Greater Brookfield

Atmospheric Emissions Inventory

Final Report
March 2010

Prepared for

GVA Grimley Limited

Revision Schedule

Greater Brookfield
Atmospheric Emissions Inventory
March 2010

Rev	Date	Details	Prepared by	Reviewed by	Approved by
01	17/11/09	Air Quality	**Peter Wood/Elisha Williams**	**Garry Gray** Associate-Air Quality	**Garry Gray** Associate-Air Quality
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1 Introduction

1.1 Introduction

GVA Grimley have been appointed by Broxbourne Borough Council to support them in the development of a retail and town centre strategy. As part of that task, Scott Wilson have prepared an Atmospheric Emissions Inventory to allow the impact of specific measures to be considered with respect to their impact on the magnitude of emissions from road vehicles on journeys to and from retail centres.

The focus of the study is concerned with land in the vicinity of Halfhide Lane, to the west of A10 Great Cambridge Road in Greater Brookfield, Broxbourne. The development proposals are for a retail-led scheme and would provide residents of Broxbourne and the surrounding areas with an alternative choice of destination for shopping based activities.

Any change in choice of shopping destination would change the routes and total distances travelled by shoppers and there would be a corresponding change in the magnitude of exhaust emissions created by the vehicles in which they travel. This study provides design life estimates of the magnitude of emissions of carbon dioxide (as carbon), oxides of nitrogen, particulate matter and total hydrocarbons, for with development and without development scenarios.

1.2 Scope

The assessment considers three scenarios for each year from 2018 to 2038:

- Do-Minimum Scenario – represents a situation in which the choice of shopping venues remains as it currently is and patterns of venue choice remain unchanged over time.
- Base Scenario (non-cautious) – represents a situation in which a new retail venue is in operation in Greater Brookfield, where a non-cautious estimate of venue choice is applied.
- Base Scenario (cautious) – represents a situation in which a new retail venue is in operation in Greater Brookfield, where a cautious estimate of venue choice is applied.

The estimates are based on the results of a telephone survey of choice of venue provided to Scott Wilson. As part of that survey information, assumptions have been made as to the predicted 'non-cautious' and 'cautious' travel patterns that are expected to occur, following the provision of the Greater Brookfield retail facilities. To summarise these assumptions:

- **Non-Cautious** – Those that shop in the study area are predicted to change their shopping and corresponding travel habits, in favour of Greater Brookfield, on the basis of the retail offer that will be provided there.
- **Cautious** – Those that shop locally are predicted to generally retain their existing shopping and travel habits, whilst those that travel further for shopping are predicted to be more likely to change their shopping and corresponding travel habits, in favour of Greater Brookfield, on the basis of the retail offer that will be provided there.

2 Overview of Approach

2.1 Inventory Input Information

The telephone survey data details shopper's residential location, the location of their preferred shopping venue and the associated mode of travel. The survey grouped the survey responses into 12 zones (see Appendix A), based on the residential location of the individuals surveyed. Zones 1 to 4 represent residents of Broxbourne.

The mode of travel was either by car, by taxi, by van or by public transport. The route and likely road speeds vary for these vehicle types depending on the location of residential properties and the location of shopping venues. Scott Wilson's transport team derived activity rate data for vehicle movements associated with the journeys registered by the telephone survey.

Activity rate data is in the form of vehicle kilometres travelled between zones, for each mode of travel. This information was subdivided by activity associated with speed limits of 30 mph to 70 mph, in 10 mph intervals. The method used to derive activity rate data is summarised in Appendix B of this report.

2.2 Calculation of Emissions per Zone

Emission factors have been calculated for journeys between zones made by each mode of travel, based on the vehicle emissions database contained in the Design Manual for Roads and Bridges. These emission factors are based on a reference activity rate of 100 vehicles making one-way trips. By multiplying the emission factor by the projected number of trips made between zones (the activity rate), an estimate of emissions for each pollutant is derived.

A breakdown of the emissions for return trips starting in each zone are reported in the summary tab of each scenario spreadsheet, and further information relating to this is provided at Appendix C.

2.3 Calculation of Total Emissions for Each Scenario

The total emission for each pollutant is the sum of the emissions for return journeys starting in each zone. Total emissions are reported for carbon dioxide (as carbon), oxides of nitrogen, particulate matter and total hydrocarbons.

