



<b>Meeting</b>	<b>Service Leadership Team</b>	<b>Agenda Item</b>	61
	<b>Performance &amp; Resources Board</b>		15
<b>Meeting Date</b>	11 January 2021		
	25 January 2021		
<b>Report Author:</b>	Director of Innovation, Risk & Future Development		
<b>Presented By</b>	Director of Innovation, Risk & Future Development		
<b>Subject</b>	<b>Key Stations</b>		
<b>Type of Report:</b>	Decision		

## RECOMMENDATIONS

Members of the board are asked to note the content of this paper and the key stations approved by the Service Leadership Team (SLT) in December 2020.

## BACKGROUND

Service Control currently mobilise frontline appliances to 'standby' at identified key/joint key stations (Listed in Appendix One) in order to maintain a strategic level of emergency cover across the Service. These were reviewed in early 2020, in part to help with contingency planning for the Service's response to COVID-19. This report reviews current arrangements against the Service's response standards; -

- 1 To get our first attendance to an incident which is potentially life-threatening within an average of 10 minutes from the time we receive a call.
- 2 To get our first attendance to an incident within 15 minutes on 90% of occasions from the time we receive a call.

## OPTIONS AND ANALYSIS

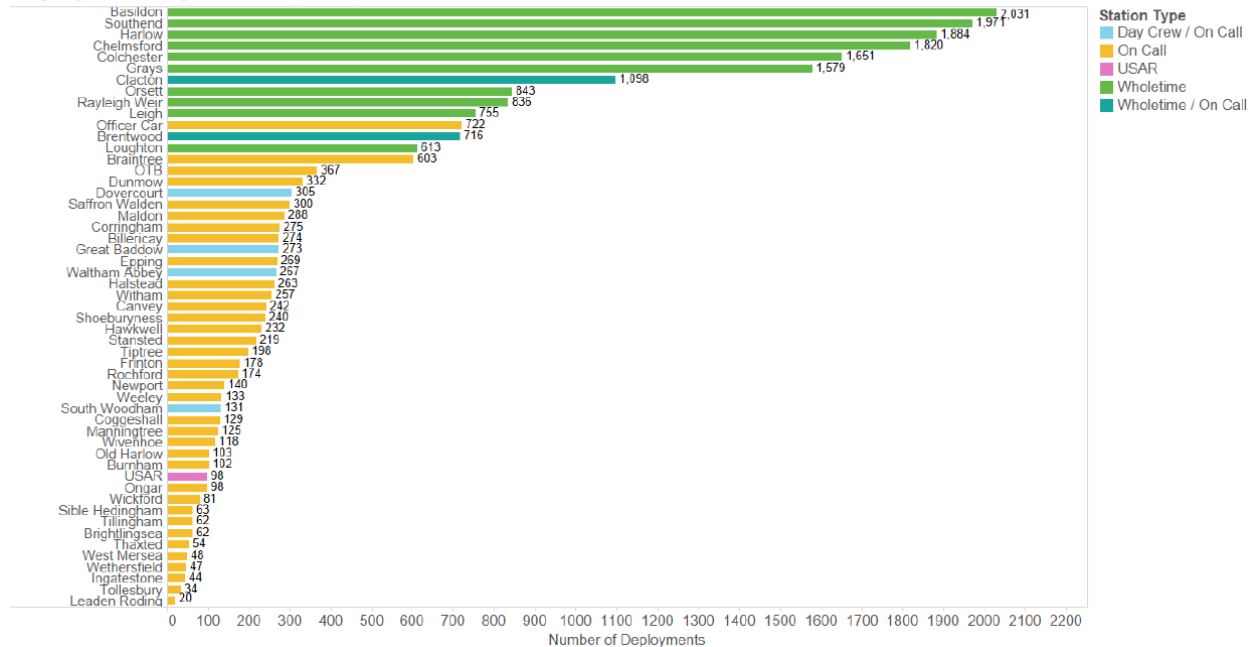
The Service Integrated Risk Management Process (IRMP) sets out how the Service will mitigate risk to the communities of Essex from risk of fire and other aspects of the Service's core functions. Firstly, through its Prevention and Protection work the Service would reduce the need to respond, however, when we do the Service has the aim to attend operational incidents as set out in its response standards.

The Key Station policy provides the basis for the Service's Control function to ensure that when the Service operational resources are allocated to other incidents, moves are made

to optimise the Service's ability to still meet its response standards. This is not a blank canvas approach to operational cover, but a means of maintaining availability of resources in the Service's busier areas, whilst also understanding the importance of maintaining cover at stations more remote from other resources.

