Document Control Sheet

Document prepared by:

James Wiffen
Senior Transport Planner

Transport Planning
Victoria House
Chelmsford
CM1 1JR

T 01245 342577
E james.wiffen@essexhighways.org
W www.essex.gov.uk/highways

Report Title	Technical Note 8 – Sensitivity and Stress Testing the Site Sustainability Scoring System / Epping Forest District Car Ownership & Use Mapping
Project Number	44TP006 / B3553R0E
Status	Draft
Revision	-
Control Date	20th June 2016

Record of Issue

Issue	Status	Authors	Date	Check	Date	Review	Date
1	Draft	B. Antliff J. Wiffen	20/06/16	T. Kruger	20/06/16	T. Kruger	20/06/16

Approved for Issue By	Date
J. Jones	20/06/16

Distribution

Organisation	Contact	Number of Copies
Essex County Council	David Sprunt	Electronic
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Technical Note 8

Part One: Sensitivity and Stress Testing the Site Sustainability Scoring System

Introduction

Part one of this technical note documents the sensitivity and stress testing of the scoring and ranking system developed to appraise the sustainable accessibility of Epping Forest District Council (EFDC)'s Local Plan sites. Further details of the scoring and ranking system can be found in the preceding technical note[1].

The additional tests were undertaken to ensure that the scoring and ranking system was sufficiently robust to support to stand up to a high level of scrutiny.

When considering the sensitivity of the scoring and ranking system, it was important that the mechanism was responsive to changes in weightings so as to have an impact on the performance and ranking of SLAA development sites. However, it was equally important for the mechanism to not be overly sensitive, where small changes in weighting significantly affected overall study conclusions.

Assumptions / Methodology

The sustainable accessibility scoring system was designed to be moderated by the weightings applied to seven appraisal objectives derived from the WebTAG Appraisal Summary Table.

Sensitivity testing involved making small changes to the score weighting given to one particular appraisal objective thereby marginally increasing its importance over its original (control) weighting. Stress testing involved exaggerating the score weighting given to one particular appraisal objective, significantly increasing its importance over other objectives and checking its impact. This process was undertaken for each of the seven appraisal objectives.

The weightings given to each appraisal objective for a 'control' scenario were determined through discussions with EFDC, where 'commuter journey time reliability' and 'physical activity related to walking/cycling' were identified as being of greatest importance. This 'control' (or original) scenario can be seen in Table 1 below, and is expected to be taken forward for the spatial option site selection process.

For each sensitivity test, the score for a single objective was increased by 10 points and the remaining objectives were reduced proportionally so as to maintain an overall weighting total of 100.

For each stress test, the weighting of an individual objective was increased to 60, with the weightings of the remaining objectives reduced proportionally to maintain an overall total of 100.

[1] Technical Note 7 – Sustainable Accessibility Ranking, Mapping & Analysis – September 2015

Table 1 below shows the weightings for the control/original scenario followed by the weightings for the sensitivity and stress tests for Appraisal Objective 1 – 'Typical commuter journey time'.

Table 1 – Weightings used for the control/original scenario and the sensitivity/stress testing of Appraisal Objective 1 (as an example)

Sensitivity Weighting				
Appraisal objectives	**Test No.**	**Control (Original Weighting)**	**Sensitivity Test (1)**	**Stress Test (1)**
Economy				
Typical commuter journey time	**1**	10	20.0	60.0
Commuter journey time reliability	**2**	20	17.8	8.9
Environment				
Noise and air quality linked to vehicle flow and congestion	**3**	10	8.9	4.4
Social (health, education etc.)				
Typical non-commuter journey time	**4**	15	13.3	6.7
Non-commuter journey time reliability	**5**	15	13.3	6.7
Physical activity related to walking/cycling	**6**	5	4.4	2.2
Access to local services	**7**	25	22.2	11.1

Findings

Summary tables showing the score and ranking changes per area of Epping Forest District can be found at the end of this technical note.

With reference to Tables 2 and 3, the findings of the sensitivity tests revealed the following:

- Averaged scores for sites across settlement areas in Epping Forest were shown to vary little as a result of the sensitivity tests. The highest score changes were, perhaps understandably, found in Sawbridgeworth (the area within Epping Forest District), as well as other rural areas, where the number of sites located in the settlements was comparatively low. Changes in ranking were subsequently shown to remain largely static following small changes in weights.
- It is noted that the scoring mechanism reflects the particular sensitivity of rural sites to the weighting placed on access to local services.
- Sites that scored well under a particular objective, scored correspondingly higher when the associated weighting was increased under the sensitivity test. In some instances, this led to a small/moderate jump in individual site ranking; demonstrating that the scoring mechanism was receptive to small changes made to the weights.
- However, for each of the sensitivity tests undertaken, no significant change in site ranking was observed, therefore demonstrating that the ranking system was not overly sensitive to small changes in the weight allocated to any objective.
- The largest site rank change occurred when increasing the weighting given to Appraisal Objective 7 (Access to local services) by 10 points. The site with the largest rank change was:

  SR-0074 (Land to the east of the A414, New House Farm, Harlow

Under this sensitivity test, the Outer Harlow site gained 11 points and rose 23 places in the rankings of the 212 sites included. Through further investigation it was found that the site scored well in many of the indicators linked to 'access to local services' - being within close walking distance to a bus stop and having good links to education and health facilities in the area, for example.

