

# Chelmsford Draft Local Plan

**Examination Hearing Statement** 

Matter 9: The Environment

November 2018



# Introduction

- 1. This hearing statement sets out the Council's response in relation to the Inspector's Matters, Issues and Questions.
- 2. All the evidence base documents referred to in this statement are listed at **Appendix A**, with their evidence base or examination document reference numbers as applicable.

# Matter 9 – The Environment

gic Policy S13 includes seeking to protect Green Belt from ropriate development. CO1 echoes this but also adds 'except in very special
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nstances.'
CO2 sets out criteria for new buildings or structures within reen Belt.
CO5 sets out criteria for infilling in the Green Belt.
CO6 provides criteria for changes of use and engineering tions.
CO7 identifies criteria for extensions to existing buildings in reen Belt.
CO8 sets out criteria for rural and agricultural/forestry ers' dwellings.
ese policies consistent with national policy on Green Belt?
what changes are necessary to make them compliant?
ecessary to repeat national policy in the Plan?

### Response to Q84

# Policy CO1 – Green Belt, Green Wedges, Green Corridors and Rural Areas

- 3. The Council is satisfied that Policy CO1 is consistent with national policy and that no changes are necessary.
- 4. The wording of Policy CO1 reflects the wording of the NPPF (2012). Paragraph 79 of the NPPF (2012) states that "The fundamental aim of Green Belt policy is to prevent urban sprawl by keeping land permanently open; the essential characteristics of Green Belts are their openness and their permanence". Policy CO1 sets out the planning objectives for each of the countryside designations, which includes the Green Belt. Section A) states that the "openness and permanence of the Green Belt will be protected", in line with paragraph 79 of the NPPF (2012). The policy also reflects the wording of paragraph 87 of the NPPF (2012) by stating that "Inappropriate development will not be approved except in very special circumstances".

5. Whilst Policy CO1 does partly repeat national policy, this is considered necessary because CO1 is an overarching countryside policy, which clearly sets out the objectives for each of the different countryside designations, including those that are locally defined. The City Council has a local approach to undeveloped areas therefore, for consistency and clarity it is considered necessary to include the objectives for Green Belt in the same way that the objectives are set out for Green Wedge, Green Corridors and Rural areas.

# Policy CO2 – New Buildings and Structures in the Green Belt

6. Subject to a main modification as set out below, Policy CO2 is considered to be consistent with the NPPF (2012). Criteria A) i), ii), iii) v), vi), vii), viii) and ix) are all reflective of the wording of paragraphs 89 and 90 of the NPPF (2012), which set out the exceptions to inappropriate development. Criteria iv) as written allows for new buildings for education and community uses which can demonstrate a requirement for a Green Belt location. It is recognised that this part of the policy needs to be modified to comply with the NPPF (2012). A main modification to the policy is therefore proposed as follows:

### Proposed changes:

Delete criterion A. (iv) of Policy CO2.

Amend the text of paragraph 8.49 of the Reasoned Justification to:

The Council acknowledges that due to the extent of the Green Belt in Chelmsford there may be instances where new buildings related to community or educational uses may be proposed e.g. a new village hall, new ancillary buildings related to an existing school. In accordance with the NPPF, these types of uses will be considered inappropriate development. However, the locational need for these types of uses will be given appropriate weight when considering whether there are very special circumstances that weigh in favour of the proposals.

7. Criteria B) reflects the wording of paragraph 89, bullet point 6 and adds greater clarity for the decision maker in how to assess these types of developments. Criteria B), i-iii) provides a comprehensive method for assessing the visual and physical impact of redevelopment of brownfield sites in the Green Belt. Criteria iv) seeks to ensure that redevelopment of brownfield sites does not result in developments (such as residential properties) in unsustainable locations. Criteria iv) seeks to encapsulate paragraph 30 of the NPPF (2012) into the policy, which states that "local planning authorities should support a pattern of development which, where reasonable to do so, facilitates the use of sustainable modes of transport".

- 8. Part C of Policy CO2 also reflects the wording of paragraph 89 of the NPPF (2012) in relation to replacement of buildings with changes of emphasis to address local circumstances. The requirement for the building to be of permanent and substantial construction is to avoid the replacement of shacks or dilapidated buildings which through the passage of time have blended into the landscape. To replace buildings which may only have had a short life expectancy would be perpetuating the built form which may otherwise have terminated in the short/mid-term. This is set out at paragraph 8.52 of the reasoned justification.
- 9. Part D) relates to the provision of residential outbuildings. It is recognised that this element of the Policy needs to be deleted to comply with the NPPF (2012)
- 10. A main modification to the policy is therefore proposed as follows:

### Proposed changes:

Delete criterion A. (x) and D) of Policy CO2.

Delete the last two sentences of paragraph 8.48 of the Reasoned Justification.

### Policy CO5 – Infilling in the Green Belt, Green Wedge, Green Corridor and Rural Area

11. Policy CO5 is consistent with paragraph 89 bullet point 5 of the NPPF (2012), which states that limited infilling in villages is not inappropriate development. The Policy qualifies what "limited" means by requiring the site to be "a small gap in an otherwise built up frontage" and "limited so as not to impact unacceptably on the function and purpose of the Green Belt". The reasoned justification at paragraph 8.73 also provides clarity on what constitutes a "village" in the Chelmsford context. Policy CO5 is consistent with paragraph 89 of the NPPF (2012).

# Policy CO6 – Change of use (land and buildings) and Engineering Operations

- 12. Paragraph 89, bullet point 3 of the NPPF (2012) allows for "the extension or alteration of a building provided that it does not result in disproportionate additions over and above the size of the original building". Paragraph 90 allows for the "re-use of buildings provided that the buildings are of permanent and substantial construction". Policy CO6 is consistent with these paragraphs of the NPPF (2012). The change of use of land in the Green Belt is specifically omitted from section A of the Policy because the NPPF (2012) does not list this as an exception to inappropriate development. It is recognised, however, that the re-use of a building can result in alterations to the use of its curtilage and criterion iii) seeks to ensure that any such change would not be harmful to the openness of the Green Belt. This is a pragmatic approach to these types of development as it would be unrealistic to expect, for example, a barn re-used as a dwelling not to have any domestic outdoor use associated with it, or a commercial re-use not to have any parking. Policy CO6 therefore seeks to control the impact of these associated uses on the Green Belt.
- 13. In order to avoid abuse of the policy and therefore buildings being constructed in the Green Belt where they might not otherwise be, the policy includes a requirement iv) where the building was constructed less than ten years ago for the purposes of agriculture it can be demonstrated that it is no longer required for agriculture. Secondly, to ensure that the building must have been originally constructed and used for the purpose intended and not with a view of re-using it in the future as a dwelling, the policy requires that for conversions to dwellings, the building must have been constructed more than ten years ago. This is consistent with the fundamental aim of Green Belt policy "to prevent urban sprawl by keeping land permanently open" (paragraph 79 of the NPPF (2012)).
- 14. Policy CO6 is consistent with national policy and takes into account local circumstances.

# Policy CO7 – Extensions to existing buildings within the Green Belt, Green Wedges, Green Corridors and Rural Area

- 15. Policy CO7 part A) I) is consistent with paragraph 89 bullet point 3 of the NPPF (2012). The reasoned justification, paragraph 8.83 advises that "original building" means that as built at 1<sup>st</sup> April 1974 due to this being the date at which the current district was formed.
- 16. Part A) ii) reflects the necessity of all development to "seek to secure high quality design and a good standard of amenity for all existing and future occupiers of land and buildings" (Core principle 4, paragraph 17 of the NPPF (2012))
- 17. Policy CO7 is consistent with national policy and takes into account local circumstances.

# Policy CO8 – Rural and Agricultural/Forestry Workers' Dwellings

- 18. Paragraph 55 of the NPPF (2012) states that local planning authorities should avoid new isolated homes in the countryside unless there are special circumstances such as the essential need for a rural worker to live permanently at or near their place of work in the countryside. This does not of course relate to the Green Belt. The Council's administrative area does, however, have numerous farmsteads within the Green Belt where the need for an agricultural/forestry workers dwelling could arise.
- 19. In order to avoid mis-use, the Council requires any proposal for a new agricultural/forestry workers dwelling to meet all the criteria set out within the policy, which in the case of a new start up business may mean the temporary siting of a caravan, which would otherwise be inappropriate development in the Green Belt. The Council's interpretation of paragraph 89 of the NPPF (2012) is that caravans or dwellings for agricultural workers are inappropriate development in the Green Belt. Policy CO8 therefore requires very special circumstances, which clearly outweigh the harm to the Green Belt, to be demonstrated if an agricultural/forestry workers dwelling or caravan is to be permitted. The functional and financial tests of Policy CO8 are rigorous to ensure that a new dwelling in the Green Belt can be justified. This is to ensure that the fundamental aim of Green Belt Policy, to keep land permanently open and to prevent urban sprawl, is maintained.
- 20. Policy CO8 is therefore consistent with national policy and takes into account local circumstances.

Q85	Strategic Policy S13 also states that the main river valleys are identified as valued landscapes and designated as green wedges and green corridors. This is reiterated in Policy CO1.
	<ul> <li>a. Are these valued landscapes in the context of paragraph 109 of the Framework and if so is this based on robust evidence and are they clearly justification?</li> <li>b. How have green wedges and green corridors and their respective boundaries been determined? Are their designations supported by appropriate methodologies and criteria?</li> <li>c. Have the purposes of green wedges and green corridors been clearly defined within the Plan and does land with their boundaries meet the required purposes?</li> </ul>

# Response to Q85a

- 21. The definition of river valleys directly responds to para 109 of the NPPF (2012) in identifying valued landscapes, for protection and enhancement as part of the Green Infrastructure of the City. Their definition also responds to the requirements in the NPPF (2012) that:
  - the health and well-being of communities should be recognised through recreational provision (para. 73 of the NPPF (2012)).
  - appropriate weight should be given to the importance and contribution of protected wildlife sites and landscape areas (para. 113 of the NPPF (2012)).
  - Local Plans should plan positively for the creation, protection, enhancement and management of networks of biodiversity and green infrastructure (para. 114 of the NPPF (2012)).
  - Local Plans should also include policies which plan for biodiversity at a landscape scale across local authority boundaries, and should identify and map components of local ecological networks (para. 117 of the NPPF (2012)).
  - Local Plans should contain a clear strategy for enhancing the natural, built and historic environment, and supporting Nature Improvement Areas where they have been identified (para. 157 of the NPPF (2012)).
- 22. Green Wedges and Green Corridors are identified as locally valued landscapes of particular significance to the identity of the City which is founded on the valleys of the Rivers Chelmer, Can and Wid. **TP005** summaries their respective roles as follows:

5.7 "The purpose of Green Wedges is to maintain and protect the open character of the landscape of the river valleys, to provide physical links between the urban area of Chelmsford and the countryside beyond, to provide an important network of natural habitats and various formal and informal leisure and recreation uses. The Green Wedge designations have previously been successful in protecting harmful development and maintaining the character of Chelmsford. The City Council has successfully defended these principles at appeals for development in the Green Wedge. Their continued protection is seen as a key structural element of the new Local Plan.

5.8 Additionally, the Green Wedges and Green Corridors Review Report 2017 **(EB094)**, also identified 'Green Corridors' which have been included as a local landscape designation within the Pre-Submission Local Plan. These areas are identified for the protection of the special qualities of their landscapes, recognising their role as working landscapes and that some development will occur, but this should be particularly sensitive to the River Valley landscape."

The principle of Green Wedges as planning and landscape management instrument was established in the adopted Core Strategy (2008) where the Inspector in his report (EB164) noted that:

4.138 "The historic character and landscape of the District, its town centre and the surrounding urban area have been defined and shaped by its rivers, their valleys and flood plains. Those valleys have been, and will continue to be, essential in maintaining that distinctive local character that is such an important and attractive feature of the district. <u>Their loss or erosion should not be countenanced</u>" [emphasis added].

4.139 "The rivers and their valleys act as green lungs providing important amenity, recreation, nature conservation habitats, corridors for wildlife and attractive open riverscape features that give definition and contrast to the townscape through which they run. <u>In my view, the river valleys represent crucial and irreplaceable landscape features that are important and distinctive in making Chelmsford what it is</u> [emphasis added]. Accordingly, I see the policies as being necessary to give coherence to, and recognition of, the importance that river valleys and flood plains make in defining the urban landscape and its connection with the rural hinterland. They are deserving of special protection, which could be diminished or eroded in a general criteria-based policy. The need for special protection is justified by the intense pressure to develop any open land in, or adjacent to, the built-up areas of the District."

- 24. The current boundaries of the Green Wedges were defined in subsequent Area Action Plans (EB119, EB120, EB163 & EB165).
- 25. A comprehensive survey of the river valleys has been undertaken **(EB094A & EB094B)** which established the boundaries of the river valleys and mapped their functions. Together these provide convincing evidence underpinning their designation, responding directly to the requirements of the NPPF (2012).
- 26. **EB094A & EB094B** have formed part of evolution of the Local Plan and the evidence presented has been an important aspect of the consultation process which invited comments on the rationale for, and proposed boundaries of, the Green Wedges and Green Corridors.

27. The Green Wedges and Corridors are valued landscapes that are based on robust evidence, which is clearly justified.

### **Response to Q85b**

- 28. The extent of the Green Wedges and Green Corridors have been determined through systematic survey and analysis (EB094A & EB094B).
- 29. The starting point for the definition of Green Wedges and Green Corridors are the existing Green Wedges and the 2006 Landscape Character Assessment **(EB099)** which identifies the distinctive river valley landscapes of the Chelmer, Can and Wid as a River Valley Landscape Character Type which is sub-divided into three Landscape Character Areas. The approach taken to the survey is set out in Chapters 2 and 3 of **EB094A** which is based on best practice from equivalent studies around the country (for example Derby, Harrogate and Leicester/Harborough/Blaby/Oadby/Hinckley & Bosworth), that is identifying the spatial unity and distinctive character of the river valleys in visual and functional terms.
- 30. The purposes of Green Wedges and Green Corridors have been determined in relation to the multifunctional role of the river valleys as distinctive landscape, biodiversity, recreational and historic entities which merit protection and enhancement. These roles were established through the survey of 23 individual land parcels identified along the river valleys, and identified boundaries which define their extent, in terms of landscape character, recreational, historic and nature conservation functions.
- 31. No substantive objections to the principle of the designation Green Wedges or Green Corridors have been raised throughout the preparation of the Local Plan. On the contrary, there has been widespread support from private individuals and developers who recognise their importance as assets which complement and enhance new development and the character of the City as a whole. The boundaries of the Green Wedges and Green Corridors are clearly based on a comprehensive and robust evidence base.

### **Response to Q85c**

32. The multifunctional roles of Green Wedges and Green Corridors is established in the evidence study **(EB094A)** which identifies the river valleys as recognisable landscape entities but notes the changing balance of their functions from the urban and suburban areas of the City to the open countryside. These complementary roles are summarised in the supporting text to Policy CO1 (para 84.3) of the Submission Plan **(SD001)**.

- 33. The functions and complementary roles of the Green Wedges and Green Corridors are recognised in the intention of the proposed policies CO1 to CO8 of **SD001**. These take a pragmatic approach to recognising that the river valleys are landscapes which will evolve; the policies are designed to guide this evolution such that the essential landscape and general character of the river valleys endures and will contribute to the sustainable development of the City.
- 34. All land within the Green Wedges and Green Corridors is judged to meet the purposes established for them as part of the distinctive landscape of the river valleys, and variously performing recreational, biodiversity and cultural heritage roles, and specifically in the case of Green Wedges, a place-shaping function.
- 35. Green Wedges and Green Corridors are fundamental to the rationale for, and delivery of, the Green Infrastructure Strategic Plan (EB021A & EB021B). The Green Infrastructure Strategic Plan has been developed around the river valleys as an irreplaceable multifunctional resource, with a clear link between the Green Wedges and Green Corridors and the Green Infrastructure Strategic Plan set out in EB094A.
- 36. Establishing the physical framework of Green Infrastructure through the designation of the river valleys as Green Wedges and Green Corridors accords with the requirement in the NPPF (2018) that:

171. "Plans should: distinguish between the hierarchy of international, national and locally designated sites; allocate land with the least environmental or amenity value, where consistent with other policies in this Framework; take a strategic approach to maintaining and enhancing networks of habitats and green infrastructure; and plan for the enhancement of natural capital at a catchment or landscape scale across local authority boundaries."

Question 86	Are the criteria for green wedges and green corridors set out in Policies CO3, CO5, CO6, CO7 and CO8 justified, effective and consistent with national policy?

# Response to Q86

37. The Council's position is that the criteria set out in Policies CO3, CO5, CO6, CO7 and CO8 are justified, effective and consistent with the NPPF (2012) which seeks at paragraph 109 to protect and enhance valued landscapes, at paragraph 113 to protect wildlife or landscape areas and paragraph 117 to plan for biodiversity at a landscape scale.

- 38. Policies CO3, CO5, CO6, CO7 and CO8 take forward the established principle of the identification of the river valleys as valued landscapes. The policies recognise their distinctive character and multifunctional role which merits protection from development which would materially harm their character and function. In doing so, the policies seek to preserve the quality of openness (**EB094A**) and therefore landscape character which defines the river valleys and ensure that their wider functions relating to biodiversity, flood prevention, recreation and cultural heritage are protected. As noted in the response to Question 85, the river valleys are a defining feature of the City's character that is irreplaceable, the Council has a duty to protect, and the unmerited erosion of which should not be countenanced.
- 39. The policies are pragmatic in their tone and intended application, recognising that the Green Wedges and Green Corridors are working landscapes and development which is demonstrably required, is proportionate and sensitively planned can be acceptable. As such Policies CO3, CO5, CO6, CO7 and CO8 are effective in their approach, underpinned by the successful application of Green Wedge policy in the current Local Plan. They are based on the principle of Policy CO1 that development is restricted only to the degree that it should be appropriate to the receiving landscape and not compromise the functions of the Green Wedges and Green Corridors, specifically that: "Development which materially harms the character and appearance of this valued landscape will be resisted". Extension of that policy to include Green Corridors is entirely logical and, as set out in the response to Question 85, fundamental to establishing a City-wide approach to the protection and enhancement of Green Infrastructure (EB021A & EB021B) through the use of contiguous features which can demonstrate multifunctional value. As drafted, Policies CO3, CO5, CO6, CO7 and CO8 provide a clear and consistent benchmark against which development proposals can be judged whilst ensuring that the wider aims of the Plan can be realised.
- 40. Policies CO3, CO5, CO6 and CO8 are consistent with national policy and take into account local circumstances.

# Policy CO3 – New buildings and structures in Green Wedges and Green Corridors

41. The main river valleys of Chelmsford form an attractive and important leisure and recreation resource, containing wildlife habitats and represent the key component of Chelmsford's strategic green infrastructure network. Where the main river valleys permeate into the existing or proposed built up areas of Chelmsford, this identified value is amplified and development pressure is at its greatest. The purpose of Policy CO3 is to prevent an unchecked erosion of open land in these sections of the river valleys which would be harmful to the character and function of these areas.

