Fine Particulate Source Apportionment UPDATE for the Williams Lake Airshed Based on Calpuff Modelling

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$\mu g/m^3$	micrograms (of contaminant) per cubic metre of air
PM	Particulate Matter
PM_{10}	Particulate Matter with an aerodynamic diameter less than or equal to 10microns
$PM_{2.5}$	Particulate Matter with an aerodynamic diameter less than or equal to 2.5microns
WSHH	Wood stove home heating

ACKNOWLEDGEMENT

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1. INTRODUCTION

This is one of a series of documents developed as part of an air quality assessment for Williams Lake, British Columbia in support of airshed management planning. For complete documentation on airshed management in the Williams Lake area please refer to the following reports:

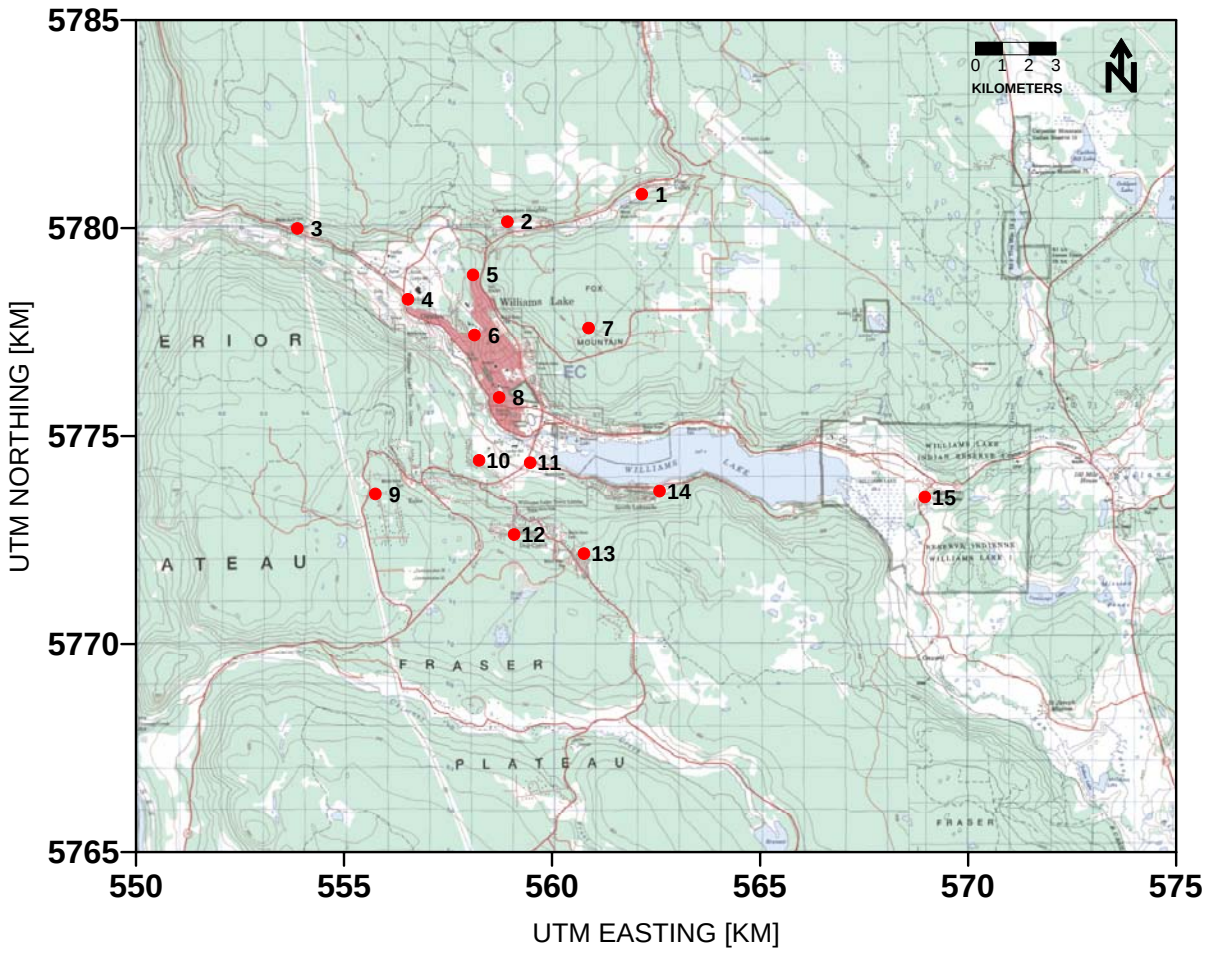
- CALMET Modelling for the Williams Lake Airshed (Levelton Consultants, 2004)
- CALPUFF Modelling for the Williams Lake Airshed (Levelton Consultants, 2005)

As a continuation to these reports, Levelton Consultants Ltd. (Levelton) was retained by the Ministry of Water, Land, and Air Protection (MOE), to complete a source apportionment exercise of fine particulate matter at 15 locations (receptors) in the Williams Lake airshed. This document focuses on the results of the work.

The objective of the source apportionment (using CALPUFF output) is to determine relative contributions (mass and % of total) from all sources of fine particulate (PM_{10} and $PM_{2.5}$) to the annual average concentration at selected receptors in the airshed. The locations of the 15 receptors are presented in Table 1-1 and graphically in Figure 1-1. The nearest grid point to each receptor was used to represent the location.

Table 1-1 Source apportionment receptor locations

Receptor	UTM Easting	UTM Northing	Location Name/Description
1	562.1570	5781.817	Pine Valley end of Dale Road
2	558.9257	5780.156	Commodore Crescent at Pamela Road
3	553.8774	5779.993	Comer Hill Trailer Park
4	556.5372	5778.289	Glendale Edwards Dr
5	558.1002	5778.876	11th Avenue
6	558.1344	5777.430	Columneetza Monitoring Site
7	560.8780	5777.597	Fox Mountain Pheasant Road at Garnet Road
8	558.7272	5775.930	CRD/Library Monitoring Site
9	555.7535	5773.610	Esler Road at Kalyn Road
10	558.2453	5774.417	WL Golf and Country Club
11	559.4742	5774.360	Skyline Monitoring Site
12	559.0879	5772.634	Gibbon Road at Richards Street
13	560.7671	5572.175	Cateline Dr at Dog Creek Rd
14	562.5834	5773.680	Qualeen School
15	568.9601	5773.536	Sugarcane Reserve Band Office



Numbered receptors correspond to *Location Name/Descriptions* in Table 1-1

Figure 1-1 Locations of source apportionment receptors.

The annual predictions at each receptor along with respective contributions from each source group are presented in Tables 5-1 to 5-4. The contributions from each source group are summarized in terms of mass ($\mu g/m^3$) and in terms of total mass predicted at each receptor. To characterize the distribution of PM_{10} and $PM_{2.5}$ three sets of charts representing the following scenarios have been prepared:

- percent contribution from all source groups to the total predicted annual average concentration (includes road dust and secondary particulate matter – $PM_{2.5}$)
- percent contribution from all source groups to the total predicted annual average concentration, excluding road dust, and
- percent contribution from all permitted sources to the total predicted permitted source group annual average concentration

Note that model performance measures indicate that road dust estimates are conservative (i.e. higher than actual) for most areas of the airshed. Values are within a factor of two. This is why the percent contribution from all source groups, to the total predicted annual average concentration, excluding road dust has been included in the source apportionment exercise.

Each source group contains source types which are defines as:

Agricultural: Agricultural emissions

Commercial: Oil and gas, gravel pits, restaurants, municipal landfills, bakeries, welding, commercial/light industrial, dry cleaning, degreasing, printing, paint coatings, space heating, wood-waste landfills, asphalt application emissions.

Mobile: Heavy duty and light duty vehicles, off road vehicles, and rail emissions.

Residential: Backyard burning, BBQ's, structural fires, tobacco, consumer products, paint application, residential oil and gas, lawn equipment, construction/demolition emissions. (excludes home heating).

WSHH: Emissions from wood stove home heating.

LCB: Emissions from land clearing burning.

Permitted: Industrial emissions authorized by a MOE Waste Management Permit.

Unpaved road dust: Emissions from unpaved roads in the airshed.

Paved road dust: Emissions from paved roads in the airshed.

- Paved and unpaved roads within the Williams Lake Airshed were identified by MOE and are identified in Figure 1-2.

Secondary: Emissions from chemically formed sulphate and nitrate particles. (Applied to $PM_{2.5}$ apportionment only as these particles are very fine).

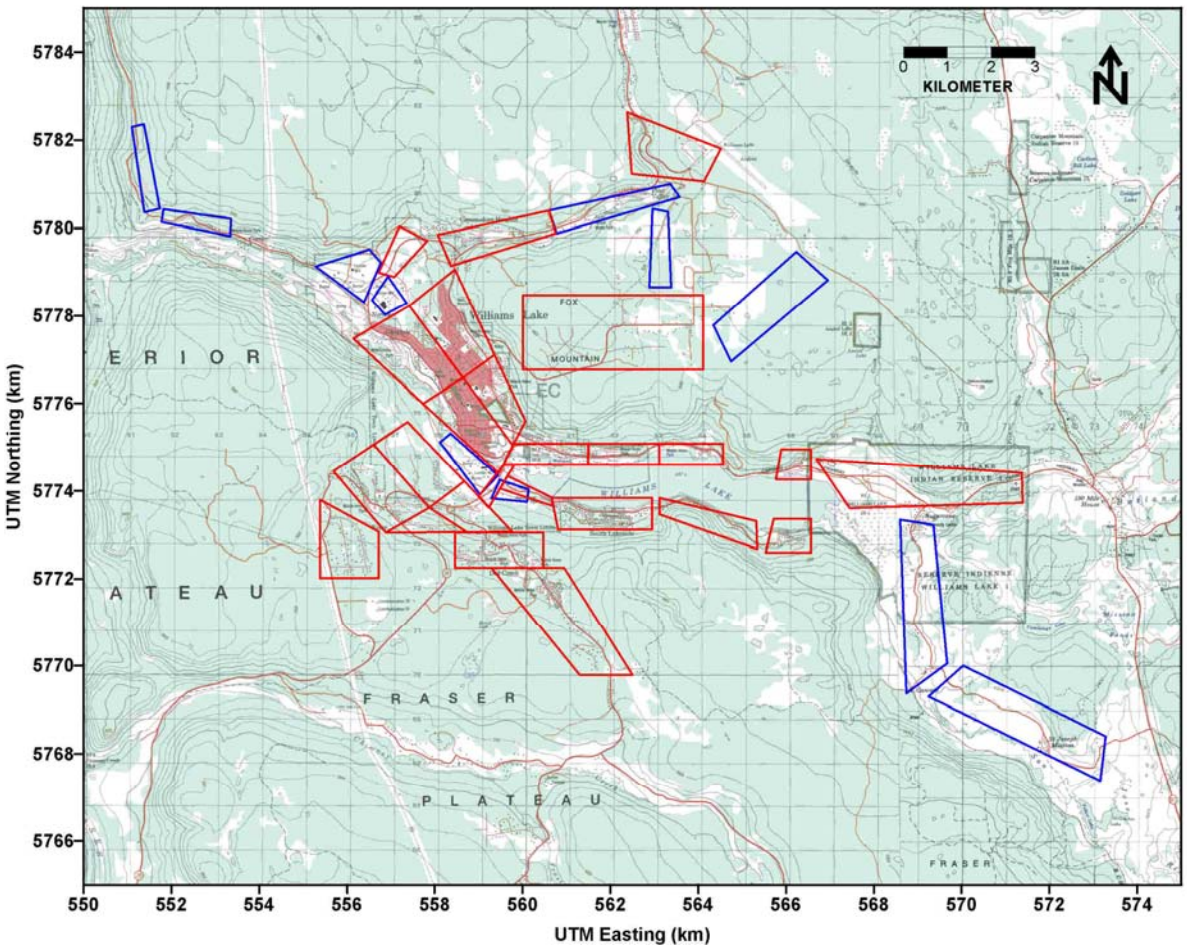


Figure 1-2 Williams Lake Airshed modelled road dust area sources - (Road Dust – paved (red) and unpaved (blue)

2. DISCUSSION BY RECEPTOR LOCATION

2.1 PINE VALLEY END OF DALE ROAD

The Calpuff modelling exercise indicates that the predicted annual average PM_{10} concentration at this location was 7.54 $\mu g/m^3$ (Table 5-1). Of this 77.6% is attributable to paved road dust (Figure 6-1). Only 2.0% is attributable to unpaved road dust. If road dust is removed from the apportionment exercise, wood stove home heating (WSHH) dominates with a 39.0% contribution to annual average PM_{10} concentrations (Figure 6-2). WSHH, although technically a residential source, was modelled separately from other residential sources. We can see from the apportionment that at this location, WSHH is a significant source on its own. Other significant sources include mobile (contributing 26.2%) and permitted sources (contributing 21.0%). Of the permitted sources Weldwood of Canada contributes 43% to the annual average PM_{10} concentration in this location. West Fraser Mills contributes 13%, Riverside (Soda Creek) contributes 12%, and Riverside (West) contributes 10% (Figure 6-3). All other permitted sources at this location each contributed less than 10% to the PM_{10} concentrations. In terms of concentrations it is important to note that although Weldwood of Canada is responsible for 43% of the PM_{10} concentrations the concentration contributing to this percentage is 0.13 $\mu g/m^3$.

The annual $PM_{2.5}$ concentration at this location was predicted at 4.55 $\mu g/m^3$ (Table 5-3). When considering all sources contribution for $PM_{2.5}$ paved road dust dominates contributing to almost half of the total annual average $PM_{2.5}$ concentration (49.7%) (Figure 6-4). Unpaved road dust contributes much less (1.6%). Exclusion of road dust (Figure 6-5) reveals a strong contribution from WSHH (40.8%). This is followed by mobile sources (21.4%), permitted sources (13.1%), and secondary particulate matter (12.1%). Land clearing burning (LCB) contributes 4.8%. In total, the remaining residential, agricultural and commercial sources contribute 7.7%. Apportionment of permitted sources reveals Weldwood of Canada as the largest contributor at this location (49%) (Figure 6-6). West Fraser Mills contributes 12% followed by Riverside (West) at 11%. All other permitted sources contribute less than 10% each.

2.2 COMMODORE CRESCENT AT PAMELA ROAD

The predicted annual average PM_{10} concentration at this location was at 2.84 $\mu g/m^3$ (Table 5-1). Compared to the other source apportionment receptor locations, this is the lowest annual concentration. Paved road dust dominates by contributing approximately 50% of the annual average PM_{10} concentration whereas unpaved road dust contributes 1.8% (Figure 6-7). Exclusion of road dust from the apportionment reveals permitted sources dominate (contributing 80.3%) (Figure 6-8) WSHH has the next largest contribution here (8.7%), although it is small compared to the permitted sources. Examination of the permitted sources indicates Weldwood of Canada contributes 50% to the annual average PM_{10} concentration at this location (Figure 6-9). The PM_{10} concentration from Weldwood of Canada is 0.56 $\mu g/m^3$. Following Weldwood of Canada are West Fraser Mills at 13% and Riverside (Soda Creek) at 12%. The remainder of the permitted sources contribute less than 10% each.

The annual predicted $PM_{2.5}$ concentration at this location was 2.05 $\mu g/m^3$. This is the lowest annual concentration compared to other source apportionment receptors (Table 5-3). Examination of the apportionment of $PM_{2.5}$ concentrations at this location indicates that permitted

sources contribute the most to the annual $PM_{2.5}$ concentrations at 42.8% (Figure 6-10). This is higher than the paved road contribution, which for $PM_{2.5}$ is 23.1%. Unpaved road contributions are small at 1.6%. Exclusion of road dust leads to a 56.8% contribution from permitted sources followed by a 20.0% contribution from secondary particulate matter and 12.4% from WSHH (Figure 6-11). Mobile, residential, LCB, agricultural and commercial contribute 4.8%, 3.3%, 1.7%, 0.4%, and 0.6% respectively. Examination of permitted sources (Figure 6-12) reveals Weldwood of Canada contributing 58% to the annual $PM_{2.5}$ concentration. West Fraser Mills contributes 12%, with all other sources contributing less than 10% each.

2.3 COMER HILL TRAILER PARK

The predicted annual average PM_{10} concentration at this location was 6.45 $\mu g/m^3$ (Table 5-1). The Comer Hill Trailer Park location is influenced by a 60.5% contribution from permitted sources to the annual PM_{10} concentrations (Figure 6-13). WSHH contributes 27.0%, followed by 6.9% from paved roads and 3.4% from unpaved roads. Exclusion of road dust (Figure 6-14) increases the contributions of all sources. Permitted sources contribute 67.4% followed by WSHH at 30.1%, residential at 1.8%, mobile at 0.3%, commercial at 0.3%, LCB at 0.1% and agricultural having a negligible contribution. Figure 6-15 breaks down the contributions from permitted sources. Weldwood of Canada and West Fraser Mills are the main contributors at 31% each. Riverside (Soda Creek) is also mentionable with a contribution of 22%. Although Gene's paving is the closest permitted source to this receptor it does not have any significant emissions of particulate matter, and the contribution of Gene's Paving compared to other permitted sources is 1%.

The predicted annual average $PM_{2.5}$ concentration at this location was 5.99 $\mu g/m^3$ (Table 5-3). Contributions of $PM_{2.5}$ concentrations to the annual average (Figure 6-16) indicate permitted sources contribute 48.5%. WSHH is at 31.7%. Secondary particulate matter contributes 12.4% and the remaining sources (paved road dust, unpaved road dust, residential, mobile, agricultural, LCB and commercial) contribute 7.6% in total. Exclusion of road dust increases all other sources (Figure 6-17) slightly, but because road dust only contributed a small portion to the overall annual $PM_{2.5}$ concentrations, the percentages did not change significantly from the previous figure. Permitted sources were dominated by Weldwood of Canada (40%) followed by West Fraser Mills (29%) (Figure 6-18).

2.4 GLENDALE EDWARDS DRIVE

The predicted annual average PM_{10} concentration at this location was 17.90 $\mu g/m^3$ (Table 5-1). The contribution of sources to the annual average PM_{10} concentration shows that permitted sources dominate at 80.6% (Figure 6-19). Paved and unpaved road dust follow at 9.8% and 5.2% respectively. Exclusion of road dust (Figure 6-20) reveals permitted sources to contribute 94.9% to the annual PM_{10} concentration. All other sources are low (below 5%).

To evaluate permitted source contributions Figure 6-21 is examined. Jackpine Forest Products dominates at 40%, with Weldwood of Canada at 31%. Riverside (Soda Creek) contributes 10%. The remaining permitted sources contribute approximately 19% in total. The higher contribution of permitted sources to the annual average PM_{10} concentration is expected at this location as the majority of the permitted sources are situated close to this receptor.

The predicted annual average $PM_{2.5}$ concentration at this location was 11.26 $\mu g/m^3$ (Table 5-3). Similar to PM_{10}, $PM_{2.5}$ contributions from this location are dominated by permitted sources (73.4%). All other sources are less than 10% each (Figure 6-22). Exclusion of road dust (Figure 6-23) increases the contribution from permitted sources to 81.4%. WSHH is next at 8.7% and secondary particulate matter follows at 8.1%. Residential, commercial, agricultural, LCB and mobile sources contribute less than 1% each. Apportionment of permitted sources (Figure 6-24) shows Weldwood of Canada and Jackpine Forest Products as the main contributors at 35% and 33% respectively. All other permitted sources contribute 10% or less each.

2.5 11TH AVENUE

The annual predicted PM_{10} concentration at this location was 9.68 $\mu g/m^3$ (Table 5-1). The main contributor to this concentration is permitted sources which contribute 47.8% to the annual average (Figure 6-25). This is followed by paved road dust which contributes 39.1%. Exclusion of road dust (Figure 6-26) indicates permitted sources contribute 80.2%, followed by WSHH at 15.9% and mobile at 2.6%. The permitted source contribution is mainly from Weldwood of Canada which contributes 63%. Besides Riverside (Soda Creek) which contributes 12% all other permitted sources contribute 10% or less (Figure 6-27). The large contribution from permitted sources at this receptor can be explained by the proximity to Weldwood of Canada and other permitted sources which are located to the west of this receptor.

The annual predicted $PM_{2.5}$ concentration at this location was 6.83 $\mu g/m^3$ (Table 5-3). When considering all sources, permitted sources contribute the most at 48.5% followed by paved road dust at 19.2% and WSHH at 18.9% (Figure 6-28). Exclusion of road dust increases the percentages of permitted and WSHH to 60.8% and 23.8% respectively (Figure 6-29). Other significant sources include secondary particulate matter at 10.9%. When examining permitted sources Weldwood of Canada dominates at 67% (Figure 6-30). All other permitted sources contribute 10% or less.

2.6 COLUMNEETZA MONITORING SITE

The predicted annual average PM_{10} concentration at this location was 26.20 $\mu g/m^3$, which is the second highest predicted concentration for all receptors (Table 5-1). In this location paved road dust dominated with a 62.8% contribution while unpaved road dust was low, contributing only 0.4% to the annual PM_{10} concentration (Figure 6-31). This is not unexpected as there are little or no unpaved roads near this location, however the road dust contribution is likely over estimated at this site. Exclusion of road dust from the apportionment (Figure 6-32) reveals that permitted sources contribute 48.2% followed by WSHH at 39.4%. Break down of permitted sources (Figure 6-33) reveals that Weldwood of Canada (located to the northwest of the receptor) contributes 66% to the annual PM_{10} concentration.

The annual $PM_{2.5}$ concentration at this location was predicted at 14.85 $\mu g/m^3$, which is the highest concentration for all locations in the source apportionment exercise (Table 5-3). Examination of all source contributions indicates a strong contribution from paved road dust, WSHH, and permitted sources (33.9, 30.4 and 24.6% respectively) (Figure 6-34). Figure 6-35 examines the contributions without the influence of road dust. The contribution from WSHH increased to 46.3% and the contribution from permitted sources increased to 37.4%. Mobile and secondary particulate matter contributed approximately 6.5% each to the total annual average $PM_{2.5}$ concentration. Examination of the partitioning of permitted sources (Figure 6-36) reveals Weldwood of Canada dominating at 73%.

2.7 FOX MOUNTAIN PHEASANT ROAD AT GARNET ROAD

The predicted annual average PM_{10} concentration at this location was 12.61 $\mu g/m^3$ (Table 5-1). Paved road dust dominates PM_{10} concentrations with a contribution of 81.6% of all contributing sources (Figure 6-37). Exclusion of the large road dust contribution (Figure 6-38) reveals permitted sources contributing 39.5% followed closely by residential sources at 27.8%. Mobile sources contribute 18.7% to the annual average PM_{10} concentration and WSHH is lower here than the previous source apportionment figures, with a contribution of 11.9%. Weldwood of Canada makes 43% of the permitted sources (Figure 6-39).