With reference to Tables 3 and 4, the findings of the stress tests revealed the following:

- Averaged scores for sites across settlement areas in Epping Forest were shown to change more substantially as a result of the stress tests. Again, the highest score changes were found in rural settlements where the number of sites comprising the average was comparatively low. Despite this, however, overall changes in ranking were shown to remain reasonably static. This therefore demonstrated that the ranking system was not overly sensitive to changes in weights.
- When significant emphasis was placed on access to public transport, the scoring mechanism was shown to heavily penalise sites in rural areas. Conversely, urban areas in close proximity to congested junctions were shown to fare poorly with a heavy weighting placed on environmental quality. The scores of all settlement areas were adversely impacted by an increase in the weighting given to walking and cycling.
- Sites that scored well under a particular objective, scored significantly higher when the associated weight was increased under the stress test. In a number of instances, this led to a significant rise in individual site ranking – demonstrating that the scoring mechanism was responsive to large changes made to the weightings.
- However, for each of the stress tests undertaken, no significant change in site ranking was observed, therefore demonstrating that the ranking system was not overly sensitive to small changes in the weight allocated to any objective.
- The largest site rank change occurred when increasing the weighting given to Appraisal Objective 5 (Non-commuter journey time reliability) to 60 points. The site with the largest rank change was:

  SR-0800 (Land to the East of Theydon Bois)

  Under this sensitivity test, the Theydon Bois site gained 58 points and rose 53 places in the rankings of the 212 sites included. Through further investigation it was found that the site was located very close to Theydon Bois Rail Station as well as education centres in the area. The site was also located away from junctions with existing congestion. These attributes, linked to non-commuter journey time reliability, were shown to contribute to an increased score and thus higher rank.

Both the sensitivity and stress tests have shown that, whilst the scoring method is not sensitive to small changes, significant adjustments made to weights does impact on the site scores and rankings. However, the tests have shown that the ranking of overall settlements changes very little, regardless of weighting. This ensures that a change in the importance given to one appraisal objective will not influence overall conclusions regarding the patterns of sustainable accessibility across the District.

Table 2 – Effect of sensitivity tests on overall sustainability scores per area in Epping Forest District

Sensitivity Testing: Change in Sustainability Score								
Area	Average Sustainability Score	Sensitivity Test 1	Sensitivity Test 2	Sensitivity Test 3	Sensitivity Test 4	Sensitivity Test 5	Sensitivity Test 6	Sensitivity Test 7
Loughton	355	2	2	4	5	5	5	6
Debden	345	2	3	4	5	7	3	5
Epping	303	3	1	2	5	2	3	2
Buckhurst Hill	296	-4	-1	2	-2	1	0	-2
Thornwood	296	-2	0	0	-4	1	-4	-4
Chigwell	268	-8	-2	-3	-7	-2	-6	-10
Waltham Abbey	261	-4	0	2	-1	1	-2	-3
Theydon Bois	263	-6	-2	-5	-5	-2	-10	-16
Sheering	228	-3	0	6	1	-1	1	1
Outer Harlow	225	-2	4	2	1	6	-3	-2
North Weald	216	2	5	4	4	9	2	4
Chipping Ongar	202	-3	1	-2	-5	0	-5	-5
Nazeing	191	-4	-2	2	-3	-1	-3	-7
Sawbridgeworth	196	-22	-12	-14	-27	-18	-21	-34
Roydon	164	-8	-3	-1	-8	-3	-8	-12
The Rodings	182	-6	-1	-4	-7	-3	-10	-14
Abridge	110	-3	2	3	0	3	-3	-2
Sewardstone & High Beach	124	-13	-3	1	-11	-2	-7	-11
Stapleford Abbotts	107	-9	-2	-3	-9	-7	-10	-13
Matching Green & Moreton	72	-13	-3	-2	-13	-4	-10	-14
Fyfield	63	-15	-5	-4	-16	-7	-13	-18
Blackmore	60	-15	-5	-4	-17	-8	-13	-19

Table 3 – Effect of sensitivity tests on overall sustainability ranking per area in Epping Forest District

Sensitivity Testing: Change in Area Rank								
Area	Rank	Sensitivity Test 1	Sensitivity Test 2	Sensitivity Test 3	Sensitivity Test 4	Sensitivity Test 5	Sensitivity Test 6	Sensitivity Test 7
Loughton	1	0	0	0	0	0	0	0
Debden	2	0	0	0	0	0	0	0
Epping	3	0	0	0	0	0	0	0
Buckhurst Hill	4	0	0	1	1	0	1	1
Thornwood	5	0	0	-1	-1	0	-1	-1
Chigwell	6	0	0	0	0	0	0	-1
Waltham Abbey	7	1	0	1	1	1	1	2
Theydon Bois	8	-1	0	-1	-1	-1	-1	-1
Sheering	9	0	-1	0	0	-1	0	0
Outer Harlow	10	0	1	0	0	1	0	0
North Weald	11	0	0	0	0	0	0	0
Chipping Ongar	12	0	0	0	0	0	0	0
Nazeing	13	1	1	1	1	1	1	1
Sawbridgeworth	14	-2	-1	-1	-2	-2	-1	-2
Roydon	15	0	0	0	0	0	0	0
The Rodings	16	1	0	0	1	1	0	1
Abridge	17	0	0	0	0	0	0	0
Sewardstone & High Beach	18	0	0	0	0	0	0	0
Stapleford Abbotts	19	0	0	0	0	0	0	0
Matching Green & Moreton	20	0	0	0	0	0	0	0
Fyfield	21	0	0	0	0	0	0	0
Blackmore	22	0	0	0	0	0	0	0

