



2024 Coursework Sample

**To what extent does the road infrastructure
and traffic in central Guildford cause a
variation in the amenity value of the River
Wey?**

To what extent does the road infrastructure and traffic in central Guildford cause a variation in the amenity value of the River Wey?



Word count: 7979

To what extent does the road infrastructure and traffic in central Guildford cause a variation in the amenity value of the River Wey?

Purpose

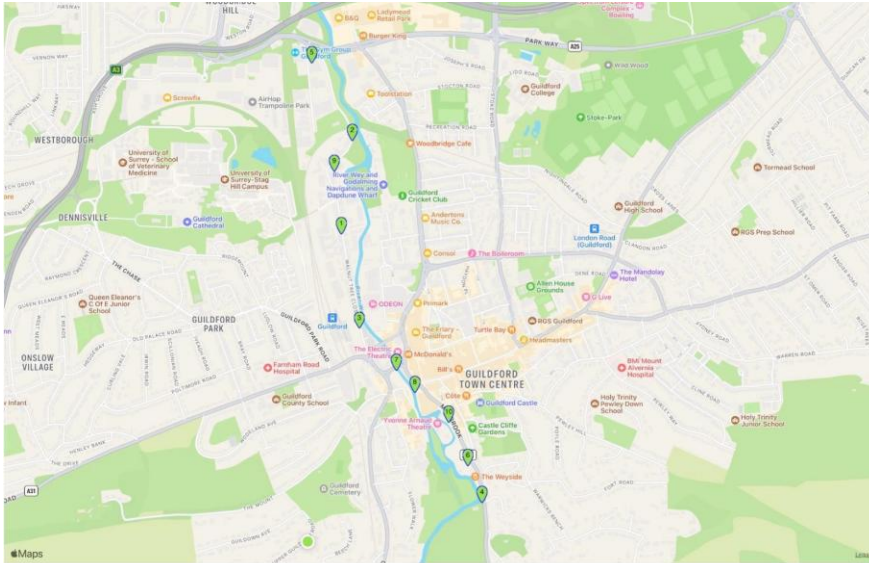


Figure 1- Map of the different sites surrounding the River Wey, taken from MapIt

The purpose of this investigation is to find out the extent to which the road infrastructure and traffic in central Guildford cause a variation in the amenity value of the River Wey. Guildford is a town situated in Surrey with a population of 77,057,

clear aim at a manageable scale

with the River Wey passing through the heart of Guildford. This study aims to illustrate the importance of the management of Guildford's road systems and its impact on the utilisation. For example, the sustainable management of external factors, such as road infrastructure or provision of public transport, can cause great variation in the amenity value of areas in the near proximity to the River Wey.

Recognising this, Guildford Borough Council, have produced plans to reduce traffic flow along Walnut Tree Close, in order to *create a more pleasant environment along the road to encourage more walking and cycling*¹. The implementation of sustainable travel such as this is fundamental for communities to become more sustainable and resilient. For many councils, sustainability is at the forefront of their urban planning as sustainable management can enhance amenity value around environmental features.

sets the scene + justifies the study

Context / relevance

¹ Get Surrey

<https://www.getsurrey.co.uk/news/surrey-news/guildford-town-centre-congestion-charge-25090320>

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Figure 2 - photo of the River Wey at Guildford Rowing club, taken from Wikipedia

The River Wey is a tributary river of the River Thames, and passes through central Guildford. There is a walkway with some green spaces on both sides of the river and some street furniture. Native Land, a housing development company, has received an all-clear for its £125 million plan to transform Debenhams shopping centre into St Mary's Wharf, which includes 185 private and affordable houses and 21,000 square feet of retail space. Furthermore, the building will be carbon zero, aiding Guildford's sustainability mantra, and create an extra 1 acre of public accessibility to the river. This will help to *reconnect the town with the riverside, and provide new stimulus for the high street*². River accessibility is fundamental for future communities as functions of urban areas change. Many towns are experiencing more demand for housing, whilst shopping centres move outside due to changing shopping patterns. Good river accessibility can help to support sustainable living in these communities.

relevance
of
enquiry
to
creating
sustainable
urban
env.

clear / can be
justified.

² Construction Enquirer

<https://www.constructionenquirer.com/2022/11/24/all-clear-for-125m-guildford-debenhams-redevelopment/>

To what extent does the road infrastructure and traffic in central Guildford cause a variation in the amenity value of the River Wey?



Figure 3 - photo of the River Wey near the Odeon, site 5, taken from SurreyLive



Figure 4 - photo of the River Wey at Debenhams, site 9, taken from SurreyLive

Framework of the study

1. How does the road system affect the visual value at different sites?

Visual value is an important factor to consider when studying amenity value. An unobstructed view of the river can increase the value of the site. Roads with infrastructure blending into the natural surroundings can help to minimise the road system's negative impact on the river's beauty.

2. How does traffic affect the tranquillity at different sites?

logical
+ well
justified
framework
to the
study

To what extent does the road infrastructure and traffic in central Guildford cause a variation in the amenity value of the River Wey?

Fast flowing traffic, typically found on A roads, can reduce the tranquillity of the river due to noise pollution. However, heavily congested roads also produce noise and air pollution from the running engines, masking the natural noises associated with rivers. Speed limits, congestion charges and increased public transport opportunities can help to mitigate the impact of traffic on the tranquillity of the river.

3. How does the road infrastructure affect access to the river and land available for recreation at selected sites?

Large, fast flowing roads, such as A roads, restrict access to the river and land available for recreation because a lack of pedestrian crossings makes it dangerous to cross. However, the implementation of bus stops or pedestrian crossings can help to increase the ability of pedestrians to be able to access the river on A roads. It is important that the road infrastructure does not disrupt the dynamic equilibrium of the river system process such as erosion and sedimentation.

Relevant background theory

This study links to the sustainability and causality concept of the Edexcel Geography Syllabus.

Sustainability is investigated through how the current, carbon-based road system affects the local environment, in particular the river systems, and whether the river provides a good quality of life for the residents of this generation and future generations. Causality is also investigated in how different factors influence the amenity value of the River Wey.

may
make
relevant
road
location

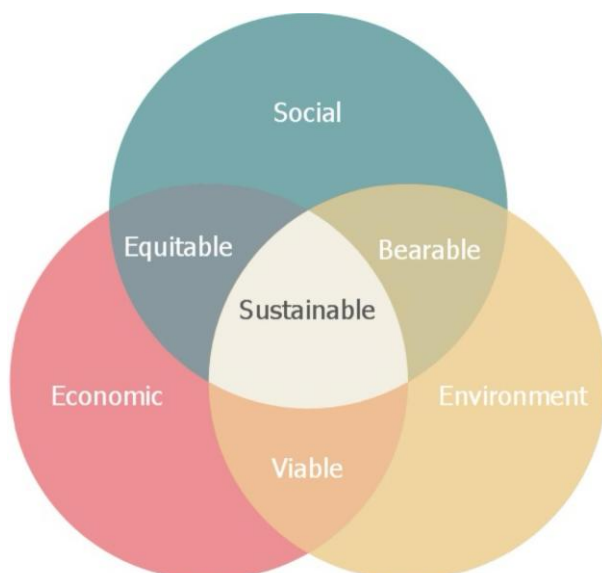


Figure 5 - Circle of Sustainability, taken from ResearchGate

Wider geographical context

As of 2022, some Guildford MPs have commenced research into implementing a congestion charge in Guildford to reduce traffic flow and open up the river. Traffic reduction is important for the futurity of communities, so that communities can enjoy liveable and tranquil spaces near the river. The plan includes *getting rid of the one way system because two way-roads mean slower traffic and more*

relevant
in the
context

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*attention paid to pedestrians; open up the riverside to the town centre; removing some traffic lanes to give priority to cyclists, pedestrians and buses and maintaining access to all key destinations in the town such as the bus station, train station and car parks.*³ As the UK government begins to place increasing importance on tackling Climate Change, the transportation infrastructure will have great relevance. By encouraging the use of public transport and travel by foot or bicycle, Guildford council can reduce their carbon footprint, which also has global benefits, whilst new entrepreneurial opportunities and space for housing is created through the removal of roads running through the centre of Guildford. Climate action can also help to maintain the good health of the River Wey by minimising pollution.

applied to local area.