When considering $PM_{2.5}$, the predicted annual average $PM_{2.5}$ concentration at this location was 6.61 $\mu g/m^3$ (Table 5-3). Examination of all source contributions (Figure 6-40) indicates paved road dust dominates with 56.9% of the annual $PM_{2.5}$ concentrations. Unpaved road dust is 0.7%. Exclusion of road dust (Figure 6-41) reveals approximately equal apportionment between permitted and residential sources (approximately 24% each). Additionally there is approximately equal apportionment between WSHH, secondary particulate matter and mobile sources (approximately 16.5% each). Permitted sources are dominated by Weldwood of Canada (49%) (Figure 6-42).

2.8 CRD/LIBRARY MONITORING SITE

The annual predicted PM_{10} concentration at this location was 9.54 $\mu g/m^3$ (Table 5-1). Paved road dust and permitted sources dominate all source contributions at 41.9% and 38.2% respectively (Figure 6-43). Unpaved road dust contributes 2.5%. Exclusion of road dust increases the contribution from permitted sources to 68.7% (Figure 6-44). WSHH contributes 21.3%. The contribution from commercial sources is higher than residential, mobile and agricultural sources, as expected at this downtown location. Permitted sources are divided between three main sources; Weldwood of Canada (30%), Riverside (East) (29%), and Riverside (West) (20%) (Figure 6-45).

The annual predicted $PM_{2.5}$ concentration at this location was 6.78 $\mu g/m^3$ (Table 5-3). Permitted sources dominated (41.8%) but paved road dust was also high (18.7%)(Figure 6-46) On exclusion of road dust permitted sources make up 52.4% of the annual $PM_{2.5}$ concentration (Figure 6-47). WSHH contributed 26.9% at this location. Secondary particulate matter contributed 12.0%. Permitted sources are dominated again by Weldwood of Canada (to the northwest) with a contribution of 39% (Figure 6-48), other significant permitted sources are Riverside (East) at 23% and Riverside (West) (to the south) at 18%.

2.9 ESLER ROAD AT KALYN ROAD

The predicted annual average PM_{10} concentration at this location was 18.35 $\mu g/m^3$ (Table 5-1). Paved road dust dominates all source contributions with a contribution of 70.0% to the annual PM_{10} concentration (Figure 6-49) Unpaved road dust, on the other hand, is almost negligible. Exclusion of road dust (Figure 6-50) reveals WSHH as the dominant source (68.8%). Permitted sources contribute only 11.7% to the annual PM_{10} concentration likely due to the large influence of WSHH. Mobile contributes 9.2% and LCB contributes 7.4%. Permitted sources with large contributions include Weldwood of Canada (26%), Riverside (West) (19%), West Fraser Mills (16%), Riverside (East) 16% and Riverside (Soda Creek) (13%) (Figure 6-51).

When considering $PM_{2.5}$, the predicted annual average $PM_{2.5}$ concentration at this location was 9.32 $\mu g/m^3$ (Table 5-3). WSHH dominates this location with a contribution of 43.8% to the annual $PM_{2.5}$ concentration, followed by a 37.0% contribution from paved road dust. Unpaved road dust is minimal, contributing only 0.2% (Figure 6-52). Exclusion of road dust (Figure 6-53) to the source apportionment reveals that WSHH is the dominant source contributing 69.6% to the annual $PM_{2.5}$ concentrations for this location. When examining the role of the permitted sources to the annual $PM_{2.5}$ concentration Figure 6-54 indicates that Weldwood of Canada is the largest contributor at 34%.

2.10 WL GOLF AND COUNTRY CLUB

The predicted annual average PM_{10} concentration at this location was 14.22 $\mu g/m^3$ (Table 5-1). Examination of the contribution from all sources shows that permitted sources contribute the most (41.5%), but the contribution from unpaved roads is also high (31.4%) (Figure 6-55). Paved roads also show a significant contribution of 19.1% to the annual PM_{10} concentration. The exclusion of road dust (Figure 6-56) reveals very high contributions from permitted sources (83.7%). WSHH follows with a contribution of 11.4%. Examination of permitted sources indicates that most of the PM_{10} is from Riverside (West) (44%) and Riverside (East) (36%) (Figure 6-57). All other permit sources are below 10% or negligible. The larger contribution from Riverside (West) and Riverside (East) at this location is expected as both of these sources are slightly northeast of this location.

The predicted annual average $PM_{2.5}$ concentration at this location was 7.88 $\mu g/m^3$ (Table 5-3). Figure 6-58 illustrates the contributions from all sources at this location. Permitted sources contribute the most to the annual $PM_{2.5}$ concentration (47.7%). Unpaved road dust is significant as the second highest source (15.9%). Paved road dust contributes (11.9%). Exclusion of the road dust sources (Figure 6-59) increases the permitted source contribution to 66.1%, WSHH follows with a contribution of 19.9%. Secondary particulate matter contributions are also noteworthy at 8.9%. Permitted sources (Figure 6-60) reveal Riverside (West) as the greatest contributor to the annual $PM_{2.5}$ concentration with a value of 44%, followed by Riverside (East) with a value of 31%.

2.11 SKYLINE MONITORING SITE

The predicted annual average PM_{10} concentration at this location was 26.84 $\mu g/m^3$ (Table 5-1). Figure 6-61 shows that permitted sources dominate (70.2%) all source contributions. Paved road dust and unpaved road dust follow with percentages of 16.0 and 4.3 respectively. Removal of road dust from the apportionment (Figure 6-62) shows that permitted sources are responsible for 88.1% the contribution to the annual PM_{10} concentration. Based on visual observations near this station, it is postured that roaddust is more significant than what the model predicted. Commercial and WSHH contribute 8.2 and 3.1 percent respectively and all other sources contribute less than 1% each. The break down of permitted sources (Figure 6-63) shows that Riverside (West) contributes 61% to the annual PM_{10} concentration. Riverside (East) has the next highest contribution at 30%.

The predicted annual average PM_{10} concentration at this location was 13.79 $\mu g/m^3$ (Table 5-3). Examination of all sources (Figure 6-64) shows that permitted sources dominate, and contribute 72.6% to the annual predicted $PM_{2.5}$ concentration. Besides permitted sources other noteworthy sources are WSHH (6.9%), paved road dust (10.3%), secondary particulate matter (4.3%), and unpaved road dust (2.8%). Removal of road dust increases the contributions from all the

aforementioned sources (Figure 6-65). Apportionment of permitted sources (Figure 6-66) shows Riverside (West) and Riverside (East) as the main contributors (58% and 29% respectively).

2.12 GIBBON ROAD AT RICHARDS STREET

The predicted annual average PM_{10} concentration at this location was 27.85 $\mu g/m^3$, the highest concentration predicted at any of the selected source apportionment receptors. (Table 5-1). Here, paved road dust dominates the source apportionment with a contribution of 67.9%, unpaved road dust is negligible at 0.1% (Figure 6-67). Removal of road dust shows that WSHH contributes 64.3% to the total average annual PM_{10} concentration, with residential sources following with a 12.3% contribution (Figure 6-68). Permitted sources are low at 7.3% compared to other location in the source apportionment exercise. Break down of permitted sources reveals Riverside (West) and Weldwood of Canada contribute equally with 26% (Figure 6-69). Riverside (East) and West Fraser Mills follow at 19% and 12% respectively.

The predicted annual average $PM_{2.5}$ concentration at this location was 14.27 $\mu g/m^3$, which is the second highest concentration of the source apportionment receptors (Table 5-3). All source contributions (Figure 6-70) indicate WSHH has the highest contribution to the predicted annual $PM_{2.5}$ concentration (42.9%) with paved road dust second at 34.9%.Unpaved road dust is negligible at 0.2%. Exclusion of road dust (Figure 6-71) shows that most of the $PM_{2.5}$ is from WSHH (66.0%) followed by residential (11.1%), mobile (6.8%), LCB (6.4%), permitted (5.6%), and secondary particulates (3.9%). Permitted sources, although low in comparison to WSHH are broken down in Figure 6-72. Weldwood of Canada and Riverside (West) dominate the permitted sources with contributions to the predicted annual average $PM_{2.5}$ concentration of 34% and 24% respectively.

2.13 CATELINE DRIVE AT DOG CREEK ROAD

The predicted annual average PM_{10} concentration at this location was 4.23 $\mu g/m^3$, the second lowest concentration predicted at the selected source apportionment locations (Table 5-1). Contributions from all sources were evaluated and are presented in Figure 6-73. Almost 50% of the PM_{10} at this location is attributable to paved road dust. The contribution of unpaved road dust to the annual PM_{10} concentration is low at 0.9%. Exclusion of road dust (Figure 6-74) shows that WSHH is the dominant source contributing 60.2%. Permitted and Mobile sources follow with contributions of 29.3% and 4.0% respectively. Permitted sources at this location (Figure 6-75) are influenced mainly by Riverside (West) (29%) and Weldwood of Canada (24%).

The predicted annual $PM_{2.5}$ concentration at this location was 3.31 $\mu g/m^3$, the second lowest concentration predicted at the selected source apportionment locations (Table 5-3). Figure 6-76 illustrates the source contributions for $PM_{2.5}$ at this location. WSHH contributes approximately 50% to the annual $PM_{2.5}$ concentration. Paved road dust is also fairly high with a contribution of 19.3%. Unpaved road dust, on the other hand, is almost negligible contributing only 0.8%.Exclusion of road dust (Figure 6-77) elevates WSHH to 62.8% followed by permitted sources at 19.7%, secondary particulate matter at 10.0%, and LCB sources at 2.6%. Source apportionment of permitted sources is presented in Figure 6-78. Weldwood of Canada and Riverside (West) contribute 33% and 28% respectively.

2.14 QUALEEN SCHOOL

The predicted annual average PM_{10} concentration at this location was 25.13 $\mu g/m^3$ (Table 5-1). When examining all source contributions (Figure 6-79), paved road dust has the most significant contribution (74.0%) while unpaved road dust is negligible at 0.4%. Removal of road dust from the apportionment (Figure 6-80) reveals WSHH is the dominant source contributing 57.8% to the annual PM_{10} concentration at this location. Permitted sources follow with a contribution of 25.8%. Examination of permitted sources in more detail (Figure 6-81) shows that the main contributors to the annual PM_{10} concentration are Riverside (West) (37%), Riverside (East) (26%) and Weldwood of Canada (18%).

The predicted annual average $PM_{2.5}$ concentration at this location was 12.30 $\mu g/m^3$ (Table 5-3). When considering all sources (Figure 6-82), 43.9% of $PM_{2.5}$ at this location is attributable to paved road dust, while only 0.5% is attributable to unpaved road dust. Removal of road dust from the apportionment (Figure 6-83) reveals WSHH is the dominant source contributing 59.0% of the annual $PM_{2.5}$ concentration. Permitted sources, mobile, secondary particulate matter and residential sources follow with contributions of 19.9%, 9.4%, 7.2%, and 3.5% respectively. Apportionment of permitted sources (Figure 6-84) shows that Riverside (West) is the largest contributor (33%), followed by Weldwood of Canada (27%) and Riverside (East) 20%.

2.15 SUGARCANE RESERVE BAND OFFICE

The predicted annual average PM_{10} concentration at this location was 5.59 $\mu g/m^3$ (Table 5-1). Examination of all sources at this location (Figure 6-85) shows that the paved road dust contributes 48.1% to the annual PM_{10} concentration. This is followed by WSHH (27.2%). The contribution of unpaved road dust at this location is 13.1%. Removal of road dust (Figure 6-86) reveals that 70.3% of the annual PM_{10} concentration is attributable to WSHH. Permitted sources are second, contributing 14.9% to the annual PM_{10} concentration. Further break down of the contribution from the permitted sources is presented in Figure 6-87. The main contributors are Weldwood of Canada (32%), Riverside (West) (23%), Riverside (East) (16%) and Riverside (Soda Creek) (10%).

The predicted annual average PM_{10} concentration at this location was 4.23 $\mu g/m^3$ (Table 5-3). All source contributions (Figure 6-88) shows a diverse apportionment. WSHH has the highest contribution at 44.0% of the annual average $PM_{2.5}$ concentration. Paved road dust represents 24.1% of the $PM_{2.5}$ whereas unpaved road dust represents 7.5% of the annual average $PM_{2.5}$. Removal of road dust (Figure 6-89) increases the contribution of WSHH to 64.2% followed by permitted sources at 12.7%, secondary particulate matter at 11.6%, mobile at 4.7%, residential sources at 3.4%, and agricultural sources at 3.0%. Examination of permitted sources (Figure 6-90) shows that Weldwood of Canada and Riverside (West) contribute 43% and 20% respectively.

3. OBSERVATIONS

As outlined by (Plain 2003) there are uncertainties associated with road dust emissions. Due to these uncertainties the source apportionment was done for two cases – with road dust and without road dust. When road dust was included it was often the dominant source with paved roads contributing more to the average annual concentration compared to unpaved road dust. The results of this source apportionment indicate that controlling road dust may have a significant impact on annual particulate matter concentrations. Paved road dust was the main contributor to the PM_{10} annual average concentration at 10 of the 15 receptor locations and for $PM_{2.5}$ at it was the main contributor at 4 of the 15 locations.

In addition to road dust, wood stove home heating was a large contributor to the annual particulate matter concentrations at most locations. WSHH was the main contributor (not including road dust) for 6 out of 15 locations for PM_{10} and 7 out of 15 locations for $PM_{2.5}$. Locations with high PM_{10} contributions from WSHH include Sugarcane Reserve Band Office (receptor 15), Elser Rd (receptor 9), Gibbon Rd (receptor 12), Cateline/Dog Creek (receptor 13), Qualeen School (receptor 14) and Pine Valley (receptor 1). Examination of Numbered receptors correspond to *Location Name/Descriptions* in Table 1-1

Figure 1-1 shows that these receptors are, for the most part, located out of the industrial and city centers in residential areas. Higher WSHH is expected in rural residential areas as more residents in these areas rely on wood stoves to heat their homes.

When considering all sources groups together, permitted sources are large contributors to the annual PM_{10} and $PM_{2.5}$ at many locations. Contributions range from 2.4% to 80.6% for PM_{10} and from 3.7% to 73.6% for $PM_{2.5}$ (Table 5-2 and Table 5-4) When road dust is not included, permitted sources have the largest contribution to PM_{10} at the 9 of 15 locations (8 out of 15 locations for $PM_{2.5}$). The 9 receptors for PM_{10} are Glendale/Edwards (receptor 4), Skyline (receptor 11), WL Golf (receptor 10), Commodore (receptor 2), 11th Avenue (receptor 5), CRD/Library (receptor 8), Comer Hill (receptor 3), Columneetza (receptor 6) and Fox Mountain (receptor 7).

When examining the permitted source group on its own, the top 5 contributors for PM_{10} are: Riverside (West), Weldwood of Canada, Riverside (East), Jackpine Forest Products, West Fraser Mills, and Riverside (Soda Creek) (in that order). The top 5 contributors for $PM_{2.5}$ are: Weldwood of Canada, Riverside (West), Riverside (East), West Fraser Mills, and Jackpine Forest Products (in that order). Apportionment of these sources revealed that Weldwood of Canada was the main contributor to the annual PM_{10} concentration for 9 out of 15 locations. For $PM_{2.5}$ Weldwood of Canada was the largest contributor at 12 out of 15 locations. The influence of Weldwood of Canada was seen throughout the Williams Lake airshed. Riverside (West) and Riverside (East) also contributed significantly at many receptor locations. For PM_{10} Riverside (West) was the largest contributor at 3 out of 15 locations. For $PM_{2.5}$ Riverside (West) was the largest contributor for 3 out of 15 locations.

Considering all source groups together residential source contributions range from 0.3% to 5.0% for PM_{10} and 0.0% to 10.8% for $PM_{2.5}$. Exclusion of road dust raises these contributions to a low of 0% and a high of 27.8% for PM_{10} and to a low of 0% and a high of 22.1% for $PM_{2.5}$.

Commercial sources were fairly low for all locations except Skyline and the CRD/Library receptors. Mobile contributions were highest at the Pine Valley and Fox Mountain locations (PM_{10} contribution of 26.2% and 18.7% respectively and a $PM_{2.5}$ contribution of 21.4% and 16.8% respectively). Secondary particulate matter was applied to $PM_{2.5}$ contributions only and resulted in a range of 3.9% to 20.7% contribution. The largest contribution from secondary particulate matter occurred at the Commodore Crescent location. Agricultural contributions were low throughout the airshed with a maximum contribution of 5.5 and 3.0% at Sugarcane Reserve Band Office for PM_{10} and $PM_{2.5}$ respectively.

4. REFERENCES

Levelton Consultants. 2004. CALMET Modelling for the Williams Lake Airshed. Ministry of Environment, Cariboo Region. Williams Lake, BC.

Levelton Consultants. 2005. CALPUFF Modelling for the Williams Lake Airshed. Ministry of Environment, Cariboo Region. Williams Lake, BC.

MOE, Plain, E. 2003 (revised February, 2004). Fine Particulate Source Apportionment for the Quesnel Airshed Using Results from a CALPUFF Modelling Exercise. Ministry of Environment, Cariboo Region. Williams Lake, BC.

5. TABLES

Table 5-1 Combined Source Contributions to the PM_{10} Annual Average Concentration at Each Receptor ($\mu g/m^3$)

Location Name	Receptor #	X (km)	Y (km)	Permitted	Residential	WSHH	LCB	Commercial	Agricultural	Mobile	Paved Road Dust	Unpaved Road Dust	Total
Pine Valley	1	562.5	5781	0.32	0.07	0.60	0.08	0.00	0.05	0.40	5.85	0.15	7.54
Commodore Cresent	2	559	5780	1.12	0.00	0.12	0.03	0.01	0.00	0.08	1.43	0.05	2.84
Comer Hill	3	554	5780	3.90	0.11	1.74	0.01	0.02	0.00	0.02	0.44	0.22	6.45
Glendale Edwards Dr	4	556.5	5778	14.42	0.01	0.62	0.01	0.07	0.00	0.07	1.76	0.94	17.90
11th Avenue	5	558	5778.75	4.63	0.00	0.92	0.01	0.04	0.00	0.15	3.80	0.13	9.68
Columneetza	6	558.25	5777.75	4.64	0.48	3.79	0.01	0.05	0.00	0.66	16.46	0.11	26.20
Fox Mtn Garnet Rd.	7	561	5777.75	0.89	0.62	0.27	0.02	0.01	0.02	0.42	10.28	0.08	12.61
CRD/Library	8	558.75	5776	3.65	0.05	1.13	0.01	0.32	0.00	0.15	4.00	0.24	9.54
Esler Road	9	556	5773.5	0.64	0.15	3.77	0.41	0.01	0.00	0.51	12.84	0.03	18.35
WL Golf and Country	10	558.25	5774.5	5.90	0.04	0.81	0.04	0.15	0.00	0.10	2.72	4.46	14.22
Skyline	11	559.5	5774.5	18.86	0.00	0.66	0.02	1.75	0.00	0.10	4.30	1.14	26.84
Gibbon Road	12	559	5772.5	0.65	1.10	5.73	0.62	0.02	0.00	0.79	18.90	0.04	27.85
Cateline Dr. @ Dog Creek Rd	13	560.5	5772	0.63	0.05	1.29	0.07	0.02	0.00	0.09	2.05	0.04	4.23
Qualeen	14	562.5	5773.5	1.66	0.26	3.71	0.01	0.04	0.01	0.73	18.60	0.10	25.13
Sugarcane	15	569	5773.5	0.32	0.08	1.52	0.00	0.01	0.12	0.12	2.69	0.73	5.59

Table 5-2 Combined Source Contributions to the PM_{10} Annual Average Concentration at Each Receptor (% of Total)

Location Name	Receptor #	X (km)	Y (km)	Permitted	Residential	WSHH	LCB	Commercial	Agricultural	Mobile	Paved Road Dust	Unpaved Road Dust	Total
Pine Valley	1	562.5	5781	4.3%	1.0%	8.0%	1.1%	0.0%	0.7%	5.3%	77.6%	2.0%	100.0%
Commodore Cresent	2	559	5780	39.4%	0.0%	4.3%	0.9%	0.4%	0.2%	2.7%	50.3%	1.9%	100.0%
Comer Hill	3	554	5780	60.5%	1.7%	27.0%	0.1%	0.2%	0.0%	0.3%	6.9%	3.4%	100.0%
Glendale Edwards Dr	4	556.5	5778	80.6%	0.1%	3.5%	0.0%	0.4%	0.0%	0.4%	9.8%	5.2%	100.0%
11th Avenue	5	558	5778.75	47.9%	0.0%	9.5%	0.1%	0.4%	0.0%	1.6%	39.2%	1.3%	100.0%
Columneetza	6	558.25	5777.75	17.7%	1.8%	14.5%	0.0%	0.2%	0.0%	2.5%	62.8%	0.4%	100.0%
Fox Mtn Garnet Rd.	7	561	5777.75	7.0%	5.0%	2.1%	0.1%	0.1%	0.1%	3.3%	81.6%	0.6%	100.0%
CRD/Library	8	558.75	5776	38.2%	0.5%	11.9%	0.1%	3.3%	0.0%	1.6%	41.9%	2.5%	100.0%
Esler Road	9	556	5773.5	3.5%	0.8%	20.6%	2.2%	0.1%	0.0%	2.8%	70.0%	0.1%	100.0%
WL Golf and Country	10	558.25	5774.5	41.5%	0.3%	5.7%	0.3%	1.1%	0.0%	0.7%	19.1%	31.4%	100.0%
Skyline	11	559.5	5774.5	70.3%	0.0%	2.5%	0.1%	6.5%	0.0%	0.4%	16.0%	4.3%	100.0%
Gibbon Road	12	559	5772.5	2.4%	4.0%	20.6%	2.2%	0.1%	0.0%	2.8%	67.9%	0.1%	100.0%
Cateline Dr. @ Dog Creek Rd	13	560.5	5772	14.8%	1.3%	30.5%	1.6%	0.4%	0.1%	2.0%	48.5%	0.9%	100.0%
Qualeen	14	562.5	5773.5	6.6%	1.0%	14.8%	0.0%	0.2%	0.0%	2.9%	74.0%	0.4%	100.0%
Sugarcane	15	569	5773.5	5.8%	1.4%	27.2%	0.0%	0.1%	2.1%	2.1%	48.1%	13.1%	100.0%

Table 5-3 Combined Source Contributions to the $PM_{2.5}$ Annual Average Concentration at Each Receptor ($\mu g/m^3$)