Table 4 – Effect of stress tests on overall sustainability scores per area in Epping Forest District

Stress Testing: Change in Sustainability Score								
Area	Average Sustainability Score	Stress Test 1	Stress Test 2	Stress Test 3	Stress Test 4	Stress Test 5	Stress Test 6	Stress Test 7
Loughton	355	-4	-7	-3	5	3	-11	8
Debden	345	-9	-1	-4	5	11	-23	4
Epping	303	11	-7	-6	11	-2	-10	1
Buckhurst Hill	296	-16	-2	13	-6	4	-12	-4
Thornwood	296	-2	7	3	-11	7	-31	-11
Chigwell	268	-16	11	5	-13	6	-24	-19
Waltham Abbey	261	-17	4	14	-4	6	-19	-7
Theydon Bois	263	-2	16	5	-1	11	-38	-35
Sheering	228	-19	-2	29	0	-9	-13	2
Outer Harlow	225	-17	13	5	0	20	-33	-8
North Weald	216	-11	5	-1	2	21	-28	2
Chipping Ongar	202	-5	14	0	-12	7	-33	-10
Nazeing	191	-10	2	29	-2	3	-15	-15
Sawbridgeworth	196	-19	24	27	-42	-8	-23	-60
Roydon	164	-17	11	27	-14	6	-22	-23
The Rodings	182	-2	19	12	-8	7	-41	-29
Abridge	110	-17	9	15	0	12	-26	-8
Sewardstone & High Beach	124	-42	10	41	-26	9	-14	-19
Stapleford Abbotts	107	-14	18	25	-11	-4	-32	-25
Matching Green & Moreton	72	-35	17	38	-26	11	-24	-26
Fyfield	63	-33	19	39	-31	6	-24	-31
Blackmore	60	-32	20	40	-33	4	-24	-32

Table 5 – Effect of stress tests on overall sustainability ranking per area in Epping Forest District

Stress Testing: Change In Area Rank								
Area	Rank	Stress Test 1	Stress Test 2	Stress Test 3	Stress Test 4	Stress Test 5	Stress Test 6	Stress Test 7
Loughton	1	0	0	0	0	0	0	0
Debden	2	0	0	0	0	0	0	0
Epping	3	0	-1	-2	0	-1	0	0
Buckhurst Hill	4	0	0	2	1	0	1	1
Thornwood	5	0	1	0	-1	1	-1	-1
Chigwell	6	-1	-1	-1	-2	-1	0	-1
Waltham Abbey	7	0	0	2	1	0	1	2
Theydon Bois	8	1	1	-1	1	1	-1	-2
Sheering	9	0	-1	0	0	-2	0	1
Outer Harlow	10	0	1	0	0	1	0	-1
North Weald	11	0	0	-2	0	1	0	1
Chipping Ongar	12	0	-1	-2	0	0	-2	0
Nazeing	13	1	-1	2	1	1	2	1
Sawbridgeworth	14	-2	1	2	-2	-2	0	-3
Roydon	15	0	0	0	0	0	1	1
The Rodings	16	1	1	0	1	1	-1	1
Abridge	17	0	-1	-1	1	0	0	0
Sewardstone & High Beach	18	-2	0	0	-1	0	0	0
Stapleford Abbotts	19	2	1	1	0	0	0	0
Matching Green & Moreton	20	0	0	0	0	0	0	0
Fyfield	21	0	0	0	0	0	0	0
Blackmore	22	0	0	0	0	0	0	0

Part Two: Epping Forest District Car Ownership & Use Mapping

Introduction

Following the Sustainable Accessibility appraisal of Local Plan development sites in Epping Forest District, it was agreed with EFDC that both average car ownership levels, and Journey-To-Work (JTW) by car statistics from the 2011 Census would be mapped within Epping Forest District. The mapping would be used to investigate if different peak hour trip rates could be applied to potential development sites, depending on their proximity to urban centres.

Findings from this study would have the potential to assist in the selection of sites for inclusion in the Local Plan Spatial Options, and be incorporated into the forthcoming Highway Impact Appraisal of development proposals in the District.