The chart one below shows the busiest station by deployments in 2019.

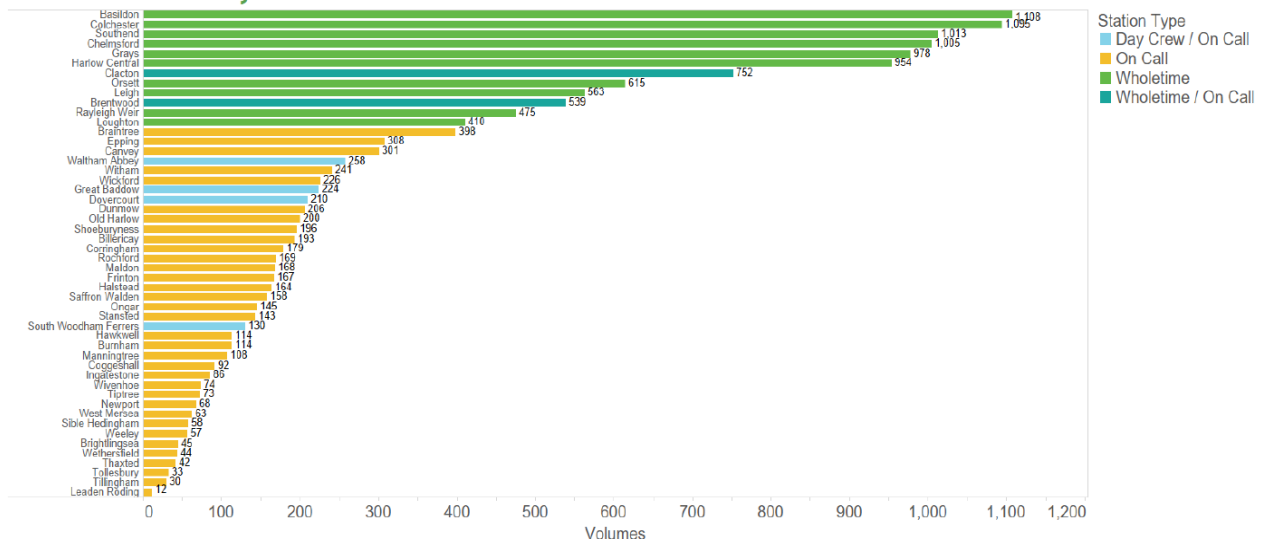
### Deployments by Station (2019)



The first seventeen stations at the top of the list are currently key stations or joint key stations with the exception of from Leigh and Orsett fire stations. Map 1 in Appendix 2 shows the fifteen stations with 12 minute isochrone (15 minute less 1 minute to call handle and 2 minutes to mobilise from station – as those standing-by would be on station) around them. As can be seen from both maps in Appendix 2, the omission of Orsett and Leigh can be justified as their station grounds are accessible by other appliances.

The chart below takes into account that the number of deployments by a stations can be dependent on the appliances availability. Chart two shows incident volumes by Station Ground, notably Canvey, Epping, Waltham Abbey and Witham are higher up the chart.

### Incident Volumes by Station Ground - 2019



Earlier in 2020, the Director of Innovation, Risk and Future Development compared the then Service key station policy with 'Local Optimisation' report from Process Evolution. It is believed that the conclusions of this report are still relevant, and so this is included in Appendix Three. In essence the recommendation set out to continue with the current locations, with the addition of Witham as a key station.

On this basis, the only locations that are currently identified as key stations, which were not in the top 17 of chart one, were Canvey Island, Witham and joint key stations, Burnham and Tillingham and Sible Hedingham and Halstead. Map 2 in Appendix Two has Canvey Island, Witham, Burnham and Halsted added.

On the basis of the second chart, the addition of Witham provides better cover based on actual calls on Station grounds and Witham does also provide additional cover in the centre of the county. Though Canvey's station ground can be covered within 12 minutes by Rayleigh Wier station, it does feature more highly in the second chart, being the Service's third busiest On-call station. Canvey is a two-pump station, with the rescue pump being unavailable 11% of the time in 2019, and WT being unavailable on nearly 90% of the time in 2019. Also considering, by the very nature of being an Island, Canvey's access routes are limited, it is therefore considered prudent to continue with Canvey as a key station.