Location Name	Receptor #	X (km)	Y (km)	Permitted	Residential	WSHH	LCB	Commercial	Agricultural	Mobile	Secondary	Paved Road Dust	Unpaved Road Dust	Total
Pine Valley	1	562.5	5781	0.29	0.11	0.90	0.11	0.00	0.06	0.47	0.27	2.26	0.07	4.55
Commodore Cresent	2	559	5780	0.90	0.00	0.20	0.03	0.01	0.01	0.08	0.32	0.49	0.03	2.05
Comer Hill	3	554	5780	2.90	0.08	1.90	0.01	0.02	0.00	0.03	0.74	0.22	0.09	5.99
Glendale Edwards Dr	4	556.5	5778	8.29	0.00	0.88	0.01	0.06	0.00	0.07	0.83	0.65	0.46	11.26
11th Avenue	5	558	5778.75	3.33	0.00	1.30	0.01	0.04	0.01	0.16	0.59	1.32	0.08	6.83
Columneetza	6	558.25	5777.75	3.65	0.25	4.51	0.01	0.04	0.01	0.62	0.66	5.03	0.06	14.85
Fox Mtn Garnet Rd.	7	561	5777.75	0.74	0.62	0.46	0.02	0.01	0.03	0.47	0.44	3.76	0.05	6.61
CRD/Library	8	558.75	5776	2.84	0.02	1.46	0.02	0.28	0.01	0.14	0.65	1.27	0.10	6.78
Esler Road	9	556	5773.5	0.51	0.00	4.13	0.40	0.01	0.00	0.42	0.34	3.49	0.02	9.32
WL Golf and Country	10	558.25	5774.5	3.76	0.03	1.13	0.06	0.09	0.00	0.11	0.51	0.94	1.25	7.88
Skyline	11	559.5	5774.5	10.02	0.00	0.96	0.03	0.27	0.01	0.11	0.60	1.42	0.38	13.79
Gibbon Road	12	559	5772.5	0.52	1.03	6.12	0.59	0.01	0.00	0.63	0.36	4.98	0.02	14.27
Cateline Dr. @ Dog Creek Rd	13	560.5	5772	0.52	0.03	1.66	0.07	0.01	0.00	0.08	0.27	0.64	0.03	3.31
Qualeen	14	562.5	5773.5	1.36	0.24	4.04	0.02	0.03	0.01	0.64	0.49	5.40	0.06	12.30
Sugarcane	15	569	5773.5	0.37	0.10	1.86	0.01	0.01	0.09	0.14	0.33	1.02	0.32	4.23

Table 5-4 Combined Source Contributions to the $PM_{2.5}$ Annual Average Concentration at Each Receptor (% of Total)

Location Name	Receptor #	X (km)	Y (km)	Permitted	Residential	WSHH	LCB	Commercial	Agricultural	Mobile	Secondary	Paved Road Dust	Unpaved Road Dust	Total
Pine Valley	1	562.5	5781	6.4%	2.3%	19.9%	2.3%	0.1%	1.4%	10.4%	5.9%	49.7%	1.6%	100.0%
Commodore Cresent	2	559	5780	43.9%	0.0%	9.6%	1.3%	0.5%	0.3%	3.7%	15.4%	23.7%	1.6%	100.0%
Comer Hill	3	554	5780	48.5%	1.3%	31.7%	0.2%	0.3%	0.0%	0.4%	12.4%	3.7%	1.6%	100.0%
Glendale Edwards Dr	4	556.5	5778	73.6%	0.0%	7.8%	0.1%	0.6%	0.0%	0.7%	7.4%	5.8%	4.1%	100.0%
11th Avenue	5	558	5778.75	48.7%	0.0%	19.0%	0.1%	0.5%	0.1%	2.4%	8.7%	19.3%	1.1%	100.0%
Columneetza	6	558.25	5777.75	24.6%	1.7%	30.4%	0.1%	0.3%	0.0%	4.2%	4.4%	33.9%	0.4%	100.0%
Fox Mtn Garnet Rd.	7	561	5777.75	11.2%	9.4%	7.0%	0.3%	0.2%	0.5%	7.1%	6.6%	56.9%	0.7%	100.0%
CRD/Library	8	558.75	5776	41.8%	0.4%	21.5%	0.2%	4.1%	0.1%	2.1%	9.6%	18.7%	1.5%	100.0%
Esler Road	9	556	5773.5	5.5%	0.0%	44.4%	4.3%	0.1%	0.0%	4.5%	3.6%	37.4%	0.2%	100.0%
WL Golf and Country	10	558.25	5774.5	47.7%	0.3%	14.4%	0.8%	1.1%	0.1%	1.4%	6.5%	11.9%	15.9%	100.0%
Skyline	11	559.5	5774.5	72.7%	0.0%	6.9%	0.2%	2.0%	0.0%	0.8%	4.4%	10.3%	2.7%	100.0%
Gibbon Road	12	559	5772.5	3.7%	7.2%	42.9%	4.1%	0.1%	0.0%	4.4%	2.6%	34.9%	0.2%	100.0%
Cateline Dr. @ Dog Creek Rd	13	560.5	5772	15.7%	1.0%	50.2%	2.1%	0.3%	0.1%	2.4%	8.0%	19.3%	0.8%	100.0%
Qualeen	14	562.5	5773.5	11.1%	2.0%	32.8%	0.2%	0.3%	0.1%	5.2%	4.0%	43.9%	0.5%	100.0%
Sugarcane	15	569	5773.5	8.7%	2.3%	44.0%	0.1%	0.1%	2.0%	3.2%	7.9%	24.1%	7.5%	100.0%

6. FIGURES

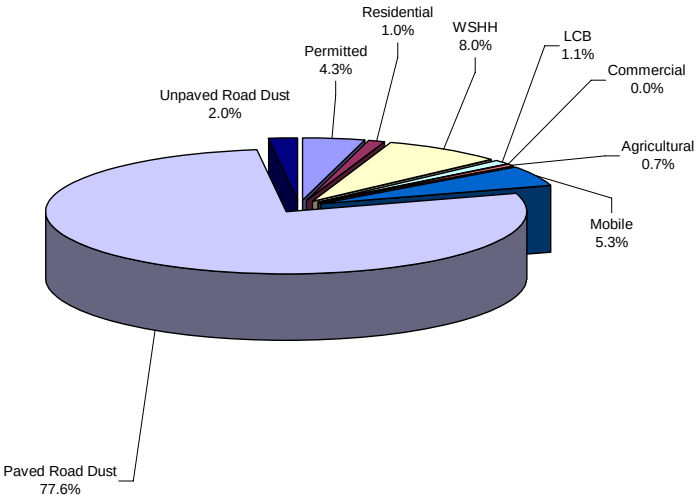


Figure 6-1 Pine Valley end of Dale Road: All Source Contributions for PM_{10}

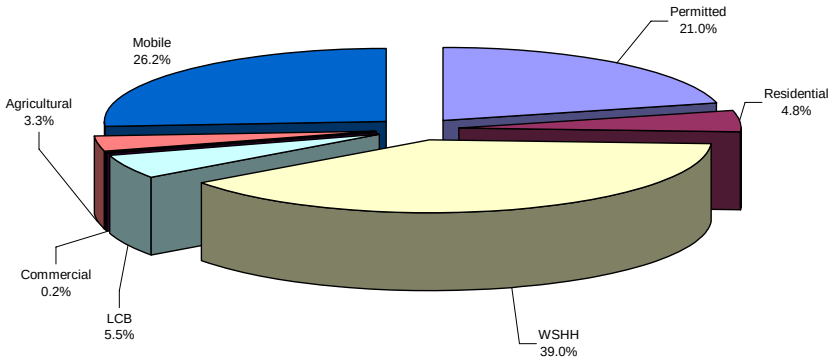


Figure 6-2 Pine Valley end of Dale Road: Source Contributions for PM_{10} (Excluding Road Dust)

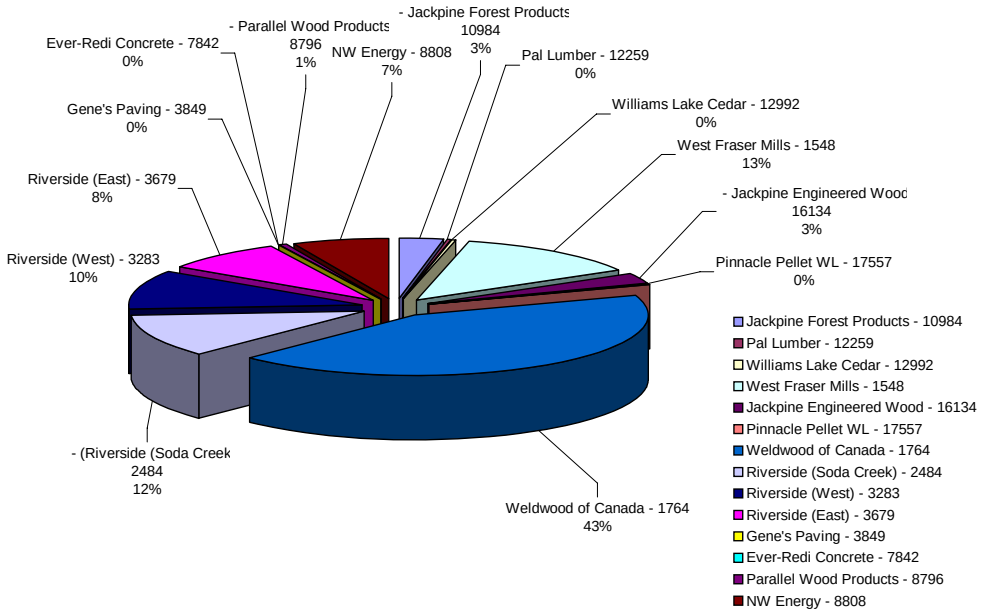


Figure 6-3 Pine Valley end of Dale Road: Permit Source Contributions for PM_{10}

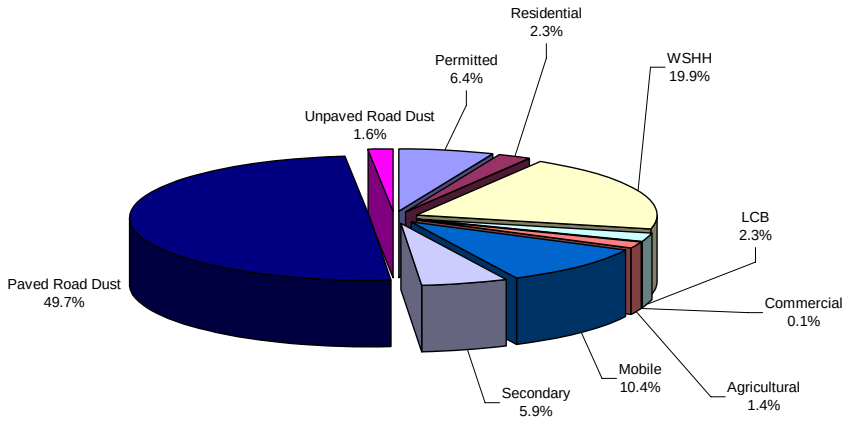


Figure 6-4 Pine Valley end of Dale Road: All Source Contributions for $PM_{2.5}$

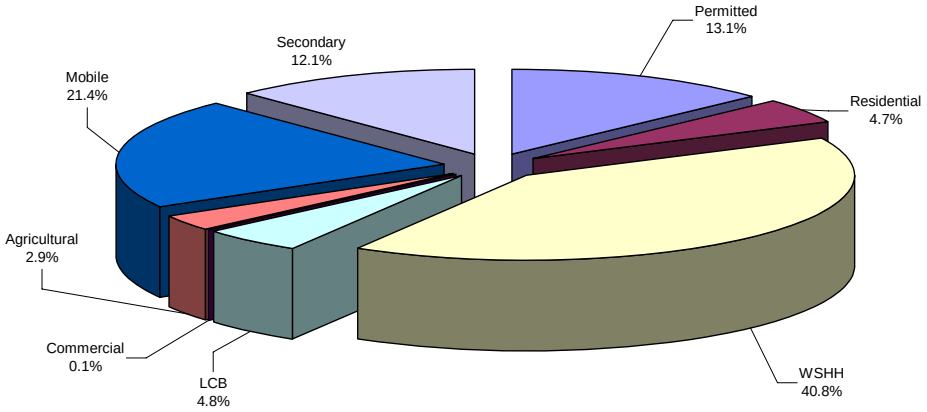


Figure 6-5 Pine Valley end of Dale Road: Source Contributions for $PM_{2.5}$ (Excluding Road Dust)

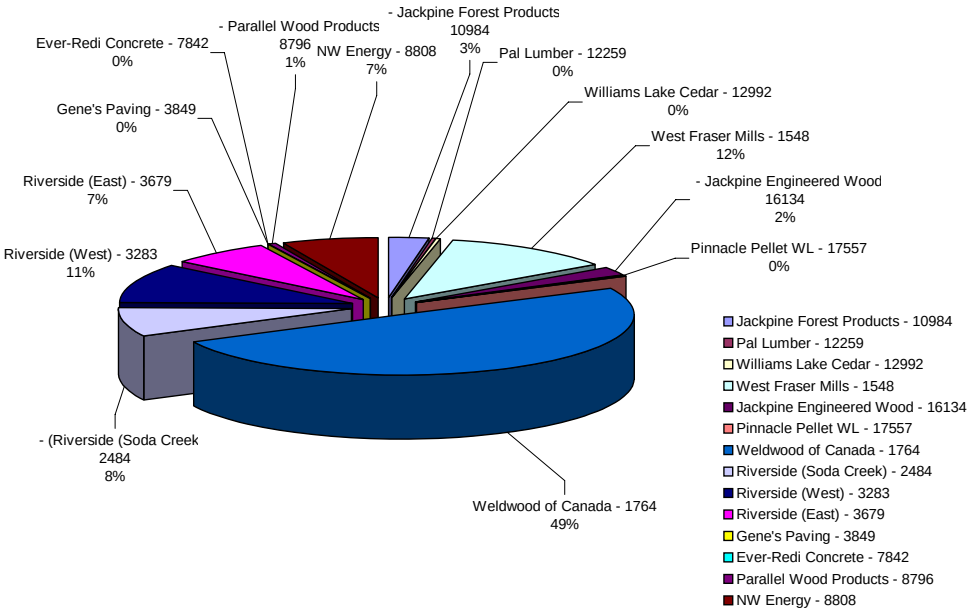


Figure 6-6 Pine Valley end of Dale Road: Permit Source Contributions for $PM_{2.5}$

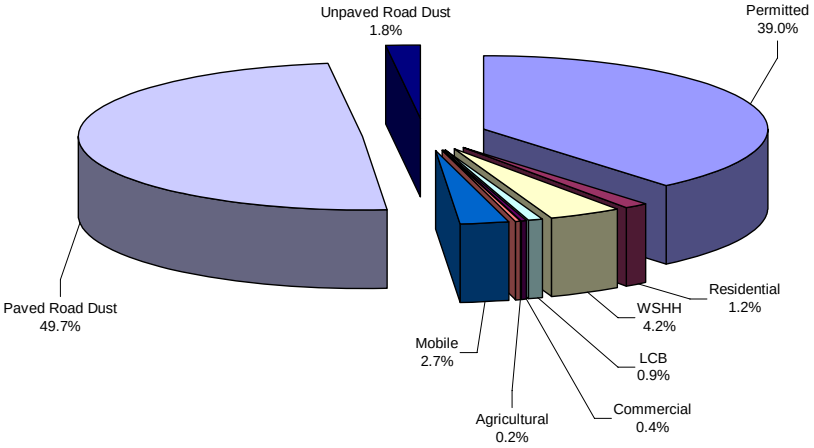


Figure 6-7 Commodore Crescent at Pamela Road: All Source Contributions for PM_{10}

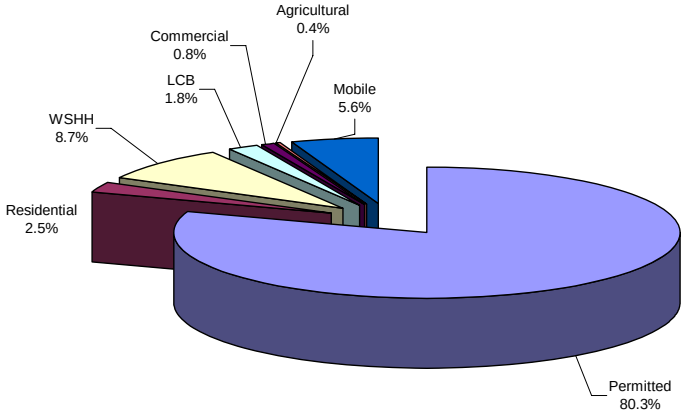


Figure 6-8 Commodore Crescent at Pamela Road: Source Contributions for PM_{10} (Excluding Road Dust)

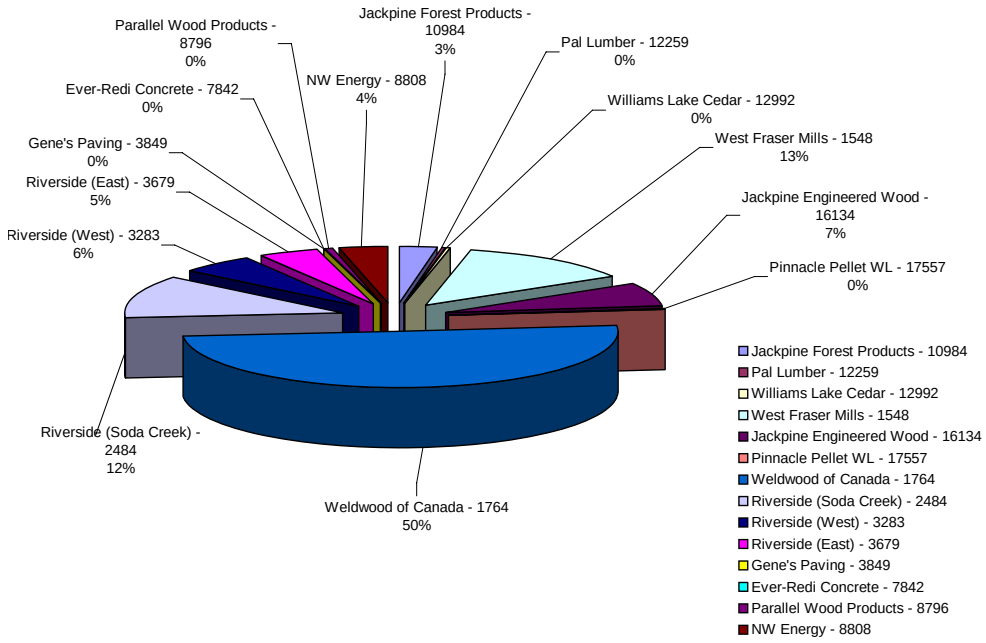


Figure 6-9 Commodore Crescent at Pamela Road: Permit Source Contributions for PM_{10}

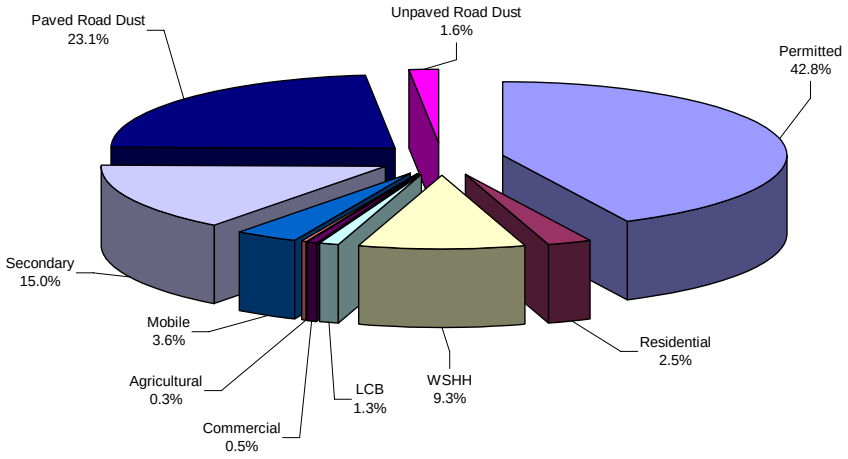


Figure 6-10 Commodore Crescent at Pamela Road: All Source Contributions for $PM_{2.5}$

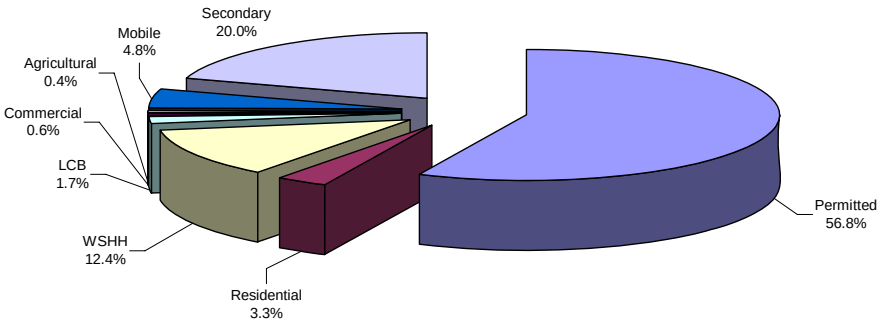


Figure 6-11 Commodore Crescent at Pamela Road: Source Contributions for $PM_{2.5}$ (Excluding Road Dust)

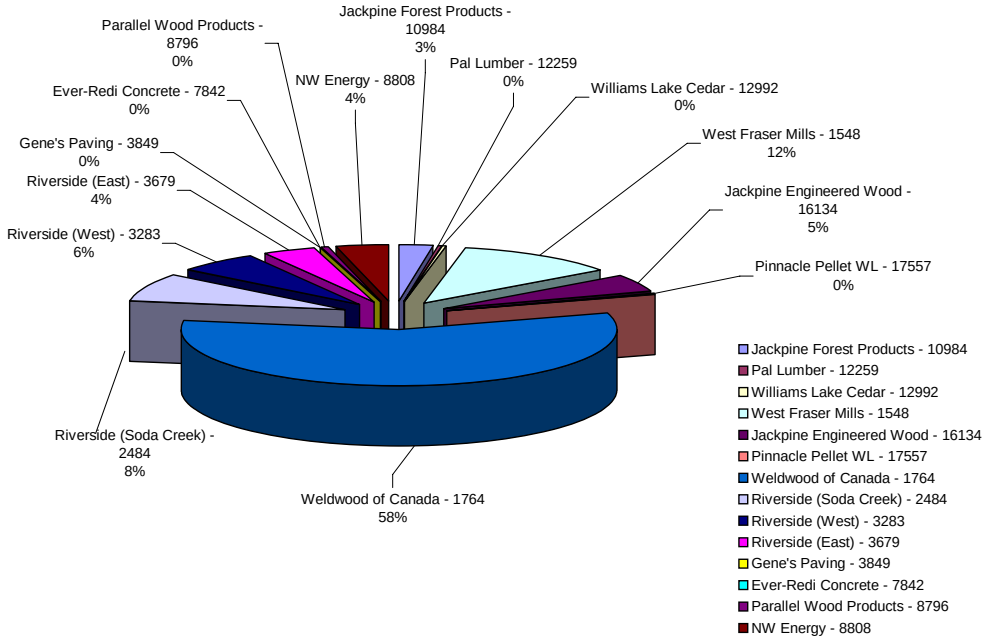


Figure 6-12 Commodore Crescent at Pamela Road: Permit Source Contributions for $PM_{2.5}$