Field methodologies and data collection

Primary data collection

Primary data was collected through stratified sampling, which meant that the most representative data was collected. The primary data was collected on Friday the 25th of August 2023.

→ using

Site sampling

The 10 sites were selected along the River Wey in Guildford, running from Woodbridge Meadows Road to Shalford road. These sites were selected using stratified sampling, so that the sites could demonstrate the greatest variation in amenity value. By using 10 sites, it enabled a large proportion of Guildford to be analysed. Furthermore, stratified sampling avoided inaccessible areas by the river caused by construction works. The transport survey, photos, bipolar visual survey, smellscape and decibel readings were conducted at each of those 10 sites.

Ethical considerations

All participants gave fully informed consent when answering the questionnaire. Names and personal details were also kept anonymous to ensure privacy was maintained. When taking photos, faces were not captured to protect people's identity.

✓ relevant ethical considerations applied

³ Get Surrey <https://www.getsurrey.co.uk/news/surrey-news/guildford-town-centre-congestion-charge-25090320>

just his sampling size & sample

To what extent does the road infrastructure and traffic in central Guildford cause a variation in the amenity value of the River Wey?

← josh hazi & style & ament.

Questionnaire sampling

The questionnaire consisted of 8 questions, with a range of question types. Likert questions were used to gauge how strong public opinion was on the impact of road infrastructure and traffic on each of the sites. This provided quantitative data, which was easy to compare, to help identify the site with the least amenity value. Furthermore, option questions were used to ascertain whether the public thought that road infrastructure was the fundamental cause of the variation in the amenity value of the River Wey.

Method for Data Collection

Types of method	Purpose of method	Description of method used	Justification of frequency and timing of methods used
Primary Data - transport surveys used to collect quantitative data <i>good understanding of purpose</i>	This data collection will help in comparing the sites by how polluted the area is. By collecting traffic flow, traffic speed and types of traffic this can help to indicate how congested the site is. Congestion data can be used to assess the level of noise pollution at the site. If the road infrastructure noise masks the natural soundscapes of the river, the area's tranquillity can be reduced. This helped to answer the enquiry question.	This survey was conducted by visiting each site. A tally was used to assess the type of vehicle moving through each site. The type of vehicle was weighted to best determine the levels of congestion in the area. A tally was again used to record the number of vehicles travelling in certain speed brackets. This was also weighted to demonstrate the varying effect of vehicle speed on pollution levels. <i>thorough description of methods used</i>	This data was collected on the 25th of august at 9am, during the school holidays, because that was when congestion levels were likely to be highest. Traffic was counted for 15 minutes at every site. This provided a more accurate view of the site's tranquillity levels. <i>josh hazi & tungs</i>
Primary Data - photos used to collect qualitative data	The purpose of the photographs was to visually illustrate the urban river environment. Using photographic evidence	At each site subjectively selected images were taken, to best represent the urban river environment. These	Photographs were taken at each site multiple times to obtain a wide and inclusive image of the sites. This gave an

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	helped to compare the sites' visual aesthetic, helping to determine the visual value and accessibility of the sites, and how the road infrastructure can hinder this. This was then used to determine which site had the greatest amenity value.	were then used in the questionnaire to help compare the site's characteristics and determine the road infrastructure affects access to the river, and in turn its effect on amenity value.	accurate representation of the sites and was useful to support the data collected. The data was collected at 10am on a Friday in the summer holidays, when the urban river environment was likely to be busiest. This gave a more accurate vision of how accessible the River Wey was.
Primary Data - bipolar surveys used to collect quantitative data	This data helped assess the visual value of the urban river environment, by ranking various characteristics of the site. It focused on a variety of visual aspects such as recreational attributes and pleasantness of green spaces, and the implication of traffic and road infrastructure on these characteristics. This was then used to determine the amenity value of the sites. A higher score indicated greater amenity value.	This survey was conducted by visiting each site. A scale ranging from zero to five was used to assess the characteristics of each site. This was also weighted to demonstrate the varying importance of urban river characteristics on the amenity value.	This data was collected over one day. It was collected on a Friday at 1pm in the summer holidays, when the urban river environment was likely to be busiest. This gave a more accurate indicator of the site's greatest amenity value.
Primary Data - questionnaire used to collect quantitative data	The purpose of this data collection was to gauge people's overall perception of the River Wey. Additionally using photos, ranking scales and word associations will help answer the enquiry question of how road infrastructure	This data was collected online as the largest sample size was able to be collected of 112. It was sent out via email to colleagues, family and friends. Binary, score and option questions were used in order to obtain the	This research was conducted to enable a large sample of people to give their perception of the area. The questionnaire was open over a period of a month, from August the 25th until September the 25th.

things were justified

centres were just trying to answer purpose

just this scale

style of questions

Size & sample

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	and traffic in central Guildford causes a variation in the amenity value of the River Wey.	most reliable data for the enquiry question.	This enabled many people to answer the questions.
Primary Data - decibel readings used to collect quantitative data	The purpose of this data collection was to assess the noise levels at each of the sites. Noise levels are a useful way of assessing tranquillity levels as noisy areas are likely to be less tranquil. This helped to answer the enquiry question.	This data was collected at each of the sites. A decibel metre app was used and each reading was taken three times at each of the sites. An average was then calculated using these readings.	The data was collected 3 times and an average was taken to increase the reliability of the data. The data was taken at various times on a Friday at 10am, 12pm and 2pm to provide a more accurate idea of the site's tranquillity levels.
Primary Data - smellscapes used to collect qualitative data	The purpose of this data collection was to determine the different types and strength of smells at each of the sites. Unpleasant and pungent smells can contribute to less people accessing the river for recreational purposes, lowering the amenity value of the site.	This data was collected at each of the sites. An aroma wheel was used to identify the type of smell. A scale from 0-10 was then used to assess the strength of the smell, with 0 being very weak and 10 being very strong.	This data was collected on a Friday at 1pm during the summer holidays, as this is when economic activity is likely to be highest. This gave a more accurate result of the type and strength of smell when the site was at its busiest, and therefore its greatest amenity value.

Types of method	Purpose of data	Description of specific data selected	An assessment of the accuracy of the source
Secondary Data - AA traffic news was used to assess the sites qualitative data theaa.com	This information was collected because it shows traffic speed. This provided an indicator of the congestion levels, thus helping answer the sub question of tranquillity levels.	Traffic flow was measured using four categories, with green indicating fast flowing traffic and red indicating slow moving traffic on the AA traffic news website. This data was then compared	The data was collected at the time of primary data collection, so that it was the most accurate for the data collected . The website is updated regularly by the AA so it is a reliable source of information.