Within the remaining joint key stations, Burnham and Tillingham and Sible Hedingham and Halstead are lower risk areas, that are more challenging due to the remoteness of their locations. Looking at the second isochrone map, Burnham would be in excess of a 25-minute drive from Maldon. Although Tillingham is closer and could be argued better located towards the centre of the Dengie peninsular, it is one of the lowest risk areas for the Service, attracting only 30 calls in 2019. Tillingham's pump was unavailable 28% of the time in 2019, and Burnham's 27%. To not have cover within the Burnham would be an acceptance of extended response times.

As can be seen from the maps, when it comes to the North of the County, though stations are the Service's quieter locations operationally, they also tend to be areas where it is more challenging to maintain availability and are currently not meeting Service response standards. Map 2 shows that the inclusion of Halsted to help cover North Essex provides good coverage, with the gap between Halstead and Saffron Waldon being Wethersfield and Thaxted stations, both of which averaged less than an operational call a week in 2019.

For the reasons set out, it is therefore concluded that there is still a need to maintain these four as key/joint key stations.

So far as Epping Forest District is concerned, the current joint key stations are Waltham Abbey and Loughton, with Loughton being the station filled if they are both not available for some reason. The isochrone maps show that, when considering fire cover in Essex, it would increase operational cover within Essex to have Epping available rather than Loughton. Epping is prominent within both charts above, and also within the 'Local Optimisation' report where, with Great Dunmow, Epping was identified as a key strategic location when (identified in the (page 14)) Comparing Optimal Outputs to Current Bases and the (page 17) 'Blank Canvas' model. Currently, Loughton is preferred as being a wholtime station does have more facilities for standby crews to use, but it is recommended that further work is completed in developing Epping as a future key station ahead of Loughton.

The station grounds of the key stations, and those in italics in the joint key stations accounted for approximately two thirds of the Service's operational incidents. Also taking into account the overlap onto other stations (i.e. Grays and Basildon attending Orsett calls, and Rayleigh and Southend attending Leigh's) these 19 locations provide a template of strategic locations which provide significant operational cover and, in maintaining their availability, will be prominent in the Service performing well against their response standards.

The availability of appliances is currently dependant on the shift pattern in place at each station, with wholtime resources more readily available, also supported by policies such as additional shift working, pre-arranged and dynamic outduties. The Service is largely performing well against its response standards at wholtime stations.

In acknowledgement of recognised need to resource the key stations which are On-call stations, and the Service's commitment to meet its response standards, it is recommended that the following On-call stations are identified Strategic Key Locations; -

- Braintree
- Burnham
- Canvey
- Dovercourt
- Epping<sup>1</sup>
- Great Dunmow
- Halstead
- Maldon
- Saffron Waldon
- Witham

Whereby the Service should look to maintain availability levels at these stations in the same manner as currently accorded to wholtime locations.

## **DEGRADATION LIST**

It is recommended that the Degradation List remains as per the report in Appendix Three.

## **BENEFITS AND RISK IMPLICATIONS**

This paper sets out the Service policy when considering appliance availability where, for whatever reason, the Service is experiencing a situation which is impacting significantly on its appliance availability.

## **FINANCIAL IMPLICATIONS**

There are no financial implications directly from this paper.

## **EQUALITY AND DIVERSITY IMPLICATIONS**

None directly from this paper.

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<sup>1</sup> Include as per previous observations in the paper

## **WORKFORCE ENGAGEMENT**

This paper will be consulted on with all representative bodies.

## **LEGAL IMPLICATIONS**

The recommendations in this paper will inform operational planning to ensure the Service is compliant with the requirements of the Fire Service's Act 2004.

## **HEALTH AND SAFETY IMPLICATIONS**

Non-specific to this paper.

## Appendix One – Key/Joint Key Stations

<b>Key Stations</b>	<b>Joint Key Stations</b>
<b>10 Colchester</b>	<b>12 Clacton &amp; 19 Weeley</b>
<b>11 Dovercourt</b>	<b>35 Rayleigh &amp; 47 Hawkwell</b>
<b>30 Southend</b>	<b>43 Burnham &amp; 44 Tillingham</b>
<b>34 Chelmsford</b>	<b>67 Ingatestone &amp; 51 Brentwood</b>
<b>46 Maldon</b>	<b>80 Sible Hedingham &amp; 81 Halstead</b>
<b>50 Grays</b>	<b>83 Stansted &amp; 87 Dunmow</b>
<b>52 Basildon</b>	<b>72 Loughton &amp; 73 Waltham Abbey</b>
<b>54 Canvey Island</b>	
<b>70 Harlow</b>	
<b>78 Braintree</b>	
<b>85 Saffron Walden</b>	
<b>25 Witham</b>	