3 Emission Estimates

The magnitude of emissions associated with round trips from each zone are displayed in Appendix D of this report:

- Figure DC1 summaries emissions of Carbon for the three scenarios
- Figure D2 summaries emissions of oxides of nitrogen (NOx) for the three scenarios
- Figure D3 summaries emissions of particulate matter (PM_{10}) for the three scenarios
- Figure D4 summaries emissions of total hydrocarbon (THC) for the three scenarios

3.1.1 Do-Minimum Scenario Emission Estimates

Spreadsheet D127404_AEI_DM.xls contains the emission estimate calculations for the Do Minimum scenario.

In the Do-Minimum scenario total emissions of carbon in the assumed opening year of 2018 are 55 thousand tonnes (Table 1). For the design period of this study (2018 to 2038) the total emissions are estimated to be 1.25 million tonnes of carbon.

Table 1: Do-Minimum Scenario Emission Estimates

Period	Carbon (T/yr)	NO_x (Kg/yr)	PM_{10} (Kg/yr)	THC (Kg/yr)
2018	55,000	447,000	9,000	86,000
Total for 2018 to 2038	1,248,000	9,400,000	186,000	2,103,000

Figures D1 to D4 include the raw inventory values, but values in this table have been rounded to a more meaningful number of significant figures.

The single largest contribution to emissions is from travel starting in zone 6. This zone (Waltham Abbey) includes markedly higher bus, taxis and car/van vehicle kilometres travelled than any other zone. Currently this population shop at distant venues on a more regular basis than residents of other groups.

3.1.2 Baseline (Non-Cautious) With-Development Emission Estimates

Spreadsheet D127404_AEI_DS_Base.xls contains the emission estimate calculations for the Baseline (Non-Cautious) scenario.

In the Baseline (Non-Cautious) with-development scenario total emissions of carbon in the assumed opening year of 2018 are 50 thousand tonnes (Table 2). For the design period of this study (2018 to 2038) the total emissions are estimated to be 1.12 million tonnes of carbon. Over the design life of the development the estimated reduction in carbon emissions from shopping related travel is 9.9%, relative to the Do-Minimum Scenario.

Table 2: Baseline (Non-Cautious) with Development Scenario Emission Estimates

Period	Carbon (T/yr)	NO_x (Kg/yr)	PM_{10} (Kg/yr)	THC (Kg/yr)
2018	50,000	403,000	8,000	78,000
Total for 2018 to 2038	1,124,000	8,465,000	170,000	1,898,000

Figures D1 to D4 include the raw inventory values, but values in this table have been rounded to a more meaningful number of significant figures.

3.1.3 Baseline (Cautious) With-Development Emission Estimates

Spreadsheet D127404_AEI_DS_CAUTIOUS.xls contains the emission estimate calculations for the Baseline (Cautious) scenario.

In the Baseline (Cautious) with-development scenario total emissions of carbon in the assumed opening year of 2018 are 49 thousand tonnes (Table 3). For the design period of this study (2018 to 2038) the total emissions are estimated to be 1.11 million tonnes of carbon. Over the design life of the development the estimated reduction in carbon emissions from shopping related travel is 11.5%, relative to the Do-Minimum Scenario.

Table 3: Baseline (Cautious) With-Development Scenario Emission Estimates

Period	Carbon (T/yr)	NO_x (Kg/yr)	PM_{10} (Kg/yr)	THC (Kg/yr)
2018	49,000	396,000	8,000	76,000
Total for 2018 to 2038	1,105,000	8,328,000	165,000	1,868,000

Figures D1 to D4 include the raw inventory values, but values in this table have been rounded to a more meaningful number of significant figures.

4 Summary

The household telephone survey information has been used to consider the extent to which residents of Broxbourne and the surrounding area are expected to alter their shopping and corresponding travel habits, should new retail facilities be provided at Greater Brookfield.

In doing-so, 'Non-Cautious' and 'Cautious' assumptions have been made relating to the likelihood that shoppers will change their travel habits, based on the Greater Brookfield retail offer (as discussed at **Section 1.2**). This analysis has allowed estimates of the magnitude of road vehicle exhaust emissions associated with journeys to retail destinations to be calculated.

This analysis has identified that if existing patterns of shopping and travel behaviour were to continue over the period from 2018 to 2038, then the total emissions of carbon attributable to such journeys would be 1.25 million tonnes.

For the Baseline (non-cautious) scenario, which assumes that shoppers in the area may change their habits in favour of new facilities at Greater Brookfield (for both local and journeys over slightly greater distances), the projected journeys would generate 1.12 million tonnes of carbon between 2018 and 2038.