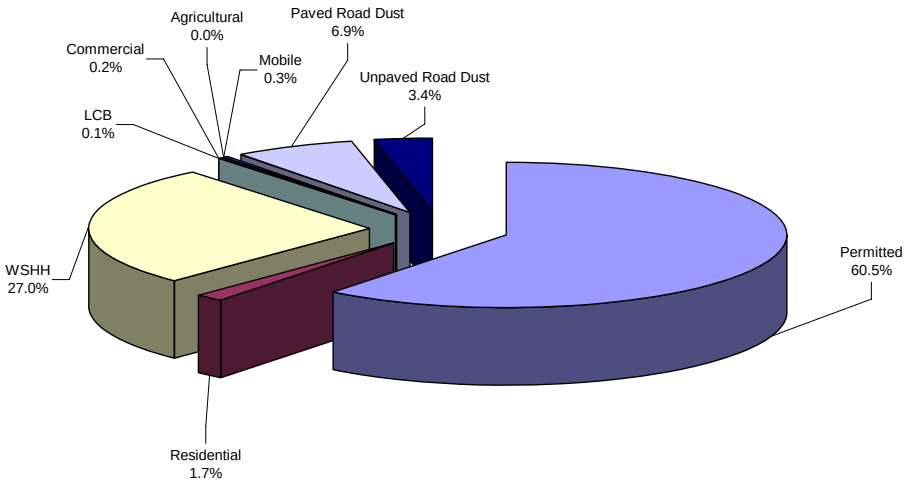


Figure 6-13 Comer Hill Trailer Park: All Source Contributions for PM_{10}

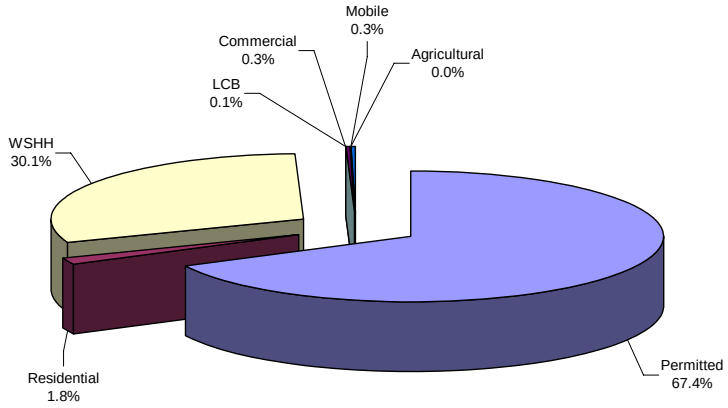


Figure 6-14 Comer Hill Trailer Park: Source Contributions for PM_{10} (Excluding Road Dust)

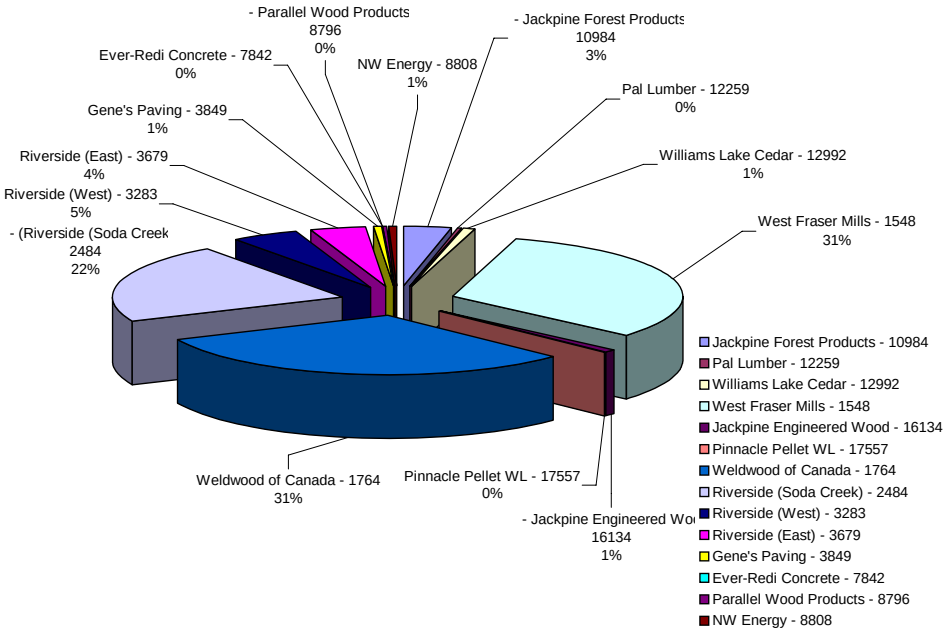


Figure 6-15 Comer Hill Trailer Park: Permit Source Contributions for PM_{10}

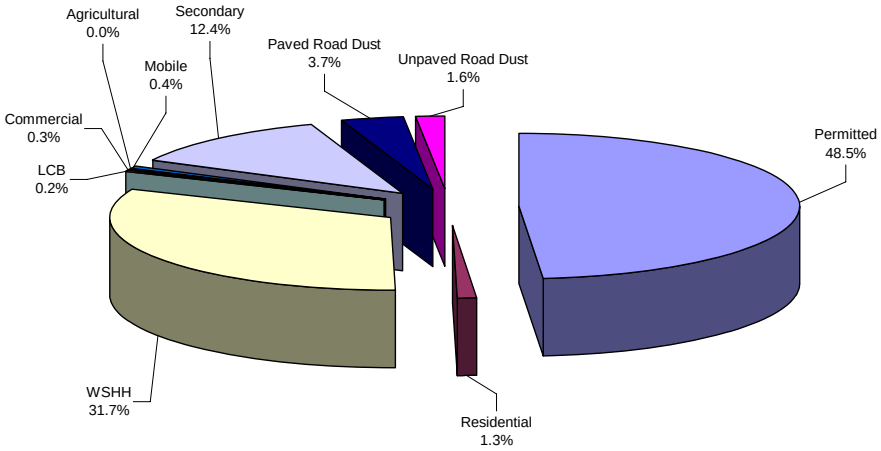


Figure 6-16 Comer Hill Trailer Park: All Source Contributions for $PM_{2.5}$

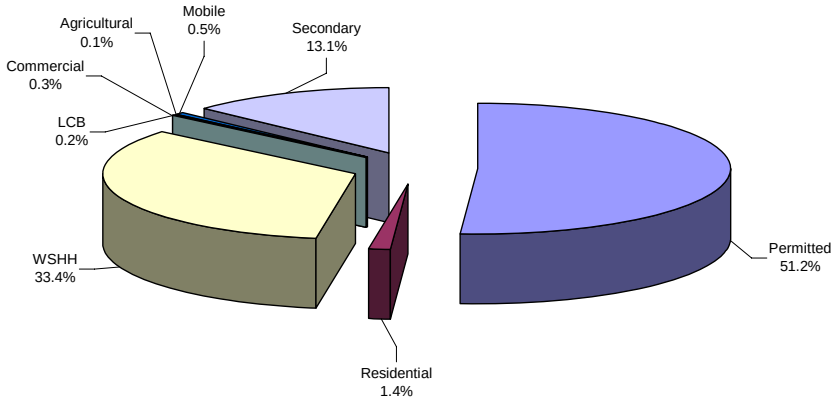


Figure 6-17 Comer Hill Trailer Park: Source Contributions for $PM_{2.5}$ (Excluding Road Dust)

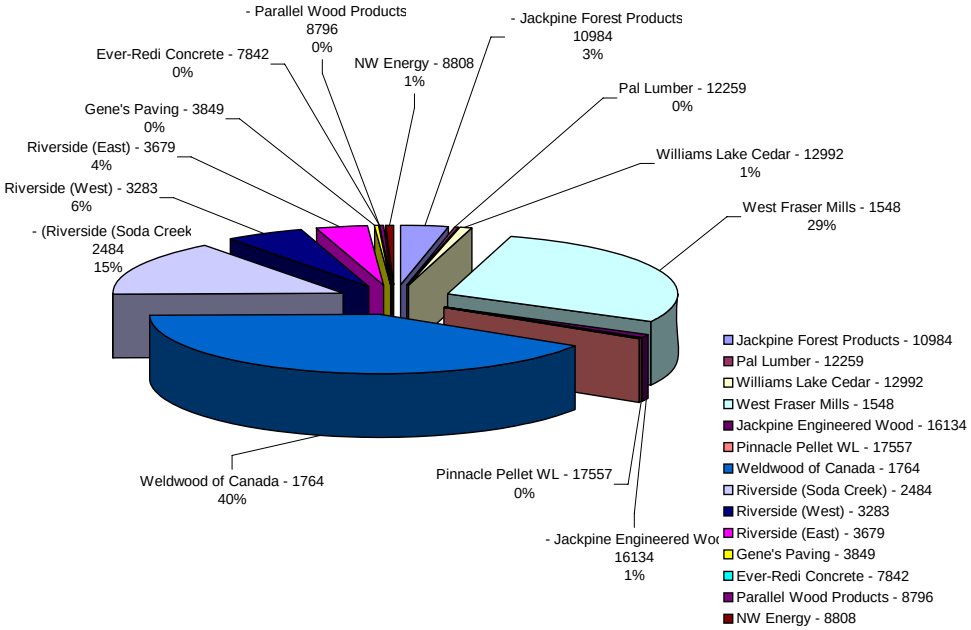


Figure 6-18 Comer Hill Trailer Park: Permit Source Contributions for $PM_{2.5}$

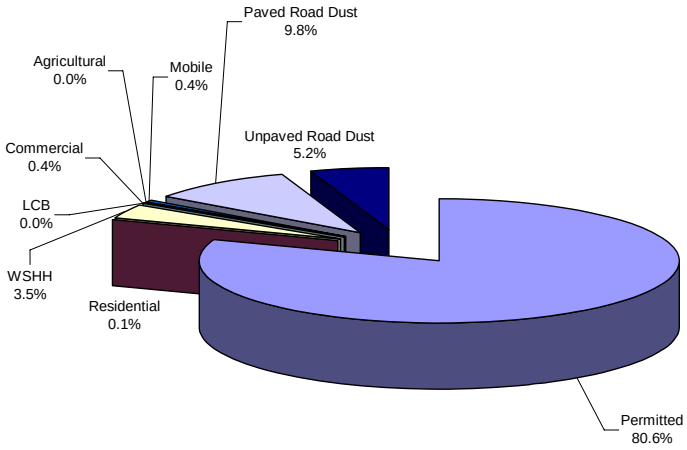


Figure 6-19 Glendale Edwards Dr: All Source Contributions for PM_{10}

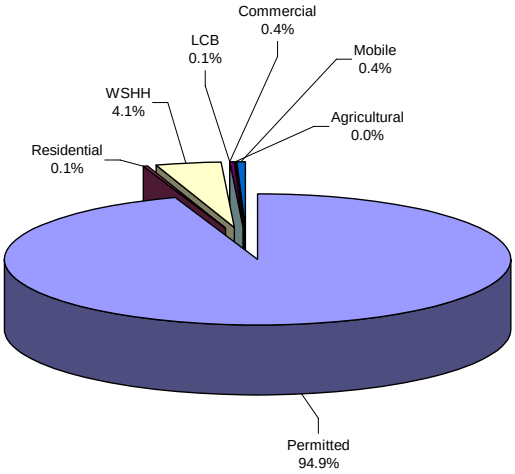


Figure 6-20 Glendale Edwards Dr: Source Contributions for PM_{10} (Excluding Road Dust)

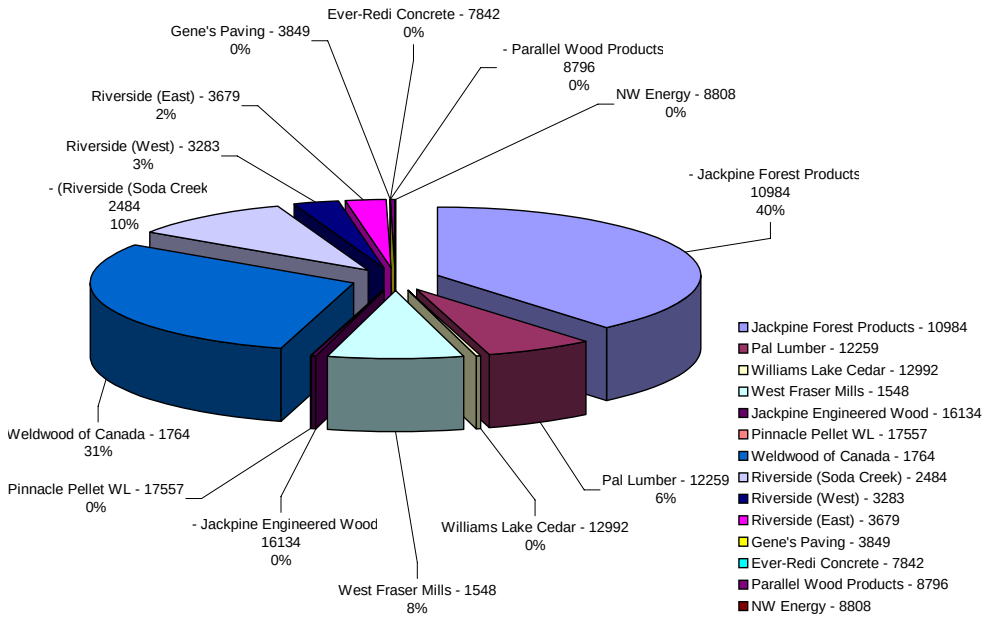


Figure 6-21 Glendale Edwards Dr: Permit Source Contributions for PM_{10}

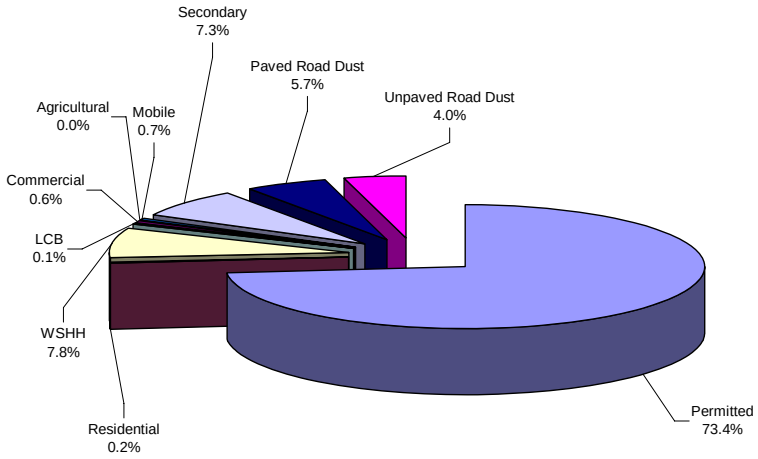


Figure 6-22 Glendale Edwards Dr: All Source Contributions for $PM_{2.5}$

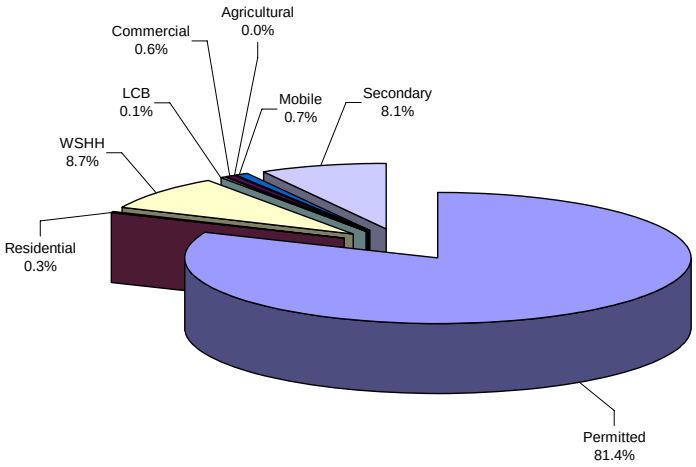


Figure 6-23 Glendale Edwards Dr: Source Contributions for $PM_{2.5}$ (Excluding Road Dust)

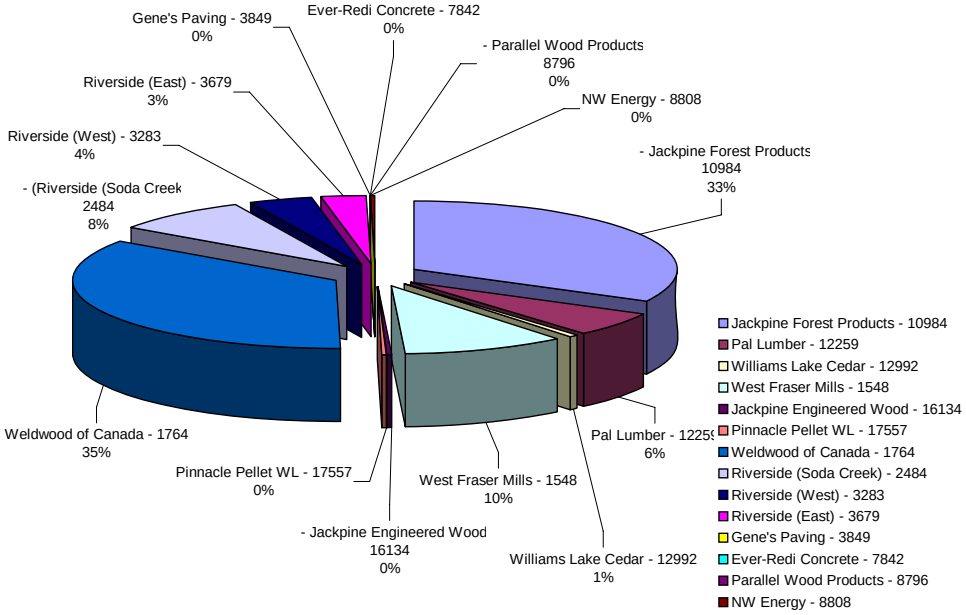


Figure 6-24 Glendale Edwards Dr: Permit Source Contributions for $PM_{2.5}$

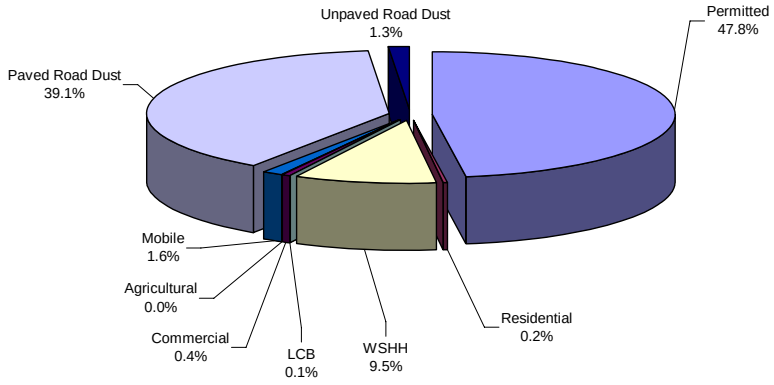


Figure 6-25 11th Avenue: All Source Contributions for PM_{10}

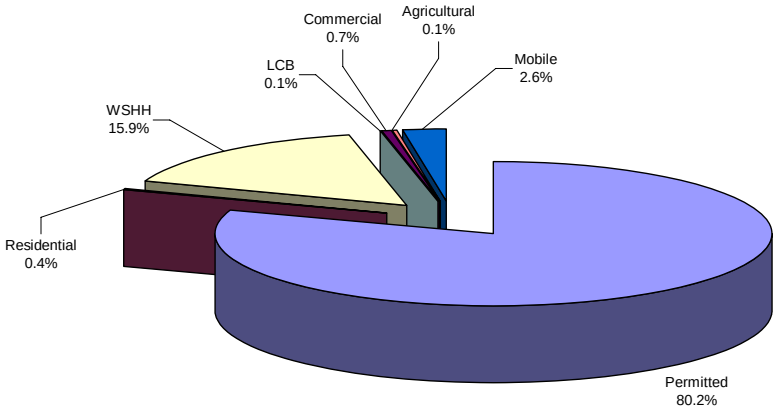


Figure 6-26 11th Avenue: Source Contributions for PM_{10} (Excluding Road Dust)

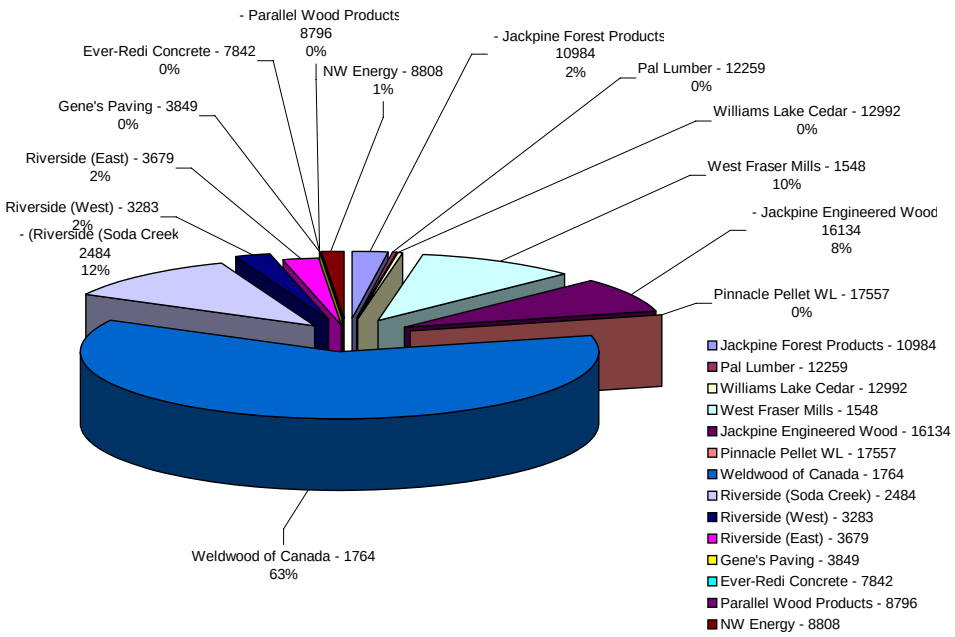


Figure 6-27 11th Avenue: Permit Source Contributions for PM_{10}

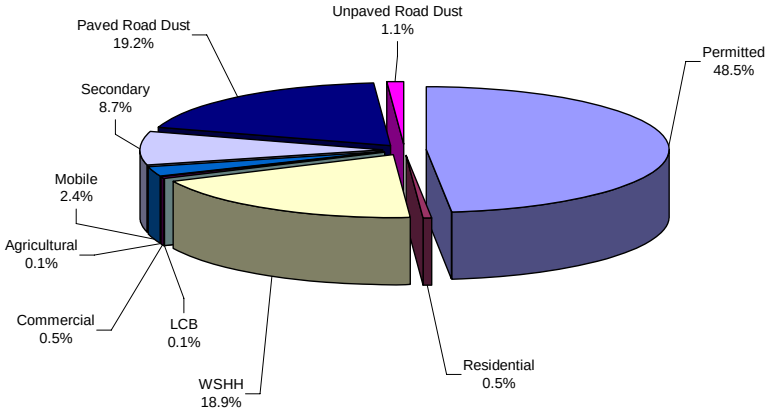


Figure 6-28 11th Avenue: All Source Contributions for $PM_{2.5}$

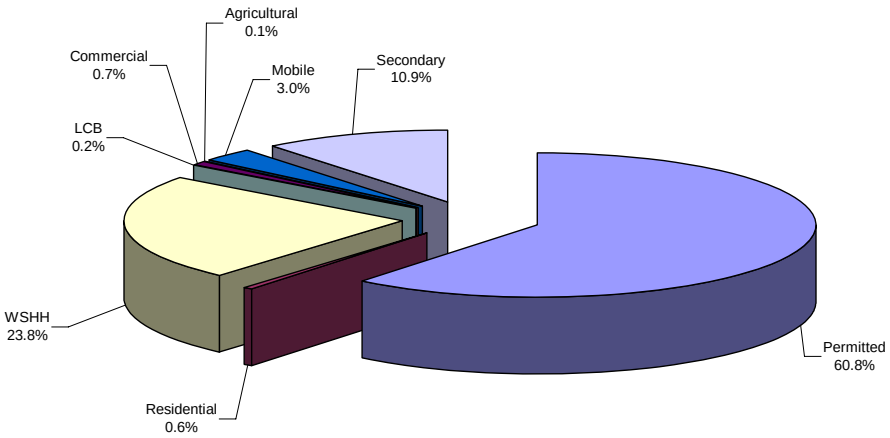


Figure 6-29 11th Avenue: Source Contributions for $PM_{2.5}$ (Excluding Road Dust)