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		and contrasted to the information collected in the transport survey.	
Secondary Data - Guildford Borough council's air particles data was used to assess the sites quantitative data	The purpose of collecting this data was to determine the impact of traffic on air pollution levels. By collecting the levels of dangerous air particles such as NO ₂ , it helped to indicate the impact of traffic on the amenity value of the site.	Annual concentration of NO ₂ and PM _{2.5} data was found on the Guildford Borough website, demonstrating the areas in Surrey where pollution is highest. Furthermore, data on the economic and social cost of air pollution was used to identify the impact of congestion on amenity value.	The data is likely to be very accurate as it was a detailed report and it was performed by the local council. However, the report was published in 2019. This means that the data may be less reliable as air pollution levels change over time.
Secondary Data - Maps and Google Earth was used to assess the sites qualitative data	This information was collected because it shows the location of the sites in relation to the road infrastructure of Guildford. This helped to determine the correlation between the distance of the sites to the road and amenity value.	Google maps was used to identify the sites and the facilities around them. OS maps helped show sites clearly and identified the surrounding infrastructure.	Using google earth, maps and OS maps gives a more accurate view of the site. Google earth helped to give an indication of any construction work which could be hindering access to some of the sites. This source is updated by google regularly so is very reliable.

therefore explores the reliability of secondary sources

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Data Presentation And Analysis

Divided bar charts

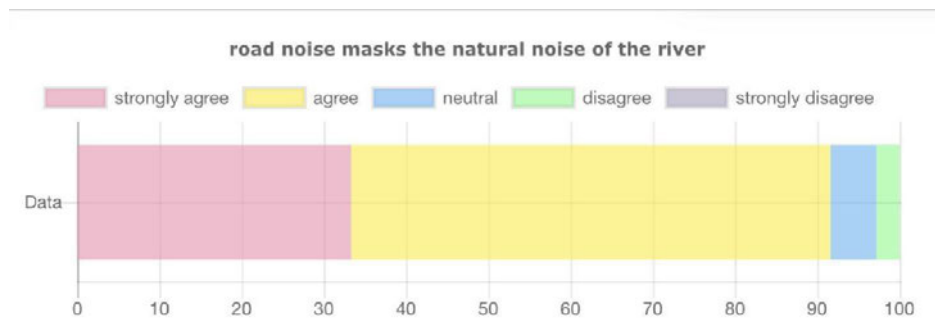


Figure 6 - Stacked divide bar chart demonstrating to what extent participants thought that the road noise masked the natural noise at the river

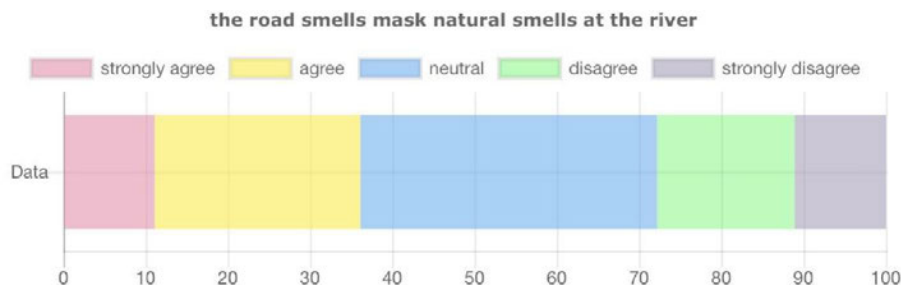


Figure 7 - Stacked divided bar chart demonstrating to what extent participants thought that the road smells masked the natural smells at the river

anonymous
data
presentation
+
accurate

Figure 6 and 7 shows the responses to two questions asked in the questionnaire regarding tranquillity levels. Participants of the questionnaire gave full consent and were kept anonymous to ensure the data collection was ethical.

There was a strong agreement with the statement that 'road noise masks the natural noise of the river', with 91.7% of respondents either strongly agreeing or agreeing. This shows that the reduction of natural noise due to traffic flow at the River Wey has a significant impact on tranquillity levels. Participants were

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also asked their view on the statement that 'the road smells mask natural smells at the river'. There was not a resounding consensus on the effect of traffic on natural smells at the River Wey, with only 48.2% of participants strongly agreeing or agreeing. Instead, 22.2% of participants remained neutral over the matter. It is difficult to interpret what participants meant by 'neutral', and this does not help to answer the sub-question of 'How does traffic affect the tranquillity at different sites?'. A questionnaire without a 'neutral' option would have helped to gauge a better answer to the sub-question.

In conclusion, this data shows the negative impact of traffic on tranquillity levels. There is potential for the data to be invalid as the questionnaire is qualitative data and therefore incurs bias. Furthermore, the views of the participants of the questionnaire may not be representative of the whole population due to the small sample size and opportunistic sampling.

*clear
judgments*

*undesirable
limitations*

Rose Diagram

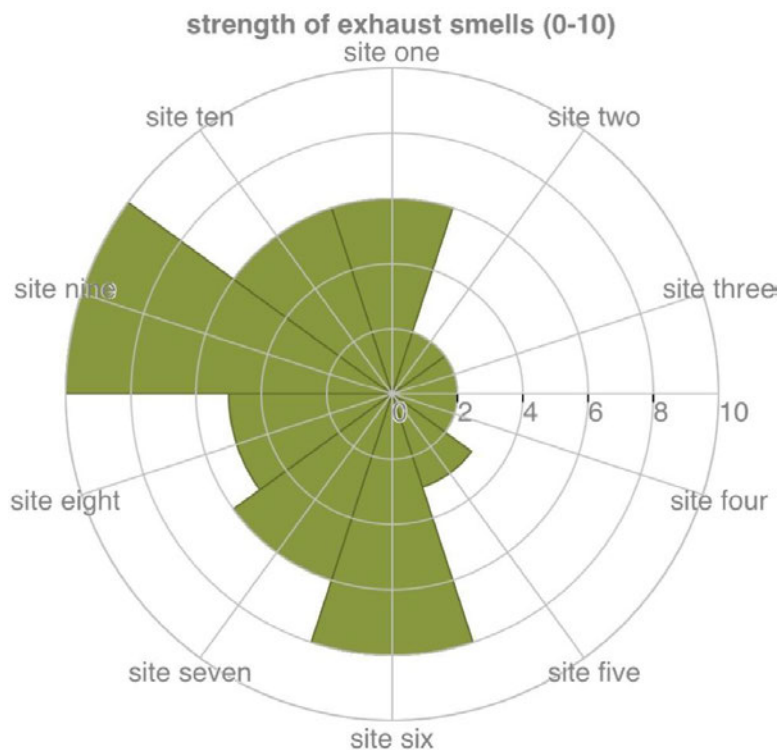


Figure 8 - strength of exhaust smells ranging from 0-10 at each of the sites

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Figure 8 shows the strength of exhaust smells, on a scale from 0-10, at each of the sites. There is a general trend that the strength of exhaust smell increases as you get closer to the peak land value intersection (PLVI). For example, at site 9, which is 0.42km from the PLVI, has the highest strength of exhaust smell. On the other hand, site 3, which is 0.9km from the PLVI, has a very weak exhaust smell. One factor which influences the strength of the exhaust smell at each site is the number of vehicles.

identifies trends

clear judgement

Vehicles emit air pollutants, such as nitrogen oxides, which contributes immensely to the smell of exhausts. Larger vehicles, such as HGVs, exacerbate the smell. For example, according to Figure 9, site 3 had the lowest number of vehicles recorded, 60, and in turn it had one of the lowest strength of exhaust smell recorded of 2. Strong exhaust smells are good indicators of air pollution, which has a significant impact on tranquillity levels.