Methodology

In order to produce the requested mapping the 25th, 50th and 75th percentiles for both, 'average cars per dwelling' and 'percentage journey to work by car' statistics were calculated using 2011 Census data for all Output Areas (OAs) in Epping Forest District. These three percentile values for each statistic can be seen in Table 6

Table 6 - Percentile values derived from Census OA values for 'average cars per dwelling' and 'percentage journey to work by car' in Epping Forest District

Percentile	Average cars per dwelling for OAs in Epping Forest District	Percentage journey to work by car for OAs in Epping Forest District
25th	1.12	30%
50th	1.37	35%
75th	1.66	41%

Using the boundaries in Table 6, each OA in Epping Forest District was assigned two scores - one for 'average cars per dwelling' and another for 'percentage journey to work by car'. The scores in each category for each OA can be seen below in Tables 7 & 8.

Tables 7 & 8 - Scoring system based on average number of cars per dwellings and percentage journey to work by car

Average number of cars per dwelling	Score
<1.12	1
1.12 - 1.37	2
1.37 - 1.66	3
>1.66	4

Percentage journey to work by car	Score
<30%	1
30%-50%	2
35%-41%	3
>41%	4

For each OA, the scores for both categories were added together to give a final score of between 2 and 8 points. A low combined score indicates a lower dependency on cars relative to other OAs in Epping Forest District, whilst a high combined score indicates a higher relative car dependency.

Plots of Census OAs in Epping, Loughton, Waltham Abbey, Chipping Ongar, and the wider Epping Forest District were then produced, illustrating implied car dependency throughout Epping Forest

District. The OA combined scores and the assigned colours used in the appendix maps (A1-A5) at the end of this report are shown in Table 9.

Tables 9 - OA combined score and associated level of car ownership/use in Epping Forest

OA combined score boundaries	Relative level of car ownership/use in Epping Forest	Colour used for OA in appendix maps
2	Low	
3-4	Low-Medium	
5-6	Medium-High	
7-8	High	

The mapped data revealed an apparent correlation between average car ownership/use and the proximity of an OA to an urban centre. Specifically, OAs with a lower combined score – associated with lower car ownership and use (relative to other OAs in Epping Forest District), were invariably located in urban centres. By contrast, OAs with a higher combined score – associated with higher car ownership and use, were predominantly located in rural areas of the District.

As a result of this correlation, it was considered reasonable to match the four spatial classifications found within the TRICS database to OA score boundaries – as shown in Table 10 below.

Table 10 – OAs' Car ownership/use combined scores mapping to TRICS classifications

OA combined score boundaries	TRICS classification
2	Town Centre
3-4	Edge of town centre
5-6	Suburban
7-8	Rural

This association provided a reasoned argument for taking site location into consideration when calculating trip rates from the TRICS database. Separate trip rates could be derived for town centre, edge of town centre, suburban and rural sites which could then be applied to Local Plan developments in Epping Forest District based on the OA that each development was located within.

For the purpose of illustrating the difference in trip generation between urban and rural sites, the TRICS database was subsequently used to compile average trip rates from surveyed sites, dependent on build type (private house, affordable flat etc.) and TRICS location classification.

For uncommon categories where TRICS data was limited – e.g. rural flats and town centre houses, data was extrapolated/interpolated based on trends observed from categories better represented in the TRICS database.

Table 10 – Trip generation values derived from the TRICS database for a 100 dwelling site – dependent on makeup and location

Morning departure trips generated by a 100 dwelling site				
Site makeup	Site location			
-	Town centre	Edge of town centre	Suburban	Rural
Private house		28	36	39
Affordable house		18	26	29
Private flat	5	20	28	
Affordable flat	0	0	8	

Evening arrival trips generated by a 100 dwelling site				
Site makeup	Site location			
-	Town centre	Edge of town centre	Suburban	Rural
Private house		20	18	18
Affordable house		22	19	19
Private flat	4	11	13	
Affordable flat	0	6	8	

Table 10 shows the expected number of morning peak hour (0800-0900) departure trips and evening peak hour (1700-1800) arrival trips at a typical 100 dwelling site. The data shows that the build type and location of a development site will likely have an impact on trip generation.

Conclusions

The mapping of 'average cars per dwelling' and 'percentage journey to work by car' statistics per Census OA illustrates an apparent correlation between car ownership/use and proximity to urban centres. Specifically, OAs in urban centres are largely associated with lower car ownership and use (relative to other OAs in Epping Forest District), whilst those in rural parts of the District are predominantly associated with higher car ownership and use.

This association provides a reasoned argument for taking site location into consideration when calculating development trip rates from the TRICS database. By doing so, it can be argued that 'sustainability' based on site location (e.g. lower car use in town centres) would then be better represented through the trip generation values calculated and used in subsequent highway impact modelling.

The latest review of trip rates from the TRICS database (taking into account build type *and* location) could also be used alongside the Sustainable Accessibility appraisal of Local Plan development sites as an indicator of site 'sustainability' in terms of potential traffic generation. This could be referenced amongst other indicators as part of the Local Plan site selection process.