This equates to a reduction in emissions of carbon of 9.9%, relative to the Do-Minimum scenario (which excludes the provision of new retail facilities at Greater Brookfield).

For the Baseline (cautious) scenario, which assumes that shoppers who travel slightly further afield may change their habits in favour of new facilities at Greater Brookfield (whilst other local shoppers would be expected to continue to shop at the same destinations), the projected journeys would generate 1.11 million tonnes of carbon between 2018 and 2038.

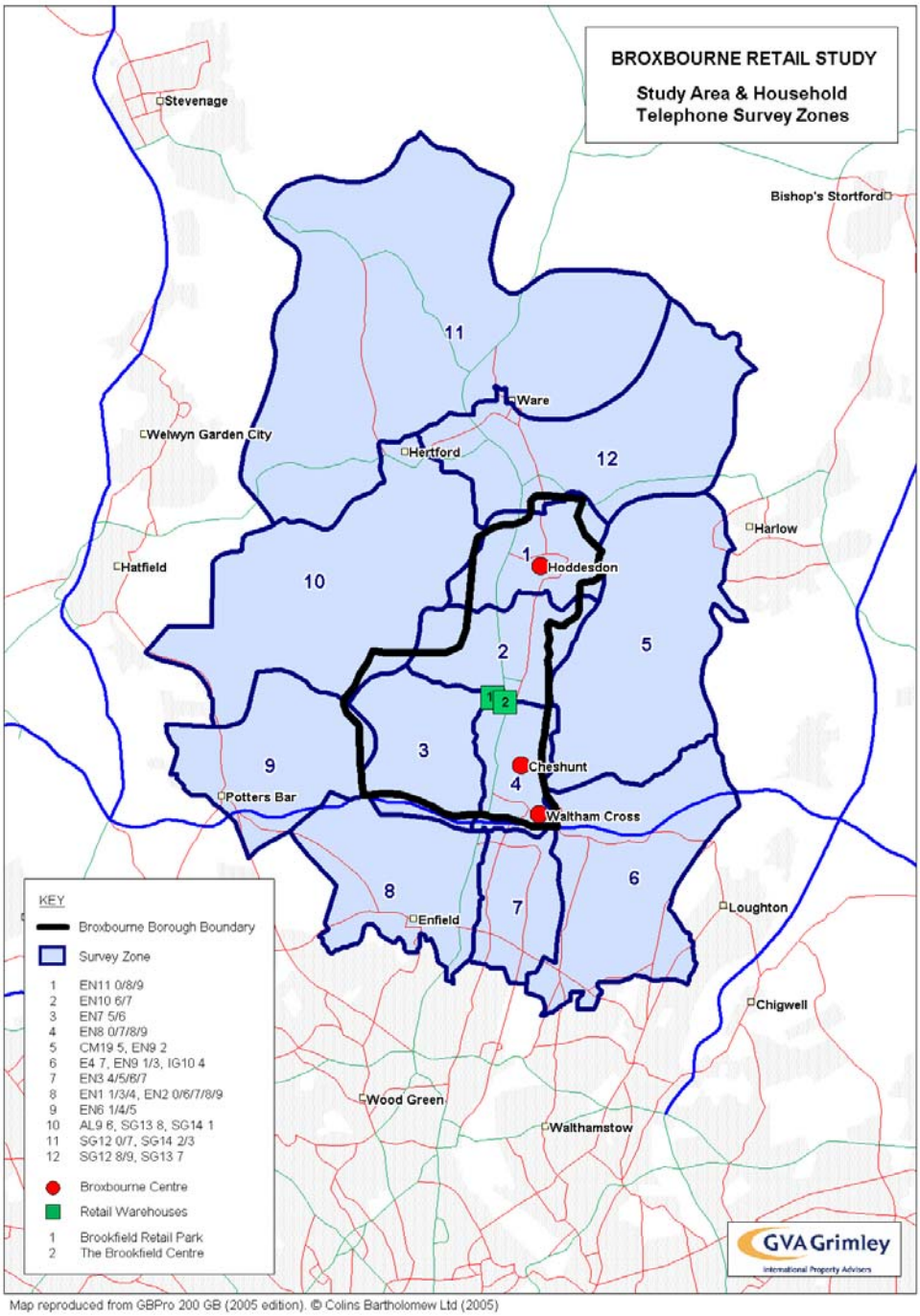
This equates to a reduction in emissions of carbon of 11.5%, relative to the Do-Minimum scenario (which excludes the provision of new retail facilities at Greater Brookfield).

