFIRMATION OF APPLIED GUIDING PRINCIPLES

Design & Management Guidelines:
Environmental

7.8 Protect surface and groundwater resources

FIGURE 36

- the maintenance of vegetation of greatest ecological value provides buffering of surface and groundwater
- limited use of hogfuel
- drainage diversion from sacrifice area paddocks to buffer pastures
- regular removal and composting of horse manure
- perimeter infiltration swale around riding rings
- decreased use of impervious surfaces: gravel lanes and trails used to increase infiltration
- dry wells: used to get clean rainwater infiltrated for groundwater recharge without getting contaminated
CONFIRMATION OF APPLIED GUIDING PRINCIPLES

Design & Management Guidelines:
Environmental

7.9 Promote a reduction in resource use

FIGURE 37

- use of recycled rubber stall mats reduces the amount of bedding needed to absorb urine
- use of recycled bedding
- use of recycled rubber feed buckets
- solar powered electric fencing
- use of manure for pastures reduces amount of commercial fertilizer
- water from roof runoff can be stored in covered rain barrels
- promotion of non-vehicular transportation: pedestrian, equestrian, cycling
Design & Management Guidelines:
Environmental

7.10 Protect and enhance wildlife habitat

FIGURE 38

- vegetation of greatest ecological value is protected for wildlife habitat

- ponds and other wetlands are protected with a minimum 15 metre riparian buffer

- the fenced off-leash dog park would minimize disturbance to wildlife and wildlife habitat

- brush piles, rock piles, snags, hedgerows, and stands of trees and shrubs provide habitat in pastures
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Township of Langley Parks and Recreation. South Langley Regional Trail Map.

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APPENDIX I  List of Noxious Weeds
(Source: Whatcom)
Class A Weeds

"Class A weeds are non-native species with a limited distribution in Washington. Preventing new infestations and eradicating existing infestations is the highest priority. Control of these species is required by law" (Whatcom).

<table>
<thead>
<tr>
<th>Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>bean- caper, Syrian</td>
<td>Zygophyllum fabago</td>
</tr>
<tr>
<td>blueweed, Texas</td>
<td>Helianthus ciliaris</td>
</tr>
<tr>
<td>broom, Spanish</td>
<td>Spartium junceum</td>
</tr>
<tr>
<td>buffalobur</td>
<td>Solanum rostratum</td>
</tr>
<tr>
<td>buffalobur</td>
<td>Solanum rostratum</td>
</tr>
<tr>
<td>clary, meadow</td>
<td>Salvia pratensis</td>
</tr>
<tr>
<td>cordgrass, salt meadow</td>
<td>Spartina patens</td>
</tr>
<tr>
<td>crupina, common</td>
<td>Crupina vulgaris</td>
</tr>
<tr>
<td>flax, spurge</td>
<td>Thymelaea passerina</td>
</tr>
<tr>
<td>four o'clock, wild</td>
<td>Mirabilis nyctaginea</td>
</tr>
<tr>
<td>goatsrue</td>
<td>Galega officinalis</td>
</tr>
<tr>
<td>hawkweed, yellow devil</td>
<td>Hieracium floribundum</td>
</tr>
<tr>
<td>hogweed, giant</td>
<td>Heracleum mantegazzianum</td>
</tr>
<tr>
<td>hydrilla</td>
<td>Hydrilla verticillata</td>
</tr>
<tr>
<td>johnsongrass</td>
<td>Sorghum halepense</td>
</tr>
<tr>
<td>knapweed, bighead</td>
<td>Centaurea macrocephala</td>
</tr>
<tr>
<td>knapweed, Vochin</td>
<td>Centaurea nigrescens</td>
</tr>
<tr>
<td>lawnweed</td>
<td>Soliva sessilis</td>
</tr>
<tr>
<td>Mustard, garlic</td>
<td>Alliaria petiolata</td>
</tr>
<tr>
<td>nightshade, silverleaf</td>
<td>Solanum elaegnifolium</td>
</tr>
<tr>
<td>sage, clary</td>
<td>Salvia sclarea</td>
</tr>
<tr>
<td>sage, Mediterranean</td>
<td>Salvia aethiopsis</td>
</tr>
<tr>
<td>Saltcedar</td>
<td>Tamarix ramosissima</td>
</tr>
<tr>
<td>spurge, eggleaf</td>
<td>Euphorbia oblongata</td>
</tr>
<tr>
<td>starthistle, purple</td>
<td>Centaurea calcitrana</td>
</tr>
<tr>
<td>thistle, Italian</td>
<td>Carduus pycnocephalus</td>
</tr>
<tr>
<td>thistle, milk</td>
<td>Silybum marianum</td>
</tr>
<tr>
<td>thistle, slenderflower</td>
<td>Carduus tenuflorus</td>
</tr>
<tr>
<td>velvetleaf</td>
<td>Abutilon theophrasti</td>
</tr>
<tr>
<td>woad, dyers</td>
<td>Isatis tinctoria</td>
</tr>
</tbody>
</table>
Class B Weeds
“Class B weeds are non-native species that are presently limited to portions of the state. Class B species are designated for control in regions where they are not yet widespread. Preventing infestation in these areas is a high priority. In regions where a Class B weed is already abundant, control is decided at the local level, with containment as the primary goal” (Whatcom).