One reason air pollution has a significant impact on tranquillity levels is its negative impact on health. High levels of harmful air particles, such as nitrogen dioxide, can cause respiratory problems such as asthma, undermining tranquillity levels. Another reason why air pollution has a significant impact on tranquillity levels is its disruption to outdoor activities. For example, many people are discouraged from walking and other outdoor activities in smelly areas. This leads to a decrease in opportunities for relaxation and tranquillity around the River Wey. This data analysis links to the sustainability concept investigated in the investigation. The data analysis shows that the sites with the highest strength of exhaust smells cause low levels of both environmental and economic futurity, suggesting the negative effect traffic has on sustainability.

traces approach

In conclusion, this data links to the overall question because it demonstrates the detrimental effect of air pollution on tranquillity levels. There is potential for the data to be invalid as the data collection was only performed once and the strength of exhaust smells is subjective, creating bias in the results.

Furthermore, the strength of exhaust smells does not have direct causality with air pollution levels, only correlation.

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Transport survey

Figure 9 shows the number of vehicles recorded in a time period of 15 minutes at each site. Vehicles had different weightings to demonstrate the varying impact each type of vehicle has on the urban environment. For example, lorries were weighted as 3 points due to their high contribution to greenhouse gas emissions and harmful pollutants. On the other hand, bicycles were weighted as $\frac{1}{2}$ of a point because of their promotion of sustainable living through zero emissions.

There is a general trend that the number of vehicles recorded increases as you get closer to the peak land value intersection (PLVI). For example, at site 7, which is 110m from the PLVI, the flow of traffic is very high, at 668. This is contrasted

with site 1, which is 1430m from the PLVI, where the flow of traffic is very low, at 75. As the number of vehicles recorded increases, tranquillity levels fall. Noise pollution is one factor which influences

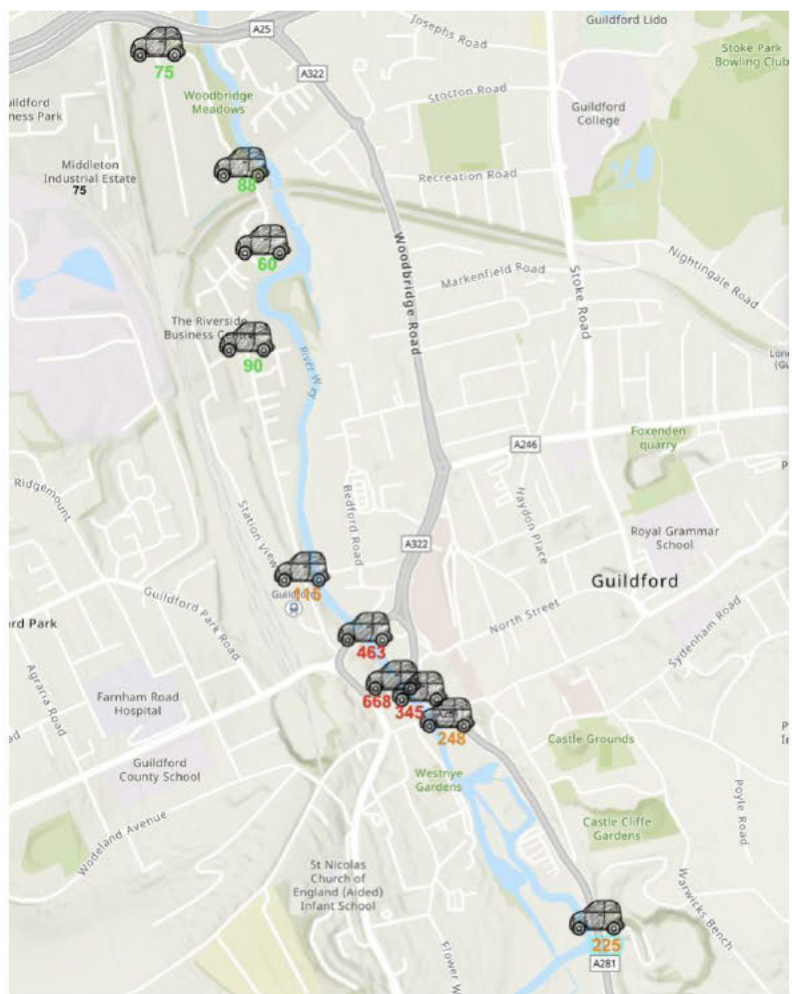


Figure 9 - weighted number of vehicles at each site in a period of 15 minutes

615
1
appropriate
data
representation

To what extent does the road infrastructure and traffic in central Guildford cause a variation in the amenity value of the River Wey?

tranquillity levels. By comparing figure 9 to figure 10, we can deduce that there is a positive relationship between traffic flow and noise pollution. For example, at site 7, where the flow of traffic is very high, there is a noise level of 66dB, one of the highest readings taken. The road noise from the running engines masks the natural noise of the River Wey, reducing tranquillity levels. It is also important to note the high level of traffic regionally, with *Surrey's roads carrying over 60% more than the national average amount of traffic*⁴.

noise reading applied.

In conclusion, this data shows the damaging effects of the close proximity of road infrastructure and therefore volume of traffic on tranquillity levels surrounding the River Wey. There is potential for the data collected to be invalid as the counting was only done once at each timeframe and location. It is also important to note the data was collected during a school holiday period, increasing the number of drivers.

refers to variability

Decibel readings

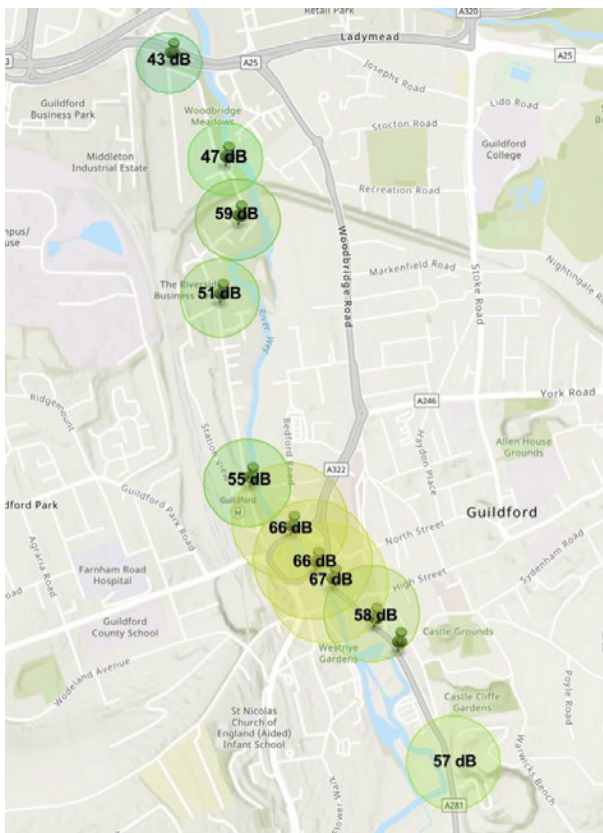


Figure 10 - decibel readings at each site

Figure 10 shows the noise levels at each of the sites, measured in decibels. The readings were taken 3 times at every site and an average was taken.