Service Control will mobilise an appliance to standby at a key/ joint key station under the following criteria:

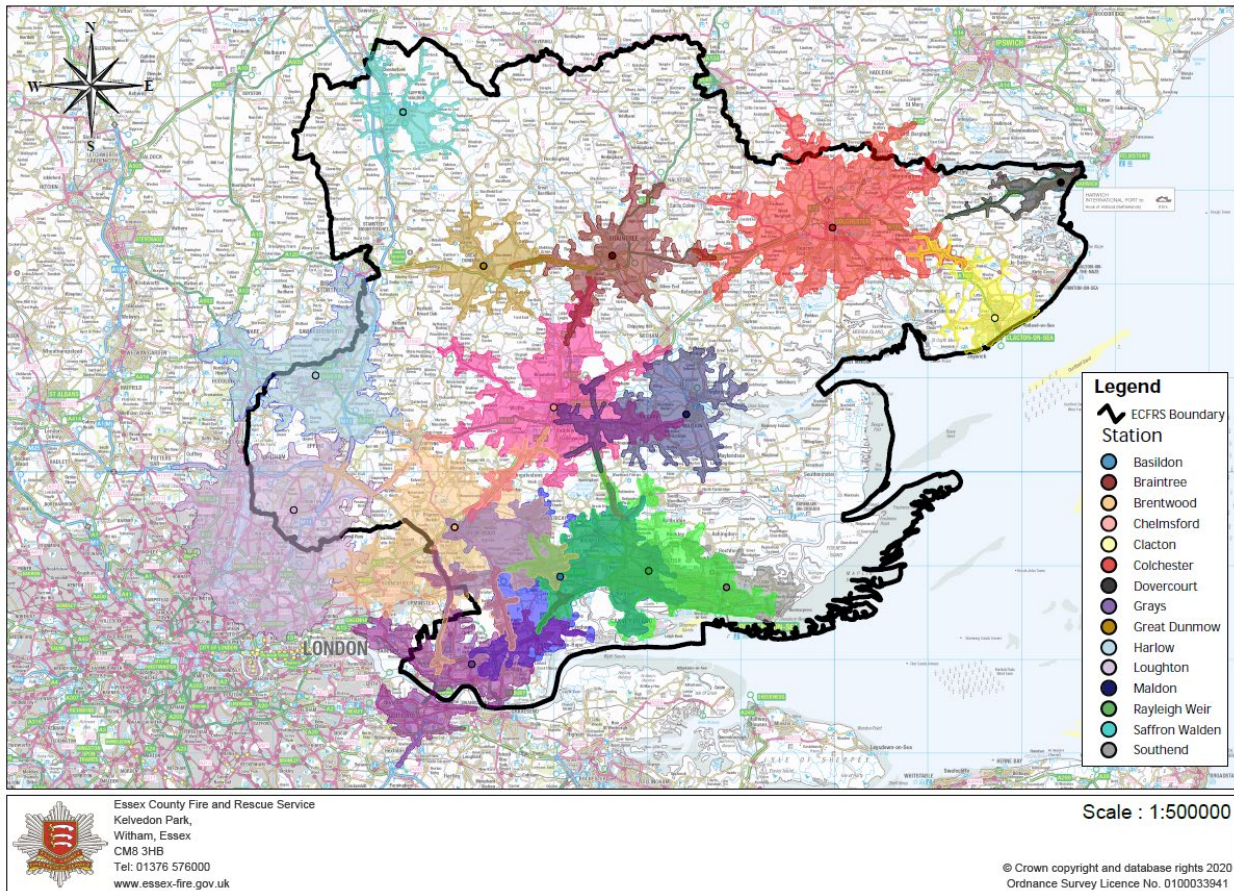
- When an appliance(s) from a key station or both joint key stations will be detained at incident in excess of 30 minutes or are off the run.
- When an appliance(s) from a key station or both joint key stations are mobilised to an incident as part of a 'make up'.
- When appliances from a key station or both joint key stations have been ordered out of the Service area.
- When the Fire Control Officer believes operational cover will be enhanced, taking into account global availability.

Service Control may pick any of the locations listed above for an appliance to standby at, based on providing maximum emergency cover.