- 42. Where the river valleys extend into the open countryside, they perform a different role. They are still attractive but tend to be more rural and agricultural in nature. These areas, which will be designated as Green Corridors, also require protection from unrestricted development, but to a slightly lesser extent than Green Wedges, as development pressure on Green Corridors is also likely to be less due to their location, further from the main urban areas. Therefore these areas are considered valued landscapes in the context of paragraph 109 of the NPPF (2012).
- 43. Criteria A) of Policy CO3 seeks to ensure that any new building in the Green Wedge or Green Corridors needs to be located there in order to prevent a harmful proliferation of buildings, which would adversely affect the openness of these valued landscapes.
- 44. Proposals deemed acceptable by Policy CO3 A) would allow for economic development in these areas which is consistent with paragraph 28 of the NPPF (2012). Local community facilities and appropriate facilities for outdoor sport and recreation are permitted in these areas as it is recognised that the Green Wedges and Corridors have an important role in providing the health and well-being of communities through recreational provision. This is consistent with paragraphs 70 and 73 of the NPPF (2012). The policy will effectively control the built form that may be permitted within the Green Wedges and Corridors to protect the areas for their landscape value and biodiversity but will also allow the communities around them to meet their identified needs.
- 45. Part B) of Policy CO3 recognises that redevelopment of previously developed land is acceptable in these areas, consistent with the Core Principles set out at paragraph 17 of the NPPF (2012). The policy would be effective, however in ensuring that any redevelopment of brownfield land must be sensitive to the character and appearance of these valued landscapes in accordance with paragraph 109 of the NPPF (2012).
- 46. Part C) of Policy CO3 relates to replacement buildings and seeks to ensure that replacement buildings in Green Wedges are not materially larger than the buildings that they replace. One of the key characteristics of Green Wedges is their openness. This policy is therefore justified and effective in ensuring that openness in these areas is maintained.
- 47. Overall, the criteria of Policy CO3 is justified, consistent and effective in protecting identified valued landscapes in accordance with NPPF (2012) paragraph 109.

# Policy CO5 – Infilling in the Green Belt, Green Wedge, Green Corridor and Rural Area

48. The policy is consistent with the NPPF (2012) by allowing infilling where this would not unacceptably impact on the function and objectives of the designation and where the gap between dwellings is small (Criterial B i) and ii). This is effective in protecting the identified valued landscape in accordance with paragraph 109 of the NPPF (2012).

- 49. The NPPF (2012) allows for infilling in villages in the Green Belt as one of the exceptions to inappropriate development (paragraph 89). Although infilling is not specifically mentioned as being acceptable within the countryside, it is reasonable to conclude that given Green Belt has the highest level of protection, infilling in the Green Wedges and Green Corridors is also acceptable.
- 50. The reasoned justification advises that the impact of any proposals for infilling will be carefully considered to ensure that gaps in the development pattern which positively contribute to the existing setting of a hamlet or group of dwellings are not lost. The policy is justified and consistent with paragraphs 17 and 56 of the NPPF (2012) which require development proposals to recognise the intrinsic character and beauty of the countryside and respond to local character and history and reflect the identity of local surroundings. The policy is effective, justified and consistent with National Policy.

# Policy CO6 – Change of use (land and buildings) and Engineering Operations

51. Policy CO6 is consistent with national policy by allowing re-use of rural buildings within the Green Wedges and Green Corridors. The NPPF (2012) places no restrictions on reuse of rural buildings in the countryside but does qualify that buildings suitable for reuse in the Green Belt must be of permanent and substantial construction. Policy CO6 reflects the wording of paragraph 89 of the NPPF (2012) in requiring buildings for reuse in the Green Wedges and Green Corridors to also be of permanent and substantial construction. This is because one of the key qualities of these identified valued landscapes is their open and special character. The requirement for the building to be of permanent and substantial construction is to avoid the replacement of dilapidated buildings which through the passage of time have blended into the landscape. In addition, to replace buildings which may only have had a short life expectancy would be perpetuating the built form which may otherwise have terminated in the short/midterm. The policy is effective, justified and consistent with National Policy.

# Policy CO7 – Extensions to existing buildings within the Green Belt, Green Wedges, Green Corridors and Rural Area

52. Policy CO7 is consistent with national policy in that it allows for extensions to existing buildings whilst ensuring that the purposes of the Green Wedge or Green Corridor designation are not conflicted with. The policy is therefore compliant with paragraph 109 which seeks to protect valued landscapes. The Green Wedge and Green Corridor designations seek to protect the river valleys for their openness and function as important green networks. The policy requires extensions to existing buildings to be proportionate in size in relation to the host building to ensure that they do not have a significant impact on the host building's size or appearance within this protected landscape. The policy is therefore effective, justified and consistent with National Policy.

# Policy CO8 – Rural and Agricultural/Forestry workers dwellings

53. Policy CO8 allows for the construction of a new dwelling or stationing of a caravan in the Green Wedge or Green Corridor in accordance with paragraph 55 of the NPPF (2012). The NPPF (2012) requires applications for new isolated homes in the countryside to be able to demonstrate "an essential need" for a rural worker to live permanently at or near their place of work. The Policy includes criteria to ensure that the need for the new dwelling or caravan can be justified and that all other, less intrusive, alternatives have first been explored. To limit the size of the building and its consequential impact on the valued landscape, criteria v.) requires the size of the accommodation to relate to the needs of the rural worker to be employed under their current situation. The Policy is therefore considered to be effective and justified and compliant with paragraphs 55 and 109 of the NPPF (2012).

Question 87 Does the Plan clearly define what the Rural Areas are?

### **Response to Q87**

- 54. Strategic Policy S13 The Role of the Countryside clearly defines what the Rural Areas are. The second paragraph of this policy states "The countryside outside of the Urban Areas and Defined Settlement, not within the Green Belt is designated as the Rural Area." The areas designated as Urban Areas, Defined Settlements and Green Belt are all clearly shown on the Pre-Submission Document Policies Map January 2018 (SD001). Any area outside of these designations is Rural Area.
- 55. There will be some areas of the borough where land falls within a Green Wedge or a Green Corridor, within the Rural Area. These are essentially valued landscapes within a Rural Area and have a higher level of protection.

Question 88	Strategic Policy S13 states that there are <i>'further areas within the countryside that are sensitive to change'</i> . What are these areas and is it clear how a decision-maker will consider development proposals within them?
	It also identifies that other areas of the countryside, including recognised areas of ecological, historic and functional importance will also be protected from inappropriate development? What is meant by <i>'inappropriate development'</i> in this context?

### Response to Q88

56. The Council's response to this question is divided into two parts

Part 1 - Strategic Policy S13 states that there are *'further areas within the countryside that are sensitive to change...'*. What are these areas and is it clear how a decision-maker will consider development proposals within them?

- 57. The structure of Strategic Policy S13 is to seek to firstly recognise the national and local areas of importance in Chelmsford and their role. This is addressed through paragraphs one and two respectively of the policy. The third paragraph of the policy relates to other areas that, whilst they may not have a national or local designation, have a role and function in the countryside and are sensitive to change through growth. The Landscape Character Assessment **(EB 100A-D)** provides a basis in identifying these sensitive areas.
- 58. Where growth is located within or close to such locations, the relevant site allocation policies specifically identify and address these particular sensitivities to ensure development mitigates any potential impact. The site allocation policies, therefore, make clear to decision makers how development proposals should be considered against these areas of sensitivity. On this basis, the third paragraph of Policy S13 is a repetition of the site allocation policies and can be deleted. A minor modification is therefore proposed as set out below:

### Proposed changes:

Delete the third paragraph of Strategic Policy S13 and paragraph 6.80 of the Reasoned Justification.

Part 2 – It also identifies that other areas of the countryside, including recognised areas of ecological, historic and functional importance will also be protected from inappropriate development? What is meant by *'inappropriate development'* in this context?

59. Inappropriate development in this context refers to inappropriate development in the Green Belt with reference to paragraph 87 of the NPPF (2012). It is recognised, however, that as the sentence is worded, this implies that the words "inappropriate development" refer to other types of areas of recognised importance. A minor modification is therefore proposed as follows:

#### **Proposed changes:**

Alter the first sentence of Strategic Policy S13 to include the words "and harmful" after the word "inappropriate"

Question 89	Are the criteria for rural areas set out in Policy CO4, CO5, CO6,
	CO7 and CO8 justified, effective and consistent with national
	policy?

60. The Council's position is that the criteria set out in Policies CO4, CO5, CO6, CO7 and CO8 are justified, effective and consistent with paragraph 17 of the NPPF (2012) which seeks to recognise the intrinsic character and beauty of the countryside and support thriving rural communities within it. The policies also allow for economic growth in rural areas (NPPF 2012, paragraph 28), seek to secure high quality design and a good standard of amenity for occupants of land and buildings (NPPF 2012, paragraph 17). The policies plan positively for the provision of community facilities (NPPF 2012, paragraph 70), affordable housing to reflect local needs (NPPF 2012, paragraph 54) homes for rural workers and re-use of rural buildings (NPPF 2012, paragraph 55).

### Policy CO4 – New buildings and structures in the Rural Area

- 61. Policy CO4 requires the decision maker to identify the intrinsic character and beauty of the countryside before determining whether or not the proposed development would result in any adverse impacts. This reflects paragraph 17 of the NPPF (2012). Paragraph 8.62 of the reasoned justification clarifies this succinctly by stating that "The Council will ensure that the intrinsic character and beauty of the Rural Area is recognised, assessed and, where there is material harm arising from new development is protected."
- 62. Part A) of Policy CO4 allows for new buildings for community facilities (NPPF 2012, paragraph 70), economic development (NPPF 2012, paragraph 28), education facilities (NPPF 2012, paragraph 72), outdoor sport and recreation (NPPF 2012, paragraph 73), homes for rural worker dwellings and re-use of rural buildings (NPPF 2012, paragraph 55) and secures optimal uses of heritage assets (NPPF 2012, paragraph 126). Part A) also allows for infilling, residential extensions, replacement buildings and outbuildings. Whilst none of these types of development are specifically mentioned by the NPPF (2012) in relation to the rural area, they are considered to be acceptable and appropriate within the Rural Area provided that an assessment is made on the impact of the development on the identified intrinsic character and beauty of the countryside.

- 63. Part B) of Policy CO4 recognises that redevelopment of previously developed land is acceptable in the Rural Area, consistent with the Core Principles set out at paragraph 17 of the NPPF (2012). The policy would be effective, however, in ensuring that any redevelopment of brownfield land must not result in harm to the identified intrinsic character and beauty of the countryside. Criteria B), i-iii) provides a comprehensive method for assessing the visual and physical impact of redevelopment. Criteria iv) seeks to ensure that redevelopment of brownfield sites does not result in developments (such as residential properties) in unsustainable locations. This seeks to encapsulate paragraph 30 of the NPPF (2012) into the policy, which states that "local planning authorities should support a pattern of development which, where reasonable to do so, facilitates the use of sustainable modes of transport".
- 64. Replacement buildings and residential outbuildings are permitted under parts C) and D) of this policy but an assessment of the impact of the development on its context and surroundings is required in accordance with paragraph 17, bullet point four and 58, bullet point 4 of the NPPF (2012).

### Policy CO5 – Infilling in the Green Belt, Green Wedge, Green Corridor and Rural Area

- 65. The NPPF (2012) allows for infilling in villages in the Green Belt as one of the exceptions to inappropriate development (paragraph 89). Although infilling is not specifically mentioned as being acceptable within the countryside, it is reasonable to conclude that given Green Belt has the highest level of protection, infilling in the Rural Area can be acceptable. Policy CO5 therefore allows for infilling in the Rural Area where the development would not detract from the existing character or appearance of the area.
- 66. The reasoned justification advises that the impact of any proposals for infilling will be carefully considered to ensure that gaps in the development pattern which positively contribute to the existing setting of a hamlet or group of dwellings are not lost. The policy is justified and consistent with paragraphs 17 and 56 of the NPPF (2012) which require development proposals to recognise the intrinsic character and beauty of the countryside and respond to local character and history and reflect the identity of local surroundings.

# Policy CO6 – Change of use (land and buildings) and engineering operations

67. Policy CO6 is consistent with national policy by allowing re-use of buildings within the Rural Area. The policy is consistent with paragraph 28 of the NPPF (2012) in relation to economic re uses and paragraph 55 in relation to dwellings. The policy is effective in permitting these types of uses, whilst also ensuring that conversions, changes of use of land and engineering operations do not adversely impact on the identified intrinsic character, appearance and beauty of the countryside (NPPF 2012, paragraph 17).

# Policy CO7 – Extensions to existing buildings within the Green Belt, Green Wedges, Green Corridors and Rural Area

- 68. Policy CO7 is consistent with paragraphs 17 and 56 of the NPPF (2012) which require development proposals to recognise the intrinsic character and beauty of the countryside and respond to local character and history and reflect the identity of local surroundings respectively.
- 69. The policy is effective in promoting sensitive design whilst allowing the rural economy to thrive and prosper, in accordance with paragraph 28 of the NPPF (2012).

### Policy CO8 – Rural and Agricultural/Forestry workers dwellings

- 70. Policy CO8 allows for the construction of a new dwelling or caravan in the Rural Area in accordance with paragraph 55 of the NPPF (2012). The NPPF (2012) requires applications for new isolated homes in the countryside to be able to demonstrate "an essential need" for a rural worker to live permanently at or near their place of work. The Policy includes criteria to ensure that the need for the new dwelling or caravan can be justified and that all other, less intrusive alternatives, have first been explored. Because new dwellings in the countryside are only permitted exceptionally, it is considered justified to require the size of the accommodation to relate to the needs of the rural worker to be employed under their current situation. The policy provides additional clarity to the decision maker as to what a "rural worker" means by requiring the associated business to be a "rural land-based business" rather than just a business that happens to be located within the rural area.
- 71. The Policy is therefore considered to be effective and justified and compliant with paragraph 55 of the NPPF (2012).

Question 90	Does the Plan set out a positive strategy for the conservation and enjoyment of the historic environment in accordance with national policy? Are the policies justified, effective and consistent with national policy? Are any proposed changes necessary for soundness?

### **Response to Q90**

72. Policies S5 and HE1-3 provide a means of assessing development proposals in accordance with the NPPF (2012). The policies and associated reasoned justifications provide a positive strategy for the conservation and enjoyment of the historic environment.

- 73. The Council has worked with Historic England on the development of the Local Plan from the outset and the strategy for the historic environment has evolved through this partnership working. This has led to Historic England supporting the policies in the Local Plan and subject to minor changes signed off a Statement of Common Ground (SOCG 01).
- 74. Policy S5 includes provision to designate and review Conservation Areas, update the Register of Buildings of Local Value, provision of a Buildings at Risk Register, designation of strategic land for conservation related to protecting the settings of New Hall and Moulsham Hall and recognises the contribution of local identity.
- 75. Policy HE1's reasoned justification notes the importance of appropriate uses and the contribution of setting.
- 76. In addition, Policies S1, S13, MP1 and MP2, and the site specific allocations include criteria and requirements to ensure local character is protected whilst promoting the enjoyment of the historic environment.
- 77. Taken together these policies meet the objectives of the NPPF (2012) for the conservation and enjoyment of the historic environment.
- 78. See further comments on Policy S5 under question 91, Policy HE1 under question 92 and Policies HE2 and HE3 under question 93.

Question 91	What is the purpose of Strategic Policy S5 and is it necessary when
	detailed criteria for the historic environment are set out in Policies
	HE1-HE3?

79. The purpose of Policy S5 is to provide the strategic policy principles for the more detailed Policies HE1-3 and forms part of the Councils' objective to providing a positive strategy for the protection and enjoyment of the historic environment in accordance with the objectives of NPPF (2012) paragraph 126. This objective extends beyond the tools within Policies HE1-3 which seek preservation and enhancement, to include review of Conservation Areas, securing appropriate new uses for heritage assets and reinforce the contribution of the historic environment to local character and identity to promote the conservation and enjoyment of the historic environment and aid the decision maker.

- 80. Historic England's Regulation 19 representation states for Policy S5 'We very much welcome the inclusion of a Strategic Policy for the conservation and enhancement of the historic environment. The policy helpfully refers to Conservation Areas, Listed Buildings, Registered Parks and Gardens and Scheduled Monuments together with non-designated assets. We are also pleased to see that conservation areas will be kept under review and that it makes appropriate reference to setting.' (Historic England, March 2018).
- 81. It is therefore considered that policy S5 is an important part of a comprehensive plan, which when used with Policies HE1-3, satisfies the NPPF (2012) objective of providing a positive strategy for the historic environment.

Question 92	Is Policy HE1 justified, effective and consistent with national policy? Does the policy promote development within Conservation Areas and within the setting of heritage assets which would enhance or better reveal their significance in accordance with paragraph 137 of the Framework? Are any changes necessary for soundness?

- 82. Policy HE1 aligns with the statutory duties within the Planning (Listed Building and Conservation Areas) Act 1990 to 'have special regard to the desirability of preserving the building or its setting' (sections 16 and 66, listed buildings) and 'special attention shall be paid to the desirability of preserving or enhancing the character or appearance' (section 72, conservation areas).
- 83. Policy HE1 part A includes the tests of the NPPF (2012) paragraphs 133 and 134 to weigh harm to heritage assets against public benefits. The final paragraph of Policy HE1 part A reads:

'The Council will take account of the desirability of sustaining and enhancing the significance of heritage assets and the positive contribution that conservation of heritage assets can make to sustainable communities, local character and distinctiveness'

- 84. This paragraph is considered to promote enhancement in accordance with the objective of NPPF (2012) paragraph 137.
- 85. In additional, Policy HE1 is linked to Policy S5, which includes a provision for protection and enhancement of the historic environment, the review of Conservation Areas (which include management plans and identification of enhancement opportunities), this in conjunction with HE1 provides a framework for enhancement in accordance with the objective of paragraph 137 of the NPPF (2012).

- 86. Parts B-D of the Policy HE1 provide further tests for development related to categories of heritage asset. Setting is also specifically referred to.
- 87. The reasoned justification provides further guidance, including the importance of the historic environment, assessing significance, avoiding harm and the contribution to local character.
- 88. When HE1 is read in conjunction with S5 and the reasoned justification it provides an effective means of protecting and enhancing the historic environment, which is consistent with the NPPF (2012). It is not therefore considered that any changes are necessary for soundness.

Question 93	Are Policies HE2 and HE3 sound?

- 89. Policy HE2 aligns with the NPPF (2012) paragraph 135, which provides a balanced framework for assessment of development proposals affecting non-designated heritage assets. This policy seeks to strike a balance between recognising and protecting non-designated heritage assets, whilst not being unduly restrictive with an unrealistic level of protection.
- 90. Historic England's Regulation 19 representation states 'we very much welcome a separate policy for non-designated heritage assets. The policy is clear and accords with the NPPF.' (Historic England, March 2018)
- 91. Policy HE2 provides an effective development management tool which is consistent with the NPPF (2012) and is sound.
- 92. Policy HE3 provides a means of protecting, enhancing and preserving sites of archaeological interest and their settings. The reasoned justification notes sites of national importance should be dealt with in accordance with policy HE1, which aligns with policy 139 of the NPPF (2012).
- 93. Policy HE3 has been revised to reflect the comments of the County Archaeologist (Essex County Council) and Historic England's Regulation 19 representation states 'We very much welcome a separate policy for archaeology. The policy is clear and accords with the NPPF.' (Historic England, March 2018).

a. Are the changes proposed by the Council in SD
necessary for soundness?
b. What does the term 'amenity interests' mean the context of the policy?
c. Is it clear how a decision-maker should use this when considering potential development?
d. The supporting text includes seeking new stra greenspaces including two new Country park reference is made to green infrastructure allo which are identified on the Policies Map. Are and similar allocations clearly defined within specific policies?