<table>
<thead>
<tr>
<th>Class B Designates</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blackgrass</td>
<td><em>Alopecurus myosuroides</em></td>
</tr>
<tr>
<td>Blueweed</td>
<td><em>Echium vulgare</em></td>
</tr>
<tr>
<td>bryony, white</td>
<td><em>Bryonia alba</em></td>
</tr>
<tr>
<td>bugloss, annual</td>
<td><em>Anchusa arvensis</em></td>
</tr>
<tr>
<td>bugloss, common</td>
<td><em>Anchusa officinalis</em></td>
</tr>
<tr>
<td>Camelthorn</td>
<td><em>Alhagi pseudalhagi</em></td>
</tr>
<tr>
<td>chervil, wild</td>
<td><em>Anthriscus sylvestris</em></td>
</tr>
<tr>
<td>cinquefoil, sulfur</td>
<td><em>Potentilla recta</em></td>
</tr>
<tr>
<td>cordgrass, smooth</td>
<td><em>Spartina alterniflora</em></td>
</tr>
<tr>
<td>cordgrass, common</td>
<td><em>Spartina anglica</em></td>
</tr>
<tr>
<td>Fanwort</td>
<td><em>Cabomba caroliniana</em></td>
</tr>
<tr>
<td>fieldcress, Austrian</td>
<td><em>Rorippa austriaca</em></td>
</tr>
<tr>
<td>floating heart, yellow</td>
<td><em>Nymphoides peltata</em></td>
</tr>
<tr>
<td>Gorse</td>
<td><em>Ulex europaeus</em></td>
</tr>
<tr>
<td>hawkweed, mouseear</td>
<td><em>Hieracium pilosella</em></td>
</tr>
<tr>
<td>hawkweed, polar</td>
<td><em>Hieracium atratum</em></td>
</tr>
<tr>
<td>hawkweed, yellow</td>
<td><em>Hieracium caespitosum</em></td>
</tr>
<tr>
<td>hedge parsley</td>
<td><em>Torilis arvensis</em></td>
</tr>
<tr>
<td>Indigobush</td>
<td><em>Amorpha fruticosa</em></td>
</tr>
<tr>
<td>knapweed, black</td>
<td><em>Centaurea nigra</em></td>
</tr>
<tr>
<td>knapweed, brown</td>
<td><em>Centaurea jacea</em></td>
</tr>
<tr>
<td>knapweed, diffuse</td>
<td><em>Centaurea diffusa</em></td>
</tr>
<tr>
<td>knapweed, meadow</td>
<td><em>Centaurea jacea x nigra</em></td>
</tr>
<tr>
<td>knapweed, Russian</td>
<td><em>Acroptilon repens</em></td>
</tr>
<tr>
<td>knapweed, spotted</td>
<td><em>Centaurea biebersteinii</em></td>
</tr>
<tr>
<td>kochia</td>
<td><em>Kochia scoparia</em></td>
</tr>
<tr>
<td>lepyrodiclis</td>
<td><em>Lepyodiclis holsteoides</em></td>
</tr>
<tr>
<td>loosestrife, garden</td>
<td><em>Lysmachia vulgaris</em></td>
</tr>
<tr>
<td>loosestrife, purple</td>
<td><em>Lythrum salicaria</em></td>
</tr>
<tr>
<td>loosestrife, wand</td>
<td><em>Lythrum virgatum</em></td>
</tr>
<tr>
<td>nutsedge, yellow</td>
<td><em>Cyperus esculentus</em></td>
</tr>
<tr>
<td>oxtongue hawkweed</td>
<td><em>Picris hieracioides</em></td>
</tr>
<tr>
<td>parrotfeather</td>
<td><em>Myriophyllum aquaticum</em></td>
</tr>
<tr>
<td>pepperweed, perennial</td>
<td><em>Lepidium latifolium</em></td>
</tr>
<tr>
<td>primrose, water</td>
<td><em>Ludwigia hexapetala</em></td>
</tr>
<tr>
<td>rocket, garden</td>
<td>Eruca Vesicariassp.</td>
</tr>
<tr>
<td>------------------------</td>
<td>-------------------------------------------</td>
</tr>
<tr>
<td>sandbur, longspine</td>
<td>Cenchrus longispinus</td>
</tr>
<tr>
<td>skeletonweed, rush</td>
<td>Chondrilla juncea</td>
</tr>
<tr>
<td>sowthistle, perennial</td>
<td>Sonchus arvensis arvensis</td>
</tr>
<tr>
<td>spurge, leafy</td>
<td>Euphorbia esula</td>
</tr>
<tr>
<td>starthistle, yellow</td>
<td>Centaurea solstitialis</td>
</tr>
<tr>
<td>Swainsonpea</td>
<td>Sphaerophysa salsula</td>
</tr>
<tr>
<td>thistle, musk</td>
<td>Carduus nutans</td>
</tr>
<tr>
<td>thistle, plumeless</td>
<td>Carduus acanthoides</td>
</tr>
<tr>
<td>thistle, Scotch</td>
<td>Onopordum acanthium</td>
</tr>
<tr>
<td>toadflax, Dalmatian</td>
<td>Linaria dalmatica sp.dalmatica</td>
</tr>
</tbody>
</table>