As a guide, it has been calculated that the carbon savings calculated for the non-cautious and cautious scenarios, would be roughly equivalent to 2.2 and 2.5 million km travelled by a bus, respectively. The analysis therefore indicates that there are expected to be air quality related benefits associated with providing retail facilities at Greater Brookfield, as this has the ability to reduce the number of longer-distance trips to other retail facilities.

Emissions of oxides of nitrogen, particulate matter and total hydrocarbons follow a similar pattern of change to those predicted for carbon. Although a reduction in total emissions in these pollutants is helpful in reducing background concentrations of these pollutants, it is unlikely that these emissions would translate into perceptible changes in measure concentrations at air quality sensitive locations.

Appendix A

Study Area and Households Telephone Survey Zones
Reproduction of Figure received from GVA Grimley 11/09/2009



Appendix B

Summary of Greater Brookfield Transport Methodology

Estimating Retail Trips (Origins)
TEMPRO, a Government database, was used to establish the number of car driver trips travelling on a Saturday from each retail study zone for each year of the predicted design life of the development proposals.

Establishing Travel Patterns (Destinations)
Using data provided by GVA Grimley, these estimated trip levels were then divided up between each of the study zones, according to the predicted market shares for the 'Base' and 'Cautions' calculations in the future years (i.e. beyond 2018); therefore representing a 'Do Something' situation, once the development proposals would be expected to be operational.

For comparison, the existing (i.e. 2008) market share calculations were used as a basis for the 'Do Minimum' (i.e. no development) situation, representing the approximate spread of retail trips across the local retail offer, based on the available study zone data.

Converting Trips into Vehicle Kilometres
An estimate of total vehicle kilometres travelled from each retail study zone was calculated using an internet based route finder and multiplying the journey length by the number of predicted trips, according to each year of the predicted design life.

Using the results of the Broxbourne Shopping survey, a relationship between Car drivers, Taxi and Bus was calculated, and this factor was then applied to calculate the vehicle kilometres for each respective mode.

Appendix C

Description of Inventory Structure within Excel Spreadsheets

There are three spreadsheets associated with this assessment, one per scenario as follows:
1: Do-Minimum Scenario (D127404_AEI_DM.xls)
2: Base Do-Something Scenario (D127404_AEI_DS_BASE.xls)
3: Cautious Do-Something Scenario (D127404_AEI_DS_CAUTIOUS.xls)

Each follows the same set-up, with scenario specific data inserted into the appropriate points.

Each spreadsheet has 23 tabs. Tabs 1-21 are one for each year from the year of opening (2018) to 2038. Tab 22 is a Summary Tab. Tab 23 contains Emissions data. These tabs are detailed as follows.

Tab 2018:
The Tab begins with emission factors for each of the four pollutants under consideration. These factors are per 100 vehicles covering 1 mile, at a range of speeds from 30mph to 70mph, for cars, taxis and buses. These are calculated using the DMRB Screening Tool v1.03c.
There is then a block per Zone from which the journey originates. Firstly there is a table dividing the journey from the originating zone to one of 15 shopping sites into distance travelled (in km) at a specific speed on a specific road type.
These distances travelled are then combined with the emission factors to establish the quantity of pollutant emitted per journey per vehicle type (car, taxi or bus) on each of the road types/speeds.
These are then combined to provide an overall quantity of pollutant emitted per journey.
Total vehicle kilometres travelled from that zone to each of the shopping areas are then presented by mode of transport.
Finally the vehicle kilometres travelled, the distance per trip and total emissions per trip, per mode of transport are combined to calculate the total emissions for each journey option (from zone to each shopping destination).
These are then totalled to provide total emissions for all journeys from each zone, and totalled again to provide total emissions for all journeys for 2018.

Tabs 2019-2038:
These are as above but with emission factors for the appropriate year and vehicle kilometres as calculated for that year. For years after 2025, emission factors from 2025 are used as that is the limit of the currently available factors.

Summary tab:

This tab contains two summary sets of data.
The first is the total quantity of each pollutant emitted per year, and then totalled.
The second is the quantity of pollutant emitted in 2018 per zone (where the journey originates), and then totalled.