### **Response to Q94a**

- 94. It is the Council's position that with the exception of the change AC23 relating to the Essex Recreational disturbance Avoidance and Mitigation Strategy (RAMS) as set out in the Schedule of Additional Changes (SD002), the proposed changes to Strategic Policy S6 do not go to soundness. Instead, as set out in the introduction of SD002, they improve clarity and reflect the Local Plan process.
- 95. As seen in the fifth column of **SD002**, the reasons for the proposed changes (AC20-AC26) are a result of comments made by statutory consultees, the Environment Agency (EA) and Natural England (NE), at Regulation 19 stage. The Council has worked closely with both these bodies throughout the Local Plan process and this has helped shape both locations of growth and specific Local Plan policies. On this basis, the Council considered it important to give due consideration to their Regulation 19 representations and, where appropriate, amend the text of the relevant policies to reflect their comments.
- 96. For Strategic Policy S6, it is considered that the proposed changes provide greater clarity to both developers and decision-takers on the Council's approach and objectives to conserving the natural environment. They make the policy more robust and reflect the Local Plan Duty to Cooperate through engagement with statutory bodies. They do not, however, go to the soundness of the policy.

- 97. The exception to the above, is change AC23 in **SD 002**. Since the close of consultation on the Pre-Submission Local Plan, new evidence has been provided by Natural England which means that all residential site allocations in the Local Plan must contribute to the emerging Essex-wide Recreational Disturbance Avoidance and Mitigation Strategy (RAMS). This requirement, therefore, is reflected in the Strategic Policy S6 and in the policies of the relevant site allocations as set out in **SD 002** and in the Council's Hearing Statements for Matters 6a, 6b and 6c. The requirement for RAMS contributions is considered to be a main modification.
- 98. It should be noted that the changes proposed for Strategic Policy S6 are a result of signed Statements of Common Ground (SOCG) with Natural England and the Environment Agency (SOCG 02 & SOCG 04). For Natural England, there are no areas of uncommon ground between the Council and NE with respect to their Regulation 19 representation. For the Environment Agency, there are no areas of dispute which affect the soundness of the Plan but there are some outstanding suggestions by the EA that the Council has chosen not to include in the Schedule of Additional Changes. The justification for this is clearly given the signed Statement of Common Ground (SOCG 04).

# **Response to Q94b**

- 99. The third paragraph of Strategic Policy S6 states: "The Council will ensure that new development does not contribute to water pollution and, where possible, enhances water quality, and demonstrates the advancement of biodiversity and amenity interests through the provision of a range of greenspaces."
- 100. For the purposes of this policy, "amenity interests" encompasses recreational opportunities, the creation of a sense of place for enjoyment and enhanced landscape character. The provision of greenspaces within developments will range from, for example, a Country Park which provides amenity interests through a network of public rights of way for exercise, socialising and general enjoyment in a well-managed landscape setting, to the provision of sports pitches, supporting health and well-being.
- 101. Given that greenspaces will be multifunctional, the term "amenity interests" is used to reflect the wide range of opportunities it will deliver in respect to people and places.

### **Response to Q94c**

102. The Strategic Policies in the Local Plan underpin the Spatial Strategy and set out the overarching approach to various spatial matters for development in Chelmsford. Strategic Policy S6 makes clear the Council's approach to conserving and enhancing the natural environment, highlighting the importance that is given to them.

- 103. The first two paragraphs of the policy not only provide a justification for how the Council have considered the natural environment in the Local Plan but also provides a framework when considering green infrastructure, ecosystems, biodiversity etc. at masterplanning and/or planning application stage. It provides a broad overview on how the Council views the role and function of the environment to which both developers and decision-makers will need to have a regard to when considering the natural environment.
- 104. The following paragraphs of the Policy (as set out in the Schedule of Additional Changes **(SD 002)**, set out the Council's approach to specific matters which decision-makers will need to consider for potential development. For example, the improvement of water-related biodiversity taking account of Water-Framework Directive objectives and River Basin Management Plan actions.
- 105. Accordingly, it is considered that the policy is clear on the Council's approach to the natural environment and provides clear terms of reference which decision-makers will need to consider for potential development proposals.

### Response to Q94d

- 106. The County Parks and other greenspace allocations identified in the Reasoned Justification of Strategic Policy S6 at paragraph 5.32 are clearly defined within the sitespecific policies and on the Policies Map.
- 107. With specific reference to the Country Parks, this is a clear policy requirement for Strategic Growth Site 3a – East Chelmsford (Manor Farm) and Strategic Growth Site 4 – North East Chelmsford and is identified under "Supporting on-site development" of the site policies for the sites. Further detail is also contained at paragraphs 7.128-7.129 for Strategic Growth Site 3a and paragraph 7.232 for Strategic Growth Site 4. The locations of the new Country Parks are also shown in green on Map 1 of the Pre-Submission Local Plan (SD 001).
- 108. The areas of future recreation use/SuDS identified for West Chelmsford and Great Leighs are specifically contained in the site allocation policies for Strategic Growth Site (SGS2) (West Chelmsford) and Strategic Growth Site 5a (Moulsham Hall) respectively. Under "Historic and Natural Environment" within the site policies there is a requirement for the creation of a network of green infrastructure and suitable SuDS provision. Paragraph 7.121 of the Reasoned Justification for SGS2 further expands on this and specifies that land to the west of the site boundary is allocated for future recreation use/SuDS. This is highlighted in green on Map 1 of the Pre-Submission Local Plan (SD 001). For SGS5a, further details are given at paragraph 7.254 and the area in question is shown in green on Map 16 of the Pre-Submission Local Plan (SD 001).

- 109. It should be noted that the allocation of these areas of recreation-SuDS are agreed with the site promoters of these sites in signed Statements of Common Ground (SOCG 14 & SOCG 16b).
- 110. Therefore, for the reasons set out above, it is considered that Strategic Policy S6 is justified, effective and consistent with national policy.

Question 95	Taking into account the Council's proposed changes to Policies
	NE1 and NE2 as set out in SD002, will these achieve soundness?
	Why does part B to Policy NE2 refer to 'non-protected' landscape
	features?
	Are these landscape features of importance but are not statutorily
	protected or designated?
	Is it clear what these landscape features are and is the policy
	sound in this regard?
	Are any further changes necessary?

111. The Council's position is that with the proposed changes as set out in **SD002**, Policies NE1 and NE2 will be sound.

# Policy NE1 – Ecology and Biodiversity

- 112. The proposed amendment to Policy NE1 is in response to the consultation responses from Natural England **PS2079**, **PS2085** and **PS2086** with reference to the emerging strategic approach relating to the Essex Coast Recreational disturbance Avoidance and Mitigation Strategy (RAMs). This is set out within **SOCG 02**.
- 113. Since the publication of **SD002** the Council has also received interim advice from Natural England in a letter dated 16<sup>th</sup> August 2018 in relation to the emerging RAMs. The latest advice is intended to ensure that any residential planning applications coming forward ahead of the County wide mitigation strategy, which have the potential to impact on coastal European designated wildlife sites are compliant with the Conservation of Habitats and Species Regulations 2017 (commonly known as 'the Habitat Regulations').
- 114. The advice and evidence to date shows that most of Chelmsford falls within a Zone of Influence of the coastal European designated sites under the Habitat Regulations. The RAMS project will provide appropriate mitigation for all new residential developments funded from commuted sums paid by developers. This will be achieved through the adoption of supplementary planning advice and collected through S106 Agreements.

- 115. In the interim period prior to the adoption of RAMs, the responsibility lies with individual Local Planning Authorities to ensure that adequate mitigation is provided when planning permissions for net additional dwelling units are issued. To this end Chelmsford is introducing an interim arrangement to fund mitigation and allow new residential development to proceed in advance of RAMS. The Council has identified a specific project at Marsh Farm Country Park which would provide suitable mitigation against recreational pressure there. The Country Park is a Site of Special Scientific Interest, partly because it is one of just a few sites that are used by overwintering dark bellied brent geese. The small number of overwintering sites means that the brent goose is on the Amber List for Birds of Conservation Concern, and it is a Priority Species under the UK Post-2010 Biodiversity Framework.
- 116. Financial contributions taken for each new residential development within the identified Zone of Influence will be used to increase the resilience of this protected site to recreational pressure through visitor management measures. The project will seek to keep the general public and their dogs away from the grazing marsh used by the geese.
- 117. The proposed alterations to the policy will ensure that any development proposals comply with the Habitat Regulations. The policy is therefore sound in this respect.

### Policy NE2 – Trees, Woodland and Landscape features

- 118. The amendments proposed to Policy NE2 responds to a consultation from Historic England **PS1795** to include the protection of trees within Registered Parks and Gardens within part A) of the Policy. Whilst trees within Registered Parks and Gardens would also be protected under policy HE1 part D), the inclusion within Policy NE2 seeks to consolidate the protection of important trees within these historic landscapes in accordance with paragraph 132 of the NPPF (2012).
- 119. Part B) of Policy NE2 refers to "Non-protected Landscape Features". These are indeed landscape features of importance but are not statutorily protected or designated. The reasoned justification paragraph 8.112 describes what landscape features in the countryside, suburban and urban environment constitute and gives examples of trees, hedgerows, woodlands, meadows, field margins and water features. Depending on the case, any of these features could play an important part in shaping the character and appearance of an area.
- 120. To provide greater clarity, the reasoned justification should be amended to include the words "non-protected" so that it is clear that this explanatory paragraph is referring to "non-protected landscape features".

### Proposed changes:

Amend reasoned justification paragraph 8.113 to start the first and second sentences with the words "Non-protected landscape features".

Question 96	Section 19(1A) of the Planning and Compulsory Purchase Act 2004 requires that development plan documents must (taken as a whole)
	of land in the local planning authority's area contribute to the
	mitigation of, and adaptation to, climate change. Does the Plan comply with this requirement?

- 121. The Council considers that the policies included within the Pre-Submission Local Plan **(SD001)** ensure that developments and the use of land will contribute to the mitigation of, and adaptation to, climate change.
- 122. The Local Plan comprises nine strategic priorities of which Strategic Priority 7 and Priority 8 recognise climate change.
  - Strategic Priority 7 Protecting and enhancing the Natural and Historic Environment, the Green Belt and valued landscapes recognises that there is a need to address climate change globally and locally to minimise flood risks and reduce carbon emissions. It states that there is scope within the Local Plan to contribute to reducing emissions through the location of development and the design of buildings and places within new and existing development.
  - Strategic Priority 8 Creating Well Designed and Attractive Places, and Promoting Healthy Communities recognises that good design can also help mitigate the impacts of climate change and air pollution.
- 123. Taking into account the Strategic Priorities, the Local Plan sets out the long-term Vision and Spatial Principles for managing and accommodating growth within Chelmsford up to 2036 and beyond. The Strategic Priorities are supported by the policies contained in the Local Plan, these comprise:
  - Strategic Policy S3 Addressing Climate Change and Flood Risk
  - Strategic Policy S6 Conserving and Enhancing the Natural Environment
  - Policy NE3 Flooding/SUDs
  - Policy NE4 Renewable and Low Carbon Energy
  - Policy MP2 Design and Place Shaping Principles in Major Developments
  - Policy MP3 Sustainable Buildings

- 124. Policy S3 'Addressing Climate Change and Flood Risk' provides an overarching policy to mitigate and adapt to the effects of climate change. Development that is compatible with the transition to a lower carbon future for Chelmsford is encouraged, with the policy identifying development that:
  - *"Reduces greenhouse gas emissions;*
  - Promotes the efficient use of natural resources such as water
  - *Reduces the need to travel and provides for sustainable transport modes*
  - Provides opportunities for renewable and low carbon energy technologies and schemes
  - Provides opportunities for decentralised energy and heating systems
  - Encourages design and construction techniques which contribute to climate change mitigation and adaptation
  - Minimises impact on flooding
  - *Provides opportunities for green infrastructure including city greening, and new habitat creation".*
- 125. Its development reflects the requirements of the NPPF and PPG and draws on the evidence base, with studies including Water Cycle Study, Strategic Flood Risk Assessment Level 1, and Traffic Modelling:
  - Water Cycle Study 2018 the study found no constraints with respect to water service infrastructure and the water environment to deliver new Local Plan development, on the basis that strategic water resource options and wastewater solutions would be developed in advance of development coming forward.
  - Strategic Flood Risk Assessment (SFRA) 2017 found that the majority of the
    preferred site allocations are located in low risk flood zones and therefore would
    be safe for their lifetime and not increase flood risk elsewhere. A small number
    of the preferred site allocations are in areas of higher flood risk and were
    investigated through a Level 2 SFRA. This assessment identified how the flood
    risk will be managed on and off the site, by identifying appropriate flood
    resistance and resilience measures.
  - Traffic Modelling Reports 2017 and 2018- These reports showed that any new development and various spatial strategy options tested will create additional road congestion on the local road network, with associated emissions. However, the patterns and severity of congestion across Chelmsford in the modelling remain broadly consistent regardless of differences in Local Plan development allocation and the mitigation measures identified. The latest modelling work also finds that many of the preferred site allocations, including those in and around Chelmsford, are within the scope of the sustainable travel initiatives that, for example, will encourage walking and cycling modes as an alternative to the private car.

- 126. Furthermore, these policies ensure that developments are designed in such a way to adapt and mitigate the impacts of climate change. For example, promoting green infrastructure including city greening, strategic and local green infrastructure, improving tree planting can all make an important contribution to reducing the impacts of climate change and help to remove carbon dioxide from the atmosphere and provide shade, shelter and alleviate flooding. Furthermore, the location, design and construction of new development can directly affect the environment in terms of energy use and subsequent generation of greenhouse gases, as well as the use of natural resources. The Local Plan encourages the use of renewable and low carbon energy developments, promotes water and energy efficiency such as insulation, living walls/roofs, passive solar design, tree planting and SuDS and providing resilient ecological networks. Developers are also encouraged through the policies to have regard to the waste hierarchy in the construction of new buildings.
- 127. The Pre-Submission Sustainability Appraisal **(SD004)**, in meeting the requirements of the Strategic Environmental Assessment Regulations 2004 (Schedule 2 (6 (i)), includes consideration of the effects to and from climate change. Contextual information has been presented in the baseline, and it is also identified as a key sustainability issue. In consequence, an SA objective, supported by guide questions is included in the SA framework:

"11. Climate Change: To minimise greenhouse gas emissions and adapt to the effects of climate change.

- Will it minimise energy use and reduce or mitigate greenhouse gas emissions?
- Will it plan or implement adaptation measures for the likely effects of climate change?
- Will it support the delivery of renewable and low carbon energy and reduce dependency on non-renewable sources?
- Will it promote sustainable design that minimises greenhouse emissions and is adaptable to the effects of climate change?"
- 128. The effects of the plan have then been considered against this objective.
- 129. Policy S3 has therefore been assessed as having a significance positive effect on this objective. Policy S6 is also considered to have a significant positive effect on this objective. Enhancing green infrastructure can positively contribute to addressing flood risk in the Chelmsford City Area including by providing space for flood storage and increased infiltration. The integration of SUDS can also help to mitigate flood risk. This policy also requires the appropriate management of water on sites.

130. The assessment of cumulative effects against the Climate Change Objective in the Pre-Submission SA Report **(SD 004)** states:

"New development will result in increased energy use and associated greenhouse gas emissions. However, as noted above, the concentration of new residential and employment development in and adjacent to urban areas, the promotion of strategic mixed use sustainable urban extensions that reflect Garden City principles and the delivery of strategic improvements to the walking/cycling network (including through Green Wedges) are all likely to reduce the need to travel by car and associated emissions of greenhouse gases.

The Pre-Submission Local Plan also provides a strong policy framework that seeks to minimise energy use and greenhouse gas emissions and promote climate change adaptation through the siting and design of development (see, for example, Strategic Policy S3). Policy NE4, meanwhile, supports the delivery of appropriate renewable and low carbon energy development."

131. The Council therefore considers that the Local Plan complies with the requirements of Section 19 (1A) of the Planning and Compulsory Purchase Act 2004.

Question 97	Are the provisions set out in Policy NE3 regarding flooding and SUDS justified and consistent with national policy? Are any changes necessary for soundness?

# Response to Q97

132. It is the Council's position that the provisions set out in Policy NE3 are broadly justified and consistent with national policy; some changes that are considered necessary for soundness.

### Part A of Policy NE3

133. The policy seeks to capture all forms of development, including development not within areas of flood risk. The policy requires, as a minimum, that there is no deterioration in the present situation, but seeks to achieve betterment.

134. Development should have a neutral effect on flood risk is set out in paragraph 100 of the NPPF (2012)– 'Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas of highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere. This is continued in the opening line of paragraph 103 which relates to planning applications. The Technical Guidance to the NPPF (2012) at paragraph 2 reiterates this principle. The aim of achieving betterment, in matters of flood risk, is implicit within the wording of the NPPF (2012). However, the High Court has held that there is no requirement under the NPPF to improve the flooding position, as long as development does not make it worse. Accordingly, A (ii) is to be amended to delete reference to 'achieving betterment'.

# Part B of Policy NE3

- 135. 'Flood risk' is defined in Technical Guidance to the NPPF (2012) paragraph 2 as 'risk from all sources of flooding' – rivers, the sea, rainfall, rising ground water, overwhelmed sewers/drainage systems and from reservoirs, canals and lakes. This is in addition to defining areas 'at risk of flooding' being the more recognisable Flood 2, 3 and Flood Zone 1 with critical drainage problems. Part B of Policy NE3 is therefore intended to cover all aspects of flood risk as defined in the Technical Guidance. The policy is drafted to cover all types of flood risk and specifically does not replicate the wording within the NPPF (2012) by restricting to 'areas *at* risk of flooding'.
- 136. Part B of the policy is intended to directly address paragraph 103 of the NPPF (2012) to locate vulnerable development in areas of lowest flood risk; manage risk or provide means of escape; prioritise sustainable drainage systems. Given the amendment, and explanation, proposed to part A with regard to betterment, it is proposed to qualify the point about previously developed sites in order that run-off rates and volumes are reduced as far is *reasonably practical*. This consideration of previously developed sites is supported by Essex County Council's Sustainable Drainage Systems Design Guidance (last updated in 2016) and the Defra Non-statutory technical standards for sustainable drainage systems (March 2015). Criteria B (ii) is to be amended accordingly.

# Part C of Policy NE3

137. Table 1 of the Technical Guidance to the NPPF lists, in the policy aims, that local authorities should seek the appropriate application of sustainable drainage systems (SUDs). Policy NE3 provides a local policy mechanism for doing so, but at a level at which input can be gained from the Lead Local Flood Authority (Essex County Council) (i.e. applications for Major development). Major applications are considered to offer the greatest 'opportunity' to introduce sustainable drainage systems.