**Class B County Selected**

<table>
<thead>
<tr>
<th>elodea, Brazilian</th>
<th>Egeria densa</th>
</tr>
</thead>
<tbody>
<tr>
<td>hawkweed, orange</td>
<td>Hieracium aurantiacum</td>
</tr>
<tr>
<td>hawkweed, smooth</td>
<td>Hieracium laevigatum</td>
</tr>
<tr>
<td>helmet, policeman's</td>
<td>Impatiens glandulifera</td>
</tr>
<tr>
<td>knotweed, Giant</td>
<td>Polygonum sachalinense</td>
</tr>
<tr>
<td>knotweed, Japanese</td>
<td>Polygonum cuspidatum</td>
</tr>
<tr>
<td>ragwort, tansy</td>
<td>Senecio jacobaea</td>
</tr>
<tr>
<td>scotch broom</td>
<td>Cytisus scoparius</td>
</tr>
<tr>
<td>watermilfoil, Eurasian</td>
<td>Myriophyllum spicatum</td>
</tr>
</tbody>
</table>

**Class C Weeds**

"Class C weeds are other non-native weeds found to be widespread in the state. Whatcom County Selected Class B and Class C Weeds are targeted for educational or biological efforts only" (Whatcom).

**Class C County Selected**

<table>
<thead>
<tr>
<th>beard, old man's</th>
<th>Clematis vitalba</th>
</tr>
</thead>
<tbody>
<tr>
<td>canarygrass, reed</td>
<td>Phalaris arundinacea</td>
</tr>
<tr>
<td>hawkweed, spp.</td>
<td>Hieracium (non-native)</td>
</tr>
<tr>
<td>iris, yellow flag</td>
<td>Iris pseudocorpus</td>
</tr>
<tr>
<td>ivy, English</td>
<td>Hedera hibernica</td>
</tr>
<tr>
<td></td>
<td>Hedera helix 'Baltica'</td>
</tr>
<tr>
<td></td>
<td>Hedera helix 'Star'</td>
</tr>
<tr>
<td></td>
<td>Hedera helix 'Pittsburgh'</td>
</tr>
<tr>
<td>poison-hemlock</td>
<td>Conium maculatum</td>
</tr>
<tr>
<td>St.Johnswort, common</td>
<td>Hypericum perforatum</td>
</tr>
<tr>
<td>tansy, common</td>
<td>Tanacetum vulgare</td>
</tr>
<tr>
<td>thistle, bull</td>
<td>Cirsium vulgare</td>
</tr>
<tr>
<td>thistle, Canada</td>
<td>Cirsium arvense</td>
</tr>
<tr>
<td>water lily, fragrant</td>
<td>Nymphaea odorata</td>
</tr>
</tbody>
</table>
APPENDIX II List of Plants Known to be Poisonous to Horses
(Source: Blickle, Healthy)
<table>
<thead>
<tr>
<th>Species</th>
<th>Location/Season</th>
<th>Probable Toxic Dose</th>
<th>Toxin</th>
<th>Symptoms</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buttercup, creeping</td>
<td>Moist soils</td>
<td>Very large</td>
<td>Protoaneonin</td>
<td>Inflammation and narcosis</td>
<td>Rarely eaten unless pasture overgrazed</td>
</tr>
<tr>
<td>(Ranunculus repens)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Camas, death</td>
<td>Spring</td>
<td>Less than 9 pounds</td>
<td>Steroidal, glycosidal,</td>
<td>Salivation, weakness, respiratory difficulty, nausea, convulsions, coma</td>
<td>Deadly, easily confused with edible camas after bloom</td>
</tr>
<tr>
<td>(Zigadenus venenosus)</td>
<td></td>
<td></td>
<td>alkaloid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fern, bracken</td>
<td>Fall, when pastures overgrazed</td>
<td>Cumulative large quantities</td>