Appendix D

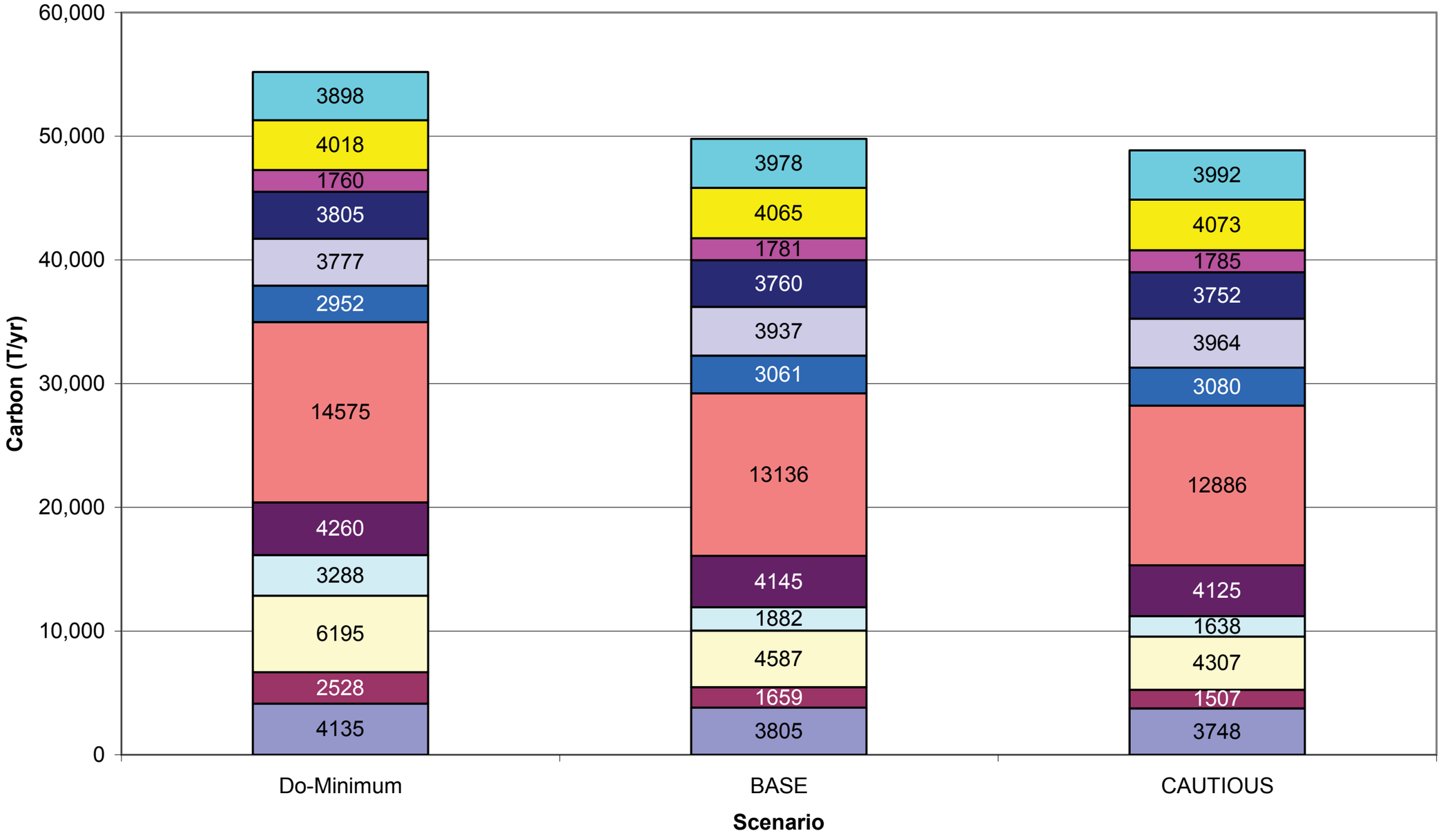
Figure D1: Contribution to Annual Carbon Emissions in 2018 from Customer Shopping Journeys for Customers Living in 12 Residential Zones

Figure D2: Contribution to Annual NOx Emissions in 2018 from Customer Shopping Journeys for Customers Living in 12 Residential Zones

Figure D3: Contribution to Annual PM_{10} Emissions in 2018 from Customer Shopping Journeys for Customers Living in 12 Residential Zones

Figure D4: Contribution to Annual Total Hydrocarbon Emissions in 2018 from Customer Shopping Journeys for Customers Living in 12 Residential Zones

Contribution to Annual Carbon Emissions in 2018 from Customer Shopping Journeys for Customers living in 12 Residential Zones



NOTES

Revision Details	By / Check	Date	Suffix

Drawing Status: FINAL

Job Title: D127404 Greater Brookfield

Drawing Title: Contribution to Annual Carbon Emissions in 2018 from Customer Shopping Journeysfor Customers living in 12 Residential Zones