# Appendix Two – Isochrone Maps

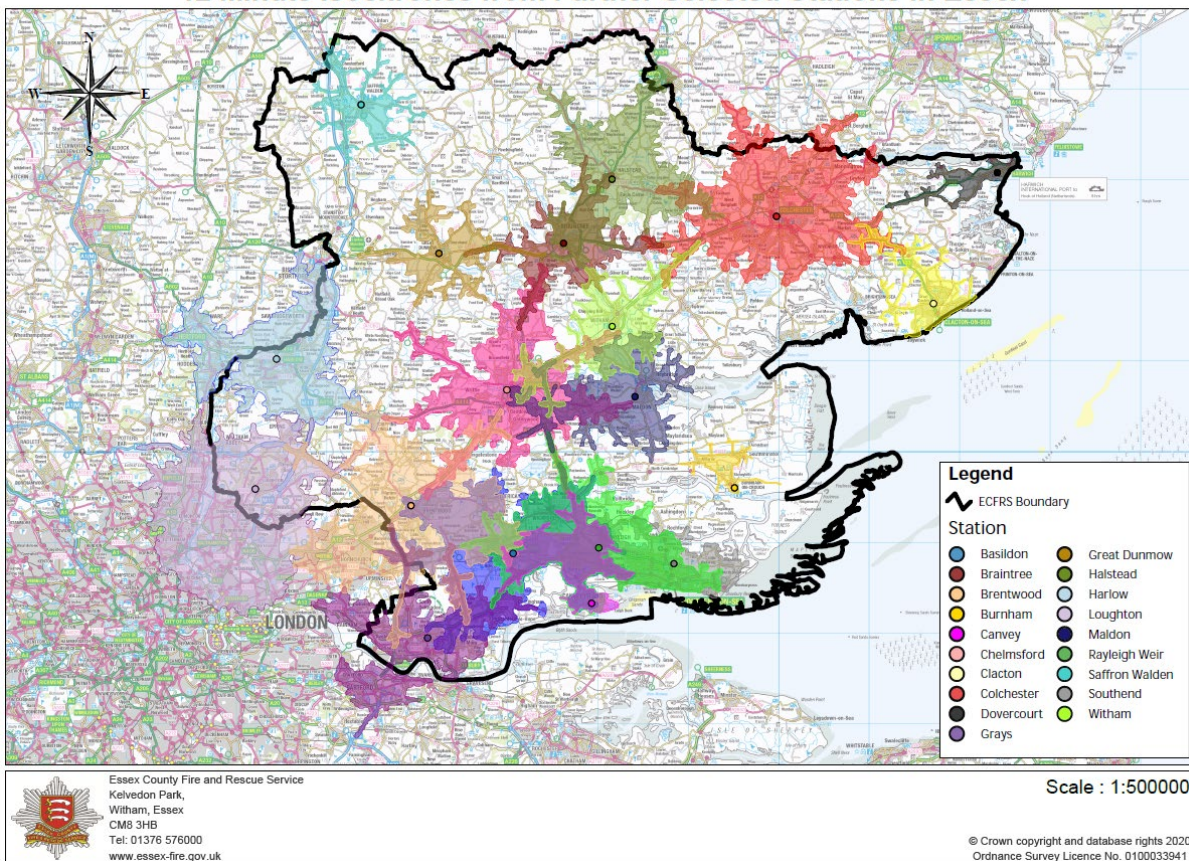
## Map 1

### 12 Minute Isochrones from Selected Stations in Essex



## Map 2

### 12 Minute Isochrones from Further Selected Stations in Essex



**ESSEX POLICE, FIRE AND CRIME COMMISSIONER**  
**FIRE & RESCUE AUTHORITY**  
 Essex County Fire & Rescue Service



<b>Meeting</b>	<b>Service Leadership Team</b>	Agenda Item	4d (+1)
<b>Meeting Date</b>	12 May 2020	Report Number	<b>20-104</b>
<b>Report Author:</b>	Director of Innovation, Risk & Future Development		
<b>Presented By</b>	Director of Innovation, Risk & Future Development		
<b>Subject</b>	<b>Key Stations/Degradation List</b>		
<b>Type of Report:</b>	Decision		

## RECOMMENDATIONS

Members of the Service Leadership Team (SLT) are asked to note the content of this paper and appendices, SLT are asked to approve the following; -

1. Approval of the first six recommendations set out in the Options and Analysis part of this report, in essence agreeing to the continuation of the current key stations, with the addition of Witham; and,
2. The approval of the three recommendations and approach set out for the Service's degradation list to inform future Business Continuity planning.