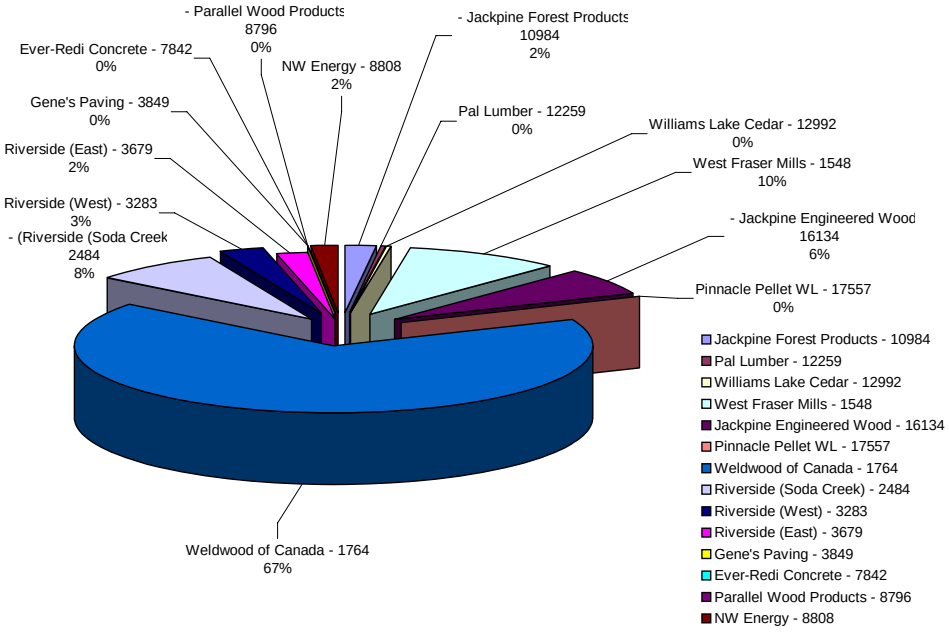


Figure 6-30 11th Avenue: Permit Source Contributions for $PM_{2.5}$

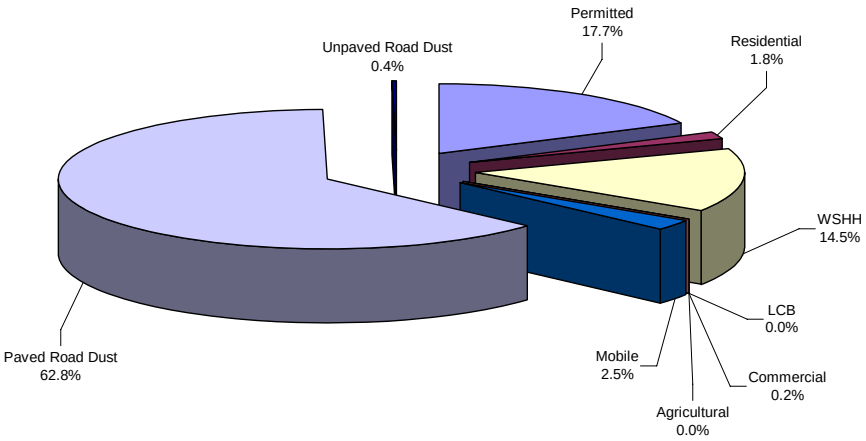


Figure 6-31 Columneetza Monitoring Site: All Source Contributions for PM_{10}

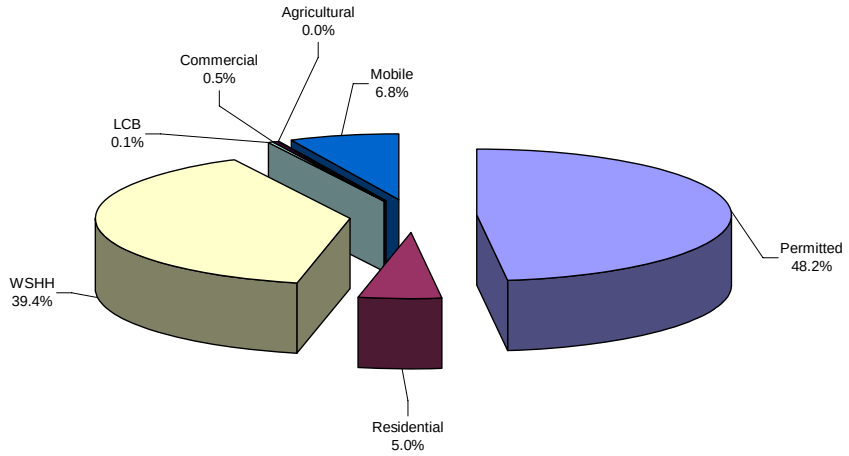


Figure 6-32 Columneetza Monitoring Site: Source Contributions for PM_{10} (Excluding Road Dust)

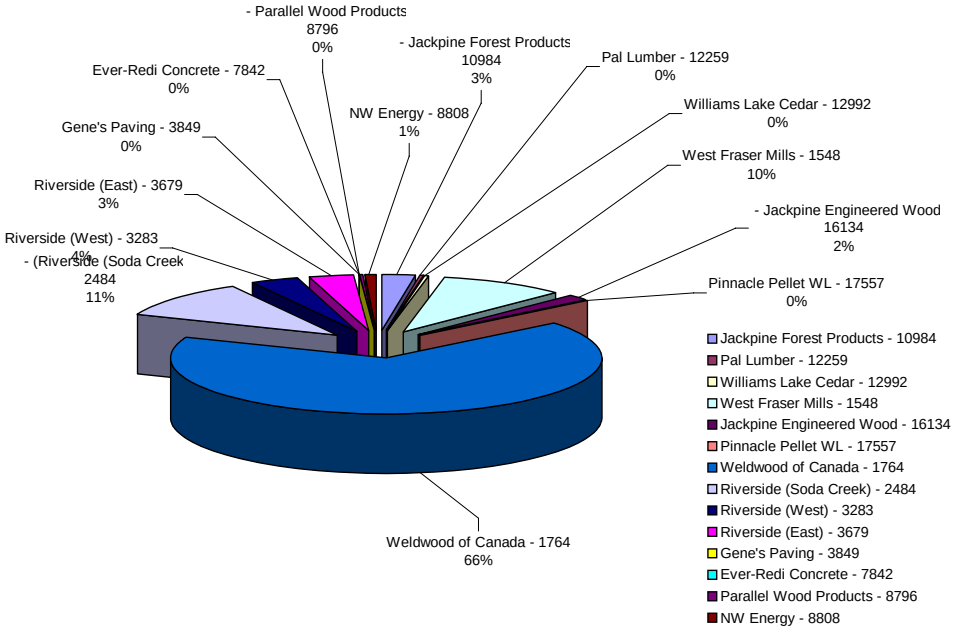


Figure 6-33 Columneetza Monitoring Site: Permit Source Contributions for PM_{10}

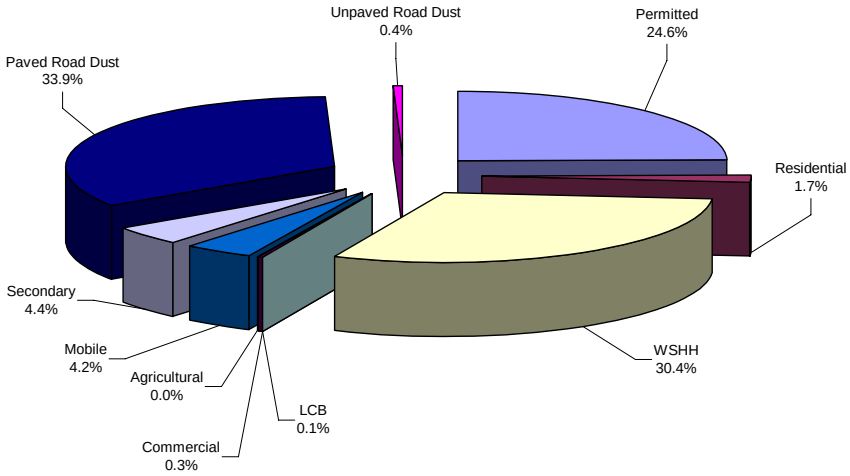


Figure 6-34 Columneetza Monitoring Site: All Source Contributions for $PM_{2.5}$

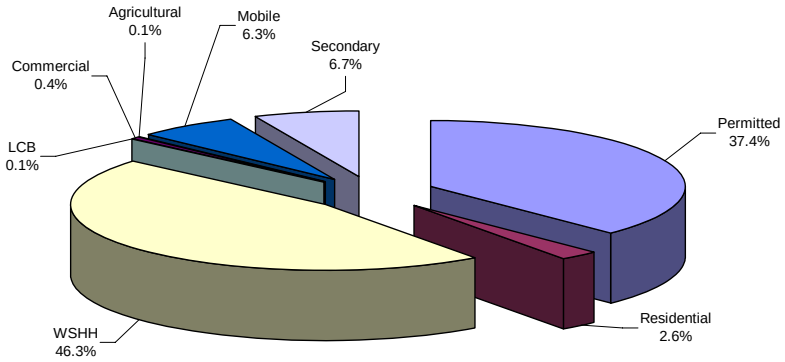


Figure 6-35 Columneetza Monitoring Site: Source Contributions for $PM_{2.5}$ (Excluding Road Dust)

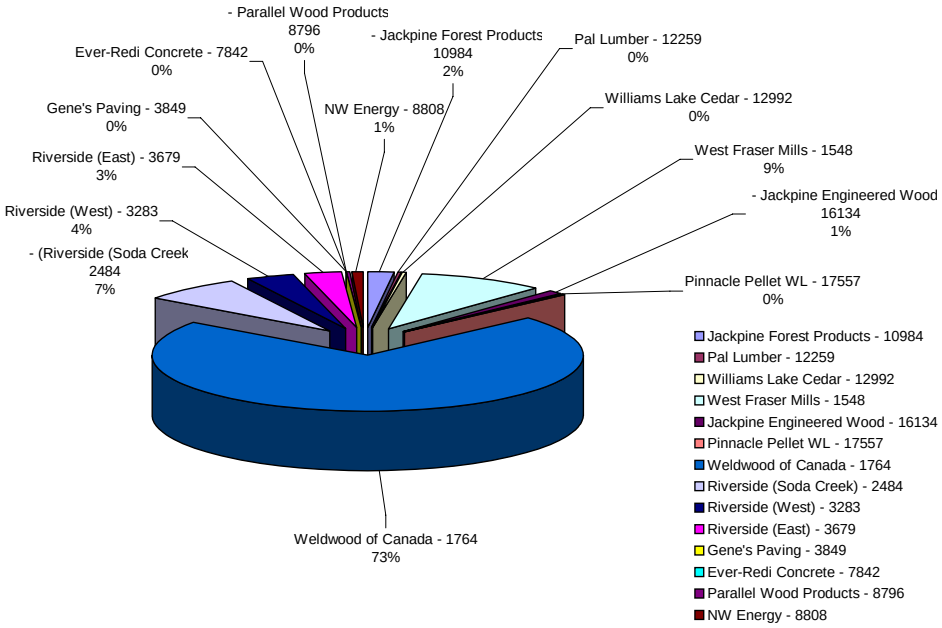


Figure 6-36 Columneetza Monitoring Site: Permit Source Contributions for $PM_{2.5}$

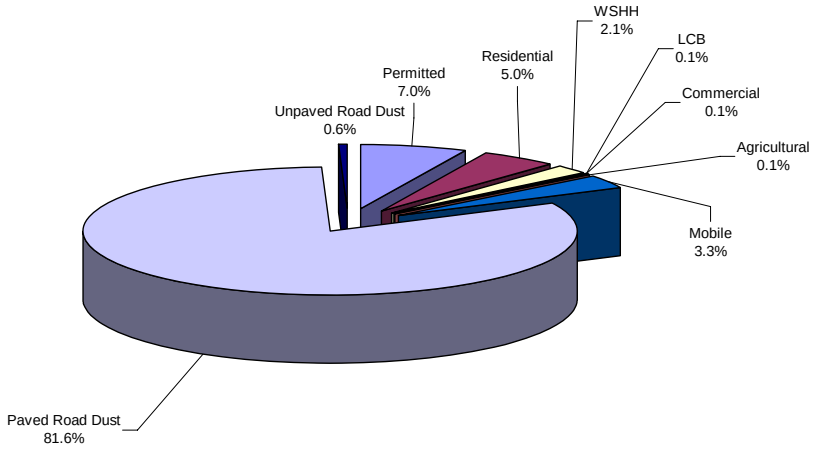


Figure 6-37 Fox Mountain Pheasant Road at Garnet Road: All Source Contributions for PM_{10}

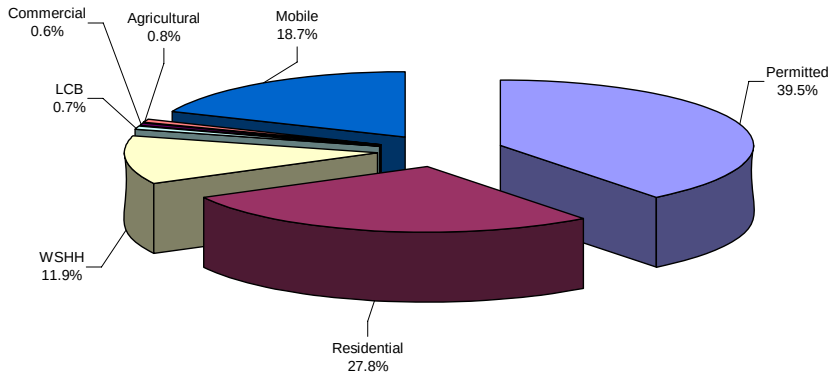


Figure 6-38 Fox Mountain Pheasant Road at Garnet Road: Source Contributions for PM_{10} (Excluding Road Dust)

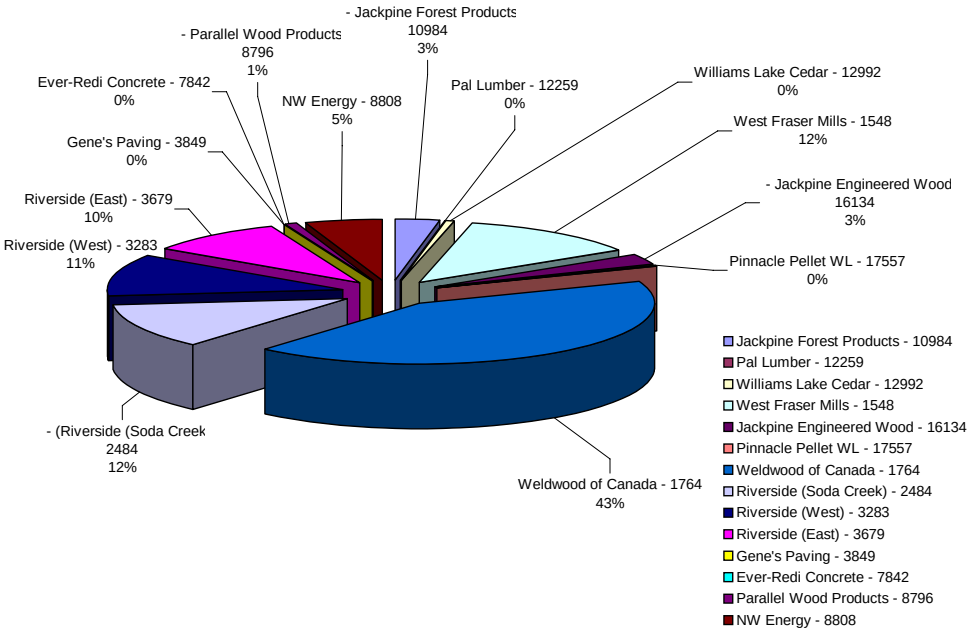


Figure 6-39 Fox Mountain Pheasant Road at Garnet Road: Permit Source Contributions for PM_{10}

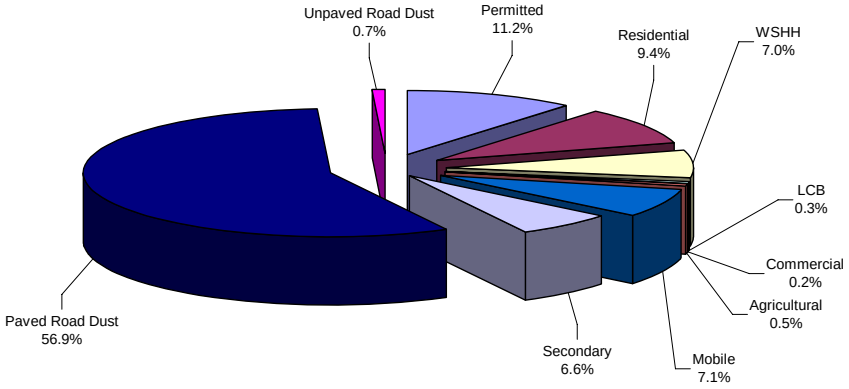


Figure 6-40 Fox Mountain Pheasant Road at Garnet Road: All Source Contributions for $PM_{2.5}$

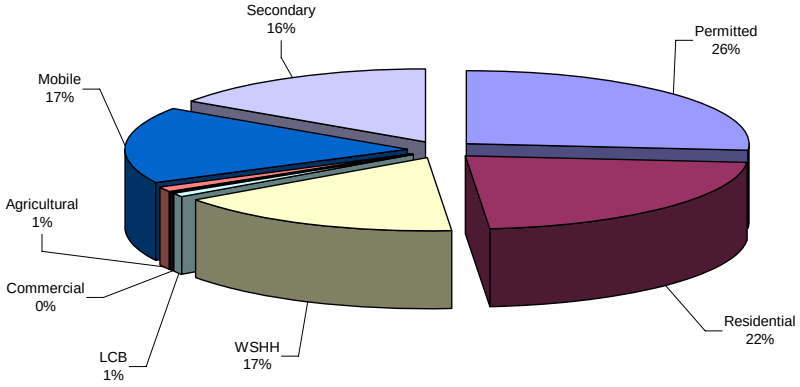


Figure 6-41 Fox Mountain Pheasant Road at Garnet Road: Source Contributions for $PM_{2.5}$ (Excluding Road Dust)

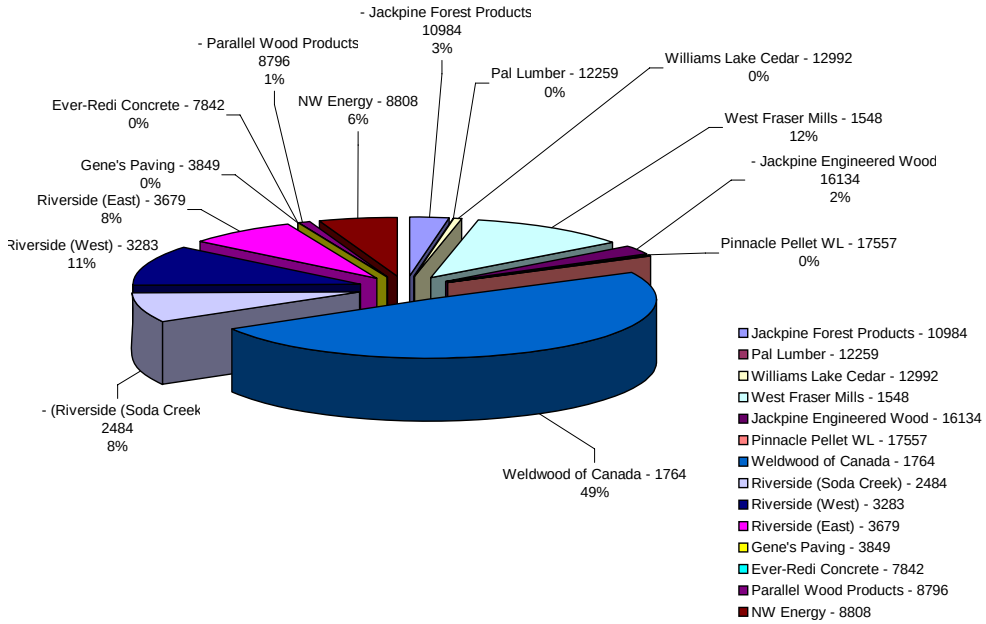


Figure 6-42 Fox Mountain Pheasant Road at Garnet Road: Permit Source Contributions for $PM_{2.5}$

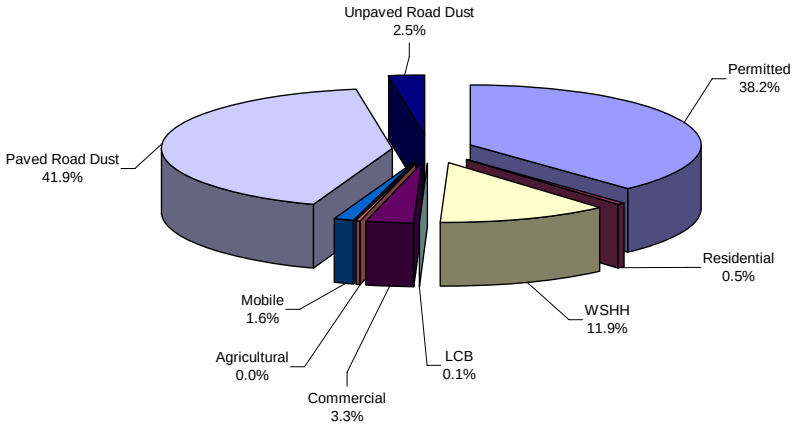


Figure 6-43 CRD/Library Monitoring Site: All Source Contributions for PM_{10}

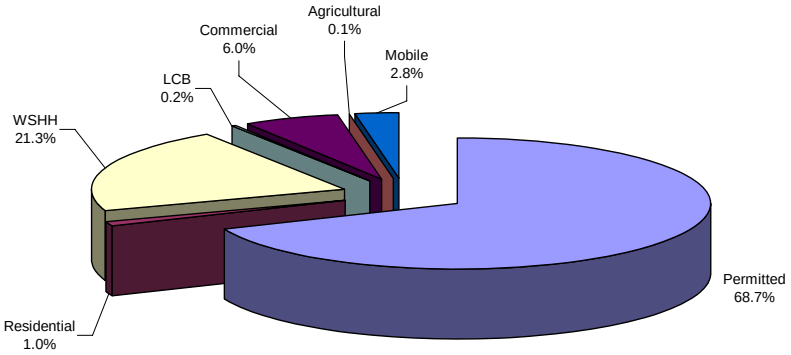


Figure 6-44 CRD/Library Monitoring Site: Source Contributions for PM_{10} (Excluding Road Dust)