Drawn	Approved		
EW	GG		
Stage 1 check	**Stage 2 check**	**Originated**	**Date**
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Drawing Number: **FIGURE D1** Rev

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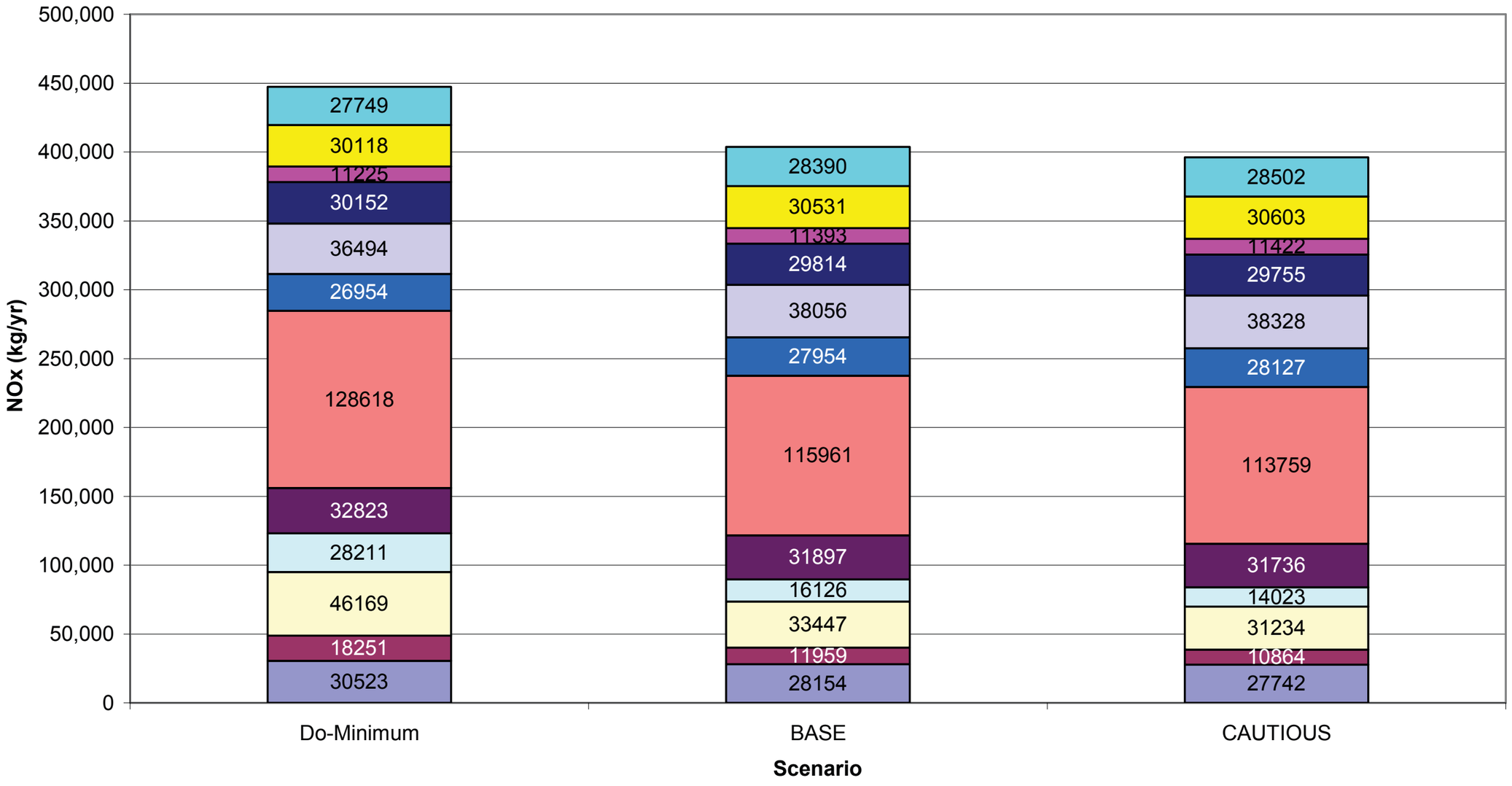
Contribution to Annual NOx Emissions in 2018 from Customer Shopping Journeys for Customers living in 12 Residential Zones