<td>Thiaminase</td>
<td>Appetite loss, timid, stupified, incoordination</td>
<td></td>
</tr>
<tr>
<td>(Pteridium aquilinum)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fiddleneck</td>
<td>Overgrazed pastures</td>
<td>Single dose 20 pounds or</td>
<td>pyrrolidine</td>
<td>Liver damage &amp; failure, depression, dermatitis, incoordination, death</td>
<td>Similar poison to Tansy Ragwort</td>
</tr>
<tr>
<td>(Amsinckia sp.)</td>
<td></td>
<td>cumulative</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foxglove</td>
<td>Acid soils</td>
<td>Very toxic (1/4 pound)</td>
<td>Digitoxin &amp; other</td>
<td>Contracted pupils, labored breathing, convulsions, death</td>
<td>Rarely eaten fresh, dangerous in hay</td>
</tr>
<tr>
<td>(Digitalis purpurea)</td>
<td></td>
<td></td>
<td>glycosides</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hemlock, poison</td>
<td>Ditches, moist disturbed areas</td>
<td>Very toxic (5 to 10 pounds)</td>
<td>Coniine and other</td>
<td>Narcosis, paralysis, death</td>
<td>Hay MAY be somewhat less toxic as the poison will slowly evaporate</td>
</tr>
<tr>
<td>(Conium maculatum)</td>
<td></td>
<td></td>
<td>alkaloids</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Species</th>
<th>Location/Season</th>
<th>Probable Toxic Dose</th>
<th>Toxin</th>
<th>Symptoms</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemlock, water</td>
<td>Low, wet areas; in spring roots pull out of ground easily</td>
<td>Very toxic (.2 to .8 pounds)</td>
<td>Circutoxin</td>
<td>Teeth grinding, muscle spasms, respiratory failure, death</td>
<td>Roots &amp; stem base most toxic. The most poisonous plant known in North America</td>
</tr>
<tr>
<td>Horsetail</td>
<td>Moist areas</td>
<td>Large quantities cumulative</td>
<td>Thiaminase</td>
<td>Thiamine deficiency causes appetite loss, incoordination</td>
<td>Poisoning occurs when dry plants are fed in hay</td>
</tr>
<tr>
<td>Knapweed, Russian &amp; Yellowstar thistle</td>
<td>Disturbed areas</td>
<td>Cumulative (600 pounds?)</td>
<td>Thiaminase</td>
<td>Brain deterioration resulting in “Chewing disease”</td>
<td>Can eventually cause death by starvation</td>
</tr>
<tr>
<td>Larkspur</td>
<td>Very toxic (1 pound)</td>
<td>Alkaloids-delphinine</td>
<td>Constipation, bloat, depression, paralysis</td>
<td>Deadly</td>
<td></td>
</tr>
<tr>
<td>Lupine</td>
<td>600 to 800 pounds</td>
<td>Alkaloids-lupinine</td>
<td>Spasms, cerebral excitement &amp; death</td>
<td>Can cause birth defects if eaten during pregnancy</td>
<td></td>
</tr>
<tr>
<td>Nightshade, black</td>
<td>Late summer, early fall, fencerows</td>
<td>1 to 10 pounds</td>
<td>Alkaloid-solanine</td>
<td>Diarrhea, convulsions, incoordination, death</td>
<td></td>
</tr>
</tbody>
</table>
# Western Washington Plants Known to Be Poisonous to Horses (USDA-SCS)