There is a general trend that noise levels increase as you get closer to the peak land value intersection (PLVI). For example, at site 8 the highest noise level was recorded of 67dB, which is 220m from the PLVI. On the other hand, at site 1 the lowest noise level was recorded of 43dB, which is 1430m from the PLVI. The higher noise levels surrounding the PLVI are caused by higher traffic levels, as supported by Figure 9. This shows the positive relationship between traffic levels and noise pollution. Noise pollution contributes to low amenity values in several ways. This is because road noise disrupts the

can be analysed

<https://www.surreycc.gov.uk/roads-and-transport/policies-plans-consultations/transport-plan/background-and-context>

method GIS

To what extent does the road infrastructure and traffic in central Guildford cause a variation in the amenity value of the River Wey?

peace and quiet of the River Wey, making it less appealing to visitors. Furthermore, noise pollution lowers property value because of the value home buyers place on serenity. This reduction in property value has a significant impact on the amenity value surrounding the River Wey.

In conclusion, high noise levels have a negative effect on amenity value. This data expresses a strong positive correlation between noise pollution and traffic levels. There is potential for the data collected to be invalid as it was only collected on one day. However, an average was taken to increase the validity of the data, and the primary data collected supports secondary research. For example, Collateral Analytics showed that *noise is among the most significant locational factors affecting the value of residential property*⁵, cementing its validity. It is also important to note that this data was collected on 25/08/23, which is in the school summer holidays, a particularly busy time of the year.

judgments
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Spearman's rank correlation coefficient

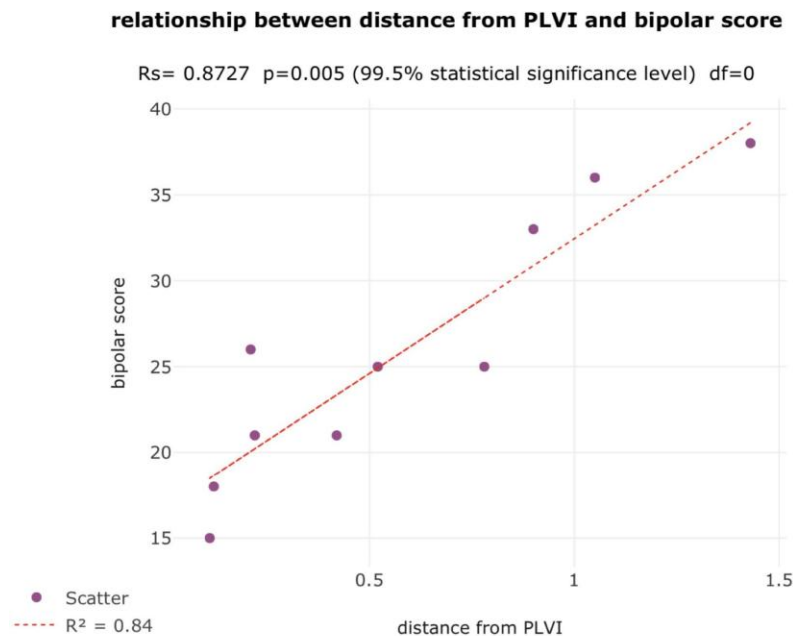


Figure 11 - scatter graph with a line of best fit showing the relationship between the bipolar score and the distance from the PLVI

⁵ Commodious <https://www.commdious.co.uk/knowledge-bank/hazards/noise/measuring-levels>

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appropriate
Statistical
analysis

A Spearman's rank correlation coefficient was calculated to see if there was a relationship between the distance from the peak land value intersection (PLVI) and bipolar score of each of the sites. The bipolar survey had 10 questions, each with different weightings, and scores from 0-5. A higher bipolar score indicated a higher amenity value. The distance from the PLVI was calculated using Google Maps.

The test concluded that there was a strong positive correlation between the distance from the PLVI and bipolar score of each of the sites. The Rs value obtained was 0.8727, suggesting very strong positive correlation. The further the site was from the PLVI, the higher the bipolar score was and therefore the higher amenity value. One factor which influences amenity value is tranquillity levels. The PLVI is defined as *the point in the CBD, often, but not always, at a road intersection, where land values are at a maximum*⁶. In Guildford, the PLVI is at a road intersection with very dense transport links, as it is on a three-lane traffic controlled roundabout next to a train station. This means that tranquillity levels are likely to be low surrounding the PLVI, and therefore there is a lower bipolar score and amenity value. Tranquillity levels were measured using the bipolar survey.

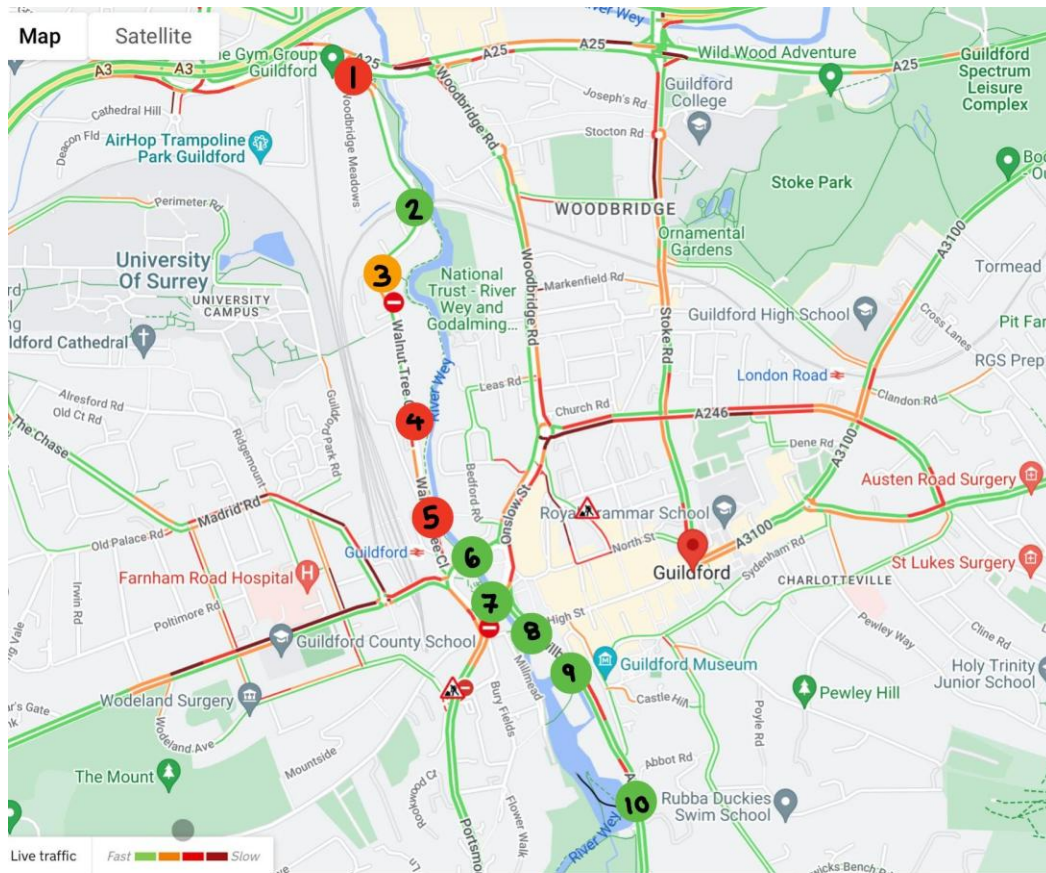
Another factor which influences amenity value is visual value. The sites in close proximity to the PLVI appear as industrial and gritty, due to heavy road infrastructure. In contrast, sites further away from the PLVI have high levels of natural beauty. This means that the visual value of the sites in close proximity to the PLVI are low, and therefore amenity levels are low.