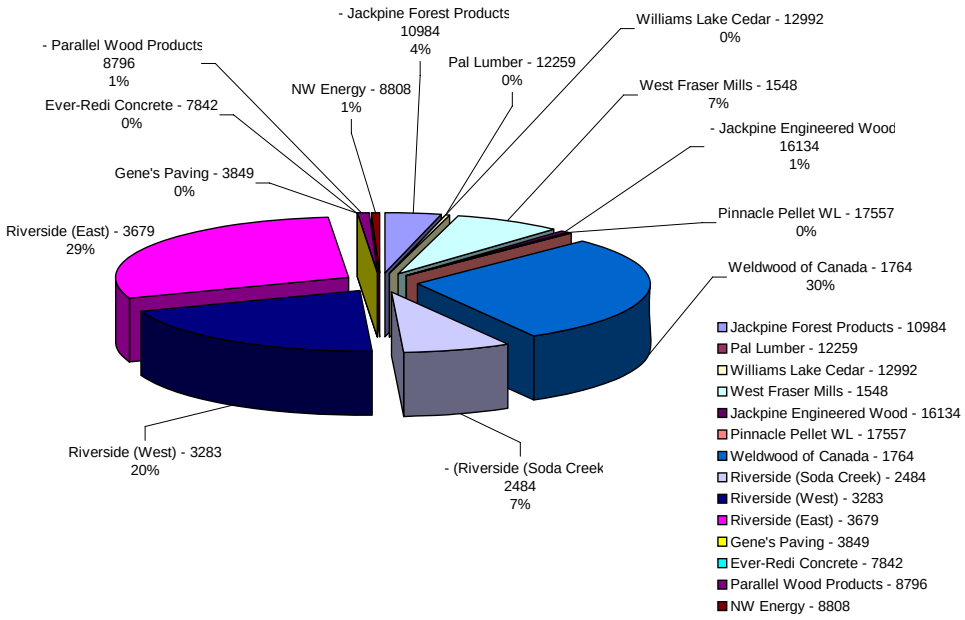


Figure 6-45 CRD/Library Monitoring Site: Permit Source Contributions for PM_{10}

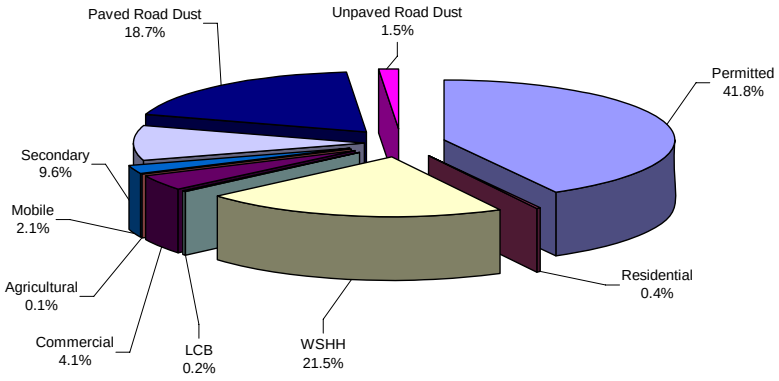


Figure 6-46 CRD/Library Monitoring Site: All Source Contributions for $PM_{2.5}$

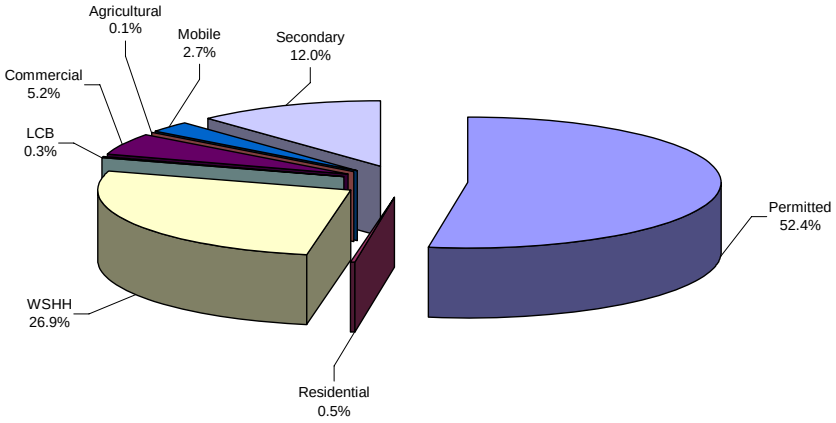


Figure 6-47 CRD/Library Monitoring Site: Source Contributions for $PM_{2.5}$ (Excluding Road Dust)

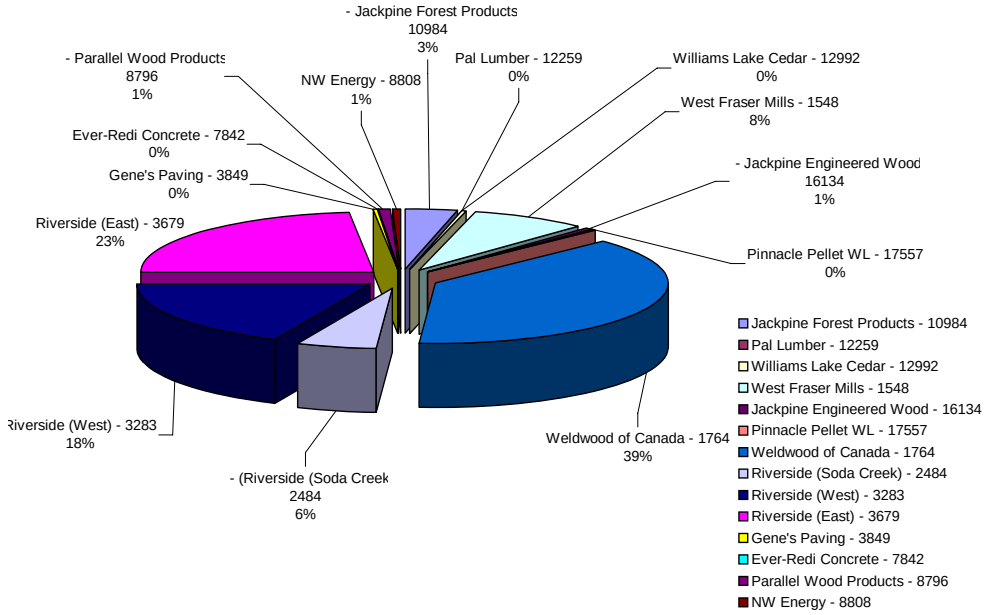


Figure 6-48 CRD/Library Monitoring Site: Permit Source Contributions for $PM_{2.5}$

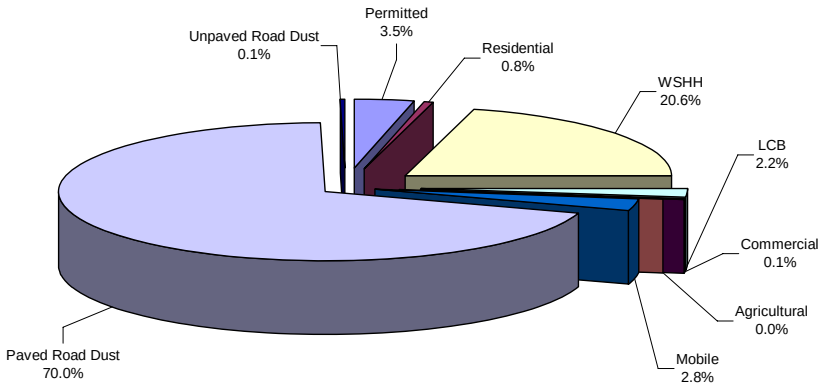


Figure 6-49 Esler Road at Kalyn Road: All Source Contributions for PM_{10}

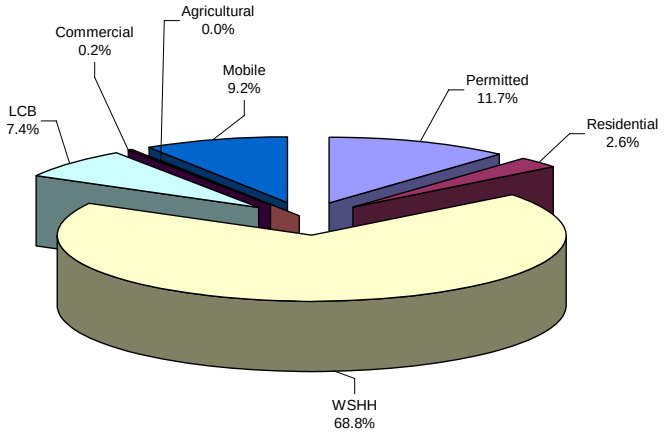


Figure 6-50 Esler Road at Kalyn Road: Source Contributions for PM_{10} (Excluding Road Dust)

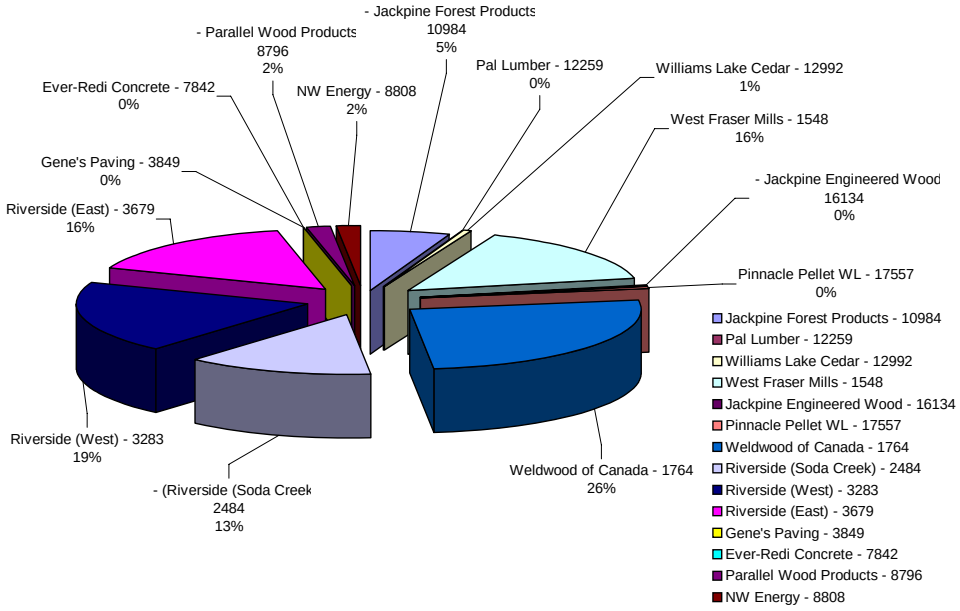


Figure 6-51 Esler Road at Kalyn Road: Permit Source Contributions for PM_{10}

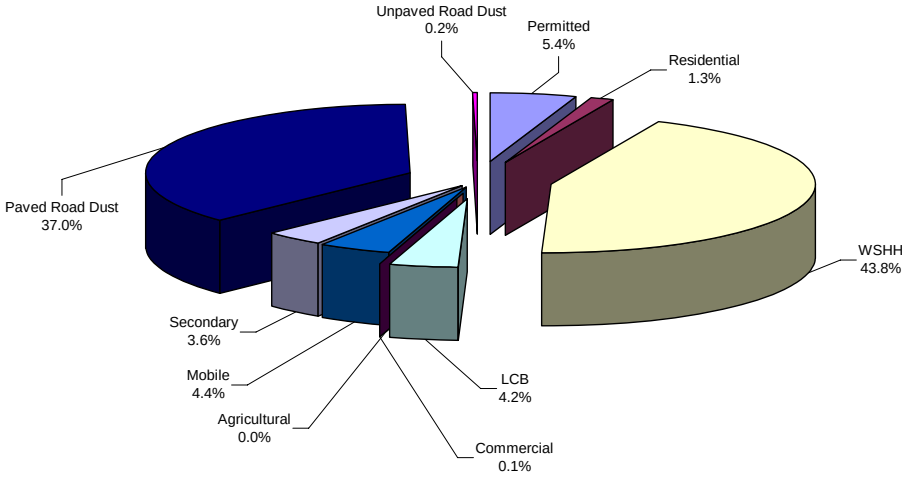


Figure 6-52 Esler Road at Kalyn Road: All Source Contributions for $PM_{2.5}$

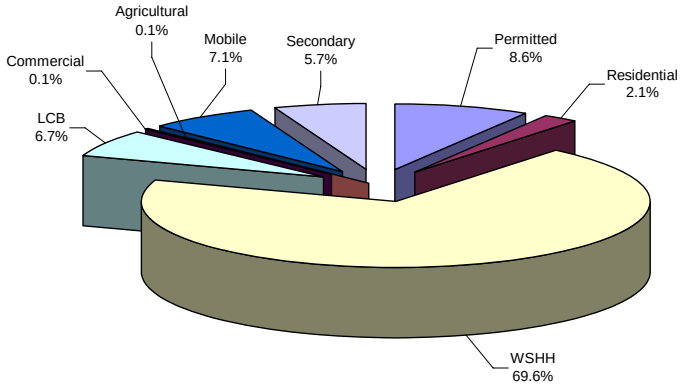


Figure 6-53 Esler Road at Kalyn Road: Source Contributions for $PM_{2.5}$ (Excluding Road Dust)

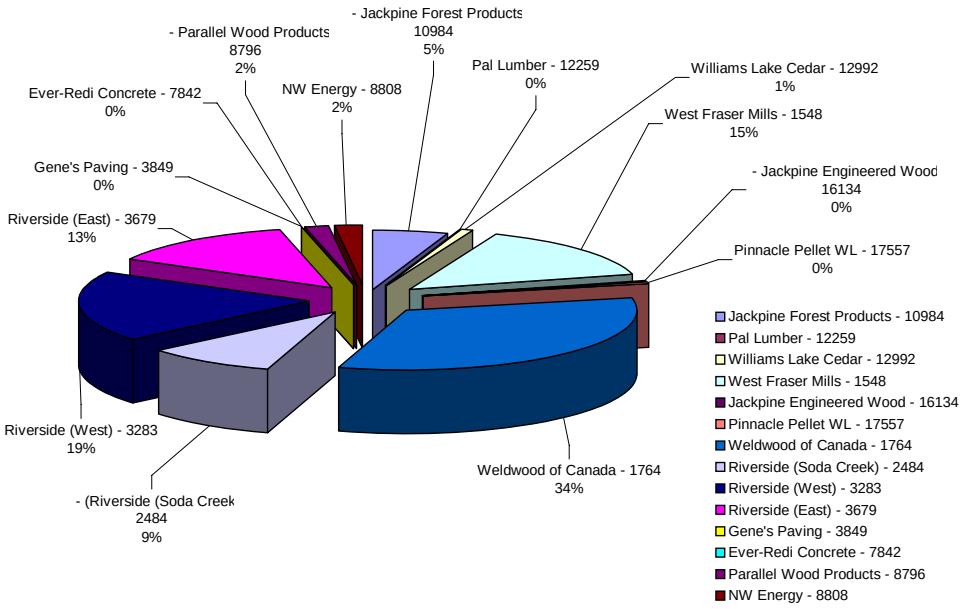


Figure 6-54 Esler Road at Kalyn Road: Permit Source Contributions for $PM_{2.5}$

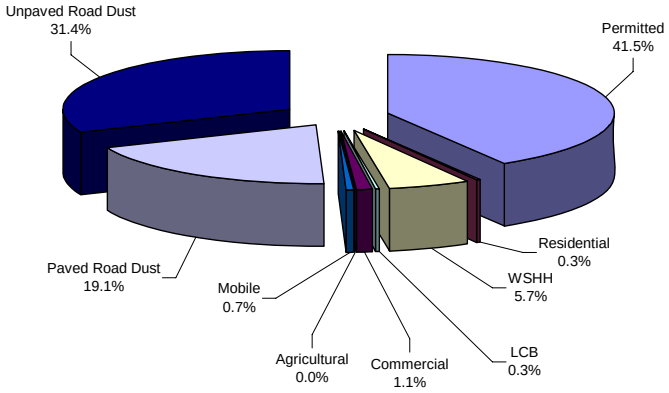


Figure 6-55 WL Golf and Country Club: All Source Contributions for PM_{10}

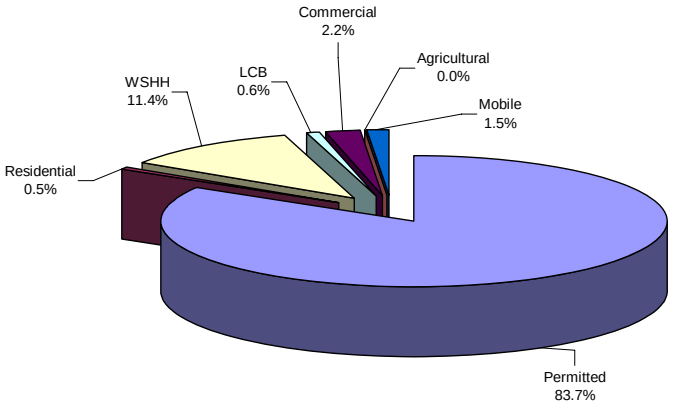


Figure 6-56 WL Golf and Country Club: Source Contributions for PM_{10} (Excluding Road Dust)

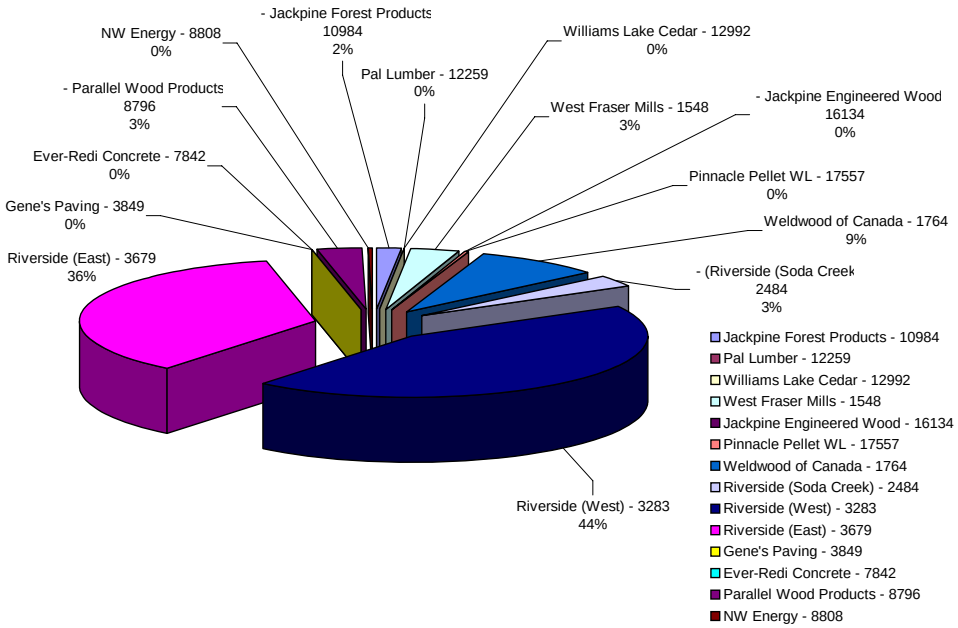


Figure 6-57 WL Golf and Country Club: Permit Source Contributions for PM_{10}

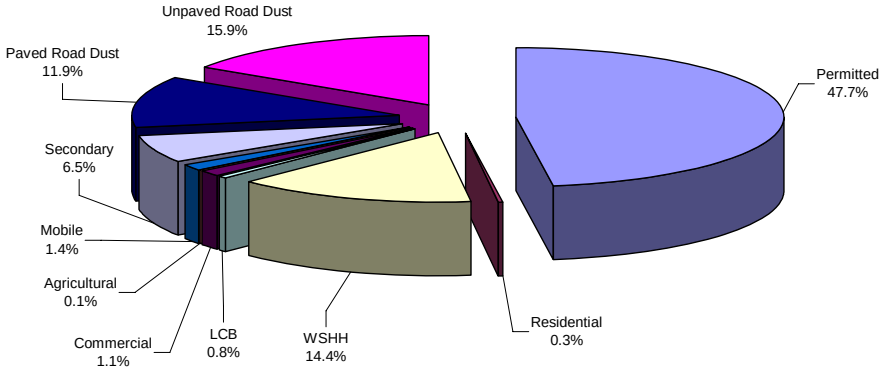


Figure 6-58 WL Golf and Country Club: All Source Contributions for $PM_{2.5}$

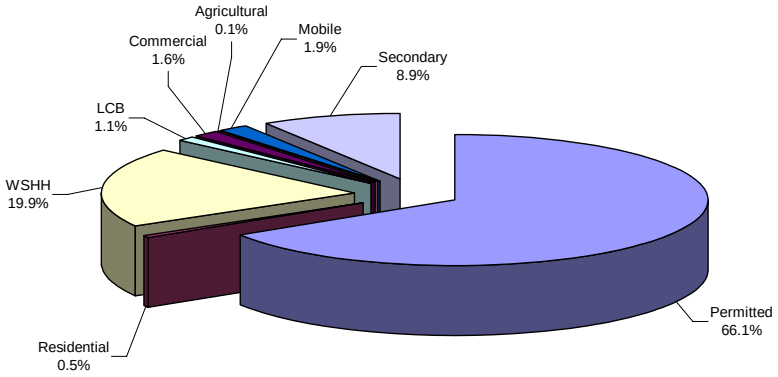


Figure 6-59 WL Golf and Country Club: Source Contributions for $PM_{2.5}$ (Excluding Road Dust)