<table>
<thead>
<tr>
<th>Species</th>
<th>Location/Season</th>
<th>Probable Toxic Dose</th>
<th>Toxin</th>
<th>Symptoms</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Oak</strong> <em>(Quercus spp.)</em></td>
<td></td>
<td>Very large</td>
<td>Tannins?</td>
<td>Constipation, blood in urine</td>
<td>Leaves can cause problems, acorn poisoning more common</td>
</tr>
<tr>
<td><strong>Ragwort, tansy &amp; Common groundsel</strong> <em>(Senecio spp.)</em></td>
<td></td>
<td>Alkaloid-pyrrolizidine</td>
<td>Liver Lesions, weakness, staggering, death</td>
<td>Liver damage is permanent. Normally avoided when fresh, eaten in hay or when wilted.</td>
<td></td>
</tr>
<tr>
<td><strong>Rhododendron</strong> <em>(Rhododendron spp.)</em></td>
<td>Small</td>
<td>Glycosides</td>
<td>Vomiting, vertigo, death from respiratory failure</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Yew</strong> <em>(Taxus spp.)</em></td>
<td>1 to 10 pounds</td>
<td>Alkaloid-taxine</td>
<td>Gastroenteritis, labored breathing, trembling, collapse</td>
<td>Rarely eaten fresh, dangerous in hay</td>
<td></td>
</tr>
</tbody>
</table>

Excerpted from: *Pasture Management for Horses and Ponies*, Gillian McCarthy; and *Plants that Poison Livestock in Thurston County*, Thurston County Noxious Weed Control Agency.