- 138. The policy requirement is intended to encourage SUDs to be multi-functional, again as an interpretation of paragraph 9 of the NPPF (pursuing sustainable development) in order to achieve several aims. In order to align with paragraph 9, it is proposed to amend the final sentence of the first paragraph to substitute 'wildlife, amenity and landscape' as they can be summarised more succinctly as per the NPPF (2012) as 'built, natural and historic environment'.
- 139. The final paragraph was inserted as an amendment following comments made by Anglian Water on the Preferred Options (see PO1509). Paragraph 100 of the NPPF (2012) clearly outlines that to 'manage flood risk from all sources' advice should be taken from relevant flood risk management bodies such as internal drainage boards.
- 140. A main modification is proposed to the policy as follows:

### Proposed changes:

Amend Policy NE3, part A (ii) as follows:

ii. it does not worsen flood risk elsewhere.

Amend Policy NE3, part B (ii) as follows:

ii. manage surface water run-off so that the run-off rate is no greater than the run-off prior to development taking place or if the site is previously developed, development reduces run-off rates and volumes as far as is reasonably practical; and

Amend Policy NE3, part C, final sentence, as follows:

As well as providing appropriate water management measures, where possible SuDS should be multi-functional to deliver benefits for the built, natural and historic environment.

Question 98	In relation to Policy NF4 does the policy provide a positive
Question 50	
	strategy for renewable and low carbon energy generation that is
	effective and in accordance with national policy?

#### Response to Q98

141. Policy NE4 and its reasoned justification are supportive of renewable and low carbon energy generation provided the criteria set out in the policy are met.

- 142. Paragraph 97 of the NPPF (2012) states that "local planning authorities should have a positive strategy to promote energy from renewable and low carbon sources". The Council's positive overall strategy can be found in Strategic Policy S3, encouraging new development that "provides opportunities for renewable and low carbon energy technologies and schemes" and also Strategic Policy S11, infrastructure supporting new development to include "opportunities for appropriate renewable, low carbon or district-scale energy production". Strategic Growth Site 4 is identified as an opportunity for 'renewable, low carbon and decentralised energy schemes'.
- 143. The Council's 'positive strategy' is therefore much wider than Policy NE4 in isolation. Two strategic policies note the overall strategy, Growth Site 4 identifies a potential appropriate location for larger scale infrastructure and Policy NE4 provides development management guidance at a local level.
- 144. As part of a review of the policy, it is noted that reference to 'setting' in criterion (iv) could be confused for reference to a listed building. It is proposed to substitute the word 'setting' with 'character of the area'.
- 145. The final sentence of the policy deals with development located in the Green Belt. Paragraph 91 of the NPPF (2012) is clear that 'elements of many renewable energy projects will comprise inappropriate development'. Also, renewable energy developments are not explicitly excluded from being inappropriate development through either paragraphs 89 or 90 of the NPPF (2012). As such this element of the policy is consistent with national policy.
- 146. Policy NE4 together with Strategic Policies S3 and S11 are effective and consistent with national policy. As set out below a minor amendment is proposed to Policy NE4:

### Proposed changes:

Amend fourth criterion of Policy NE4 to the following:

iv. do not have an unacceptable visual impact which would be harmful to the character of the area; and

Ouestion 99	Policy PA1 seeks to protect existing amenity. Is the policy sound?
	a. Is it clear what protecting <i>'amenity'</i> means and that this relates to living conditions for existing residents in part i?
	b. Is it clear what protecting 'the wider amenities of the area' means?

- 147. It is the Council's position that Policy PA1 is sound. However, a number of minor amendments to provide clarity to the reader are proposed.
- 148. It is proposed to amend the title to make the reader aware that this policy deals with both living and working environments and is split into criterion (i) and (ii) to reflect this consideration. The term 'amenity', as far as it relates to living conditions, has been explained within the reasoned justification paragraph 9.38. However, the specific word 'amenities' can be substituted for the term 'living environments' within the body of the policy and within the reasoned justification.
- 149. Within (ii) the words 'the wider amenities of the area' are considered to be imprecise and difficult to define, therefore a minor amendment is proposed:

### Proposed changes:

Amend policy title to – Policy PA1 - Protecting living and working environments

Substitute the word 'amenities' for the term 'living environments' in PA1 (i) and second sentence of 9.38

Delete the following words from PA1 (ii) - 'the wider amenities of the area'

Question 100	Policy PA2 sets out requirements for development on or near to hazardous substance sites or land and within or adjacent to an Air Quality Management Area (AQMA) or where an air quality impact assessment has been provided. Are these requirements sound?
	In relation to Part B of Policy PA2:
	a. The title implies that this only relates to the AQMA, though the policy also refers to air quality impact assessments. Is this correct? Has there been an assessment of the forecast future levels of traffic emissions related to the planned growth and is it likely to affect the air quality in other areas during the Plan period?
	b. In relation to the AQMA:
	i. To what extent are traffic emissions identified as the reason for the designation of the AQMA? What are the latest monitoring results, in particular levels of NO <sub>2</sub> ?
	ii. To what extent is development during the Plan period including completions, commitments and allocations, likely to affect the emission levels in the AQMA during the Plan? And what are the predicted emissions?
	iii. What plans are in place to reduce levels of emissions in the AQMA?

- 150. The requirements of Policy PA2 are sound in respect of both hazardous substance areas, and air quality management areas.
- 151. Part A of Policy PA2 relates to hazardous substance sites or land. The Policy accords with the NPPF (2012) (Paragraphs 109, 120, 121) which require councils to prevent unacceptable risks from pollution and land instability, and to secure safe development.
- 152. Part A is underpinned by the Water Framework Directive, the Environmental Protection Act 1990, building regulations, and environmental permitting regulations.
153. To satisfy the Council that these matters are addressed, developers are expected to undertake a preliminary risk assessment to identify potential contamination risk on the land they are promoting for development (both from on and off-site sources). The development thresholds and requirements are set out in the Council's Validation Requirements List for planning applications. Development will only be permitted where it can be demonstrated that the risks from any contamination sources can be mitigated.

#### Response to Q100a

- 154. Part B of Policy PA2 relates to development in an Air Quality Management Area (AQMA).
- 155. All developments in an AQMA which meet the criteria or thresholds set out in the Council's Validation Requirements List for planning applications are required to submit an air quality impact assessment alongside planning proposals. Developments outside an AQMA but which generate an increase in traffic or pollutants in an AQMA or are likely to have a significant impact on the air quality in the surrounding area, will be expected to identify any impacts and potential harm to air quality. This is set out in Paragraph 9.43 of Policy PA2.
- 156. An AQMA was declared at the 'Army and Navy' roundabout (junction of A138, A1060, A1114, and B1009) in December 2005.
- 157. In addition, on 11 September 2018 the Council's Cabinet approved the declaration of a second AQMA at Maldon Road in Danbury.
- 158. Since the Local Plan was submitted, an Air Quality Impact Assessment (AQIA) has been carried out for the Council's administrative area (attached at **Appendix B**). This identifies the baseline air quality profiles, and models projected scenarios for 2036 with no Local Plan development, and for 2036 with Local Plan development.
- 159. The AQIA has taken into account data collected as part of the City Council's statutory duty, traffic data from the Local Plan strategic traffic modelling, junction modelling, DfT traffic counts, and consideration of speed data, predicted emissions factors, time profiles, industrial and domestic emissions, and meteorological data.

#### **Response to Q100b**

160. i) The Council publishes an Air Quality Annual Status Report, to provide public information and fulfil Chelmsford City Council's statutory duty to review and assess air quality within its area, and to determine whether or not the air quality objectives are likely to be achieved.

- 161. In 2017, Air Quality Objectives were exceeded leading the Council to declare a new Air Quality Management Area (AQMA) in the village of Danbury. This is outlined in the Air Quality Annual Status Report 2018 **(EB 096A)**, which has been approved since the Local Plan was submitted.
- 162. Both the Army & Navy and Danbury AQMAs have been declared due to traffic emissions causing NO<sub>2</sub> concentrations to exceed the annual mean air quality objective for NO<sub>2</sub>. These were measured using roadside diffusion tubes. For 2017, the maximum measured NO<sub>2</sub> concentrations within the AQMA are as follows:
  - Army & Navy: 40.6 μg/m3
  - Danbury: 47.3 μg/m3
- 163. The annual mean air quality objective, reflecting the EU Ambient Air Quality Directive (2008/50/EC) for NO<sub>2</sub> is 40  $\mu$ g/m3.
- 164. ii) 2016 baseline data The AQIA modelling for 2016 showed exceedances of the NO<sub>2</sub> national air quality objectives along some major roads in the city centre, including some locations with potential public exposure. Exceedances were also modelled along the A12 and A130, but not extending to areas with public exposure. No exceedances of the limit values for PM<sub>10</sub> or PM<sub>2.5</sub> were modelled.
- 165. **2036 modelled data (without Local Plan)** Emissions are predicted to decrease significantly from the 2016 baseline for NO<sub>2</sub> by 2036 due to improvements in vehicle technology and progressively tighter emissions standards; with a smaller decrease for PM<sub>10</sub>. Therefore, no exceedances of the limit values for NO<sub>2</sub>, PM<sub>10</sub> and PM<sub>2.5</sub> are predicted in 2036.
- 166. **2036 modelled data (with Local Plan)** As above, emissions are predicted to decrease significantly from the 2016 baseline by 2036 due to improvements in vehicle technology and progressively tighter emissions standards. The introduction of the Local Plan is likely to have a small impact on annual average pollutant concentrations along some roads, but overall no exceedances are predicted by 2036. The difference in emissions without and with the Local Plan for specific monitoring sites are as follows:
  - NO<sub>2</sub> between less than 0.5% and 2% increase
  - PM<sub>10</sub> maximum of 1% increase
  - PM<sub>2.5</sub> maximum of 0.5% increase
- 167. The AQIA therefore shows that the impact of all pollutants in 2036 can be considered *negligible*<sup>1</sup>. The impact in intervening years may vary depending on when each development is completed, and other local factors which will be addressed in site-specific impact assessments where required to meet the Validation Requirements List criteria.

<sup>&</sup>lt;sup>1</sup> As defined by the Institute of Air Quality Management (IAQM) guidance for Land-Use Planning and Development Control: Planning for Air Quality

- 168. The detail is contained in the Air Quality Impact Assessment (Appendix B).
- 169. iii) The Army & Navy AQMA has an air quality action plan which was developed and adopted in 2008 **(EB 095)**.
- 170. The Chelmsford City Growth Package, an Essex County Council fund to improve sustainable transport in the City Centre up to 2021, contains proposals to reduce traffic and improve air quality within the Army & Navy AQMA. These actions are also detailed in the Annual Status Report **(EB 096A)**.
- 171. Actions are proposed on a zonal approach, as follows:
  - Outer Zone will target journeys from outside Chelmsford and focus on removing traffic on the outskirts of the City;
  - Mid Zone will target sustainable alternatives to the private car and encourage public transport, walking and cycling;
  - Central Zone will focus on improving the quality of the walking environment, public realm improvements and managing traffic.
- 172. The AQMA Action Plan **(EB 095)** is due to be revised in 2019 alongside development of an air quality action plan for the newly declared AQMA in Danbury.

EVIDENCE BASE	E LIST FOR MATTER 9
SD 001	Pre-Submission Local Plan and Policies Map
SD 002	Pre-Submission Local Plan Schedule of Additional Changes
SD 004	Pre-Submission Local Plan Sustainability Appraisal Report
EB 021	A Chelmsford Green Infrastructure Strategic Plan 2018-2036
	<b>B</b> Chelmsford Green Infrastructure Strategic Plan Research and Evidence
	Base Document
EB 094	A Green Wedges and Green Corridors:
	Defining Chelmsford's River Valleys Review Report
	B Green Wedges and Green Corridors:
	Defining Chelmsford's River Valleys Appendix A
EB 095	Air Quality Action Plan Army and Navy Air Quality Management Area
	(AQMA)
EB 096A	2018 Air Quality Annual Status Report (ASR)
EB 099	Braintree, Brentwood, Chelmsford, Maldon and Uttlesford Landscape
	Character Assessment
EB 100	A Chelmsford City Council Landscape Sensitivity and Capacity Assessment
	Report
	<b>B</b> Chelmsford City Council Landscape Sensitivity and Capacity Assessment
	Technical note: Landscape Sensitivity & Capacity – Additional Site
	Assessments
	<b>C</b> Chelmsford City Council Landscape Sensitivity and Capacity Assessment
	Technical Note: Chelmsford Local Plan Pre-Submission Document – Annex

	to the Landscape Sensitivity & Capacity Evidence Base Report on Land at
	South Woodham Ferrers
	D Chelmsford City Council Landscape Sensitivity and Capacity Assessment
	Technical Note: Chelmsford Local Plan Pre-Submission Document – Annex
	to the Landscape Sensitivity & Capacity Evidence Base Report: Corrections
	to Summary Tables
EB 119	Chelmsford Town Centre Area Action Plan including Proposals Map
EB 120	North Chelmsford Area Action Plan including Proposals Map
EB 163	Inspector's Report on the Examination into the Chelmsford Town Centre
	Area Action Plan Development Plan Document
EB 164	Inspector's Report on the Examination into the Chelmsford Borough
	Council Core Strategy and Development Control Policies Development Plan
	Document
EB 165	Inspector's Report on the Examination into the North Chelmsford Area
	Action Plan Development Plan Document
TP 005	Topic Paper 5: Natural Environment and Green Belt
SOCG 01	Statement of Common Ground: Historic England
SOCG 02	Statement of Common Ground: Natural England
SOCG 04	Statement of Common Ground: Environment Agency
SOCG 14	Statement of Common Ground: West Chelmsford Site Promoter on
	Strategic Matters
SOCG 16b	Statement of Common Ground: Great Leighs Holdings and Estates –
	Strategic Growth Sites 5a and 5b

Cambridge Environmental Research Consultants

# Chelmsford Draft Local Plan – Air Quality Impact Assessment

Final report

Prepared for Chelmsford City Council

18<sup>th</sup> September 2018



## Report Information

Job Title:Chelmsford Draft Local Plan - Air Quality Impact AssessmentPrepared for:Chelmsford City CouncilReport Status:Final reportReport Reference:FM1161/R4/18Issue Date:18th September 2018Author(s):Matthew WilliamsReviewer(s):Sarah StricklandIssueDateComments101/08/18Draft224/08/18Revised draft306/09/18Final418/09/18Revised final – added Maldon Road AQMA	CERC Job Number:		FM1161		
Prepared for:Chelmsford City CouncilReport Status:Final reportReport Reference:FM1161/R4/18Issue Date: $18^{th}$ September 2018Author(s):Matthew WilliamsReviewer(s):Sarah StricklandIssueDateComments101/08/18Draft224/08/18Revised draft306/09/18Final418/09/18Revised final – added Maldon Road AQMA	Job Title:		Chelmsford Draft Local Plan - Air Quality Impact Assessment		
Report Status:Final reportReport Reference:FM1161/R4/18Issue Date: $18^{th}$ September 2018Author(s):Matthew WilliamsReviewer(s):Sarah StricklandIssueDateComments101/08/18Draft224/08/18Revised draft306/09/18Final418/09/18Revised final – added Maldon Road AQMA	Prepared	l for:	Chelmsford City Council		
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IssueDateComments101/08/18Draft224/08/18Revised draft306/09/18Final418/09/18Revised final – added Maldon Road AQMA	Reviewer(s):		Sarah Strickland		
1       01/08/18       Draft         2       24/08/18       Revised draft         3       06/09/18       Final         4       18/09/18       Revised final – added Maldon Road         AQMA       AQMA	Issue	Date	Comments		
224/08/18Revised draft306/09/18Final418/09/18Revised final – added Maldon Road AQMA	1	01/08/18	Draft		
306/09/18Final418/09/18Revised final – added Maldon Road AQMA	2	24/08/18	Revised draft		
4 18/09/18 Revised final – added Maldon Road AQMA	3 06/09/18		Final		
	4 18/09/18		Revised final – added Maldon Road AQMA		
Main File(s): FM1161_CERC_ChelmsfordCC_R4_18Se 18.pdf	Main File(s):		FM1161_CERC_ChelmsfordCC_R4_18Sep 18.pdf		

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# 1 Summary

Chelmsford City Council is preparing a new Local Plan to guide development in the City Council's area until 2036. To this end, the Council commissioned Cambridge Environmental Research Consultants Ltd (CERC) to carry out air quality modelling to identify the baseline air quality profile across the administrative area, and for two future scenarios: 2036 with and without the Local Plan in place.

Pollutant emissions from vehicles were calculated using traffic model data provided by the council and supplemented by the Department for Transport (DfT) traffic counts, together with emission factors taken from the Department for the Environment, Food and Rural Affairs (Defra) Emission Factor Toolkit. To take account of the uncertainty of emission rates from diesel vehicles, these emission factors were adjusted based on real-world remote sensing data.

Emissions data from other sources were taken from the National Atmospheric Emissions Inventory (NAEI). Additional emissions from domestic gas combustion in planned development were included for the 'with Local Plan' scenario.

Modelling was carried out using the ADMS-Urban model (version 4.2) using meteorological data from Andrewsfield, the nearest Met Office weather station with suitable data, and background pollutant data from rural monitoring sites.

The modelling was carried out in line with relevant guidance including Defra's Air Quality Management Technical Guidance, TG(16), and the Institute of Air Quality Management's Land Use Planning and Development Control: Planning for Air Quality guidance. The modelling software, input data and assumptions are appropriate for the assessment, which is confirmed by the results of the model verification.

Model verification was carried out, comparing modelled concentrations with measured data for 2016. The modelling showed generally good agreement with the measured data, with the majority of modelled concentrations within 25% of the measured data (and most much better than this) and no systematic under or overprediction of concentrations.

Modelling for 2016 showed exceedences of the  $NO_2$  limit values along some major roads in the city centre, including some locations with potential public exposure. Exceedences were also modelled along the A12 and A130, but not extending to areas with public exposure. No exceedences of the limit values for  $PM_{10}$  or  $PM_{2.5}$  were modelled.

By 2036, vehicle exhaust emissions of  $NO_{x_1}$  PM<sub>10</sub> and PM<sub>2.5</sub> are predicted to decrease significantly. However, PM<sub>10</sub> and PM<sub>2.5</sub> emissions also include contributions from non-exhaust emissions, i.e. road, brake and tyre wear, which are expected to increase in proportion to traffic levels.



Modelled concentrations of NO<sub>2</sub>,  $PM_{10}$  and  $PM_{2.5}$  in 2036, both with and without the Local Plan, are all below the relevant limit values. Difference plots show that the introduction of the Local Plan is likely to have a small impact on annual average pollutant concentrations along some roads, with increases and decreases of up to 2% of the relevant limit values for NO<sub>2</sub>, 1% for PM<sub>10</sub>, and 0.5% for PM<sub>2.5</sub>.

The significance of the air quality impact of the Local Plan in 2036 was assessed using Institute of Air Quality Management guidance. The impact of all pollutants in 2036 can be considered *negligible*. The impact in intervening years may vary depending on when each development is completed and other local factors.



# 2 Introduction

Chelmsford City Council is preparing a new Local Plan to guide development in the City Council's area until 2036. To this end, the Council commissioned Cambridge Environmental Research Consultants Ltd (CERC) to carry out air quality modelling to identify the baseline air quality profile across the administrative area, and for two future scenarios: 2036 with and without the Local Plan in place.