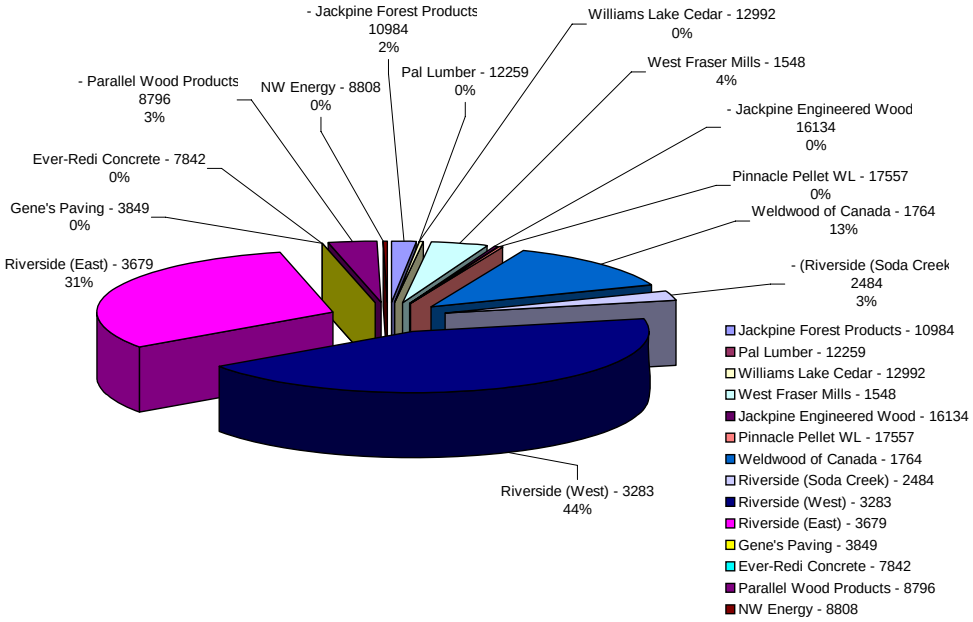


Figure 6-60 WL Golf and Country Club: Permit Source Contributions for $PM_{2.5}$

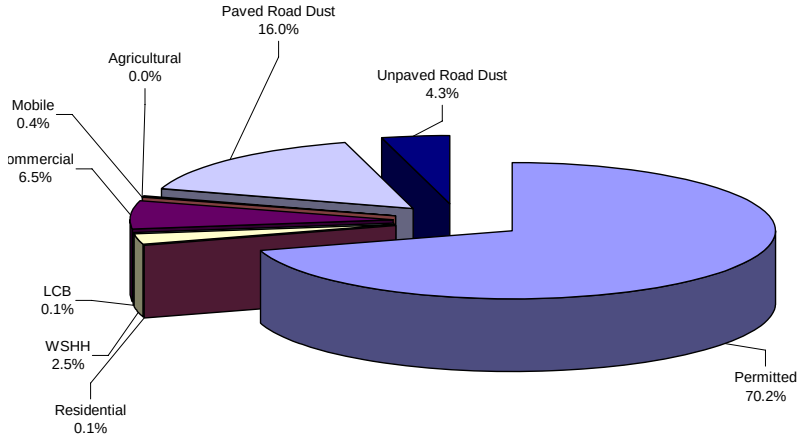


Figure 6-61 Skyline Monitoring Site: All Source Contributions for PM_{10}

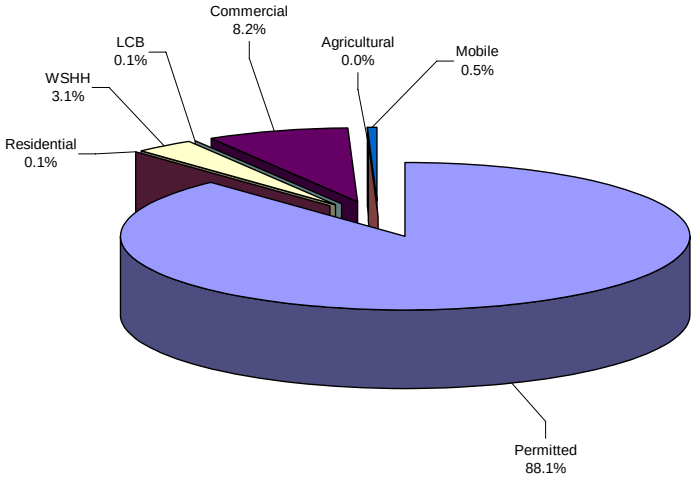


Figure 6-62 Skyline Monitoring Site: Source Contributions for PM_{10} (Excluding Road Dust)

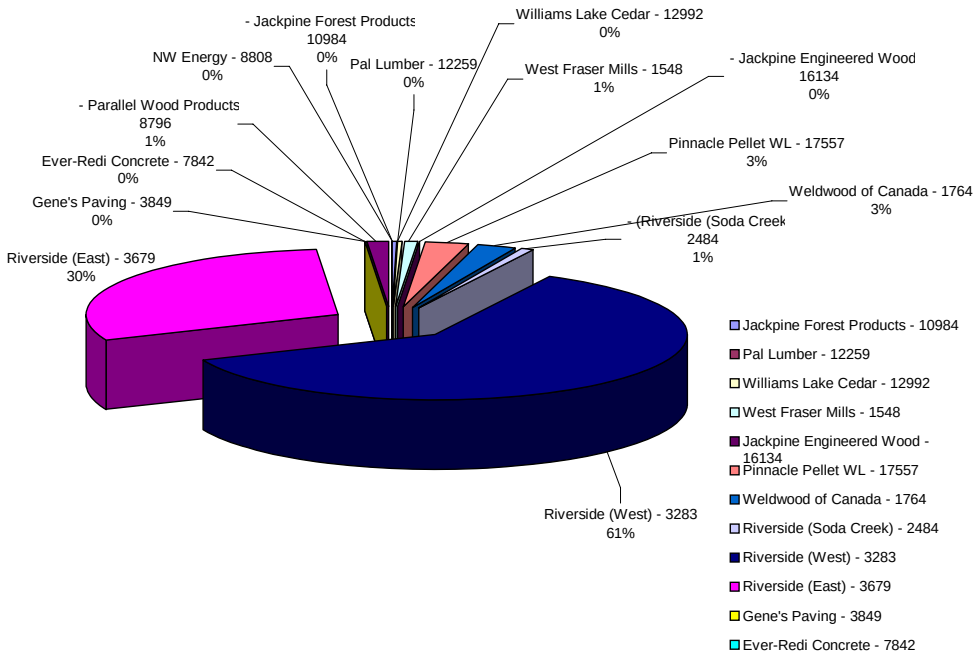


Figure 6-63 Skyline Monitoring Site: Permit Source Contributions for PM_{10}

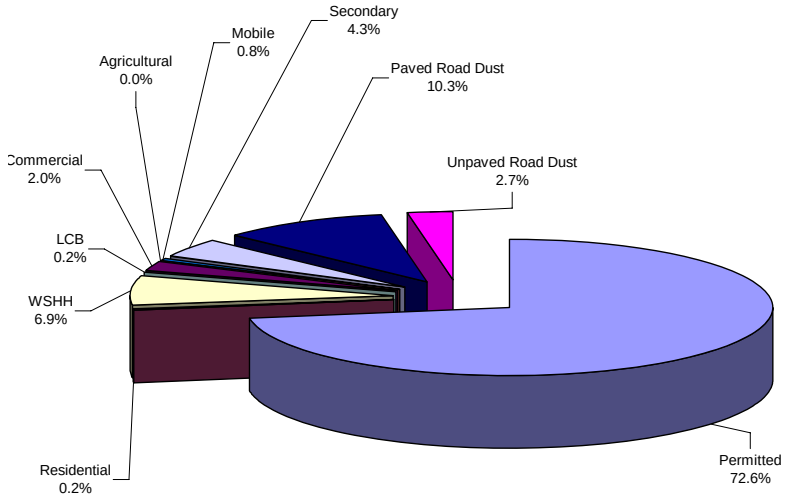


Figure 6-64 Skyline Monitoring Site: All Source Contributions for $PM_{2.5}$

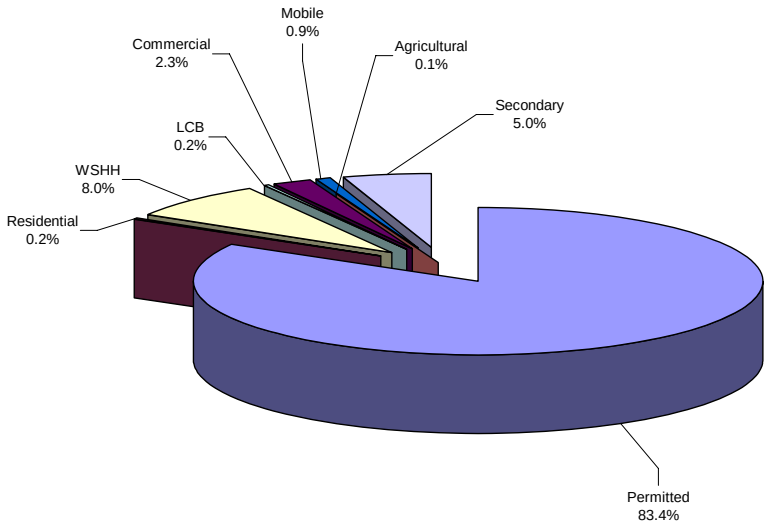


Figure 6-65 Skyline Monitoring Site: Source Contributions for $PM_{2.5}$ (Excluding Road Dust)

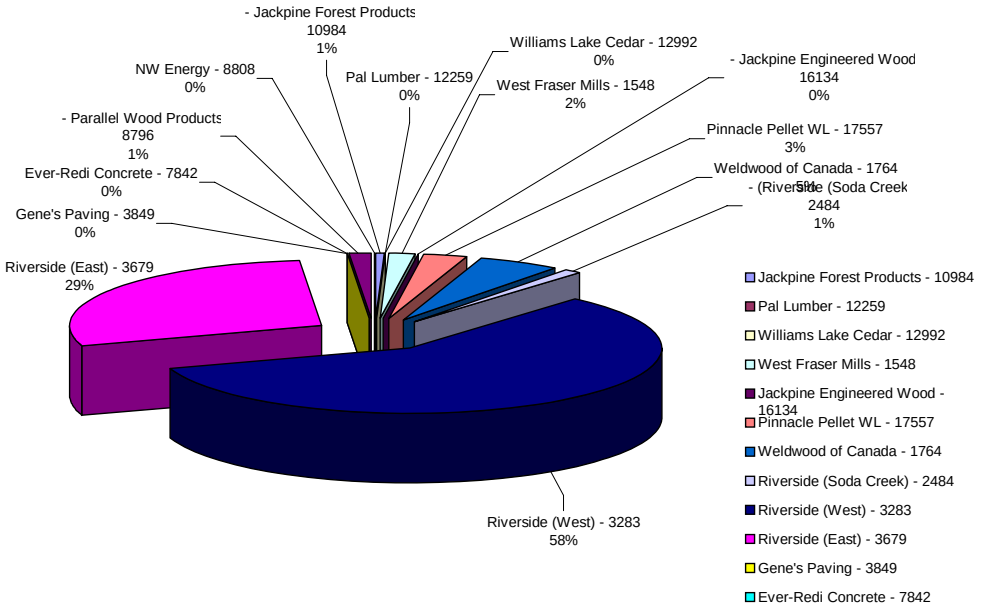


Figure 6-66 Skyline Monitoring Site: Permit Source Contributions for $PM_{2.5}$

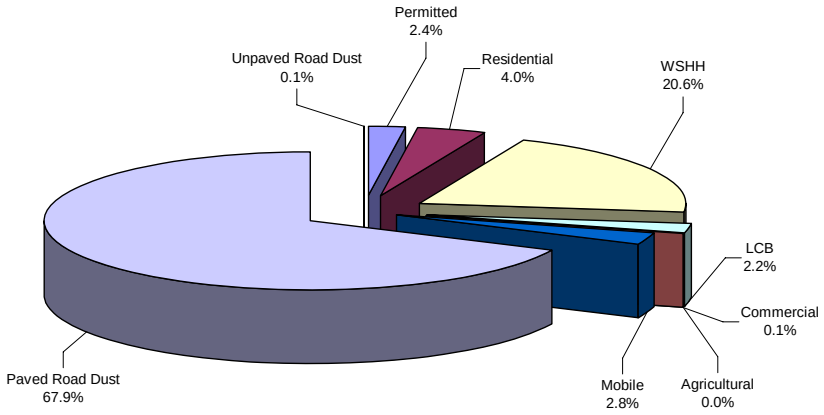


Figure 6-67 Gibbon Road at Richards Street: All Source Contributions for PM_{10}

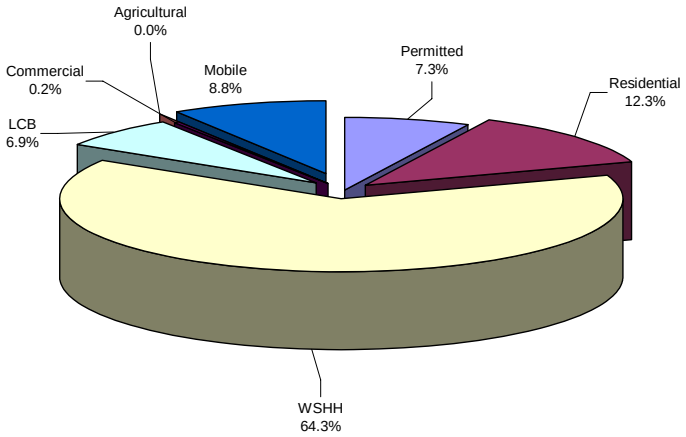


Figure 6-68 Gibbon Road at Richards Street: Source Contributions for PM_{10} (Excluding Road Dust)

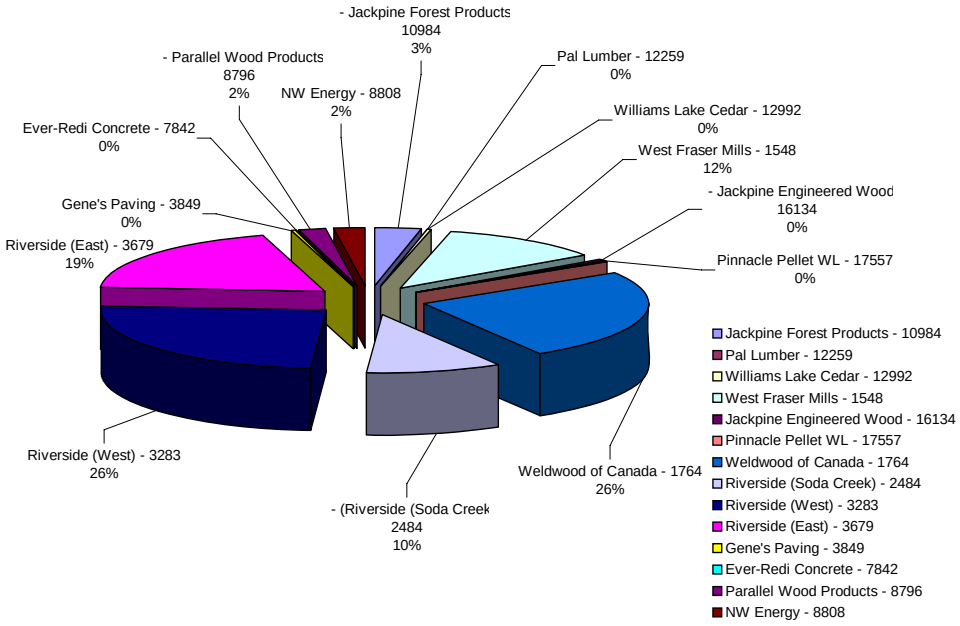


Figure 6-69 Gibbon Road at Richards Street: Permit Source Contributions for PM_{10}

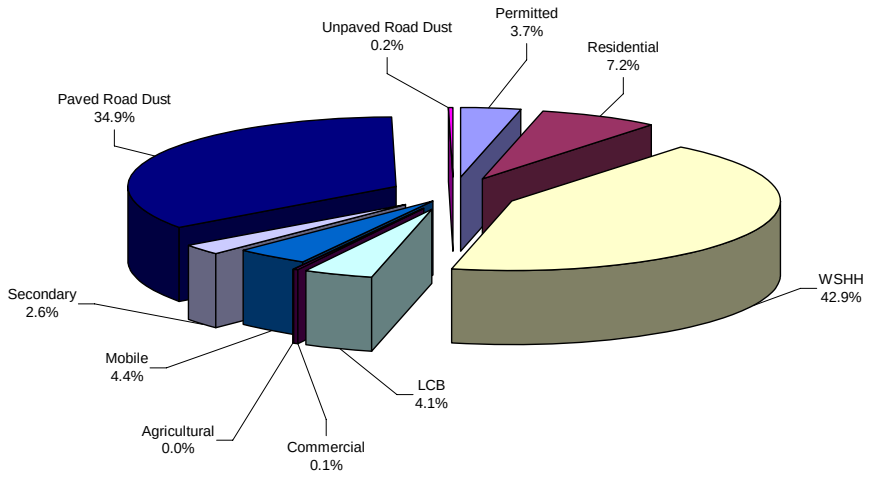


Figure 6-70 Gibbon Road at Richards Street: All Source Contributions for $PM_{2.5}$

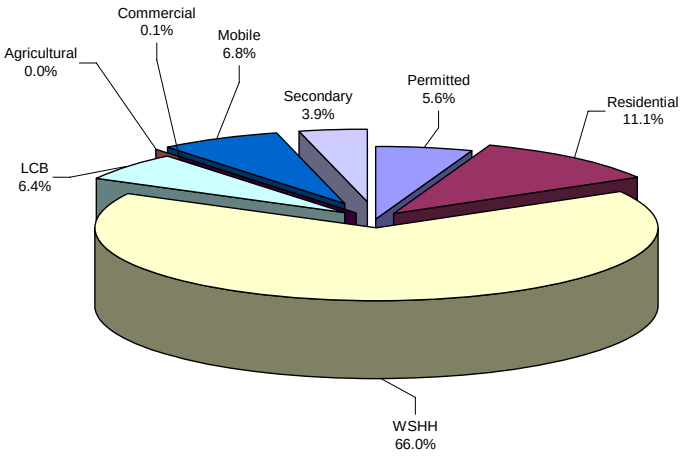


Figure 6-71 Gibbon Road at Richards Street: Source Contributions for $PM_{2.5}$ (Excluding Road Dust)

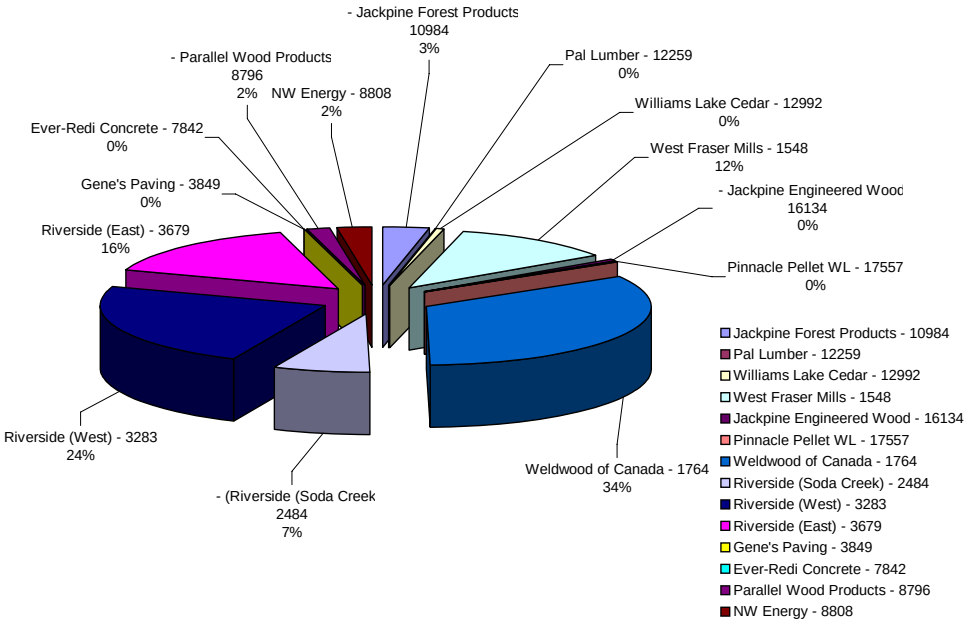


Figure 6-72 Gibbon Road at Richards Street: Permit Source Contributions for $PM_{2.5}$

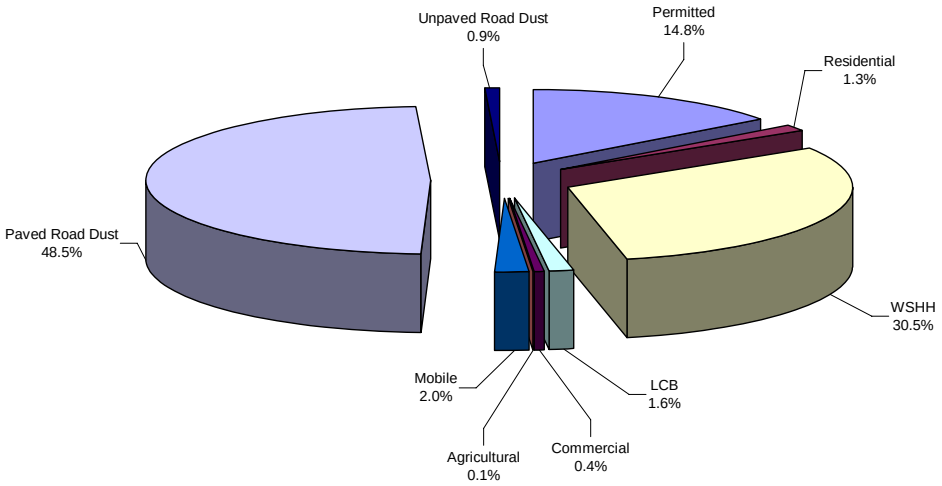


Figure 6-73 Cateline Dr at Dog Creek Rd: All Source Contributions for PM_{10}

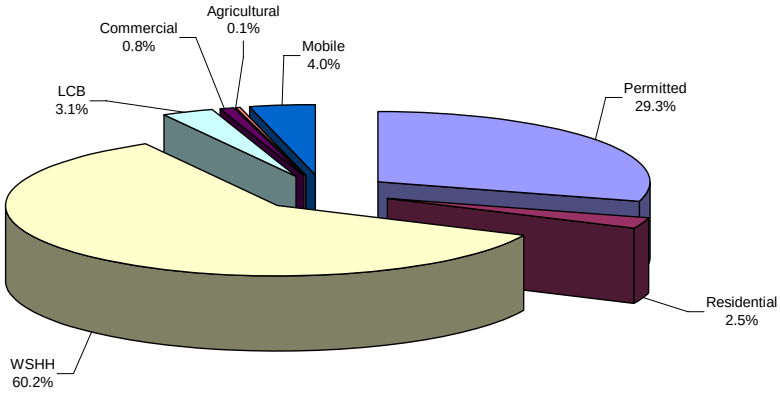


Figure 6-74 Cateline Dr at Dog Creek Rd: Source Contributions for PM_{10} (Excluding Road Dust)