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Drawing Status: FINAL

Job Title: D127404 Greater Brookfield

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Drawn	Approved		
EW	GG		
Stage 1 check	**Stage 2 check**	**Originated**	**Date**
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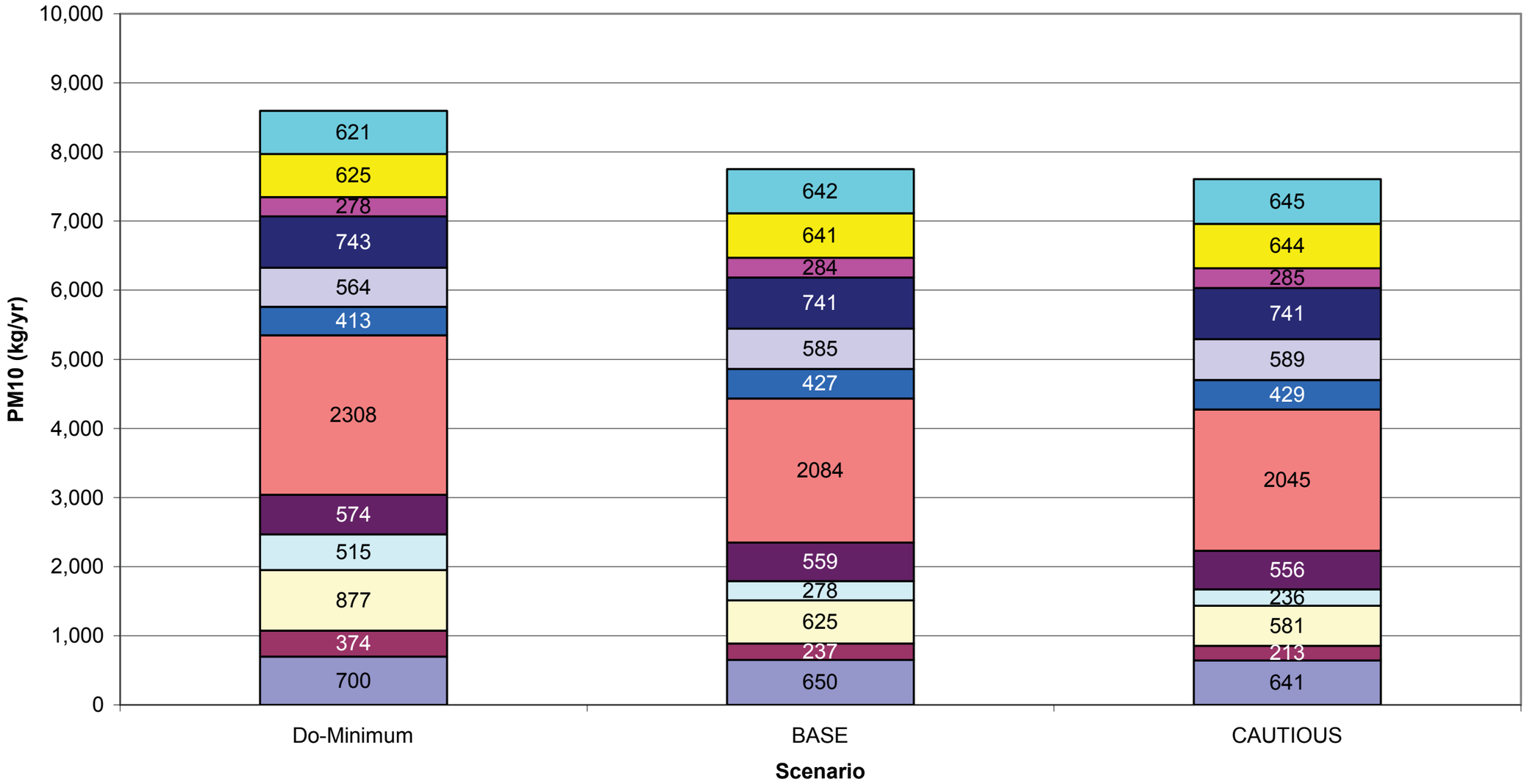
Contribution to Annual PM_{10} Emissions in 2018 from Customer Shopping Journeys for Customers living in 12 Residential Zones



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Revision Details	By / Check	Date	Suffix

Drawing Status: FINAL

Job Title: D127404 Greater Brookfield

Drawing Title: Contribution to Annual PM_{10} Emissions in 2018 from Customer Shopping Journeysfor Customers living in 12 Residential Zones

Drawn	Approved		
EW	GG		
Stage 1 check	Stage 2 check	Originated	Date
GG	GG	9511NM	27/11/09