The air quality targets, with which the calculated concentrations are compared, are presented in Section 3. An overview of the area and details of measured data are given in Section 4. The emissions data is summarised in Section 5, and the detailed model set-up is summarised in Section 6. The model verification for 2016 is presented in Section 7, and the results of detailed modelling for 2016 are presented in Section 8. The results of the modelling for the 2036 scenarios are given in Section 9 with a discussion of the results provided in Section 10.

A glossary is provided in Appendix A and a description of the ADMS-Urban model is given in Appendix B.



# 3 Air quality standards

The EU Ambient Air Quality Directive (2008/50/EC) sets binding limits for concentrations of air pollutants, which take into account the effects of each pollutant on the health of those who are most sensitive to air quality. The Directive has been transposed into English legislation as the Air Quality Standards Regulations 2010<sup>1</sup>, which also incorporates the provisions of the Fourth Daughter Directive (2004/107/EC).

*The Air Quality Standards Regulations 2010* include limit values and target values. Local authorities are required to work towards air quality objectives. In doing so, they assist the Government in meeting the limit values. The limit values are presented in Table 3.1.

	Value (µg/m³)	Description of standard			
NO	200	Hourly mean not to be exceeded more than 18 times a calendar year (modelled as 99.79 <sup>th</sup> percentile)			
NO <sub>2</sub>	40	Annual average			
<b>PM</b> <sub>10</sub>	50	24-hour mean not to be exceeded more than 35 times a calendar year (modelled as 90.41 <sup>st</sup> percentile)			
	40	Annual average			
PM <sub>2.5</sub>	25	Annual average			

 Table 3.1: Air quality limit values

The regulations also include national exposure reduction targets for  $PM_{2.5}$ , as set out in Table 3.2. These are based on the average exposure indicator (AEI), which is calculated as the three-year average of all measured  $PM_{2.5}$  concentrations at urban background locations, e.g. the AEI for 2010 must be based on measurements for the years 2009, 2010 and 2011.

Initial concentration (µg/m³)	Reduction target (%)	Year by which exposure reduction target should be met
Less than or equal to 8.5	0	
More than 8.5 but less than 13	10	
13 to less than 18	15	2020
18 to less than 22	20	
22 or more	All appropriate measures to reach 18 µg/m <sup>3</sup>	

Table 3.2: Exposure reduction target for  $PM_{2.5}$  relative to the AEI in 2010

<sup>1</sup> <u>http://www.legislation.gov.uk/uksi/2010/1001/contents/made</u>



The short-term objectives, i.e. those measured hourly or over 24 hours, are specified in terms of the number of times during a year that a concentration measured over a short period of time is permitted to exceed a specified value. For example, the concentration of  $NO_2$  measured as the average value recorded over a one-hour period is permitted to exceed the concentration of 200 µg/m<sup>3</sup> up to 18 times per year. Any more exceedences than this during a one-year period would represent a breach of the objective.

It is convenient to model objectives of this form in terms of the equivalent percentile concentration value. A percentile is the concentration below which lie a specified percentage of concentration measurements. For example, consider the  $98^{th}$  percentile of one-hour concentrations over a year. Taking all of the 8760 one-hour concentration values that occur in a year, the  $98^{th}$  percentile value is the concentration below which 98% of those concentrations lie. Or, in other words, it is the concentration exceeded by 2% (100 - 98) of those hours, that is, 175 hours per year. Taking the NO<sub>2</sub> objective considered above, allowing 18 exceedences per year is equivalent to not exceeding for 8742 hours or for 99.79% of the year. This is therefore equivalent to the 99.79<sup>th</sup> percentile value. It is important to note that modelling exceedences of short term averages is generally not as accurate as modelling annual averages.



## 3.1 Public exposure

The regulations state that exceedences of the air quality objectives should be assessed in relation to "the quality of the air at locations which are situated outside of buildings or other natural or man-made structures, above or below ground, and where members of the public are regularly present". Table 3.3 gives examples from the Defra TG(16) guidance of where the air quality objectives should apply.

Averaging period	Objectives should apply at:	Objectives should generally not apply at:
Annual average	All locations where members of the public might be regularly exposed. Building facades of residential properties, schools, hospitals, care homes etc	Building facades of offices or other places of work where members of the public do not have regular access. Hotels, unless people live there as their permanent residence. Gardens of residential properties Kerbside sites (as opposed to locations at the building facade), or any other location where public exposure is expected to be short term.
24-hour mean	All locations where the annual mean objective would apply, together with hotels. Gardens of residential properties (where relevant for public exposure e.g. seating or play areas)	Kerbside sites (as opposed to locations at the building facade), or any other location where public exposure is expected to be short term.
Hourly average	All locations where the annual mean and 24-hour mean objectives apply and: Kerbside sites (for example pavements of busy shopping streets). Those parts of car parks, bus stations and railway stations etc. Which are not fully enclosed, where members of the public might reasonably be expected to spend one hour or longer.	Kerbside sites where the public would not be expected to have regular access.

Table 3.3: Examples of where the air quality objectives should apply



## 3.2 Significance assessment

The Institute of Air Quality Management (IAQM) guidance *Land-Use Planning & Development Control: Planning for Air Quality*<sup>2</sup> sets out a methodology for assessing the significance of the air quality impact of planned developments. Table 3.4 sets out descriptors for air quality impacts based on the modelled concentration and the change in concentration relative to the air quality standard.

Long term average concentration at	% change in concentration relative to Air Quality Assessment Level (AQAL)				
receptor in assessment year	1 2-5 6-10		6-10	>10	
75% or less of AQAL	Negligible	Negligible	Slight	Moderate	
76-94% of AQAL	Negligible	Slight	Moderate	Moderate	
95-102% of AQAL	Slight	Moderate	Moderate	Substantial	
103-109% of AQAL	Moderate	Moderate	Substantial	Substantial	
110% or more of AQAL	Moderate	Substantial	Substantial	Substantial	

Table 3.4: IAQM impact descriptors

<sup>&</sup>lt;sup>2</sup> <u>http://www.iaqm.co.uk/text/guidance/iaqm-planning-development.pdf</u>



## 4 Site information

## 4.1 Site location

Chelmsford is located approximately 45 km to the northeast of central London, with the north-eastern segment of the M25 lying 15 km to the southwest of the city. The administrative area of Chelmsford covers an area of  $350 \text{ km}^2$ , centred on the city.

In 2005, Chelmsford City Council declared one Air Quality Management Area (AQMA) for annual average nitrogen dioxide ( $NO_2$ ) concentrations. This AQMA, amended in 2012, incorporates several roads leading into the Army and Navy roundabout and the Baddow Road roundabout, as shown in Figure 4.1.



Figure 4.1: Army & Navy Roundabout Air Quality Management Area

CERC

On 11<sup>th</sup> September 2018, declaration of a second AQMA at Maldon Road in Danbury, as shown in Figure 4.2, was approved by the City Council Cabinet.



Figure 4.2: Maldon Road, Danbury AQMA



### 4.2 Air quality monitoring

 $NO_2$  and  $PM_{10}$  concentrations in Chelmsford are measured at four sites using automatic monitors.  $NO_2$  concentrations are also measured at 52 sites using diffusion tubes. Automatic monitors provide high-quality measurements on an hourly basis, while diffusion tubes provide monthly measurements.

#### 4.2.1 Nitrogen dioxide

Table 4.1 shows the measured annual average NO<sub>2</sub> concentrations measured by the automatic monitors. Table 4.2 shows the number of recorded hourly average NO<sub>2</sub> concentrations exceeding the limit value of 200  $\mu$ g/m<sup>3</sup>.

Table 4.1: Annual average NO<sub>2</sub> concentrations at automatic monitors ( $\mu g/m^3$ )

ID	Location	2012	2013	2014	2015	2016
CM1	Chignal St James	16.3	13.9	14.2	12.8	14.2
CM2	Springfield Road (Prison)	34.0	31.4	28.1	28.1	28.9
CM3	Rainsford Land (Fire Station)	25.4	29.2	-	27.9	25.6
CM4	Baddow Road	36.8	33.8	-	25.8	29.6

Table 4.2: Number of	of hours with	$NO_2 > $	200 μg/m <sup>3</sup>	at automatic monitors
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		2012	2013	2014	2015	2016
CM1	Chignal St James	0	0	0	0	0
CM2	Springfield Road (Prison)	0	2	0	0	0
CM3	Rainsford Land (Fire Station)	0	0	-	0	0
CM4	Baddow Road	0	0	-	0	0

Table 4.3 shows the measured annual average  $NO_2$  concentrations measured using diffusion tubes. Note that not all sites were operational for all years; in particular, new sites were set up in 2015 and 2016. There were no recorded exceedences of the air quality standards in 2015 or 2016.



ID	Location	2012	2013	2014	2015	2016
CB01	12 Van Diemans Road	27.7	33.9	30.3	28.4	31.3
CB02	3 Moulsham Chase	19.3	25.2	21.5	20.2	20.5
CB04	28 Cleves Court	21.0	29.7	22.3	21.7	22.0
CB08	109 Balmoral Court	28.3	31.0	28.0	28.6	28.9
CB11	20 Brooklands Walk	26.7	26.6	23.4	23.4	24.4
CB13	60 Roxwell Road	18.7	20.2	18.6	16.3	18.1
CB18	180 Maldon Road	16.7	17.7	17.7	17.0	17.0
CB19	92 Maldon Road	17.1	23.7	19.7	18.6	19.6
CB20	Lyster Avenue	16.7	19.9	17.2	15.7	17.9
CB22/B/C	95 Baddow Road	26.7	36.1	32.4	30.3	32.4
CB25	20 Allen Way	18.6	23.6	20.9	19.8	20.6
CB26/B/C	214 Baddow Road	26.8	35.8	30.7	28.1	29.3
CB27/A/B	Howe Green Interchange	32.9	40.3	39.3	36.6	35.0
CB30	Colchester Road	26.0	32.7	31.3	28.2	29.1
CB31	Main Road, Boreham	24.8	29.2	26.5	24.8	26.7
CB32	2 Abbots Place	30.4	37.8	32.6	31.6	31.9
CB33	Victoria Road	27.1	37.3	31.4	31.1	28.8
CB35	129 Moulsham Street	21.8	27.5	24.3	23.2	25.5
CB36	2 Rainsford Lane	31.2	31.2	29.9	25.8	28.0
CB37	30 Victoria Crescent	23.6	27.5	24.8	22.1	24.2
CB38/39/40	Prison 1, Springfield Road	28.7	31.8	28.0	28.3	28.3
CB41	Hill Road South	16.8	19.6	17.6	16.8	16.9
CB42	Wharf Road(Gas Works)	28.8	25.2	21.3	19.2	21.7
CB44	Atlantic Business Centres,	29.4	33.2	31.1	30.0	31.1
0044	Broomfield Road	20.4	00.2	01.1	00.0	01.1
CB45	32 Van Diemans Road	24.2	30.8	29.1	24.0	28.8
CB46	32 Rochford Road	23.9	30.3	25.5	25.2	25.2
CB48	1 Weight Road	24.1	26.9	24.3	23.9	21.6
CB49	26 Rochford Road	25.3	25.2	22.3	21.4	22.7
CB52	Penpol, Victoria Road	26.6	36.5	31.8	30.8	30.4
CB55	15 Cedar Avenue	22.0	27.3	25.5	24.9	25.3
CB56	52 Goldlay Road	23.3	27.3	23.7	21.1	24.2
CB57	Goldlay House, Parkway	25.2	30.8	27.4	26.5	28.3
CB58	148 Baddow Road	32.1	45.9	36.8	35.8	36.6
CB61	10 Fraser Close	15.1	18.8	16.3	15.3	16.0
CB62/63/64	Chignal 1/2/3	13.8	13.8	12.4	11.Z	12.2
CB05/00/07	Coldley Avenue 1/2/2	23.3	20.5	23.4	22.4	23.1
	Goldiay Avenue 1/2/3	27.0	33.9 25.1	40.0	20.7	29.9
	Chelmer Road	JZ. I	20.1	22.0	23.1	21.9
	South Philliose All	-	-	-	20.0	31.0
	Maldan Daad, Danbury	-	-	-	30.0	34.3
	Maadaata Avanua	-	-	-	33.4 24.2	39.4
		-	-	-	24.3	25.0
	208 Springfield Bood	-	-	-	20.2	30.Z
		-	-	-	20.0	20.0
	2/4 Albour Lane	-	-	-	20.0	29.2
	122 Springlield Road	-	-	-	32.0	200
CB03/D/C	Raddow Road AOMS 1/2/2	-	-	-	24.2	27.5
CD04/3/0	Baulow Rodu AQIVIS 1/2/3	-	-	-	24.3	21.0 25.0
	Dus Station, Duke Street	-	-	-	39.9 10.9	00.0 21.0
CB80	135 Springfield Dood	-	-	-	19.0	21.0
CB00	144 Springfield Road		-	-	-	30.4
0000			-	-	-	00.0

Table 4.3: Annual average NO<sub>2</sub> concentrations at diffusion tube sites



#### 4.2.2 PM<sub>10</sub>

Table 4.4 shows the measured annual average  $PM_{10}$  concentrations and Table 4.5 shows the number of measured daily average  $PM_{10}$  concentrations which exceeded 50  $\mu$ g/m<sup>3</sup>. There were no measured exceedences of the air quality standards for the years 2012 to 2016.

1 10000							
		2012	2013	2014	2015	2016	
CM1	Chignal St James	24.5	18.0	17.4	20.5	17.1	
CM2	Springfield Road (Prison)	30.7	30.9	29.2	27.2	28.4	
CM3	Rainsford Lane (Fire Station)	23.3	23.1	22.2	21.0	20.8	

Table 4.4: Annual average  $PM_{10}$  concentrations at automatic monitors

Table 1 5. Number o	f dang with	$DM > 50 \mu a/m^3$	at automatic monitors
<i>1 uble 4.5. Number 0</i>	I UUVS WUU I	E 1VI 10 - JU µg/m	<i>ai automatic montiors</i>

		2012	2013	2014	2015	2016
CM1	Chignal St James	5	1	5	3	1
CM2	Springfield Road (Prison)	15	20	21	7	8
CM3	Rainsford Lane (Fire Station)	7	9	9	4	5



## 5 Emissions data

An emissions inventory was compiled for Chelmsford and the surrounding area for 2016 using CERC's emissions inventory toolkit (EMIT), version 3.4.1.

#### 5.1 Major road traffic emissions

The air quality modelling included representation of emissions from all roads across Chelmsford City Council's area. A detailed representation of emissions from major roads was included. Emissions from road transport were calculated in EMIT using measured traffic flows and speeds, together with road traffic emission factors for  $NO_x$ ,  $PM_{10}$  and  $PM_{2.5}$ .

#### 5.1.1 Traffic flows

Traffic flow data for the city were taken from three data sources: Chelmsford's Strategic Traffic model; the South Woodham Ferrers and Great Leighs junction model; and DfT traffic counts. The source of data for each road is shown in Figure 5.1.

#### Strategic Traffic Model data

For the city centre area, traffic model data from Chelmsford's Strategic (VISUM) Traffic Model were provided by Ringway Jacobs/Essex Highways, comprising annual average daily total (AADT) car, bus, LGV and HGV flows for the base year and for 2036 with and without the Local Plan.

#### South Woodham Ferrers and Great Leighs junction model data

As part of the traffic modelling work undertaken by EH Transport Planning for the assessment of Chelmsford City Council's Local Plan, a number of key junctions in South Woodham Ferrers and Great Leighs, which are outside the validated strategic model area, were modelled separately using the PICADY, ARCADY and LinSig models. AADT traffic flows for these roads were provided for the base case and 2036 with and without the Local Plan. Splits by vehicle type were not provided; these were estimated using average values from the central traffic model data.

#### **DfT traffic counts**

For other major roads in the area, traffic flow data were taken from Department for Transport traffic counts for the base year which provide the flows split into motorcycles, cars, LGVs, buses, rigid HGVs and articulated HGVs. These data do not include flows for 2036; these were adjusted to future years based on the percentage change in flows on similar adjacent roads.

#### 5.1.2 Traffic speeds

Average traffic speed data were provided for the central area. For the other roads, traffic speeds were estimated based on speeds on similar roads.



#### 5.1.3 Emission factors

Traffic emissions of NO<sub>x</sub>, NO<sub>2</sub>, PM<sub>10</sub>, PM<sub>2.5</sub> and VOCs were calculated from traffic flows using the Emission Factor Toolkit. The EfT emission factors include speed-emissions data for NO<sub>x</sub> based on the COPERT 5 software tool<sup>3</sup>. The emissions data include primary NO<sub>2</sub> emission factors for each vehicle type resulting in accurate road-by-road NO<sub>x</sub> and NO<sub>2</sub> emission rates.

Note that there is uncertainty surrounding the current emissions estimates of  $NO_x$  from all vehicle types, in particular diesel vehicles, in these factors; refer to for example an AQEG report from 2007<sup>4</sup> and a Defra report from 2011<sup>5</sup>. In order to address this discrepancy, the  $NO_x$  emission factors were modified based on recently published Remote Sensing Data (RSD)<sup>6</sup> for vehicle  $NO_x$  emissions. Scaling factors were applied to each vehicle category and Euro standard.

The EfT emission factors include  $PM_{10}$  and  $PM_{2.5}$  emissions both from exhaust and non-exhaust sources, i.e. brake, tyre and road-wear.

Note that projected vehicle fleet data is only available up to the year 2030; vehicle emissions data were therefore calculated using traffic flows for 2036 and vehicle fleet compositions for 2030. This is likely to be a conservative approach as vehicle emissions are predicted to decrease slightly each year with the uptake of newer, cleaner vehicles.

<sup>&</sup>lt;sup>6</sup> Carslaw, D and Rhys-Tyler, G 2013: New insights from comprehensive on-road measurements of  $NO_x$ ,  $NO_2$  and  $NH_3$  from vehicle emission remote sensing in London, UK. *Atmos. Env.* **81** pp 339–347.



<sup>&</sup>lt;sup>3</sup> <u>http://copert.emisia.com/</u>

<sup>&</sup>lt;sup>4</sup> Trends in primary nitrogen dioxide in the UK

<sup>&</sup>lt;sup>5</sup> Trends in NO<sub>x</sub> and NO<sub>2</sub> emissions and ambient measurements in the UK



Figure 5.1: Sources of Chelmsford traffic data

#### 5.1.4 Time-varying emissions profiles

The variation of traffic flow during the day was taken into account by applying a set of hourly profiles to the road emissions. National average profiles, published by the DfT, were used.<sup>7</sup> These profiles are shown in Figure 5.2. The profiles were applied to all major roads in the modelling area and grid sources, representing emissions of minor roads, and other emissions, aggregated on 1-km square basis, described in Section 5.3.2.



Figure 5.2: Hourly profiles used for other roads and grid sources

### 5.2 Minor Roads

The modelled road network was assumed to represent 90% of vehicle emissions within the city area. Emissions from minor roads were modelled on a 1-km resolution grid, calculated as 10% of the total road emissions from the NAEI. For 2036, the change in minor road emissions was assumed to be proportional to the change in emissions on the major road network. Similarly, the minor road emissions were adjusted for the 'with' and 'without Local Plan' scenarios based on the change in total major road emissions.