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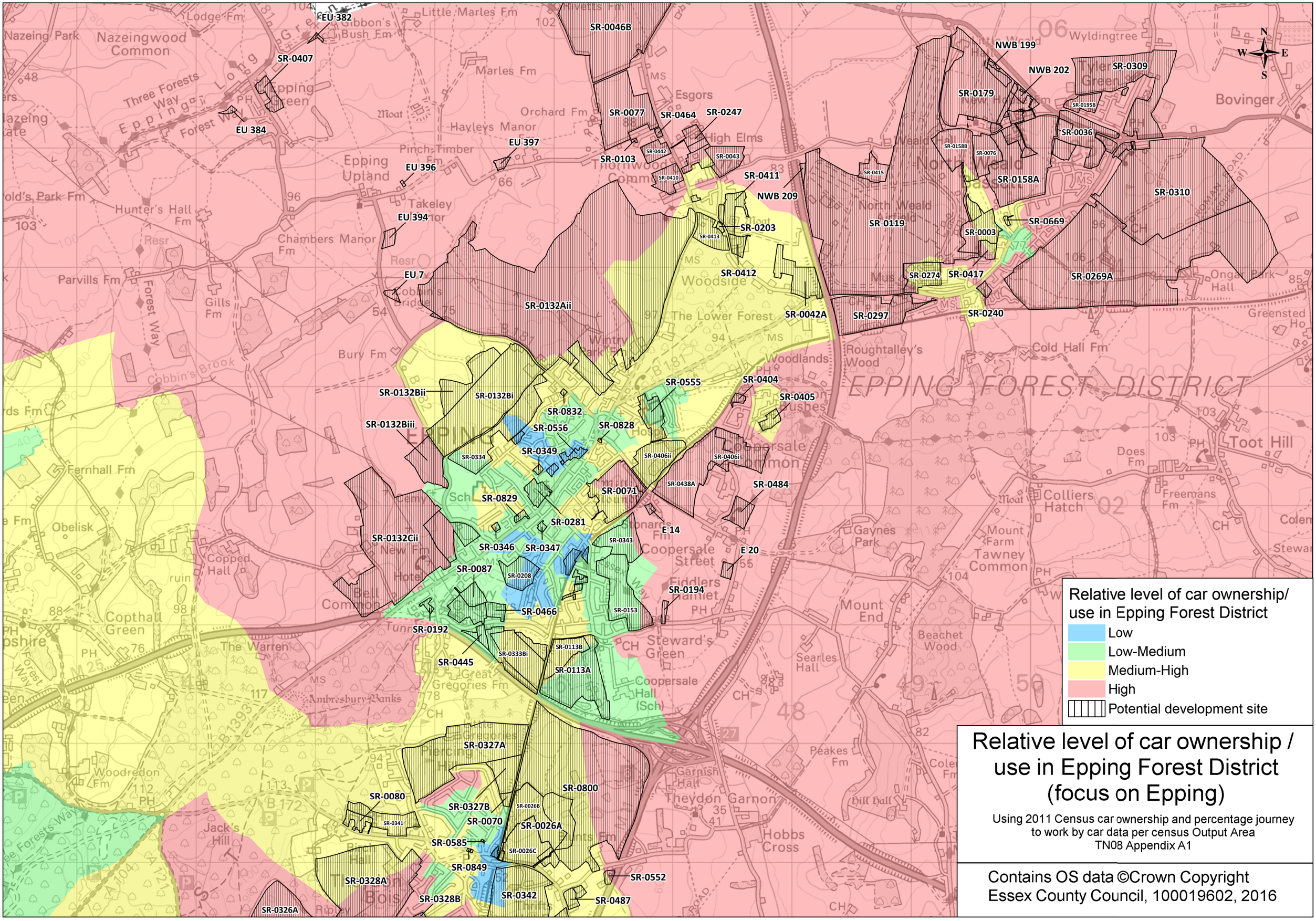

Relative level of car ownership / use in Epping Forest District (focus on Epping)

Using 2011 Census car ownership and percentage journey to work by car data per census Output Area
TN08 Appendix A1

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Relative level of car ownership / use in Epping Forest District (focus on Loughton)

Using 2011 Census car ownership and percentage journey to work by car data per census Output Area
TN08 Appendix A2

Relative level of car ownership/ use in Epping Forest District
- Low
- Low-Medium
- Medium-High
- High
- Potential development site

SR-0065 SR-0372 SR-0370 SR-0061B SR-0080 SR-0341 SR-0327A SR-0327B SR-0800 SR-0026B SR-0026A SR-0070 SR-0585 SR-0026C SR-0849 SR-0552 SR-0487 SR-0342 SR-0477 SR-0328A SR-0328B SR-0326A SR-0058 SR-0436 SR-0326C SR-0446 SR-0326B SR-0564i SR-0532 SR-0360 SR-0361 SR-0027 SR-0329 WA 42 SR-0044i SR-0044ii WA 59 SR-0872 SR-0231 SR-0359 SR-0362 SR-0564ii SR-0325 SR-0358 SR-0549 SR-0834 SR-0836 SR-0835 SR-0289 SR-0330 SR-0461 SR-0527 SR-0526 SR-0565 SR-0513A SR-0447 SR-0189 SR-0012 SR-0525 SR-0878 SR-0514 SR-0355B SR-0355A SR-0279 SR-0356 SR-0837 SR-0059 SR-0575 SR-0352 SR-0354 SR-0353 SR-0885 SR-0134 SR-0017 SR-0188 SR-0319 SR-0819 SR-0176 SR-0880 SR-0551 SR-0147 SR-0444 SR-0818 SR-0817 SR-0517 SR-0816 SR-0813 SR-0900 SR-0435 SR-0249 SR-0318 SR-0133i SR-0115 SR-0133ii SR-0225 SR-0323 SR-0898 SR-0559 SR-0111 SR-0496 SR-0812 SR-0865 SR-0810 SR-0293 SR-0825 SR-0098 SR-0108 SR-0824 SR-0200 SR-0369