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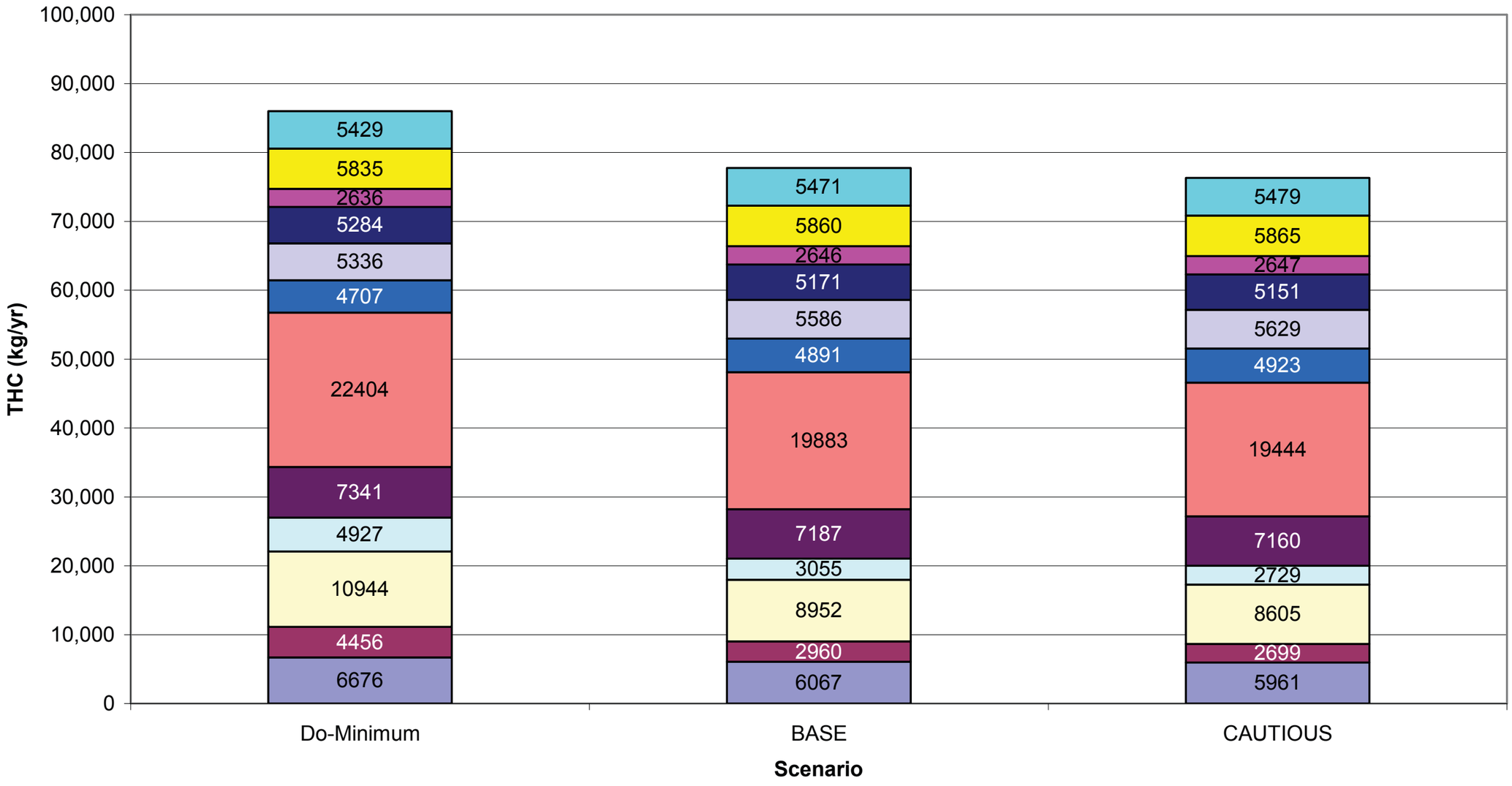
Contribution to Annual Total Hydrocarbon Emissions in 2018 from Customer Shopping Journeys for Customers living in 12 Residential Zones



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Revision Details	By / Check	Date	Suffix

Drawing Status: FINAL

Job Title: D127404 Greater Brookfield

Drawing Title: Contribution to Annual Total Hydrocarbon Emissions in 2018 from Customer Shopping Journeys for Customers living in 12 Residential Zones

Drawn	Approved		
EW	GG		
Stage 1 check	**Stage 2 check**	**Originated**	**Date**
GG	GG	9511NM	27/11/09

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