## BACKGROUND

In Appendix One is the report which was completed by Process Evolution as part of the Service's Integrated Risk Management Plan process. This deals with location optimisation for the Service and is useful in informing the Service's approach to it Key station and degradation list which are; -

**Key/Joint Key Stations** - Service Control currently mobilise frontline appliances to 'standby' at identified key/joint key stations (Appendix Two) in order to maintain a strategic level of emergency cover across the Service.

**Degradation List** - The degradation list demonstrates the relative importance of stations for coverage and can be used to help balance resource and risk in times where appliance availability is limited.

This report reviews current arrangements against it's the Service's response standards which are; -

- 3 To get our first attendance to an incident which is potentially life-threatening within an average of 10 minutes from the time we receive a call.



- 4 To get our first attendance to an incident within 15 minutes on 90% of occasions from the time we receive a call.

## OPTIONS AND ANALYSIS

### KEY STATIONS

The second of Process Evolutions reports looked at optimisation of the Services current estate/resources. This provides a useful means of reviewing the Service current key station locations. The report looked at a twelve location solution (number of stations at the time that had some wholetime resource). Below are the stations selected in the Maximising Performance scenarios (Page 14, Appendix One), with those in bold being current key stations:

- **Chelmsford**
- **Colchester**
- **Harlow**
- Orsett
- Rayleigh Weir
- **Southend**
- Billericay
- Epping
- **Braintree**
- Witham
- Brentwood
- Clacton
- **Maldon**
- Loughton
- Great Dunmow
- **Canvey Island**

#### Key station review and recommendations

- Those in bold are current key stations and are in optimal locations, therefore it is **(One) recommended that they continue as key stations.**
- Billericay appears instead of Basildon and Epping instead of Loughton/Waltham Abbey. Due to the facilities currently on the stations and their close proximity it is **(Two) recommended that Basildon and Loughton/Waltham Abbey remain as key/joint key stations.**
- Orsett appears instead of Grays. However, Corringham, were only unavailable 6.7% in 2018. Also, Grays attracted 1,015 incidents on their station ground compared to Orsett's 633 (with less than 50% of Orsett deployments being on their station ground) **(Three) it is recommended that Grays remains as a key station.**
- Two current key stations, Dovercourt and Saffron Walden, and two joint key stations, Burnham and Tillingham and Sible Hedingham and Halstead, are not mentioned with the optimum locations. These locations would have extended attendance times should the local appliance not be available (due to location of surrounding stations and local geography). In light of this, it is **(four) recommended that Dovercourt and Saffron**

**Walden remain as key stations and Tillingham/Burnham and Sible Hedingham/Halstead remain as joint key stations.**

- One station which is included in the optimum locations is Witham, which is not currently included as a key station. It is **(five) recommend that Witham is added as a key station.**
- The remaining anomalies are the Service having joint key stations instead of just one location allocated. This has been developed over the years using professional judgement. However, it is **(Six) recommended that those current joint key stations remain the same, but the key stations (as part of its IRMP review) will be subject to an annual review so as to understand how current arrangements are impacting upon the Service’s current response standards.**

**DEGRADATION LIST**

Process Evolution identified the order of priority for resources in order to maintain the highest possible level of performance, and mapped out the impact that losing the next station would have on overall ability to respond to Incidents. The results are found in Table One below.

Table One

**Degradation List - Impact of Removing the base as % vs.50 base solution**

50	All	0.0%	25	Manningtree	-4.8%
49	Corringham	0.0%	24	Ongar	-5.5%
48	Ingatestone	0.0%	23	Stansted	-6.3%
47	Wickford	0.0%	22	Frinton	-7.1%
46	Wethersfield	0.0%	21	Tiptree	-7.9%
45	Old Harlow	0.0%	20	South Woodham Ferrers	-8.7%
44	Weeley	0.0%	19	Billericay	-9.6%
43	Rochford	0.0%	18	Dovercourt	-10.8%
42	Shoeburyness	0.0%	17	Canvey Island	-12.0%
41	Wivenhoe	0.0%	16	Halstead	-13.2%
40	Leigh	-0.1%	15	Saffron Walden	-14.6%
39	Newport	-0.1%	14	Maldon	-16.1%
38	Tollesbury	-0.2%	13	Epping	-17.6%
37	Hawkeell	-0.3%	12	Dunmow	-19.2%
36	Tillingham	-0.5%	11	Witham	-21.0%
35	Leaden Roding	-0.8%	10	Basildon	-23.3%
34	Sible Hedingham	-1.1%	9	Braintree	-26.0%
33	Great Baddow	-1.4%	8	Brentwood	-29.8%
32	Coggeshall	-1.7%	7	Loughton	-34.1%
31	Thaxted	-2.1%	6	Clacton	-39.2%
30	Waltham Abbey	-2.5%	5	Chelmsford	-46.5%
29	West Mersea	-2.9%	4	Harlow	-53.9%
28	Brightlingsea	-3.3%	3	Colchester	-61.7%
27	Orsett	-3.8%	2	Southend	-70.8%
26	Burnham	-4.3%	1	Grays	-81.2%
			0	Rayleigh Weir	-100.0%