In conclusion, this data shows the damaging effects of heavy road infrastructure and therefore traffic flow on amenity value. There is potential for the data to be invalid as the bipolar survey is subjective and therefore bias was incurred. It is also important to note that this strong positive correlation does not imply causation as one variable may not cause the other. However, it is likely that the data is valid due to the quantitative nature of the Spearman's rank correlation coefficient and the very strong positive correlation.

⁶ Oxford Reference <https://www.oxfordreference.com/display/10.1093/oi/authority.20110803100312811>

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Traffic speed



GIS

Figure 12 shows the speed of traffic at each site. The speed of traffic is measured in 4 categories, with green indicating fast moving traffic and burgundy indicating slow moving traffic. The circles overlaid on the map indicate the speed of traffic at each site, in accordance with the key provided.

There is no general trend between the speed of traffic and road infrastructure surrounding the River Wey. For example, at site 7, which was on a one-way, 4 lane roundabout, the traffic speed was recorded as green, indicating that the traffic was moving fast. However, at site 2, which is a one-way, one lane road, the traffic speed was also recorded as green. This demonstrates that road infrastructure does not have a direct impact on traffic speed, and no conclusions can be drawn on the effect of traffic speed on the amenity value surrounding the River Wey.

clear judgements

To what extent does the road infrastructure and traffic in central Guildford cause a variation in the amenity value of the River Wey?

Photos - depicting road infrastructure in relation to the River Wey



Figure 13 - photos of selected sites along the River Wey

Figure 13 shows the impact that road infrastructure has on visual value and accessibility to the River Wey. Photos were taken at every site, and the most representative photos were chosen and briefly analysed. When the photos were taken, people's faces were avoided to ensure that people's identity remained protected.

etnizal

To what extent does the road infrastructure and traffic in central Guildford cause a variation in the amenity value of the River Wey?

There is a general trend that as the road infrastructure becomes greater, the accessibility to the River Wey decreases. This demonstrates a negative relationship between road infrastructure and accessibility. For example, at site 6 the road infrastructure is dense, as it is a three lane, one-way, traffic light

controlled roundabout. There is no access to the River Wey as there is no path. On the other hand, at site 10 the road infrastructure is minimal, as it is only a two-way road. There is a public footpath running on both sides of the road, and the path leads directly to a further footpath running next to the River Wey. This shows that the less road infrastructure is, the greater accessibility there is to the River Wey.

Another general trend which can be deduced from the data is that as the road infrastructure becomes greater, the visual value of the sites decrease. This demonstrates a negative relationship between road infrastructure and accessibility. For example, at site 8, there is a 3 lane road running directly next to the path. This meant that a railing had to be built next to the path, and it was concreted over. The concrete environment therefore had a negative effect on the River's value, as the presence of road infrastructure supersedes the River's natural beauty. Contrastingly, at site 3, there is a one-way road, and a path

links made to allow clear judgement

running on either side of the river. The path running along the river is set back from the road, demonstrating the minimal road infrastructure at the site. This meant that the visual value of the site was maximised through the large amount of natural beauty at the site.

In conclusion, this data links to the enquiry question because it demonstrates the impact of road infrastructure on both accessibility and visual value. There is potential for the data to be invalid due to the bias encountered when taking photos, and the data was only collected once.

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Guildford Borough's air particle data

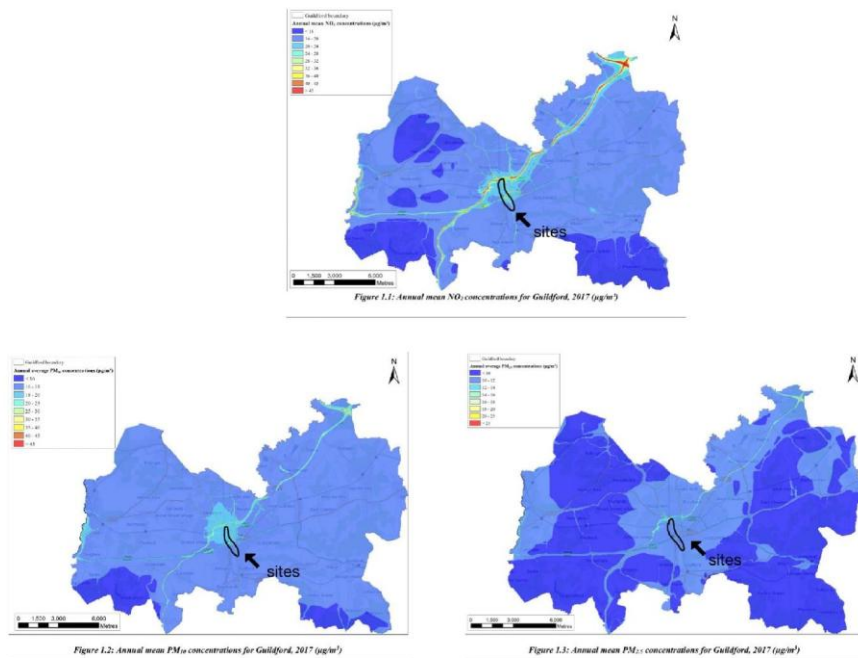


Figure 14 - maps showing the concentration of NO₂, PM₁₀, PM_{2.5} concentration in Guildford, taken from Guildford Borough Council

used secondary data.

Figure 14 shows the concentration of air pollutants in the Guildford region. The data was taken from a report by Guildford Borough council website in 2019. The air pollutants recorded were NO₂, PM₁₀ and PM_{2.5}.

There is a general trend that as the density of the road infrastructure, the concentration of air pollutants increases. For example, the annual mean concentration of NO₂ along the A3, which is a large, fast-flowing road, is above 40 micrograms per cubic metre of air. On the other hand, along the sites in Guildford where the data was collected, the highest value of NO₂ concentration is 36 micrograms per cubic metre of air. This is because the road infrastructure of the sites mostly consisted of one-lane, two-way streets. NO₂, PM₁₀ and PM_{2.5} are all by-products of combustion, so they are found in the greatest concentration where traffic flow is very high. However, this level is still above national weekday average, as in 2022, the Monday-to-Friday mean concentration at roadside sites was 25.2 µg/m³.⁷ This high air pollutant concentration has negative effects on tranquillity levels. Air pollution levels are affected by high levels of congestion, as running engines emit carbon dioxide and other pollutant

⁷ Gov UK <https://www.gov.uk/government/statistics/air-quality-statistics/nitrogen-dioxide>

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applies key concepts

particles such as NO₂. This links to the specialised concept of *causality*, as high air pollution is an indirect cause of lower tranquillity levels. From this data, we can conclude that air pollution levels are higher where the density of traffic is great. In Guildford, the highly congested and therefore polluted sites surrounding the PLVI will have a negative impact on the tranquillity levels at the River Wey. This is because poor air quality has many harmful health impacts, such as stress and discomfort.

In Conclusion, this data shows how the close proximity of road infrastructure and therefore volume of traffic has a negative impact on tranquillity levels surrounding the River Wey. There is potential for this data to be invalid as the report was produced in 2019, and my data collection was done in 2023.

Furthermore, the map provides a general overview of pollution in Guildford, which is not specific for the area in which my data was collected. However, it provides supporting secondary data to the results of my data analysis, increasing the validity of my conclusions.