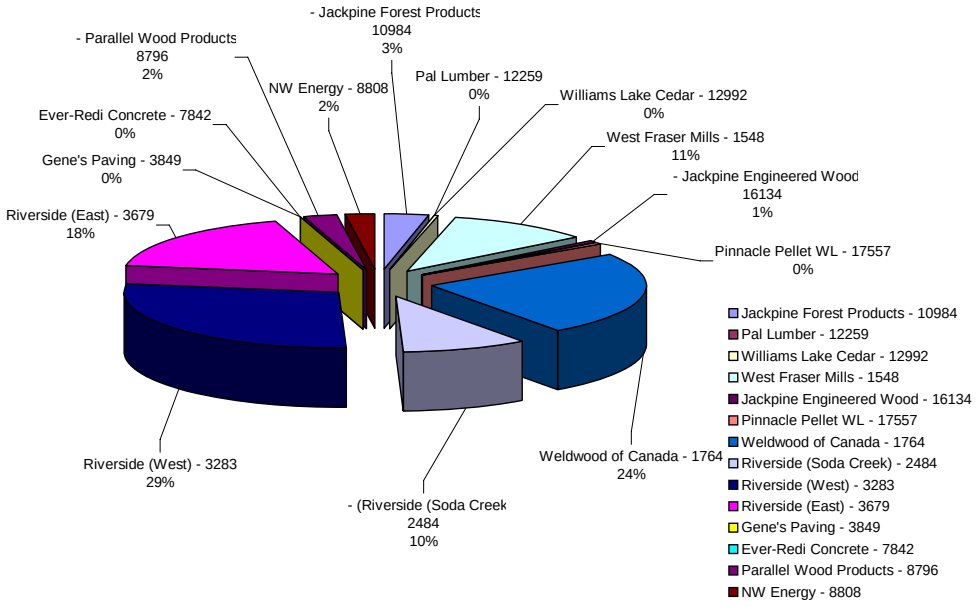


Figure 6-75 Cateline Dr at Dog Creek Rd: Permit Source Contributions for PM_{10}

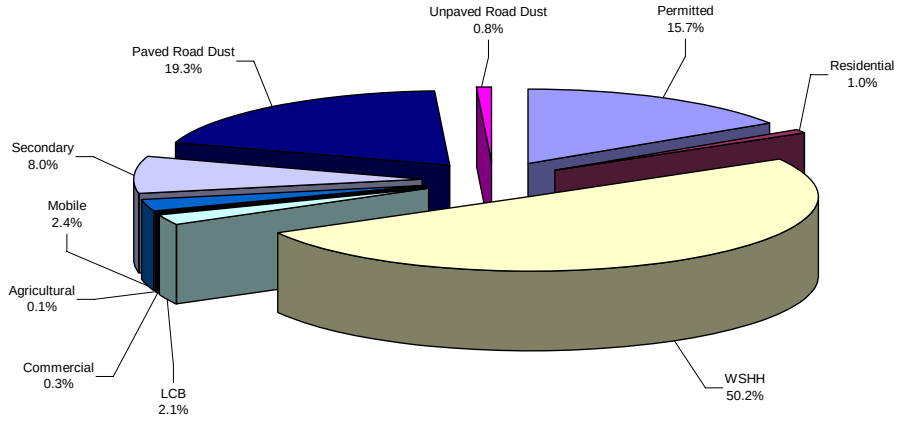


Figure 6-76 Cateline Dr at Dog Creek Rd: All Source Contributions for $PM_{2.5}$

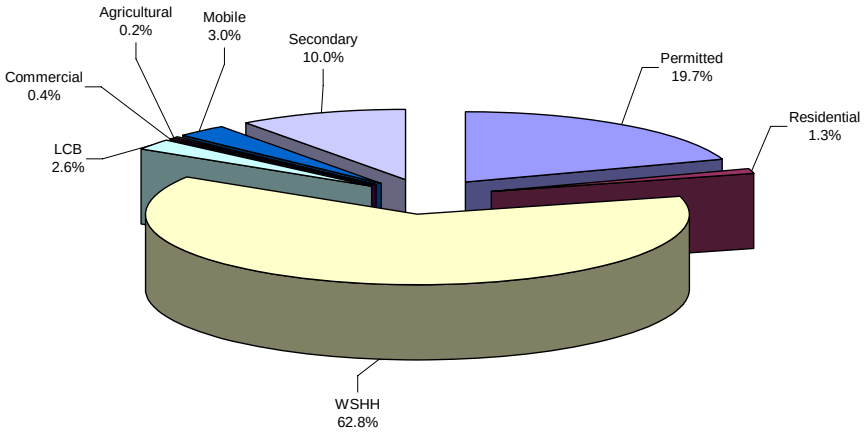


Figure 6-77 Cateline Dr at Dog Creek Rd: Source Contributions for $PM_{2.5}$ (Excluding Road Dust)

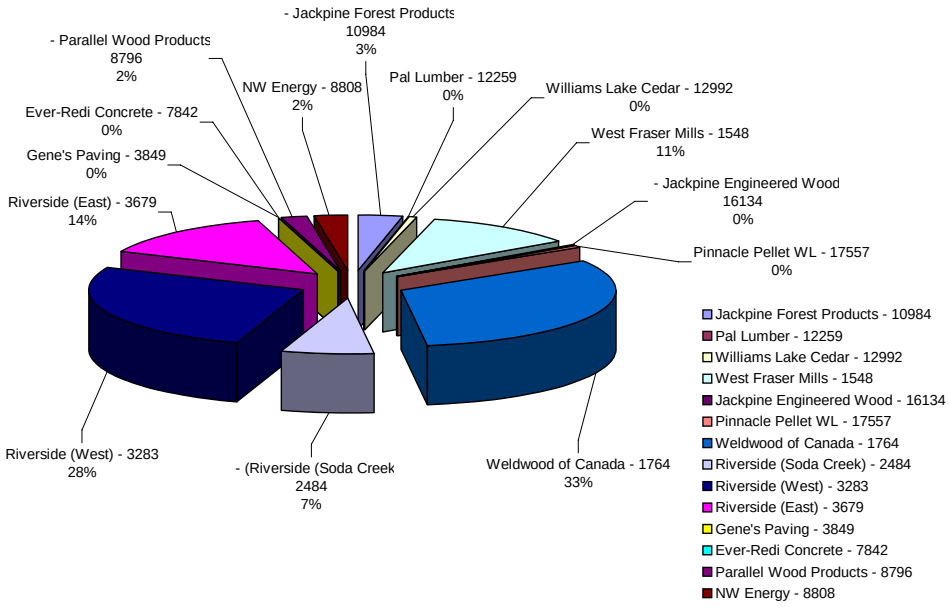


Figure 6-78 Cateline Dr at Dog Creek Rd: Permit Source Contributions for $PM_{2.5}$

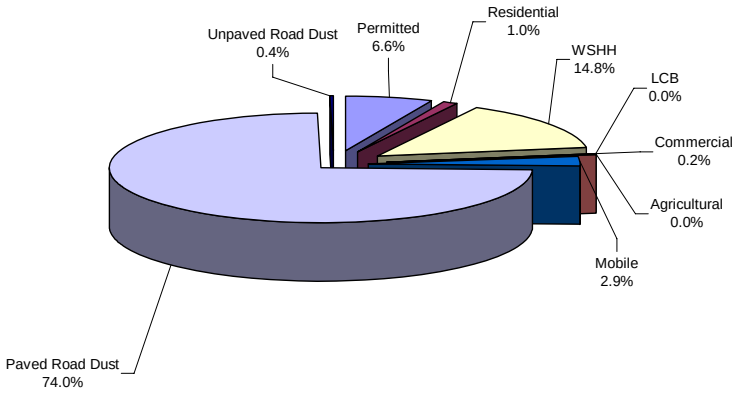


Figure 6-79 Qualeen School: All Source Contributions for PM_{10}

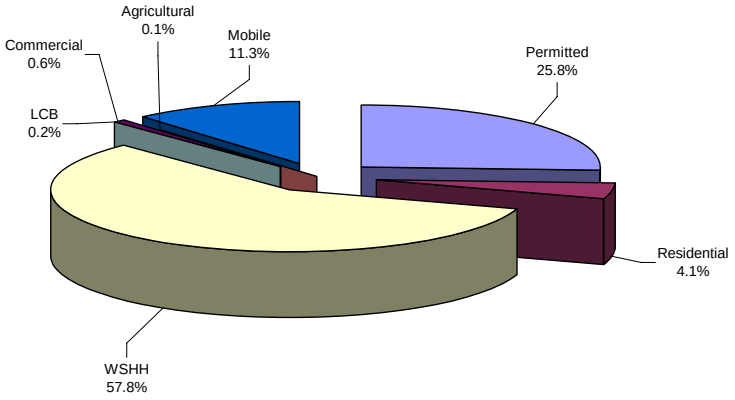


Figure 6-80 Qualeen School: Source Contributions for PM_{10} (Excluding Road Dust)

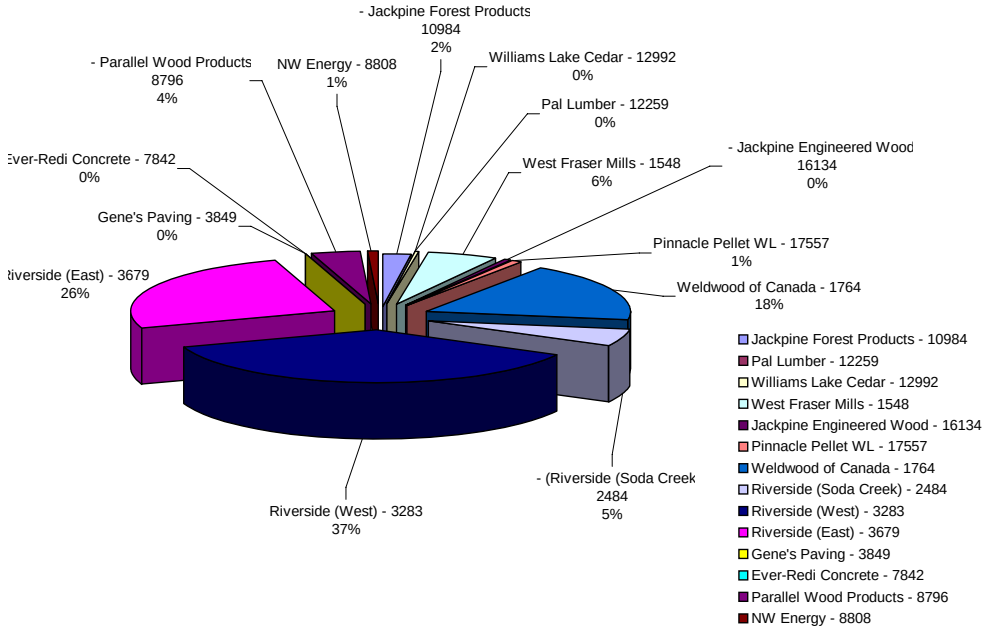


Figure 6-81 Qualeen School: Permit Source Contributions for PM_{10}

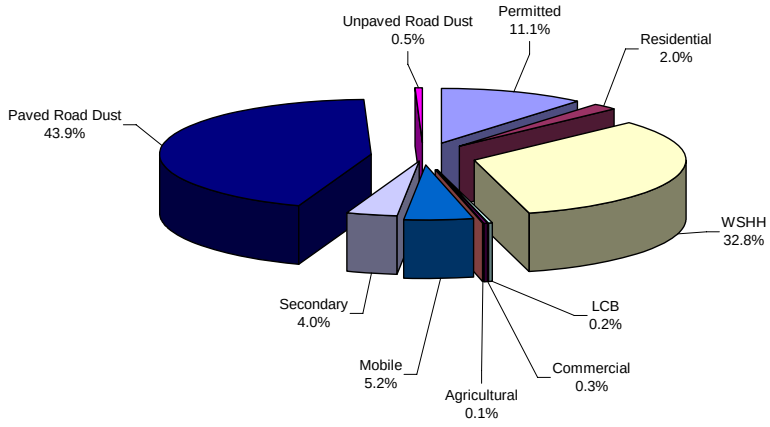


Figure 6-82 Qualeen School: All Source Contributions for $PM_{2.5}$

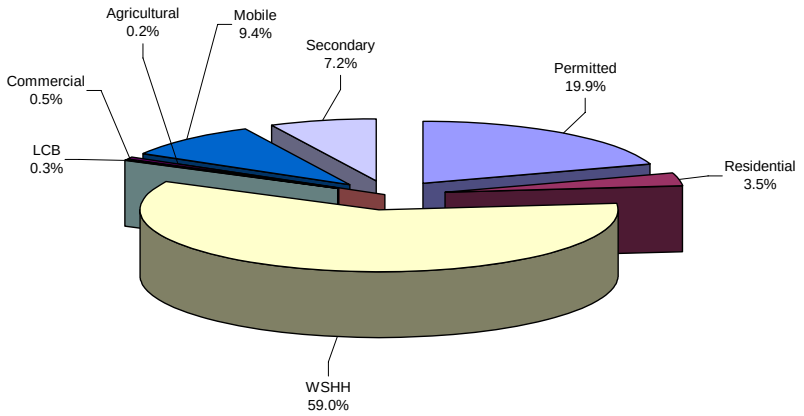


Figure 6-83 Qualeen School: Source Contributions for $PM_{2.5}$ (Excluding Road Dust)

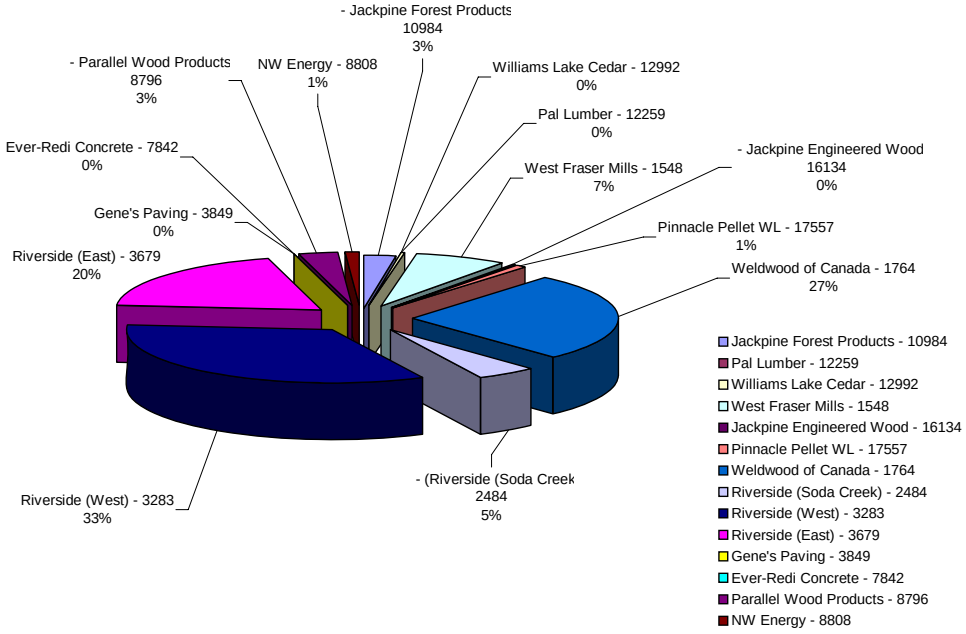


Figure 6-84 Qualeen School: Permit Source Contributions for $PM_{2.5}$

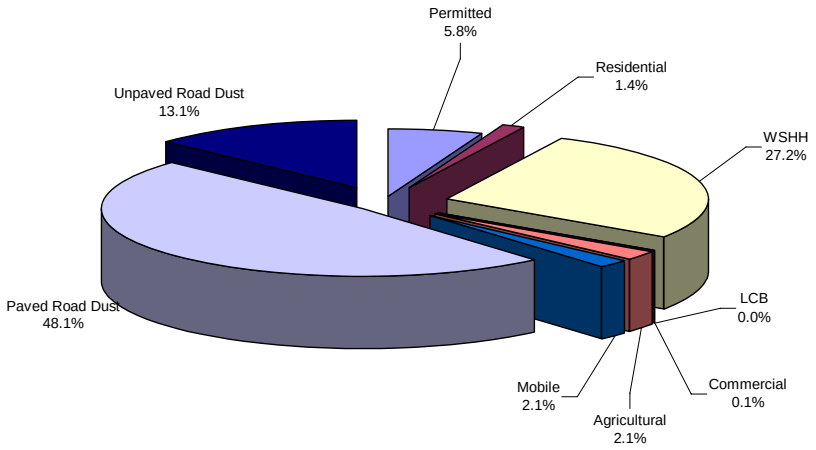


Figure 6-85 Sugarcane Reserve Band Office: All Source Contributions for PM_{10}

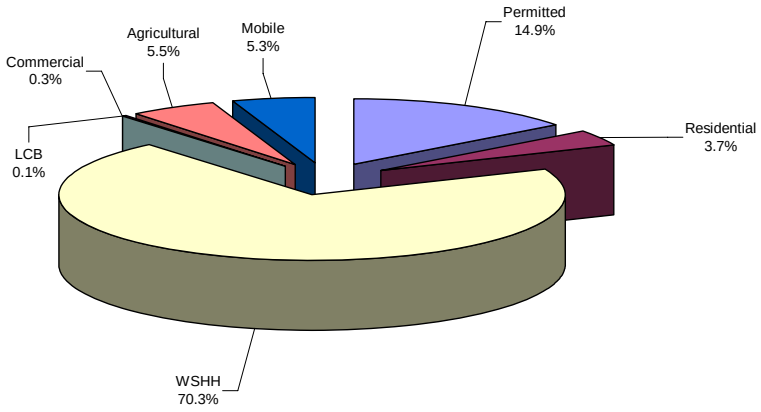


Figure 6-86 Sugarcane Reserve Band Office: Source Contributions for PM_{10} (Excluding Road Dust)

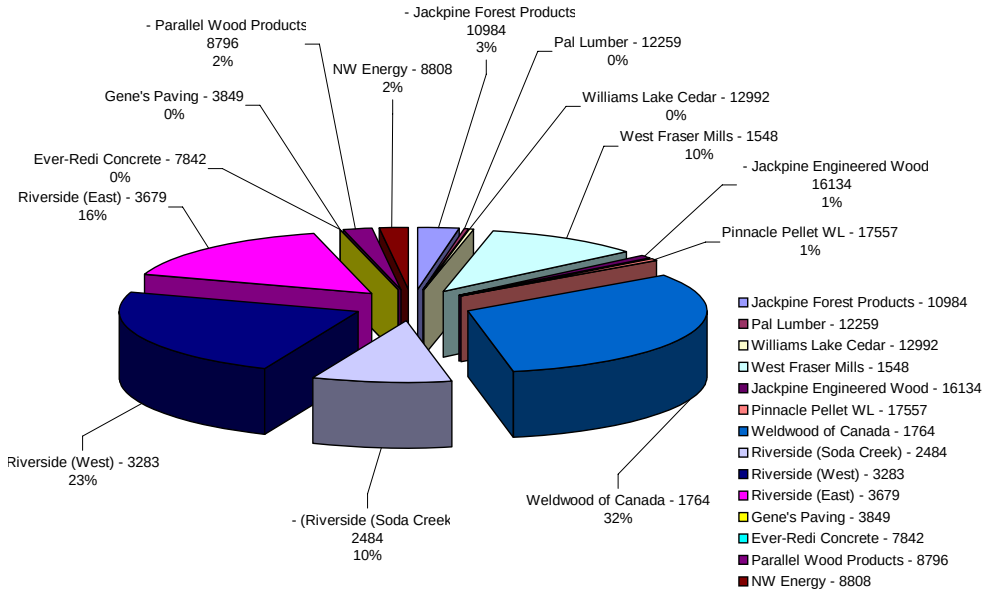


Figure 6-87 Sugarcane Reserve Band Office: Permit Source Contributions for PM_{10}

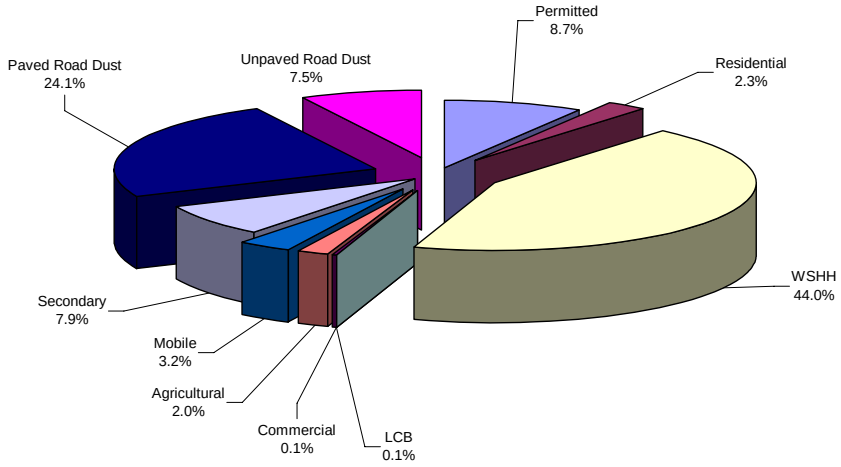


Figure 6-88 Sugarcane Reserve Band Office: All Source Contributions for $PM_{2.5}$

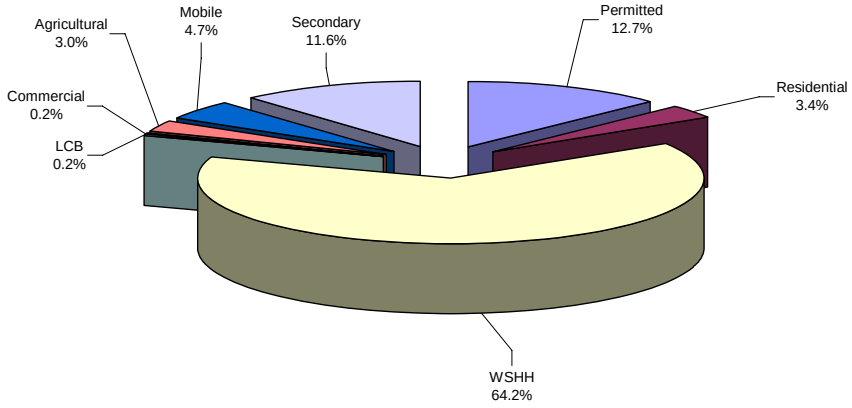


Figure 6-89 Sugarcane Reserve Band Office: Source Contributions for $PM_{2.5}$ (Excluding Road Dust)

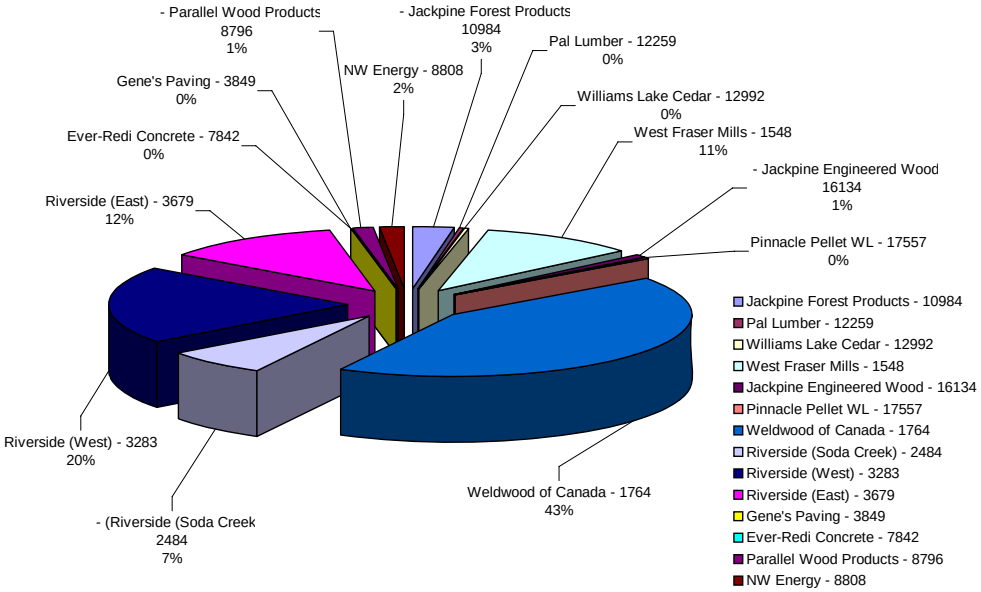


Figure 6-90 Sugarcane Reserve Band Office: Permit Source Contributions for $PM_{2.5}$