- When comparing the above table to the Service key stations (subject to recommendations one to seven being approved) the top 18 stations are either a

key station, or a joint key station, the only exceptions being Burnham and Tillingham are a joint key station and are positions 26 and 36 respectively, and Epping (13) is not currently included. With the top 18 stations being available the Service the impact on the Service would be less than 10%.

- Due to the Service's response standards being based on first attendance, when forming its business continuity plans it is **(seven) recommended that, due to the close proximity of other stations the Water tenders at Grays, Chelmsford and Southend will be taken off the run.**
- Based on the above, it is **(eight) recommended should the Service still not have sufficient wholetime personnel available the appliances at Great Baddow and South Woodham Ferrers will be taken off the run<sup>2</sup>.**
- **(nine) it is recommended that, should the Service ever be in a position whereby it cannot maintain cover at the key stations/joint key stations, due to an operational incident, or other business continuity reasons, a Critical Incident Team will be established to monitor appliance availability with Table One used to inform decision making.**

## **BENEFITS AND RISK IMPLICATIONS**

This paper sets out the Service policy when considering appliance availability where, for whatever reason, the Service is experiencing a situation which is impacting significantly on its appliance availability.

## **FINANCIAL IMPLICATIONS**

There are no financial implications directly from this paper.

## **EQUALITY AND DIVERSITY IMPLICATIONS**

Non directly from this paper.

## **WORKFORCE ENGAGEMENT**

This paper will be shared with representative bodies and the papers author will engage directly in order to encourage engagement and comment.

## **LEGAL IMPLICATIONS**

The recommendations in this paper will inform operational planning to ensure the Service is compliant with the requirements of the Fire Service's Act 2004.

## **HEALTH AND SAFETY IMPLICATIONS**

Non-specific to this paper.

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<sup>2</sup> Which appliance will be dictated by the availability of surrounding appliances at that time

# IRMP Analytical Support for Essex County Fire and Rescue Service

## Phase 2: Location Optimisation

Alistair Motion  
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Version 0.1

July 2019

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## Executive Summary

Process Evolution has been commissioned by Essex County Fire and Rescue Service to provide analytical and modelling support to its 2020 Integrated Risk Management Planning process. This report comprises the second deliverable of the support, a report detailing the outputs of the location-based optimisation

### E.1 Optimisation using Current Estate

#### E.1.1 Maximising Performance

- The first 3 bases selected were all in the South of the county, emphasising the importance to cover the demand in this region adequately.
- Some of the current Wholetime stations aren't selected until far later in the optimisation suggests that they are not in the optimal position. It may be possible under a 15min target to saturate demand within the South of the county with fewer Wholetime stations
- Overall potential to improve performance with current bases, as the solution from the Optimal 10 Wholetime station gives a similar performance to the current 12 base setup (10 Wholetime, 2 WT/OC)
- There is an opportunity to improve performance through the choice of current bases as selecting the Optimal 12 bases would increase the proportion of incidents within 15-mins response by 5.9pts compared with current setup

#### E.1.2 Minimising Overall Travel time

- 8 of the 12 selections are South of HQ location, due to a high proportion of the overall demand sits within these areas

#### E.1.3 Day Crewing Build

- Optimisation of Day Crewing stations suggests that two of the Day Crewed stations are in the right area but overall poses questions around coverage and performance

#### E.1.4 Degradation List

- The degradation list demonstrates the relative importance of stations for coverage and can be used to help balance resource and risk in times of appliance unavailability
- Braintree and Witham feature high on the list, and are seen as relatively important with high demand levels and little support in time to impact performance standard
- Leigh and Orsett occupy a position much further down the list due to a high degree of replaceability from other stations

## **E.2 Blank Canvas Approach**

- The Blank Canvas approach removes the constraint of having to choose an option from the current bases and instead allows selection at any of the over 1,000 Lowest Super Output Areas (LSOAs) within Essex
- By using the Blank canvas approach, the additional options available to be chosen leads to an improved solution, outperforming both the current structure and the optimal using existing stations
- The Blank Canvas 12 base solution produces improved performance and gives better coverage for both Maldon and Great Dunmow areas

## **E.3 Conclusion**

Overall the location-based optimisation has highlighted the importance of adequate coverage in the South of the county to maintain performance while also illustrating areas where current resourcing does not match with the optimal solution. This information, along with the findings from the Diagnosis report, shown in our first report, will be used to inform the nature of scenarios to be modelled in the third component of our work.