<sup>&</sup>lt;sup>7</sup> <u>https://www.gov.uk/government/statistical-data-sets/tra03-motor-vehicle-flow</u>



## 5.3 Non-road emissions

#### 5.3.1 Industrial sources

Eight industrial stacks emitting  $NO_x$  or particulates were identified from the NAEI within 5 km of Chelmsford City Council's area. Emissions parameters for these sources were obtained from the NAEI, and are presented in Table 5.1. All other exit characteristics were assumed to have representative values as presented in Table 5.2.

Site Name	Location	NOx	<b>PM</b> <sub>10</sub>	PM <sub>2.5</sub>
Hunt Graphics Europe Ltd, Basildon	574696, 190325	0.00	0.21	0.06
Norman Knights Ltd, Wickford	575652, 193032	0.00	0.02	0.01
Chelmsford Crematorium, Chelmsford	569653, 205873	1.88	0.08	0.08
United Utilities Green Energy Ltd, Roxwell Landfill Gas Project	565597, 208762	22.43	0.92	0.92
National Grid Gas Plc, Chelmsford Compressor Station	566110, 208350	0.27	0.01	0.01
Elyo Falcon Ltd, Basildon	571300, 190400	15.44	0.26	0.26
Novera Energy Generation No3 Ltd, Brittons Hall Farm, Roxwell	565400, 208500	18.08	0.75	0.75
Novera Energy Generation No2 Ltd, Brittons Hall Farm, Roxwell	565400, 208500	21.65	0.89	0.89

 Table 5.1: Emissions from industrial sources, tonnes/year

Table 5.2: Emission parameters used for industrial source
---

Parameter	Value
Height (m)	30
Diameter (m)	0.5
Exit velocity (m/s)	15
Temperature (°C)	100

All other industrial emissions were included in the NAEI gridded emissions as described in Section 5.3.2.

#### 5.3.2 Other emissions

Spatially-diffuse emissions from sources other than those explicitly modelled, such as emissions from domestic combustion, were represented by a set of 1-km square grid sources with a depth of 10 m. Gridded emissions data for 2015 from the NAEI<sup>8</sup> were used to represent these sources. The 2015 emissions were not adjusted to the year 2016 as any changes are expected to be insignificant.

<sup>&</sup>lt;sup>8</sup> <u>http://naei.defra.gov.uk/</u>



#### 5.3.3 Domestic emissions

The Local Plan includes several areas assigned for residential development. Additional emissions for these areas were included in the 2036 'with Local Plan' scenario. These emissions were calculated based on the number of units assigned to each area, as shown in Table 5.3. Please note that some areas and unit numbers have been reduced in the submitted Local Plan.

Site	Area (ha)	No. units
Rivermead, Chelmsford	1.6	80
Greater Beaulieu Park And Channels Area	354.5	2424
North East Chelmsford	355.7	3000
North Of South Woodham Ferrers	121.4	1250
North Of Broomfield	29.3	450
West Chelmsford	45.6	800
East Of Boreham	6.9	145
East Chelmsford - Manor Farm	27.4	250
Bicknacre North	0.7	15
Bicknacre South	0.7	15
North Of Gloucester Avenue (John Shennan), Chelmsford	6.5	200
Eastwood House Car Park, Glebe Road, Chelmsford	0.9	100
Ashby House Car Parks New Street, Chelmsford	0.8	80
Former Chelmsford Electrical And Car Wash, New Street	0.3	40
BT Telephone Exchange Cottage Place, Chelmsford	1.0	30
Chelmsford Social Club And Private Car Park 55 Springfield Road	0.7	90
Navigation Road Sites, Chelmsford	0.4	35
Travis Perkins, Navigation Road, Chelmsford	0.9	75
Car Park R/O Bellamy Court, Broomfield Road, Chelmsford	0.1	10
British Legion, New London Road, Chelmsford	0.1	15
Lockside, Navigation Road, Chelmsford	2.2	130
Baddow Road Car Park And Land To The East Of The Car Park	1.2	190
Waterhouse Lane Depot And Nursery, Chelmsford	0.8	20
Essex Police HQ And Sports Ground New Court Road	7.8	250
Former St Peters College, Fox Crescent, Chelmsford	11.2	185
Civic Centre Land, Fairfield Road, Chelmsford	1.9	100
Church Hall Site, Woodhall Road, Chelmsford	0.4	19
Garage Site, St Nazaire Road, Chelmsford	0.2	12
Garage Site And Land, Medway Close, Chelmsford	1.3	10
Land Surrounding Telephone Exchange Ongar Road Writtle	0.5	25
Land North Of Galleywood Reservoir	0.8	13
Saint Giles Moor Hall Lane Bicknacre	2.9	32
Riverside Ice And Leisure Land, Victoria Road, Chelmsford	1.1	125
East Chelmsford - Land South Of Maldon Road	7.2	100
Former Royal Mail Premises, Victoria Road, Chelmsford	1.4	150
Former Gas Works, Wharf Road, Chelmsford	3.3	250
Peninsula, Wharf Road, Chelmsford	4.1	421
East Chelmsford - Land North Of Maldon Road	2.8	50
Rectory Lane East	0.2	25
Rectory Lane West	0.7	75
Car Park West Of The County Hotel Chelmsford	0.3	45
Land Rear Of 17-37 Beach's Drive, Chelmsford	0.7	14
Great Leighs - Land East Of London Road	12.6	250
Great Leighs - Land North And South Of Banters Lane	1.4	19
Great Leighs - Land North And South Of Banters Lane	6.3	81
Great Leighs - Land East Of Main Road	4.6	100
Great Leighs - Land At Moulsham Hall	46.7	750

Table 5.3: Local Plan development areas



Emissions from each of these areas were calculated using domestic gas combustion emission factors from taken from the NAEI and a representative energy demand taken from the Department of Energy and Climate Change (DECC) Energy demand benchmarks. Table 5.4 shows the energy demand benchmarks for different types of houses; a representative value of 10,000 kWh per year was used for these calculations. The emissions were modelled as 1-km resolution grid sources, consistent with the modelling of current domestic emissions.

Туре	Energy demand (kWh/year)
Flat	6218
Terrace	8371
Semi	10306
Detached	15459
Average	10089

#### Table 5.4: DECC Energy demand benchmarks<sup>9</sup>

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\_data/file/379052/EED\_regs\_\_benchmark\_heat\_demand\_paper\_-\_261114\_.pdf



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## 6 Model set-up

Modelling was carried out using the ADMS-Urban<sup>10</sup> model (version 4.2.0). The model uses the detailed emissions inventory described in Section 5 together with a range of other input data to calculate the dispersion of pollutants. This section summarises the data and assumptions used in the modelling.

## 6.1 Surface roughness

A length scale parameter called the surface roughness length is used in the model to characterise the assessment area in terms of the effects it will have on wind speed and turbulence, which are key factors in the modelling. A value of 0.6 m was used to represent Chelmsford, representing the built-up nature of the area.

### 6.2 Monin-Obukhov length

In urban and suburban areas a significant amount of heat is emitted by buildings and traffic, which warms the air within and above an urban area. This is known as the urban heat island and its effect is to prevent the atmosphere from becoming very stable. In general, the larger the urban area the more heat is generated and the stronger the effect becomes.

In the ADMS-Urban model, the stability of the atmosphere is represented by the Monin-Obukhov parameter, which has the dimension of length. In very stable conditions it has a positive value of between 2 metres and 20 metres. In near neutral conditions its magnitude is very large, and it has either a positive or negative value depending on whether the surface is being heated or cooled by the air above it. In very convective conditions it is negative with a magnitude of typically less than 20 metres.

The effect of the urban heat island is that, in stable conditions, the Monin-Obukhov length will never fall below some minimum value; the larger the urban area, the larger the minimum value. A value of 30 metres was used in the modelling.

<sup>&</sup>lt;sup>10</sup> http://www.cerc.co.uk/environmental-software/ADMS-Urban-model.html



## 6.3 Meteorological data

The modelling used meteorological data from the Andrewsfield weather station for the year 2016. Andrewsfield is the nearest Met Office weather station with suitable data and is situated approximately 18 km north of the centre of Chelmsford. The data measured at Andrewsfield are considered to be representative of meteorological conditions at Chelmsford. A summary of the data is given in Table 6.1. Figure 6.1 shows a wind rose giving the frequency of occurrence of wind from different directions for a number of wind speed ranges.

A value of 0.1 metre was used for the surface roughness for the meteorological station, representing the rural nature of the site.

Year	Percentage used	Parameter	Minimum	Maximum	Mean
		Temperature (°C)	-3.7	32.0	10.5
2016	99.0	Wind speed (m/s)	0	19.5	4.1
		Cloud cover (oktas)	0	8	4.5

Table 6.1: Hours of meteorological data used in the modelling



Figure 6.1: Wind rose for Andrewsfield, 2016

### 6.4 Background concentrations

Nitrogen dioxide (NO<sub>2</sub>) results from direct emissions from combustion sources together with chemical reactions in the atmosphere involving NO<sub>2</sub>, nitric oxide (NO) and ozone (O<sub>3</sub>). The combination of NO and NO<sub>2</sub> is referred to as nitrogen oxides (NO<sub>x</sub>).

The chemical reactions taking place in the atmosphere were taken into account in the modelling using the Generic Reaction Set (GRS) of equations. These use hourly average background concentrations of  $NO_x$ ,  $NO_2$  and  $O_3$ , together with meteorological and modelled emissions data to calculate the  $NO_2$  concentration at a given point.

Hourly background data for these pollutants were input to the model to represent the concentrations in the air being blown into Chelmsford.

#### 6.4.1 Background data for 2016

Hourly measured  $NO_x$ ,  $NO_2$  and  $O_3$  concentrations were obtained from the Rochester Stoke, Wicken Fen, and St. Osyth rural monitoring sites which are part of the Automatic Urban and Rural Monitoring Network managed by the Environment Agency on behalf of Defra. The monitored concentration used for each hour depended upon the wind direction for that hour, as shown in Figure 6.2.  $PM_{10}$ ,  $PM_{2.5}$ , and  $SO_2$  background data from Rochester Stoke were used for all wind directions, as these pollutants are not monitored at the other two sites.



Figure 6.2: Wind direction segments used to calculate background concentrations for  $NO_x$ ,  $NO_2$  and  $O_3$ 



Table 6.2 summarises the annual statistics of the resulting background concentrations used in the modelling for 2016.

	NO <sub>x</sub>	NO <sub>2</sub>	<b>O</b> <sub>3</sub>	<b>PM</b> <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>
Annual average	11.0	14.5	51.8	17.6	15.0	2.7
99.79 <sup>th</sup> percentile of hourly average	63.0	122.5	119.1	-	-	-
90.41 <sup>st</sup> percentile of 24-hour averages	-	-	-	28.7	25.9	5.0

Table 6.2: Background concentrations for 2016 ( $\mu g/m^3$ )

### 6.4.2 Background data for 2036

Background concentrations show a flat or very slight downward trend over recent years. In order to avoid underestimating concentrations in 2036, the background data for 2016 was used unchanged, i.e. it was assumed that there will be no reduction in background concentrations over this period.

## 6.5 Street canyons

The presence of buildings either side of a road can introduce street canyon effects that result in pollutants becoming trapped, leading to increased pollutant concentrations. Street canyon effects were taken into account using the ADMS Advanced Canyon option, which makes use of detailed information for roadside buildings. The Advanced Street Canyon option can model asymmetric canyons, e.g. with different building heights on each side of the road or with buildings at different distances from the road on each side, and can take into account discontinuous canyons, i.e. buildings with gaps between.

Street canyon parameters were calculated from OS Mastermap buildings data. Street canyon data were processed for all modelled roads; street canyon effects were modelled for any section of road with buildings within 50 metres, but the effect would be small for roads where there are lots of gaps between buildings or where buildings are low or a long way from the road.



## 7 Model verification

The first stage of a modelling assessment is to verify that the input data and model setup are representative for the area. This was carried out by calculating annual average concentrations of  $NO_2$  and  $PM_{10}$  at the monitoring sites at which they are measured. Note that some monitoring sites are located adjacent to roads for which no traffic data were available. It would not be expected for the modelled concentrations to agree with the measured data at these sites, so they have been excluded from the analysis. Table 7.1 and Figure 7.1 show the measured and modelled annual average  $NO_2$  concentrations for 2016. Table 7.2 shows the measured and modelled annual average  $PM_{10}$  concentrations for 2016.



Figure 7.1: Measured and modelled annual average NO<sub>2</sub> concentrations

The modelled concentrations show generally good agreement with the measured data with no consistent under or over-prediction. The modelled concentrations are within 25% of the measured data at 89% of the sites considered; 59% are within 10% of the measured data.

There are two main locations where the modelled concentrations are significantly different from the measured data.

On Springfield Road, close to the junction with Victoria Road, the modelled concentrations are more than 25% greater than the measured data, however, further along Springfield Road, the concentrations agree much better. These discrepancies are therefore likely to be due to very local effects.



At Maldon Road, Danbury, the modelled concentration is 40% lower than the measured value, however, further along the same road at Main Road, Danbury, the modelled concentration is only 19% lower than the measured value. It should be noted that the measured concentrations at the two Danbury monitoring sites increased significantly between 2015 and 2016 (from 30.6 to 34.3  $\mu$ g/m<sup>3</sup> at CB75 and from 33.4 to 39.4  $\mu$ g/m<sup>3</sup> at CB76). The 2017 Chelmsford ASR notes these increases and suggests that they may be due to a combination of traffic management work further along the A414 and an increase in traffic volume; these changes may not be captured by the traffic data used in the modelling.

At two further sites, Atlantic Business Centre, Broomfield Road, and 10 Waterhouse Lane, the modelled concentrations are 70% and 74% of the measured values, respectively.



Code	Address	Site type	Measured	Modelled	Modelled %
CM1	Chignal	Rural	14.3	13.6	96%
CM2	Springfield Road	Roadside	29.1	28.1	97%
CM3	Rainsford Lane	Roadside	25.7	29.1	113%
CM4	Baddow Road	Roadside	29.5	28.2	96%
CB01	12 Van Diemans Road	Façade	31.3	30.4	97%
CB02	3 Moulsham Chase	Roadside	20.5	18.6	91%
CB04	28 Cleves Court	Roadside	22.0	18.8	86%
CB08	109 Balmoral Court	Façade	28.9	31.9	110%
CB11	20 Brooklands Walk	Façade	24.4	24.7	101%
CB13	60 Roxwell Road	Façade	18.1	18.5	102%
CB10	02 Maldon Road	Façade	17.0	19.7	0.0%
CB20		Façade	17.0	19.0	102%
CB20	95 Baddow Road	Facade	31.6	30.0	08%
CB22B	95 Baddow Road	Facade	32.8	30.9	90%
CB22D	95 Baddow Road	Facade	32.0	30.9	95%
CB25	20 Allen Way	Roadside	20.6	10.0	94%
CB26	214 Baddow Road	Facade	20.0	35.2	119%
CB26B	214 Baddow Road	Facade	28.3	35.2	124%
CB26C	214 Baddow Road	Facade	30.0	35.2	117%
CB32	2 Abbots Place	Facade	31.9	29.3	92%
CB33	Victoria Road	Roadside	28.8	27.4	95%
CB36	2 Rainsford Lane	Roadside	28.0	23.9	85%
CB37	30 Victoria Crescent	Facade	24.2	21.7	90%
CB38	Prison 1, Springfield Road	Roadside	27.9	28.1	101%
CB39	Prison 2, Springfield Road	Roadside	28.5	28.1	99%
CB40	Prison 3, Springfield Road	Roadside	28.6	28.1	98%
CB41	Hill Road South	Roadside	16.9	18.7	111%
CB42	Wharf Road(Gas Works)	Roadside	21.7	19.5	90%
CR44	Atlantic Business Centres,	Facado	21.1	21.7	70%
CD44	Broomfield Road	i açaue	51.1	21.7	1070
CB45	32 Van Diemans Road	Façade	28.8	29.3	102%
CB46	32 Rochford Road	Roadside	25.2	22.6	90%
CB48	1 Weight Road	Roadside	21.6	20.7	96%
CB49	26 Rochford Road	Façade	22.7	22.0	97%
CB52	Penpol, Victoria Road	Roadside	30.4	29.5	97%
CB55	15 Cedar Avenue	Façade	25.3	26.8	106%
CB56	52 Goldlay Road	Roadside	24.2	20.9	87%
CB57	Goldlay House, Parkway	Façade	28.3	25.3	89%
CB58	148 Baddow Road	Façade	30.0	30.8	84%
CB01	Chignel 1	Façaue	10.0	17.0	110%
CB02		Rural	12.0	13.0	114 %
CB03	Chignal 3	Rural	12.3	13.0	110%
CB65	Fire Station 1 Painsford Lane	Roadside	23.0	20.1	127%
CB66	Fire Station 2 Rainsford Lane	Roadside	23.0	29.1	127%
CB67	Fire Station 3 Rainsford Lane	Roadside	23.3	29.1	125%
CB68	Goldlay Avenue 1	Roadside	29.3	26.7	91%
CB68B	Goldlay Avenue 2	Roadside	30.6	26.7	87%
CB68C	Goldlay Avenue 3	Roadside	29.7	26.7	90%
CB73	Chelmer Road	Roadside	21.9	21.3	97%
CB74	South Primrose Hill	Façade	31.0	26.7	86%
CB75	Main Road, Danbury	Façade	30.0	27.8	93%
CB76	Maldon Road, Danbury	Façade	39.4	23.6	60%
CB77	Meadgate Avenue	Kerbside	25.0	22.0	88%
CB79	10 Waterhouse Lane	Roadside	35.2	26.2	74%
CB80	208 Springfield Road	Façade	25.3	26.6	105%
CB82	122 Springfield Road	Roadside	31.9	43.8	137%
CB83	134/136 Springfield Road	Roadside	38.8	44.3	114%
CB83b	134/136 Springfield Road	Roadside	38.6	44.3	115%
CB83c	134/136 Springfield Road	Roadside	36.6	44.3	121%
CB84	Baddow Road AQMS 1	Roadside	27.2	28.2	103%
CB85	Baddow Road AQMS 2	Roadside	28.1	28.2	100%
CB86	Baddow Road AQMS 3	Roadside	27.1	28.2	104%
CB88	14/ Baddow Road	⊢açade	21.8	20.6	94%
CB89	135 Springfield Road	Kerbside	37.4	49.4	132%
CRA0	144 Springtield Road	Kerpside	30.5	31.4	103%

Table 7.1: Measured and modelled annual average  $NO_2$  concentrations ( $\mu g/m^3$ )



Code	Address	Measured	Modelled	Modelled %
CM1	Chignal	15.8	16.5	104%
CM2	Springfield Road	25.9	19.6	76%
CM3	Rainsford Lane	20.3	21.2	104%

Table 7.2: Measured and modelled annual average  $PM_{10}$  concentrations ( $\mu g/m^3$ )



## 8 2016 baseline concentrations

Ground level concentrations of NO<sub>2</sub>,  $PM_{10}$  and  $PM_{2.5}$  were calculated on a regular grid of receptor points, with additional points added in the vicinity of major roads, in order to more accurately capture roadside concentrations. Concentrations were calculated to allow comparison against the air quality standards presented in Section 3, and presented in the form of coloured contour maps. The contour maps are presented showing areas with concentrations exceeding the air quality standards shown in yellow and red and areas with concentrations below the standards shown in green and blue.