Pie Charts

'the road infrastructure has detracted from the visual value of the river'

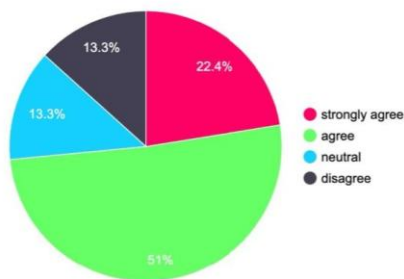


Figure 15 - Pie chart from the questionnaire question: 'to what extent do you think the road

infrastructure has detracted from the visual value of the river?'

which factor do you think detracts from the appearance of the river the most?

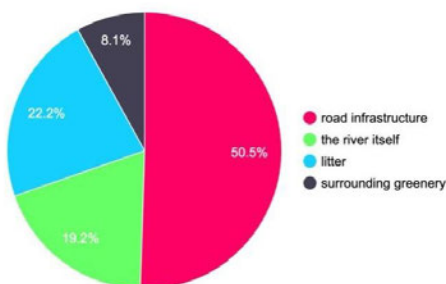


Figure 16 - Pie chart from the questionnaire question: 'which factor do you think detracts from the appearance of the river the most?'

Figure 15 and 16 shows the responses to two questions in the questionnaire regarding the impact of the road infrastructure on the visual value of the River Wey. Participants of the questionnaire gave full consent and were kept anonymous to ensure that the data was collected ethically.

There was general agreement with the statement 'The road infrastructure has detracted from the visual value of the river', with 73.4% of respondents choosing either strongly agree or agree. Following this question, participants were asked 'which factor do you think detracts from the appearance of the river the most?'. There was a narrow

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majority of 50.5% of the respondents thinking that the road infrastructure was the most significant factor out of surrounding greenery, litter and the river itself. This shows that the surrounding road infrastructure significantly reduces the visual value of the River Wey. This is because the roads running next to the river are very close, interfering significantly with the natural beauty of the river. Instead of pristine flora surrounding the river, pavements are often running alongside in order to aid the road infrastructure. For local residents of Guildford, the road infrastructure significantly diminishes the utility they derive from the visual aesthetic of the River Wey.

In conclusion, this data shows the negative impact of the close proximity of the road infrastructure in Guildford on the River Wey. However, there is potential for some invalidity in the data due to the bias of the questionnaire. Some participants may not have noticed the impact of road infrastructure on the River Wey before being asked.

Conclusion and critical evaluation

How does the road system affect the visual value at different sites?

Overall, a dense road system negatively impacts the visual value at different sites. 73.4% participants of the questionnaire agreed in some form that the road infrastructure did somewhat detract from the visual value, and 50% cited that the road infrastructure was the main detriment to the River Wey's visual value. When the road infrastructure was in closer proximity to the sites, it increased the negative impact that it had on the visual value. For example, Guildford's one way system, which was where sites 6 and 7 were located, entirely takes away from the natural beauty of the river, due to the magnitude of the road infrastructure itself and the lack of integration of the road infrastructure with the natural river surroundings. The lack of good urban planning by Guildford Borough Council has contributed to an unsustainable road infrastructure system, because of the large negative environmental impact on the River and congestion associated with the road. This has wider implications on Guildford and the surrounding community, as many studies have shown that *transportation infrastructure has an enormous impact on sustainable development*⁸. However, it is important to consider the other factors which can cause a decrease in the visual value at the different sites.

How does traffic affect the tranquillity at different sites?

⁸ NIH <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6025045>

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To what extent does the road infrastructure and traffic in central Guildford cause a variation in the amenity value of the River Wey?

High volumes of traffic has significantly decreased the tranquillity at different sites in Guildford. Tranquillity is influenced by a variety of factors including air quality, noise pollution and smells. All the data collected showed the negative impact that congestion had on the tranquillity at different sites. For example, decibel readings were significantly higher at Guildford's one way system, and secondary data showed the high concentration of air pollutants surrounding busy, congested roads. These sites also tended to have a strong exhaust smell associated with them, contributing to a less peaceful area. However, there are many other factors excluding traffic which can cause tranquillity. For example, large green spaces are important in obtaining tranquillity because they can offer a place of relaxation and recreation. Large, accessible green spaces running alongside the River Wey at the different sites would help to reduce the impact of traffic on tranquillity levels. Furthermore, the closer the traffic was to the different sites decreased the levels of tranquillity further. This is because the traffic's invasion of the natural river environment was more prevalent. It is also important to note that the data collection was not collected more than once, so the variation in tranquillity levels temporally cannot be deduced. Nevertheless, traffic is a significant factor in affecting the tranquillity at different sites.

How does the road infrastructure affect access to the river and land available for recreation at selected sites?

Road infrastructure has a somewhat negative impact on the access to the river and land available for recreation at the selected sites. For example, Guildford's one way system consists of a three lane, traffic light controlled roundabout, which is dense road infrastructure. This made access to the river very difficult at sites 6 and 7 as demonstrated through Figure 13. The dense road infrastructure also negatively impacts recreational land because of safety concerns due to inadequate pedestrian infrastructure. Furthermore, the one way system crosses the River Wey, disrupting the natural river ecosystem and therefore reducing the size and quality of recreational space surrounding the River Wey. However, access to the river and land available is also dependent on the distance of the road from the river. For example, at site 8 there is a barrier between the road infrastructure and the river recreation land. Although the recreational land isn't attractive, it is still accessible and therefore helps to minimise the impact of the road infrastructure of the sites surrounding the River Wey. Furthermore, there was little difference in accessibility to the River Wey between the one way and two way roads. This relatively light road infrastructure provided a sustainable balance between efficient transportation and

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accessibility. Access to the River Wey and land available for recreation will become increasingly important for the sustainable

future of Guildford. Between 2011 and 2021, Guildford's population increased by 4.7%, *from around 137,200 in 2011 to 143,600 in 2021*⁹. This increase in population density will result in a greater demand for recreational land, so it is important that access to the River Wey is maintained and not hindered by the surrounding road infrastructure.

Conclusion:

Overall, it can be concluded that road infrastructure and traffic in central Guildford causes a significant spatial variation in the amenity value of the River Wey. For example, at sites one and two, where there was light road infrastructure and little traffic, the amenity value was significantly higher than at sites 6 and 7, where the road infrastructure was dense and the traffic flow was heavy. During rush hour, where the traffic flow is heavier, it is likely that the traffic flow will increase, and the variation in amenity value will further increase. However, in order to conclude this, further data analysis is needed to demonstrate the temporal variation in amenity value. The analysis of the data above suggests that the road infrastructure and traffic significantly influences the visual value, accessibility and tranquillity of all of the sites, having negative impacts on the sites. The amenity value of the sites are intricately linked to the visual value, accessibility and tranquillity of the surroundings. As road infrastructure plays an increasingly important role in connectivity, their design and maintenance is crucial in minimising increasing congestion in central Guildford and protecting the River Wey from environmental damage. This links to the specialised concept of *sustainability* as the protection of the river environment and in turn the air quality is significant for the amenity value of the properties surrounding the River Wey. However, it is important to note the varying significance of visual value, accessibility and tranquillity on amenity value. It was concluded that the road infrastructure and traffic in central Guildford had the most significant impact on tranquillity levels and visual value, but accessibility's impact was only somewhat significant. However, studies have shown that the most significant factor influencing amenity value is accessibility. For example, *living within or in close proximity to desirable natural areas and environmental resources provides numerous opportunities for recreation, leisure and wildlife viewing, but also the possibility of*

clear overall conclusion

newly applied

⁹ ONS <https://www.ons.gov.uk/visualisations/censuspopulationchange/E07000209>

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*improved physical health*¹⁰. It could have been valuable to provide weightings for each sub-question because of the variation in their impact on amenity value.