Woodredon Fm, Cemy, PH, Beach Hill Park, Three Forests Way, Jack's Hill, Garnish Hall, Theydon Garnon, Hobbs Cross, Pillow Mounds, Great Monk Wood, Conservation Centre, Debden Green, Theydon Bois, Hyde's Fm, Brook Ho, Manor, Wallsgrove Ho, High Beach, Loughton Camp, Forest Way, Theydon Hall, Hill Fm, ROMAN VILLA (site of), Field Study Centre, Woodbury Hollow, Lippitts Hill, Whitehouse Plain, Piggotts Fm, Lambourne Place, Patch Park, Great Wood Hall, Lambourne, Bishop's Moat, LOUGHTON, Long Hills, The Warren, Country Club, Turnours Hall, Marchings Fm, St John's Fm, Bishop's Hall, Queen Elizabeth's Hunting Lodge, London Loop, Pettitts Hall, Taylors Fm, Rolls Park, Brownings Fm, Water Works, Buckhurst Hill, New Barns Fm, Woodford Wells

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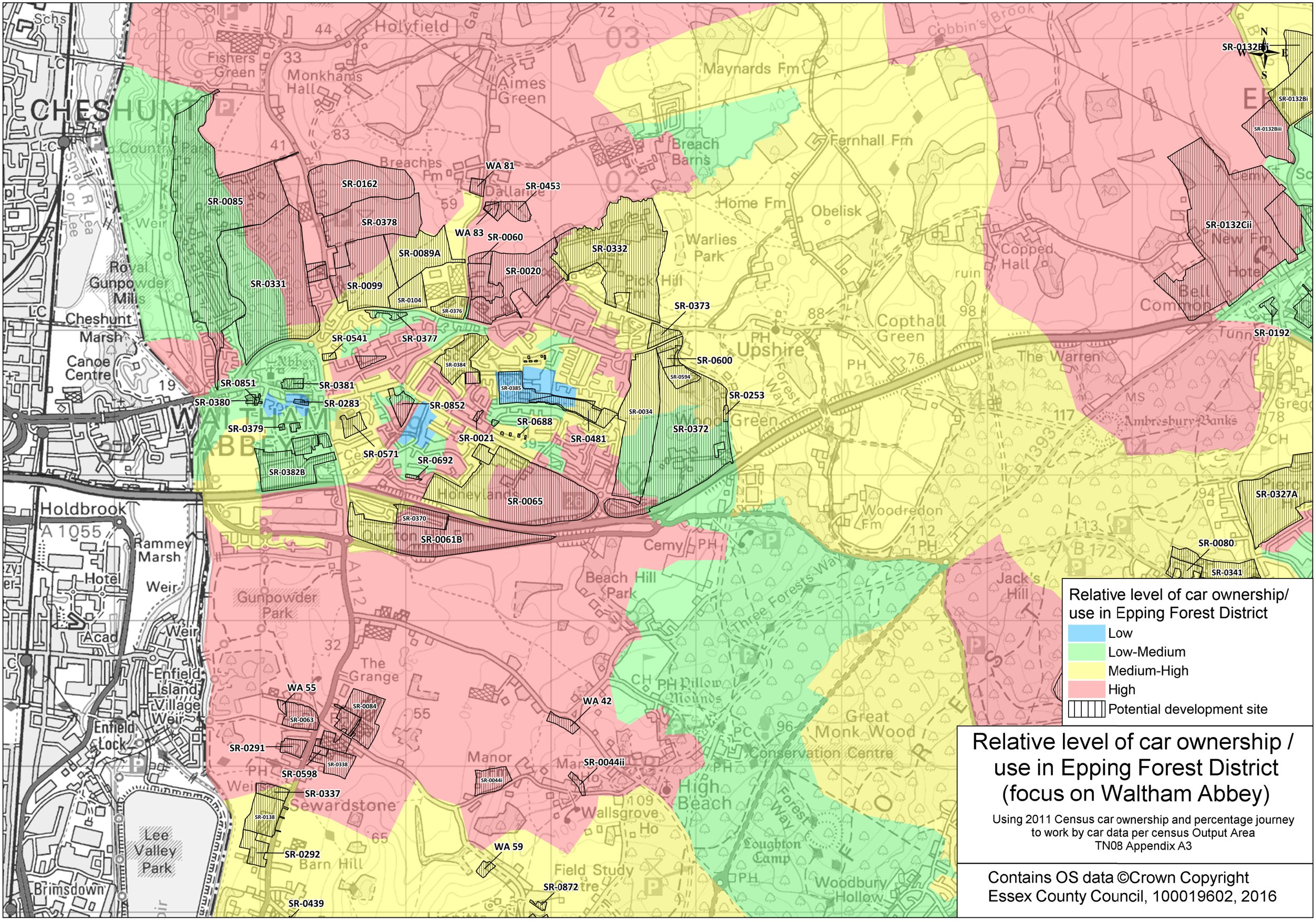
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SR-0439
Relative level of car ownership/ use in Epping Forest District
Low
Low-Medium
Medium-High
High