Figure 8.1 and Figure 8.3 show the modelled annual average and the modelled  $99.79^{\text{th}}$  percentile of hourly average NO<sub>2</sub> concentrations for 2016.

The modelled concentrations show some exceedences of the annual average NO<sub>2</sub> limit value of 40  $\mu$ g/m<sup>3</sup> in central Chelmsford: in particular along Parkway, around the Baddow and Army & Navy Roundabouts and along Springfield Road. The exceedences here, which are shown in more detail in Figure 8.2, could extend to the properties lining the roads. Exceedences were also modelled along the A12 and A130, but the exceedences are not expected to extend to any locations with relevant exposure.

The modelled concentrations show some exceedences of the hourly average  $NO_2$  limit value, but the extent of these exceedences is smaller than the extent of the exceedences of the annual average limit value.

Figure 8.4 and Figure 8.5 show the modelled annual average and  $90.41^{st}$  percentile of daily average PM<sub>10</sub> concentrations for 2016. Figure 8.6 shows the modelled annual average PM<sub>2.5</sub> concentrations for 2016. The modelling does not show any exceedences of the limit values for PM<sub>10</sub> or PM<sub>2.5</sub>.




Figure 8.1: Annual average NO<sub>2</sub> concentration 2016 (µg/m<sup>3</sup>)





Figure 8.2: Modelled exceedences of annual average NO<sub>2</sub> standard in central Chelmsford





Figure 8.3: 99.79th percentile of hourly average NO<sub>2</sub> concentrations 2016 (µg/m<sup>3</sup>)





Figure 8.4: Modelled annual average  $PM_{10}$  concentration 2016 ( $\mu$ g/m<sup>3</sup>)





Figure 8.5: Modelled 90.41<sup>st</sup> percentile of 24-hour average  $PM_{10}$  concentrations 2016 ( $\mu g/m^3$ )





Figure 8.6: Modelled annual average  $PM_{2.5}$  concentration 2016 ( $\mu g/m^3$ )



# 9 2036 concentrations

Ground level concentrations of  $NO_2$ ,  $PM_{10}$  and  $PM_{2.5}$  were calculated at the same set of output points for 2036 with and without the Local Plan in place.

Figure 9.1 and Figure 9.2 show the modelled annual average  $NO_2$  concentrations for 2036 without and with the Local Plan in place, respectively. No exceedences of the limit value are predicted with or without the Local Plan. By 2036, vehicle  $NO_x$  emissions are predicted to decrease significantly from current levels due to improvements in vehicle technology and progressively tighter emissions standards.

Figure 9.3 and Figure 9.4 show the modelled  $99.79^{\text{th}}$  percentiles of hourly average NO<sub>2</sub> concentrations for 2036 without and with the Local Plan in place, respectively. No exceedences of the limit value are predicted with or without the Local Plan.

Figure 9.5 and Figure 9.6 show the modelled annual average  $PM_{10}$  concentrations for 2036 without and with the Local Plan in place, respectively. No exceedences of the limit value are predicted with or without the Local Plan. However, it should be noted that the change in concentrations between 2016 and 2036 is much less significant than the change in NO<sub>2</sub> concentrations. This is because emissions of  $PM_{10}$  are made up of exhaust and non-exhaust emissions; only exhaust emissions are predicted to decrease in future years, with non-exhaust emissions likely to increase proportionally to traffic levels.

Figure 9.7 and Figure 9.8 show the modelled  $90.41^{st}$  percentiles of 24-hour average  $PM_{10}$  concentrations for 2036 without and with the Local Plan in place, respectively. No exceedences of the limit value are predicted with or without the Local Plan.

Figure 9.9 and Figure 9.10 show the modelled annual average  $PM_{2.5}$  concentrations for 2036 without and with the Local Plan in place, respectively. No exceedences of the limit value are predicted with or without the Local Plan.





Figure 9.1: Modelled annual average  $NO_2$  concentration, 2036 without Local Plan ( $\mu g/m^3$ )





Figure 9.2: Modelled annual average NO<sub>2</sub> concentration, 2036 with Local Plan (µg/m<sup>3</sup>)





Figure 9.3: Modelled 99.79th percentile of hourly average  $NO_2$  concentrations without Local Plan ( $\mu g/m^3$ )





Figure 9.4: Modelled 99.79th percentile of hourly average  $NO_2$  concentrations with Local Plan ( $\mu g/m^3$ )





Figure 9.5: Modelled annual average  $PM_{10}$  concentration without Local Plan ( $\mu g/m^3$ )





Figure 9.6: Modelled annual average  $PM_{10}$  concentration with Local Plan ( $\mu g/m^3$ )





Figure 9.7: Modelled 90.41<sup>st</sup> percentile of daily average  $PM_{10}$  concentrations without Local Plan ( $\mu g/m^3$ )





Figure 9.8: Modelled 90.41<sup>st</sup> percentile of daily average  $PM_{10}$  concentrations with Local Plan ( $\mu g/m^3$ )





Figure 9.9: Modelled annual average  $PM_{2.5}$  concentrations without Local Plan ( $\mu g/m^3$ )





Figure 9.10: Modelled annual average  $PM_{2.5}$  concentrations with Local Plan ( $\mu g/m^3$ )



## 9.1 Difference plots

Difference plots were calculated by subtracting the modelled annual average concentrations for 2036 without the Local Plan in place from the modelled concentrations with the Local Plan in place. The resulting concentrations are shown as maps where areas coloured red show an increase in concentrations and areas in blue show a decrease in concentrations, areas with no colour show no significant change in concentrations. The concentration levels shown correspond to 0.5% and 1% of the appropriate air quality standard; a change of less than 0.5% of the standard is generally considered to be negligible.

Figure 9.11 shows the modelled change in annual average NO<sub>2</sub> concentration with the Local Plan in place. The modelled annual average NO<sub>2</sub> concentrations at the monitoring sites at with and without the Local Plan are shown in Table 9.1. In the majority of the modelled area, NO<sub>2</sub> concentrations change by less than 0.2  $\mu$ g/m<sup>3</sup>, or 0.5% of the limit value. Along some of the major roads, the modelled changes in concentrations are greater, with the change at the majority of locations with relevant exposure less than 1% and at a small number of properties between 1% and 2%.

Figure 9.12 shows the modelled change in annual average  $PM_{10}$  concentrations. The modelled annual average  $PM_{10}$  concentrations at the monitoring sites at with and without the Local Plan are shown in Table 9.2. The areas with increases in  $PM_{10}$  concentrations are similar to those for NO<sub>2</sub>, but the areas with decreases are smaller. The maximum change in concentration at locations with relevant exposure is less than 0.4 µg/m<sup>3</sup>, or 1% of the limit value.

*Figure 9.13* shows the modelled change in annual average  $PM_{2.5}$  concentrations. The modelled annual average  $PM_{2.5}$  concentrations at the monitoring sites at with and without the Local Plan are shown in Table 9.3. The areas with significant changes in  $PM_{2.5}$  concentrations are smaller than those for  $PM_{10}$ . The maximum change in concentration at locations with relevant exposure is less than 0.125 µg/m<sup>3</sup>, or 0.5% of the limit value.





Figure 9.11: Modelled change in annual average  $NO_2$  concentration with Local Plan  $(\mu g/m^3)$ 



Code	Address	Site type	Without LP	With LP	Change (µg/m³)	Change (% of limit value)
CM1	Chignal	Rural	13.3	13.3	0.01	0.0%
CM2	Springfield Road	Roadside	19.4	19.7	0.28	0.7%
CM3	Rainsford Lane	Roadside	20.1	20.1	0.01	0.0%
CM4	Baddow Road	Roadside	18.3	18.4	0.06	0.1%
CB01	12 Van Diemans Road	Façade	19.3	19.4	0.09	0.2%
CB02	3 Moulsham Chase	Roadside	15.8	15.8	0.06	0.2%
CB04	28 Cleves Court	Roadside	15.6	15.7	0.14	0.4%
CB08	109 Balmoral Court	Façade	20.8	21.0	0.27	0.7%
CB11	20 Brooklands Walk	Façade	18.3	18.3	0.02	0.1%
CB13	60 Roxwell Road	Façade	15.4	15.5	0.10	0.3%
CB18	180 Maldon Road	Façade	15.9	16.0	0.12	0.3%
CB19	92 Maldon Road	Façade	15.5	15.6	0.12	0.3%
CB20	Lyster Avenue	Façade	15.3	15.4	0.08	0.2%
CB22	95 Baddow Road	Façade	19.2	19.3	0.08	0.2%
CB22B	95 Baddow Road	Façade	17.5	17.6	0.10	0.3%
CB22C	95 Baddow Road	Façade	17.5	17.6	0.10	0.3%
CB25	20 Allen Way	Roadside	15.8	15.9	0.08	0.2%
CB26	214 Baddow Road	Façade	20.3	20.3	0.03	0.1%
CB26B	214 Baddow Road	Façade	20.3	20.3	0.03	0.1%
CB26C	214 Baddow Road	Façade	20.3	20.3	0.03	0.1%
CB32	2 Abbots Place	Façade	16.3	16.4	0.03	0.1%
CB33	Victoria Road	Roadside	16.3	16.4	0.03	0.1%
CB36	2 Rainsford Lane	Roadside	16.3	16.4	0.03	0.1%
CB37	30 Victoria Crescent	Façade	15.3	15.4	0.08	0.2%
CB38	Prison 1, Springfield Road	Roadside	14.8	14.9	0.10	0.2%
CB39	Prison 2, Springfield Road	Roadside	19.8	20.1	0.31	0.8%
CB40	Prison 3, Springfield Road	Roadside	19.1	19.2	0.13	0.3%
CB41	Hill Road South	Roadside	16.5	16.6	0.04	0.1%
CB42	Wharf Road(Gas Works)	Roadside	18.3	18.4	0.09	0.2%
CB44	Atlantic Business Centres, Broomfield Road	Façade	17.8	17.9	0.10	0.2%
CB45	32 Van Diemans Road	Facade	19.4	19.7	0.28	0.7%
CB46	32 Rochford Road	Roadside	19.4	19.7	0.28	0.7%
CB48	1 Weight Road	Roadside	19.4	19.7	0.28	0.7%
CB49	26 Rochford Road	Façade	15.8	15.9	0.12	0.3%
CB52	Penpol, Victoria Road	Roadside	16.5	16.7	0.14	0.3%
CB55	15 Cedar Avenue	Façade	18.1	18.2	0.11	0.3%
CB56	52 Goldlay Road	Roadside	18.9	19.0	0.08	0.2%
CB57	Goldlay House, Parkway	Façade	18.1	18.2	0.12	0.3%
CB58	148 Baddow Road	Façade	16.8	17.0	0.16	0.4%
CB61	10 Fraser Close	Façade	17.4	17.5	0.12	0.3%
CB62	Chignal 1	Rural	19.6	19.8	0.23	0.6%
CB63	Chignal 2	Rural	19.4	19.5	0.11	0.3%
CB64	Chignal 3	Rural	16.9	17.0	0.11	0.3%
CB65	Fire Station 1, Rainsford Lane	Roadside	18.1	18.2	0.15	0.4%
CB66	Fire Station 2, Rainsford Lane	Roadside	19.2	19.3	0.08	0.2%
CB67	Fire Station 3, Rainsford Lane	Roadside	15.4	15.5	0.05	0.1%
CB68	Goldlay Avenue 1	Roadside	13.3	13.3	0.01	0.0%
CB68B	Goldlay Avenue 2	Roadside	13.3	13.3	0.01	0.0%
CB68C	Goldlay Avenue 3	Roadside	13.3	13.3	0.01	0.0%
CB73	Chelmer Road	Roadside	20.1	20.1	0.01	0.0%
CB/4	South Primrose Hill	⊢açade	20.1	20.1	0.01	0.0%
CB75	Main Road, Danbury	Façade	20.1	20.1	0.01	0.0%
CB/6	Ivialdon Road, Danbury	Façade	18.5	18.6	0.18	0.4%
		Nerdside	18.5	18.6	0.18	0.4%
CB19	10 vvaternouse Lane	Koadside	18.5	18.6	0.18	0.4%
CB00			10.5	10.0	0.10	0.2%
		Roadside	19.4	19.4	0.07	0.2%
	134/130 Springfield Road	Roadside	10.1	18.5	0.39	1.0%
	134/130 Springfield Road	Roadside	10.0	10.9	0.28	0.7%
	Deddow Deed ACMC 1	Roadside	10.9	17.0	0.10	0.0%
	Baddow Road AQMS 1	Roadside	19.7	19./	0.00	0.0%
	Baddow Road AQMS 2	Roadside	19.2	19.0	0.29	0.7%
CB00	147 Baddow Pood	Facado	25.0	10.0 25.6	0.11	0.3%
CB80	135 Springfield Pood	Korheida	20.0	20.0	0.54	1.47/0
CB90	144 Springfield Road	Kerbside	25.4	26.0	0.57	1.4%
0000	opinignola i toda	1.0100100	-0.7	-0.0	0.01	1. 770

Table 9.1: Modelled annual average  $NO_2$  concentrations at monitoring sites





Figure 9.12: Modelled change in annual average  $PM_{10}$  concentration with Local Plan ( $\mu g/m^3$ )



Code	Address	Site type	Without LP	With LP	Change (µg/m <sup>3</sup> )	Change (% of limit value)
CM1	Chignal	Rural	16.4	16.4	0.00	0.0%
CM2	Springfield Road	Roadside	19.3	19.3	0.07	0.2%
CM3	Rainsford Lane	Roadside	20.7	20.7	-0.01	0.0%
CM4	Baddow Road	Roadside	19.3	19.3	0.00	0.0%
CB01	12 Van Diemans Road	Façade	19.4	19.4	0.00	0.0%
CB02	3 Moulsham Chase	Roadside	18.5	18.5	0.00	0.0%
CB04	28 Cleves Court	Roadside	17.5	17.5	0.04	0.1%
CB08	109 Balmoral Court	Façade	19.6	19.7	0.06	0.1%
CB11	20 Brooklands Walk	Façade	18.7	18.7	0.00	0.0%
CB13	60 Roxwell Road	Façade	17.8	17.8	0.02	0.0%
CB18	180 Maldon Road	Façade	18.6	18.6	0.04	0.1%
CB19	92 Maldon Road	Façade	17.9	17.9	0.03	0.1%
CB20	Lyster Avenue	Façade	17.9	17.9	0.02	0.1%
CB22	95 Baddow Road	Façade	19.5	19.5	0.00	0.0%
CB22B	95 Baddow Road	Façade	19.0	19.0	0.01	0.0%
CB22C	95 Baddow Road	Façade	19.0	19.0	0.01	0.0%
CB25	20 Allen Way	Roadside	17.6	17.6	0.02	0.0%
CB26	214 Baddow Road	Façade	19.9	19.9	-0.01	0.0%
CB26B	214 Baddow Road	Façade	19.9	19.9	-0.01	0.0%
CB26C	214 Baddow Road	Façade	19.9	19.9	-0.01	0.0%
CB32	2 Abbots Place	⊢açade	17.6	1/.6	0.01	0.0%
CB33	VICTORIA ROAD	Roadside	17.6	1/.6	0.01	0.0%
CB36	∠ Rainstord Lane	Roadside	17.6	17.6	0.01	0.0%
CB3/	30 VICTORIA Crescent	⊢açade	17.3	17.3	0.01	0.0%
CB38	Prison 1, Springtield Road	Roadside	17.2	17.2	0.02	0.0%
CB39	Prison 2, Springfield Road	Roadside	19.4	19.4	0.08	0.2%
CB40	Prison 3, Springtield Road	Roadside	19.3	19.3	0.02	0.1%
CB41	Hill Road South	Roadside	18.3	18.3	0.00	0.0%
CB42	VVnart Road(Gas Works)	Roadside	19.1	19.1	0.01	0.0%
CB44	Roomfield Road	Façade	18.7	18.7	0.01	0.0%
CB45	32 Van Diemans Road	Facade	19.3	19.3	0.07	0.2%
CB46	32 Rochford Road	Roadside	19.3	19.3	0.07	0.2%
CB48	1 Weight Road	Roadside	19.3	19.3	0.07	0.2%
CB49	26 Rochford Road	Facade	18.1	18.1	0.00	0.0%
CB52	Penpol. Victoria Road	Roadside	18.2	18.2	0.01	0.0%
CB55	15 Cedar Avenue	Facade	18.8	18.8	0.01	0.0%
CB56	52 Goldlay Road	Roadside	19.3	19.3	0.00	0.0%
CB57	Goldlay House, Parkway	Façade	18.9	18.9	0.01	0.0%
CB58	148 Baddow Road	Façade	18.3	18.3	0.01	0.0%
CB61	10 Fraser Close	Façade	18.7	18.7	0.01	0.0%
CB62	Chignal 1	Rural	19.2	19.2	0.04	0.1%
CB63	Chignal 2	Rural	19.4	19.4	0.02	0.0%
CB64	Chignal 3	Rural	18.6	18.6	0.01	0.0%
CB65	Fire Station 1, Rainsford Lane	Roadside	19.0	19.0	0.02	0.0%
CB66	Fire Station 2, Rainsford Lane	Roadside	19.4	19.4	0.00	0.0%
CB67	Fire Station 3, Rainsford Lane	Roadside	18.5	18.5	0.00	0.0%
CB68	Goldlay Avenue 1	Roadside	16.4	16.4	0.00	0.0%
CB68B	Goldlay Avenue 2	Roadside	16.4	16.4	0.00	0.0%
CB68C	Goldlay Avenue 3	Roadside	16.4	16.4	0.00	0.0%
CB73	Chelmer Road	Roadside	20.7	20.7	-0.01	0.0%
CB74	South Primrose Hill	Façade	20.7	20.7	-0.01	0.0%
CB75	Main Road, Danbury	Façade	20.7	20.7	-0.01	0.0%
CB76	Maldon Road, Danbury	Façade	19.1	19.1	0.03	0.1%
CB77	Meadgate Avenue	Kerbside	19.1	19.1	0.03	0.1%
CB79	10 Waterhouse Lane	Roadside	19.1	19.1	0.03	0.1%
CB80	208 Springfield Road	Façade	18.3	18.3	0.01	0.0%
CB82	122 Springfield Road	Roadside	19.4	19.4	0.01	0.0%
CB83	134/136 Springfield Road	Roadside	18.4	18.6	0.15	0.4%
CB83b	134/136 Springfield Road	Roadside	17.9	18.0	0.11	0.3%
CB83c	134/136 Springfield Road	Roadside	18.7	18.7	0.01	0.0%
CB84	Baddow Road AQMS 1	Roadside	20.5	20.5	-0.01	0.0%
CB85	Baddow Road AQMS 2	Roadside	19.1	19.2	0.07	0.2%
CB86	Baddow Road AQMS 3	Roadside	18.2	18.2	0.01	0.0%
CB88	14/ Baddow Road	Façade	20.7	20.8	0.14	0.3%
CB88	135 Springfield Road	Kerbside	20.8	20.9	0.14	0.4%
CR30	144 Springfield Road	Kerbside	20.9	21.0	0.15	0.4%