However, by recognising the impact that road infrastructure and traffic has on amenity value, Guildford Borough Council should make a concerted effort to address the importance of holistic urban planning and transportation management. The challenges caused by road infrastructure and traffic needed to be managed in order to contribute positively to the amenity and quality of life for residents surrounding the River Wey.

Wider implications of the study:

The theory of sustainability within town centres can be applied to many towns across the UK. In particular, many suburban towns, like Guildford, have experienced population increases due to counter-urbanisation created from the COVID 19 pandemic. The COVID 19 pandemic demonstrated the value that home-owners place on well-maintained green spaces in close proximity to them. Therefore, the importance of balancing efficient road infrastructure and traffic systems with natural environments, including rivers, has never been more important for the economically viable and sustainable future of suburban towns. Guildford Borough Council should continue research into plans for a congestion charge in central Guildford, as it would help to reduce traffic and congestion, particularly for the one-way system. This is particularly important as, in the data collection, the one-way system was found to have the lowest amenity value due to the high volumes of traffic and congestion.

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London's Ultra Low Emission Zones (ULEZ) is an example of success in minimising traffic congestion. For example, *in inner London, pollution levels are 21 per cent lower than they would have been without the ULEZ*¹¹.

comparable
examples
+
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terms
of health

This has resulted in *current evidence suggesting that LEZs can reduce air pollution-related health outcomes, with the most consistent effect on cardiovascular disease*¹². As shown by the data collection

¹⁰ LSE research <https://core.ac.uk/download/pdf/17183352.pdf>

¹¹ TFL

<https://tfl.gov.uk/info-for/media/press-releases/2023/august/the-uks-largest-ever-scrappage-scheme-now-open-to-all-londoners-with-a-non-compliant-car#:~:text=A%20year%20after%20the%20inner,in%20inner%20London%20%5B6%5D>.

¹² The Lancet [https://www.thelancet.com/journals/lanpub/article/PIIS2468-2667\(23\)00120-2/fulltext](https://www.thelancet.com/journals/lanpub/article/PIIS2468-2667(23)00120-2/fulltext)

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and the specialised concept of *causality*, good air quality is vital for high tranquillity levels and therefore amenity value. However, this project was done on a large scale and air quality was a lot worse in London

than in central Guildford. However, for Guildford planners and stakeholders, it is worth considering a more moderate scheme, such as LEZs, for Central Guildford.

Guildford's current transportation system needs to be improved in order to meet the needs of the future generation. For example, *demand for travel is currently closely linked to population growth, with the South-East region accounting for 80% of the UK's projected population of 70.4 million by 2030¹³*. In order to minimise the growth in congestion experienced by the increase in population, Guildford's road infrastructure needs to be updated, as the data collection shows its negative effect on accessibility, tranquillity and visual value.

Guildford has the potential to become a model for the future of sustainable transport and living in suburban towns, and the findings from this investigation can be applied to other suburban towns when assessing the need for a more sustainable transport system. For example, the findings could be applied to Walton on Thames, which has the River Thames running alongside road infrastructure. Walton on Thames has also experienced similar population growth to Guildford, with Elmbridge population growth at 6.1%¹⁴. Heavy road infrastructure also runs alongside and across the River Thames, which has negative impacts on accessibility to the river; the visual value of the surroundings and tranquillity levels.

Therefore, the UK government could explore the possibility of expanding the already existing Low Emission Zone to Walton on Thames, a more moderate version of the ULEZ, or a congestion charge on Walton Bridge Road, which crosses the River Thames.

interesting
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Reliability of evidence and validity of conclusion:

The most reliable data was obtained through the decibel readings. The decibel readings were collected 3 times at every site and an average was calculated, which made the data very reliable. Furthermore, the data was quantitative which meant it wasn't subjected to bias and was valid. A strong general trend was identified, with strong positive correlation between the distance from the PLVI and noise levels. This correlated with tranquillity levels being significantly lower in the PLVI, suggesting variation along the

¹³ Surrey County Council

<https://www.surreycc.gov.uk/roads-and-transport/policies-plans-consultations/transport-plan/background-and-context>

¹⁴ ONS <https://www.ons.gov.uk/visualisations/censuspopulationchange/E07000207>

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River Wey. Although it cannot be concluded from the data analysis that high noise levels cause lower amenity values, it suggests that noise levels indirectly have an impact on amenity value. This form of

data collection was the most effective as it helped to conclude both the impact of noise levels on tranquillity and amenity value, helping to form an overall judgement.

Another reliable piece of data was Guildford Borough's map of Guildford on air particle data. It provided strong evidence to support my other data analysis, such as the transport survey. In my transport survey, there was a strong positive correlation between the density of road infrastructure and flow of traffic. This was supported by Guildford Borough Council's data, which suggested that as the road infrastructure became more dense and therefore the flow of traffic was greater, the presence of harmful air particulates, such as nitrogen dioxide, increased. This helped me to conclude that there was significant variation along the River Wey in air pollution, and therefore variation in amenity value. However, the map provided by Guildford Borough Council was a map of the entire of Guildford, and not focused on the sites which I had chosen. In hindsight, it would have been more reliable to find data specific to central Guildford on air particle data. Furthermore, it is important to note that none of the data collection gives a direct answer to any of the sub-questions and leaves a lot of room for interpretation, which may leave room for error.

The least reliable data was obtained through the AA's traffic speed map. Although the data was from a wider organisation, no general trend was found linking traffic speed and road infrastructure.

Furthermore, no strong evidence was provided in the impact that traffic speed had on amenity values. It would be beneficial to obtain more secondary data on how traffic speed impacts air quality.

It would be valuable to assess how different functions within central Guildford impact amenity values.

For example, the importance of tranquil surroundings is likely to be less significant for areas with a transportation function, such as the one-way system. The lower tranquillity levels may not contribute significantly to the amenity value of that particular area of central Guildford, due to its transportation function which does not require tranquil surroundings. The data would be more valid if there was a further enquiry into the different factors contributing to amenity value for different functions of areas.

Overall, this investigation has shown that road infrastructure and traffic in central Guildford does cause a variation in the amenity value along the River Wey. Recognising this, it is imperative that Guildford urban planners look to balance the efficient function of central Guildford with the environment for a sustainable future.

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Appendix

Null hypothesis- there is no correlation between the distance from the PLVI and the bipolar score

Alternative hypothesis - there is correlation between the distance from the PLVI and the bipolar score

Distance from PLVI (km)	Rank A	Bipolar Score	Rank B		
1.43	1	38	1	0	0
1.05	2	36	2	0	0
0.9	3	33	3	0	0
0.52	5	25	5.5	0.5	0.25
0.21	8	26	4	4	16
0.12	9	18	9	0	0
0.11	10	15	10	0	0
0.22	7	21	7.5	0.5	0.25
0.42	6	21	7.5	1.5	2.25
0.78	4	25	5.5	1.5	2.25
					21

$$R_s = 1 - \frac{6 \sum D^2}{n(n^2 - 1)} = 1 - \frac{6 \times 21}{10(100 - 1)} = 0.827$$

Where R_s = Spearman's rank correlation coefficient, D = difference between the two ranks of each observation, n = number of observations. The Spearman's rank correlation coefficient was carried out to a statistical significance level of 99.5%.