Potential development site
Relative level of car ownership / use in Epping Forest District (focus on Waltham Abbey)
Using 2011 Census car ownership and percentage journey to work by car data per census Output Area
TN08 Appendix A3
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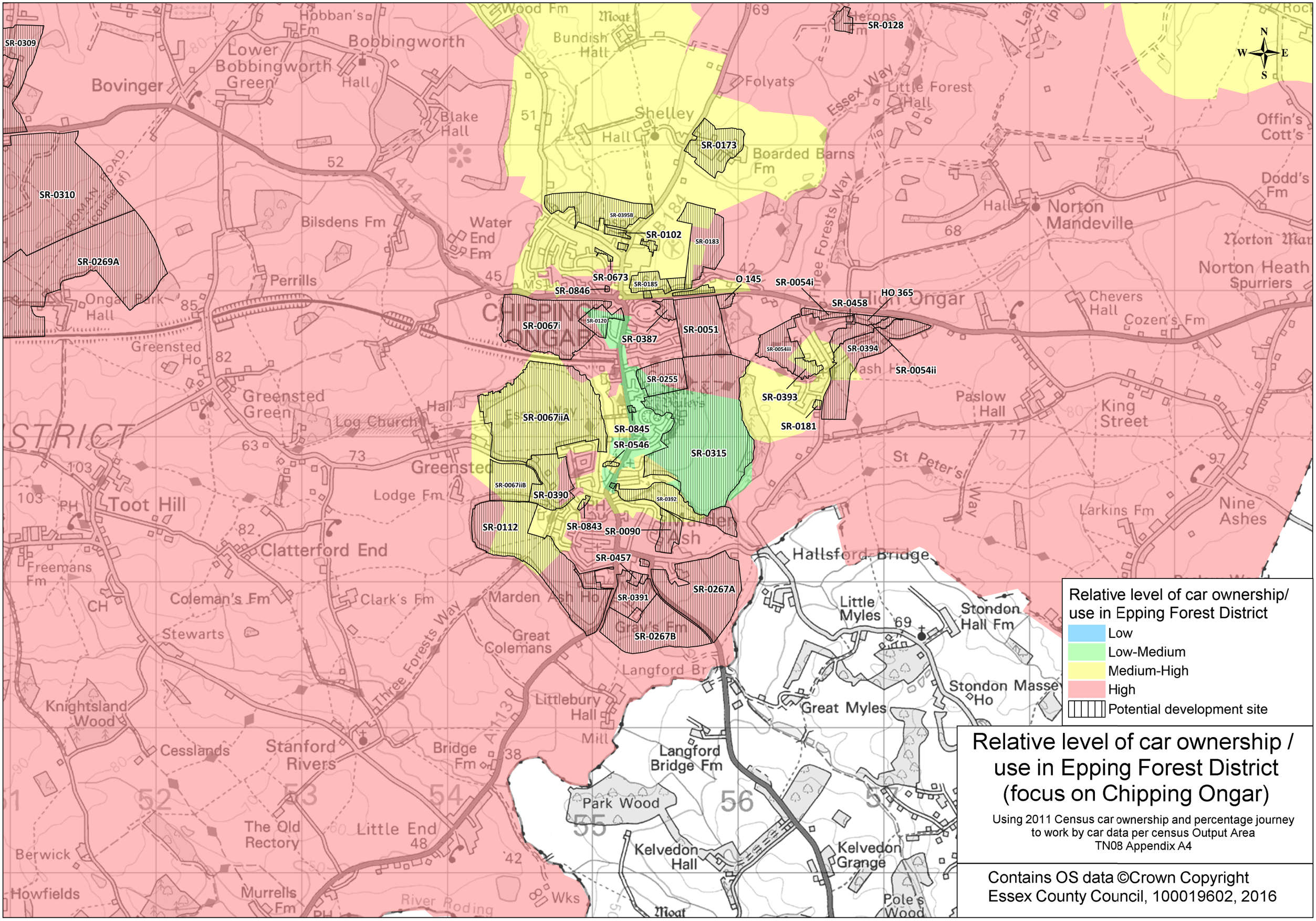
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Bobbingworth
Hobban's Fm
Blake Hall
Bilsdens Fm
Water End Fm
Perrills
Ongar Park Hall
Greensted Ho
Greensted Green
Log Church
Toot Hill
Clatterford End
Freemans Fm
Coleman's Fm
Clark's Fm
Stewarts
Knightsland Wood
Cesslands
Stanford Rivers
The Old Rectory
Little End
Berwick
Howfields
Murrells Fm
Lodge Fm
Wood Fm
Moat
Bundish Hall
Shelley Hall
Folyats
Boarded Barns Fm
Essex Way
Little Forest Hall
Three Forests Way
Norton Mandeville
Offin's Cott's
Dodd's Fm
Norton Heath
Spurriers
High Ongar
Chevers Hall
Cozen's Fm
Paslow Hall
King Street
St Peter's Way
Larkins Fm
Nine Ashes
Hallsford Bridge
Little Myles
Stondon Hall Fm