Table 9.2: Modelled annual average  $PM_{10}$  concentrations at monitoring sites





Figure 9.13: Modelled change in annual average  $PM_{2.5}$  concentrations with Local Plan  $(\mu g/m^3)$ 



Code	Address	Site type	Without LP	With LP	Change (µg/m <sup>3</sup> )	Change (% of limit value)
CM1	Chignal	Rural	11.7	11.7	0.00	0.0%
CM2	Springfield Road	Roadside	13.7	13.8	0.04	0.2%
CM3	Rainsford Lane	Roadside	14.3	14.3	-0.01	0.0%
CM4	Baddow Road	Roadside	13.8	13.8	0.00	0.0%
CB01	12 Van Diemans Road	Façade	13.9	13.9	0.00	0.0%
CB02	3 Moulsham Chase	Roadside	13.4	13.4	0.00	0.0%
CB04	28 Cleves Court	Roadside	12.4	12.4	0.02	0.1%
CB08	109 Balmoral Court	Façade	13.9	14.0	0.03	0.1%
CB11	20 Brooklands Walk	Façade	13.3	13.3	0.00	0.0%
CB13	60 Roxwell Road	Façade	12.7	12.8	0.01	0.0%
CB18	180 Maldon Road	Façade	13.5	13.5	0.02	0.1%
CB19	92 Maldon Road	Façade	12.9	12.9	0.02	0.1%
CB20	Lyster Avenue	Façade	12.9	12.9	0.01	0.1%
CB22	95 Baddow Road	Façade	13.9	13.9	0.00	0.0%
CB22B	95 Baddow Road	Façade	13.7	13.7	0.00	0.0%
CB22C	95 Baddow Road	Façade	13.7	13.7	0.00	0.0%
CB25	20 Allen Way	Roadside	12.6	12.6	0.01	0.0%
CB26	214 Baddow Road	Façade	14.2	14.2	0.00	0.0%
CB26B	214 Baddow Road	Façade	14.2	14.2	0.00	0.0%
CB26C	214 Baddow Road	Façade	14.2	14.2	0.00	0.0%
CB32	2 Abbots Place	Façade	12.4	12.4	0.00	0.0%
CB33	Victoria Road	Roadside	12.4	12.4	0.00	0.0%
CB36	2 Rainsford Lane	Roadside	12.4	12.4	0.00	0.0%
CB37	30 Victoria Crescent	Façade	12.4	12.4	0.01	0.0%
CB38	Prison 1, Springfield Road	Roadside	12.2	12.3	0.01	0.0%
CB39	Prison 2, Springfield Road	Roadside	13.8	13.8	0.04	0.2%
CB40	Prison 3, Springfield Road	Roadside	13.8	13.8	0.01	0.0%
CB41	Hill Road South	Roadside	13.1	13.1	0.00	0.0%
CB42	Wharf Road(Gas Works)	Roadside	13.6	13.6	0.01	0.0%
CB44	Atlantic Business Centres, Broomfield Road	Façade	13.5	13.5	0.01	0.0%
CB45	32 Van Diemans Road	Facade	13.7	13.8	0.04	0.2%
CB46	32 Rochford Road	Roadside	13.7	13.8	0.04	0.2%
CB48	1 Weight Road	Roadside	13.7	13.8	0.04	0.2%
CB49	26 Rochford Road	Facade	13.1	13.1	0.00	0.0%
CB52	Penpol, Victoria Road	Roadside	13.1	13.1	0.00	0.0%
CB55	15 Cedar Avenue	Facade	13.5	13.5	0.01	0.0%
CB56	52 Goldlay Road	Roadside	13.8	13.8	0.00	0.0%
CB57	Goldlay House, Parkway	Facade	13.5	13.5	0.01	0.0%
CB58	148 Baddow Road	Facade	13.2	13.2	0.01	0.0%
CB61	10 Fraser Close	Facade	13.4	13.4	0.01	0.0%
CB62	Chignal 1	Rural	13.7	13.7	0.02	0.1%
CB63	Chignal 2	Rural	13.8	13.8	0.01	0.0%
CB64	Chignal 3	Rural	13.3	13.3	0.01	0.0%
CB65	Fire Station 1, Rainsford Lane	Roadside	13.6	13.6	0.01	0.0%
CB66	Fire Station 2, Rainsford Lane	Roadside	13.9	13.9	0.00	0.0%
CB67	Fire Station 3, Rainsford Lane	Roadside	13.4	13.4	0.00	0.0%
CB68	Goldlay Avenue 1	Roadside	11.7	11.7	0.00	0.0%
CB68B	Goldlay Avenue 2	Roadside	11.7	11.7	0.00	0.0%
CB68C	Goldlay Avenue 3	Roadside	11.7	11.7	0.00	0.0%
CB73	Chelmer Road	Roadside	14.3	14.3	-0.01	0.0%
CB74	South Primrose Hill	Façade	14.3	14.3	-0.01	0.0%
CB75	Main Road, Danbury	Façade	14.3	14.3	-0.01	0.0%
CB76	Maldon Road, Danbury	Façade	13.7	13.7	0.01	0.1%
CB77	Meadgate Avenue	Kerbside	13.7	13.7	0.01	0.1%
CB79	10 Waterhouse Lane	Roadside	13.7	13.7	0.01	0.1%
CB80	208 Springfield Road	Façade	13.1	13.1	0.00	0.0%
CB82	122 Springfield Road	Roadside	13.7	13.7	0.00	0.0%
CB83	134/136 Springfield Road	Roadside	12.9	13.0	0.08	0.3%
CB83b	134/136 Springfield Road	Roadside	12.7	12.7	0.06	0.2%
CB83c	134/136 Springfield Road	Roadside	13.5	13.5	0.01	0.0%
CB84	Baddow Road AQMS 1	Roadside	14.0	14.0	0.00	0.0%
CB85	Baddow Road AQMS 2	Roadside	13.7	13.7	0.04	0.2%
CB86	Baddow Road AQMS 3	Roadside	13.1	13.2	0.01	0.0%
CB88	147 Baddow Road	Façade	14.5	14.6	0.08	0.3%
CB89	135 Springfield Road	Kerbside	14.6	14.6	0.08	0.3%
CB90	144 Springfield Road	Kerbside	14.6	14.7	0.08	0.3%

Table 9.3: Modelled annual average PM<sub>2.5</sub> concentrations at monitoring sites



## 9.2 Significance assessment

The IAQM significance criteria shown in Section 3.2 are based on the modelled total and change in annual average concentrations relative to the air quality limits. Any change in concentration of less than 0.5% of the limit value is considered *negligible*. Where the change is greater than 0.5% of the limit value, the descriptor depends both on the total concentration and the change in concentration.

For NO<sub>2</sub>, the modelled concentrations are less than 30  $\mu$ g/m<sup>3</sup>, or 75% of the limit value, at all locations with potential public exposure, and the maximum change in concentration is less than 0.8  $\mu$ g/m<sup>3</sup>, or 2% of the limit value. The change in NO<sub>2</sub> concentrations can therefore be considered *negligible*.

For PM<sub>10</sub>, the modelled concentrations are less than 30  $\mu$ g/m<sup>3</sup>, or 75% of the limit value, at all locations with potential public exposure, and the maximum change in concentration is less than 0.4  $\mu$ g/m<sup>3</sup>, or 1% of the limit value. The change in PM<sub>10</sub> concentrations can therefore be considered *negligible*.

For PM<sub>2.5</sub>, the modelled changes in concentration at locations with potential public exposure are less than 0.125  $\mu$ g/m<sup>3</sup>, or 0.5% of the limit value. The change in PM<sub>2.5</sub> concentrations can therefore be considered *negligible*.

This assessment of the significance of the air quality impact of the Local Plan is based on modelling for the year 2036. In the intervening years the impacts may vary, depending on when each development is completed and on other local factors. The impact of each development should be assessed for its opening year as part of the planning process.



# 10 Discussion

Air quality modelling was carried out for Chelmsford using ADMS-Urban to investigate the likely impact of the Chelmsford Local Plan on air quality. The modelling used traffic model data for 2016, 2036 with the Local Plan and 2036 without the Local Plan. Additional emissions from domestic combustion at planned development sites were included.

Model verification was carried out, comparing modelled concentrations with measured data for 2016. The modelling showed generally good agreement with the measured data with the majority of modelled concentrations within 25% of the measured data (and most much better than this) and no systematic under or overprediction of concentrations.

Modelling for 2016 showed exceedences of the  $NO_2$  limit values along some major roads in the city centre, including some locations with potential public exposure. Exceedences were also modelled along the A12 and A130, but not extending to areas with public exposure. No exceedences of the limit values for  $PM_{10}$  or  $PM_{2.5}$  were modelled.

By 2036, vehicle exhaust emissions of  $NO_{x}$ ,  $PM_{10}$  and  $PM_{2.5}$  are predicted to decrease significantly. However,  $PM_{10}$  and  $PM_{2.5}$  emissions also include contributions from non-exhaust emissions, i.e. road, brake and tyre wear, which are expected to increase proportionally to traffic levels.

Modelled concentrations of NO<sub>2</sub>,  $PM_{10}$  and  $PM_{2.5}$  in 2036 both with and without the Local Plan are all below the relevant limit values. Difference plots show that the introduction of the Local Plan is likely to have a small impact on annual average pollutant concentrations along some roads, with increases and decreases of up to 1% of the relevant limit values for NO<sub>2</sub> and  $PM_{10}$ .

The significance of the air quality impact of the Local Plan in 2036 was assessed using IAQM guidance. The impact of all pollutants in 2036 can be considered *negligible*. The impact in intervening years may vary depending on when each development is completed and other local factors.



# **APPENDIX A: Glossary**

AADT	Annual average daily total traffic flow
ADMS-Urban	Atmospheric Dispersion Modelling System software
AQMA	Air Quality Management Area
ARCADY	Assessment of Roundabout Capacity and Delay traffic model
DECC	Department of Energy and Climate Change
Defra	Department of Environment, Food and Rural Affairs
DfT	Department for Transport
EMIT	Emissions Inventory Toolkit software
HGV	Heavy goods vehicle
IAQM	Institute of Air Quality Management
LinSig	A traffic model
LGV	Light good vehicle
NAEI	National Atmospheric Emissions Inventory
NO	Nitric oxide
NO <sub>2</sub>	Nitrogen dioxide
NO <sub>x</sub>	Nitrogen oxides = $NO + NO_2$
PICADY	Priority Intersection Capacity and Delay traffic model
$PM_{10}$	Particulate matter with a diameter of less than 10 $\mu m$
PM <sub>2.5</sub>	Particulate matter with a diameter of less than 2.5 $\mu m$
$\mu g/m^3$	Microgrammes per cubic metre
VISUM	A traffic model



# **APPENDIX B: Summary of ADMS-Urban**

ADMS-Urban is a scientifically advanced but practical air pollution modelling tool, which has been developed to provide high resolution calculations of pollution concentrations for all sizes of study area relevant to the urban environment. The model can be used to look at concentrations near a single road junction or over a region extending across the whole of a major city. ADMS-Urban has been extensively used for the Review and Assessment of Air Quality carried out by Local Authorities in the UK and for a wide range of planning and policy studies across the world. The following is a summary of the capabilities and validation of ADMS-Urban. More details can be found on the CERC web site at www.cerc.co.uk.

ADMS-Urban is a development of the Atmospheric Dispersion Modelling System (ADMS), which has been developed to investigate the impacts of emissions from industrial facilities. ADMS-Urban allows full characterisation of the wide variety of emissions in urban areas, including an extensively validated road traffic emissions model. It also includes a number of other features, which include consideration of:

- the effects of vehicle movement on the dispersion of traffic emissions;
- the behaviour of material released into street-canyons;
- the chemical reactions occurring between nitrogen oxides, ozone and Volatile Organic Compounds (VOCs);
- the pollution entering a study area from beyond its boundaries;
- the effects of complex terrain on the dispersion of pollutants; and
- the effects of a building on the dispersion of pollutants emitted nearby.

Further details of these features are provided below.

Studies of extensive urban areas are necessarily complex, requiring the manipulation of large amounts of data. To allow users to cope effectively with this requirement, ADMS-Urban runs in Windows 10, Windows 8, Windows 7 and Windows Vista environments. The manipulation of data is further facilitated by the possible integration of ADMS-Urban with a Geographical Information System (GIS) (MapInfo, ArcGIS, or the ADMS-Mapper) and the CERC Emissions Inventory Toolkit, EMIT.

#### **Dispersion Modelling**

ADMS and ADMS-Urban use boundary layer similarity profiles to parameterise the variation of turbulence with height within the boundary layer, and the use of a skewed-Gaussian distribution to determine the vertical variation of pollutant concentrations in the plume under convective conditions.

The main dispersion modelling features of ADMS-Urban are as follows:



- ADMS-Urban is an **advanced dispersion model** in which the boundary layer structure is characterised by the height of the boundary layer and the Monin-Obukhov length, a length scale dependent on the friction velocity and the heat flux at the surface. This method supersedes methods based on Pasquill Stability Categories, as used in, for example, Caline and ISC. Concentrations are calculated hour by hour and are fully dependent on prevailing weather conditions.
- For convective conditions, a **non-Gaussian vertical profile of concentration** allows for the skewed nature of turbulence within the atmospheric boundary layer, which can lead to high concentrations near to the source.
- A **meteorological pre-processor** calculates boundary layer parameters from a variety of input data, typically including date and time, wind speed and direction, surface temperature and cloud cover. Meteorological data may be raw, hourly averaged or statistically analysed data.

### Emissions

Emissions into the atmosphere across an urban area typically come from a wide variety of sources. There are likely to be industrial emissions from chimneys as well as emissions from road traffic and domestic heating systems. To represent the full range of emissions configurations, the explicit source types available within ADMS-Urban are:

- **Roads**, for which emissions are specified in terms of vehicle flows and the additional initial dispersion caused by moving vehicles is also taken into account.
- **Industrial points**, for which plume rise and stack downwash are included in the modelling.
- Areas, where a source or sources is best represented as uniformly spread over an area.
- **Volumes**, where a source or sources is best represented as uniformly spread throughout a volume.

In addition, sources can also be modelled as a regular grid of emissions. This allows the contributions of large numbers of minor sources to be efficiently included in a study while the majority of the modelling effort is used for the relatively few significant sources.

ADMS-Urban can be used in conjunction with CERC's Emissions Inventory Toolkit, EMIT, which facilitates the management and manipulation of large and complex data sets into usable emissions inventories.

### Presentation of Results

The results from the model can be based on a wide range of averaging times, and include rolling averages. Maximum concentration values and percentiles can be calculated where appropriate meteorological input data have been input to the model. This allows ADMS-Urban to be used to calculate concentrations for direct comparison with existing air quality limits, guidelines and objectives, in whatever form they are specified.

ADMS-Urban can be integrated with the ArcGIS or MapInfo to facilitate both the compilation and manipulation of the emissions information required as input to the model and the interpretation and presentation of the air quality results provided.



#### **Complex Effects - Street Canyons**

ADMS-Urban incorporates two methods for representing the effect of street canyons on the dispersion of road traffic emissions: a basic canyon method based on the *Operational Street Pollution Model (OSPM)*<sup>11</sup>, developed by the Danish National Environmental Research Institute (NERI); and an advanced street canyon module, developed by CERC. The basic canyon model was designed for simple symmetric canyons with height similar to width and assumes that road traffic emissions originate throughout the base of the canyon, i.e. that the emissions are spread across both the road and neighbouring pavements.

The advanced canyon model<sup>12</sup> was developed to overcome these limitations and is our model of choice. It represents the effects of channelling flow along and recirculating flow across a street canyon, dispersion out of the canyon through gaps in the walls, over the top of the buildings or out of the end of the canyon. It can take into account canyon asymmetry and restricts the emissions area to the road carriageway.

### Complex Effects - Chemistry

ADMS-Urban includes the *Generic Reaction Set*  $(GRS)^{13}$  atmospheric chemistry scheme. The original scheme has seven reactions, including those occurring between nitrogen oxides and ozone. The remaining reactions are parameterisations of the large number of reactions involving a wide range of Volatile Organic Compounds (VOCs). In addition, an eighth reaction has been included within ADMS-Urban for the situation when high concentrations of nitric oxide (NO) can convert to nitrogen dioxide (NO<sub>2</sub>) using molecular oxygen.

In addition to the basic GRS scheme, ADMS-Urban also includes a trajectory model<sup>14</sup> for use when modelling large areas. This permits the chemical conversions of the emissions and background concentrations upwind of each location to be properly taken into account.

http://www.harmo.org/Conferences/Proceedings/\_Varna/publishedSections/H16-067-Hood-EA.pdf

<sup>&</sup>lt;sup>14</sup> Singles, R.J., Sutton, M.A. and Weston, K.J., 1997, 'A multi-layer model to describe the atmospheric transport and deposition of ammonia in Great Britain.' In: *International Conference on Atmospheric Ammonia: Emission, Deposition and Environmental Impacts. Atmospheric Environment*, Vol 32, No 3.



<sup>&</sup>lt;sup>11</sup> Hertel, O., Berkowicz, R. and Larssen, S., 1990, 'The Operational Street Pollution Model (OSPM).' 18<sup>th</sup> International meeting of NATO/CCMS on Air Pollution Modelling and its Applications. Vancouver, Canada, pp741-749.

<sup>&</sup>lt;sup>12</sup> Hood C, Carruthers D, Seaton M, Stocker J and Johnson K, 2014. *Urban canopy flow field and advanced street canyon modelling in ADMS-Urban*.16<sup>th</sup> International Conference on Harmonisation within Atmospheric Dispersion Modelling for Regulatory Purposes, Varna, Bulgaria, September 2014.

<sup>&</sup>lt;sup>13</sup> Venkatram, A., Karamchandani, P., Pai, P. and Goldstein, R., 1994, 'The Development and Application of a Simplified Ozone Modelling System.' *Atmospheric Environment*, Vol 28, No 22, pp3665-3678.

### Complex Effects - Terrain

As well as the effect that complex terrain has on wind direction and, consequently, pollution transport, it can also enhance turbulence and therefore increase dispersion. These effects are taken into account in ADMS-Urban using the FLOWSTAR<sup>15</sup> model developed by CERC.

#### Data Comparisons – Model Validation

ADMS-Urban is a development of the Atmospheric Dispersion Modelling System (ADMS), which is used throughout the UK by industry and the Environment Agency to model emissions from industrial sources. ADMS has been subject to extensive validation, both of individual components (e.g. point source, street canyon, building effects and meteorological pre-processor) and of its overall performance.

ADMS-Urban has been extensively tested and validated against monitoring data for large urban areas in the UK and overseas, including London, Birmingham, Manchester, Glasgow, Riga, Cape Town, Hong Kong and Beijing, during projects supported by local governments and research organisations. A summary of published model validation studies is available at <u>www.cerc.co.uk/Validation</u> with other publications available at <u>www.cerc.co.uk/publications</u>.

<sup>&</sup>lt;sup>15</sup> Carruthers D.J., Hunt J.C.R. and Weng W-S. 1988. 'A computational model of stratified turbulent airflow over hills – FLOWSTAR I.' Proceedings of Envirosoft. In: *Computer Techniques in Environmental Studies*, P. Zanetti (Ed) pp 481-492. Springer-Verlag.





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