Great Myles
Stondon Massey Ho
Marden Ash Ho
Great Colemans
Langford Br
Littlebury Hall
Mill
Langford Bridge Fm
Park Wood
Kelvedon Hall
Kelvedon Grange
Pole's Wood
Bridge Fm
Three Forests Way
A414
A113
B184
CHIPPING ONGAR
Relative level of car ownership/ use in Epping Forest District
Low
Low-Medium
Medium-High
High
Potential development site
Relative level of car ownership / use in Epping Forest District (focus on Chipping Ongar)
Using 2011 Census car ownership and percentage journey to work by car data per census Output Area
TN08 Appendix A4
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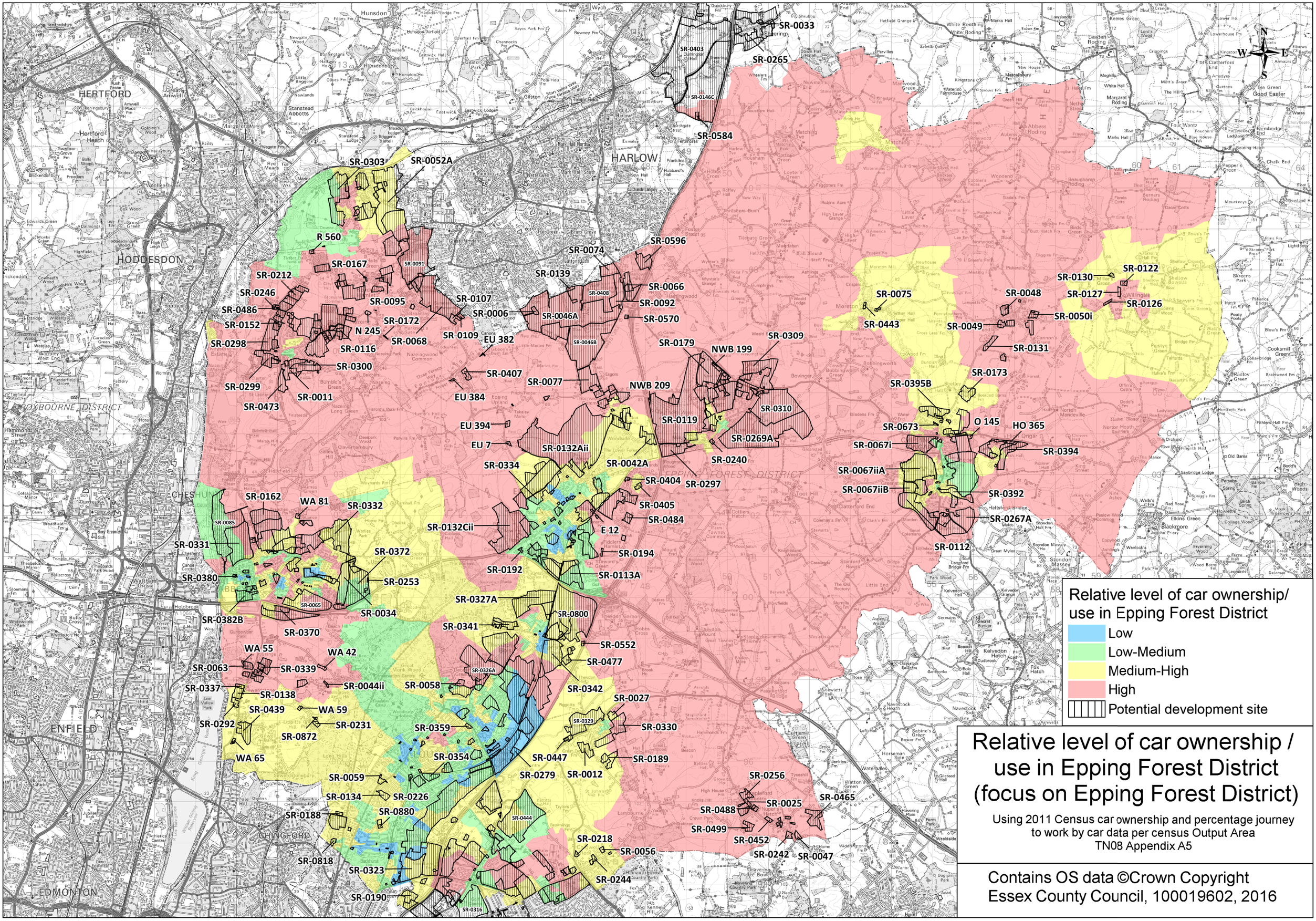
EB500H



Relative level of car ownership/ use in Epping Forest District

- Low
- Low-Medium
- Medium-High
- High
- Potential development site

Relative level of car ownership / use in Epping Forest District (focus on Epping Forest District)

Using 2011 Census car ownership and percentage journey to work by car data per census Output Area
TN08 Appendix A5