## 1 Introduction

Essex County Fire and Rescue Service (ECFRS) is currently conducting a review of the Service as part of their Integrated Risk Management Plan (IRMP) process. It will be undertaken in the context of current and future risk looking forward from 2020 with the objectives to identify opportunities to better align capacity with risk and options for capacity release.

Process Evolution has been commissioned to provide analytical support to the IRMP process. The work has been structured to provide the following three deliverables

- **Baseline report** – detailing current response demand, resource availability and response performance
- **Location optimisation report** – identifying the optimal locations for resources and their relative priority
- **Scenario report** – evaluating up to 20 different fire cover scenarios in terms of impact on response performance and the proportion of the population affected. Scenarios will be determined based on the outputs from the Baseline report, discussions from the model runs workshops and options which ECFRS are considering

### 1.1 This Report

This report is the second deliverable of the project (i.e. the Location Optimisation Report). It is a summary of the presentation made to ECFRS's IRMP team on 3<sup>rd</sup> July 2019 to the format agreed at that meeting.

### 1.2 Acknowledgement

We would like to thank Essex County Fire and Rescue Service in inviting us to undertake this programme of work, and all the members of the Fire and Rescue Service who have given their time to this project.



## 2 Location Optimisation

### 2.1 Facility Location Planner

Facility Location Planner (FLP) is a software tool used to determine the optimal locations of deployment points and facilities to satisfy geographically dispersed demand. It uses a well-proven optimisation algorithm which we have tailored for use in an emergency services context. Examples of its application to the Fire sector include proposing the optimal location for Fire Stations or locating specialist appliances such as Aerials so as to meet demand best.

Facility Location Planner optimises site location to satisfy an objective function determining the best possible position for stations. In the case of ECFRS, FLP has been used in two ways:

- Maximise performance against a 15-mins target
- Minimise the overall travel time

It is important to note that these approaches will generate different solutions, as demonstrated in the figure below:

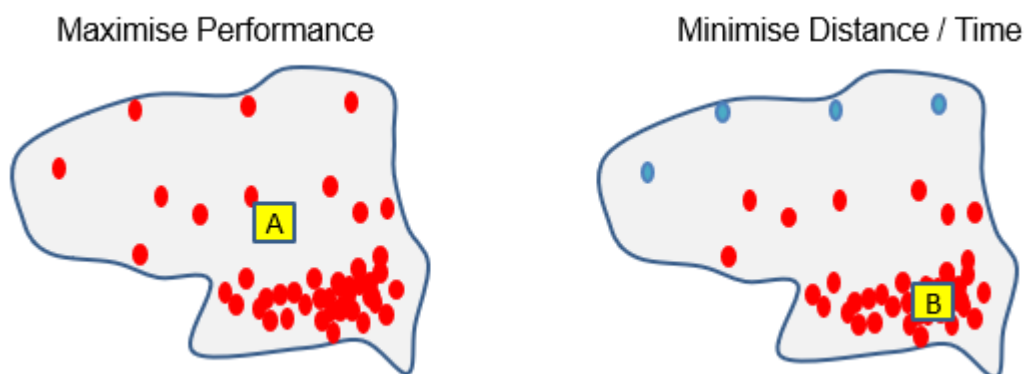


Figure 2: Comparing different performance objectives

In the example above each circle represents an incident. To maximise performance against a 15mins target, the station would be positioned outside of the main area of demand, point A, in order to bring more incidents in target. Although this approach would be suitable for maximising performance it would increase the average response time to incidents. In the minimising Time scenario, the base would be located at point B, close to the main cluster of incidents, reducing the overall time spent travelling to incidents

The two approaches to optimisation give different results. A degree of professional judgement should be applied as to what constitutes acceptable performance and whether changes to average response times and performance are tolerable.

## 2.2 FLP using Current Estate

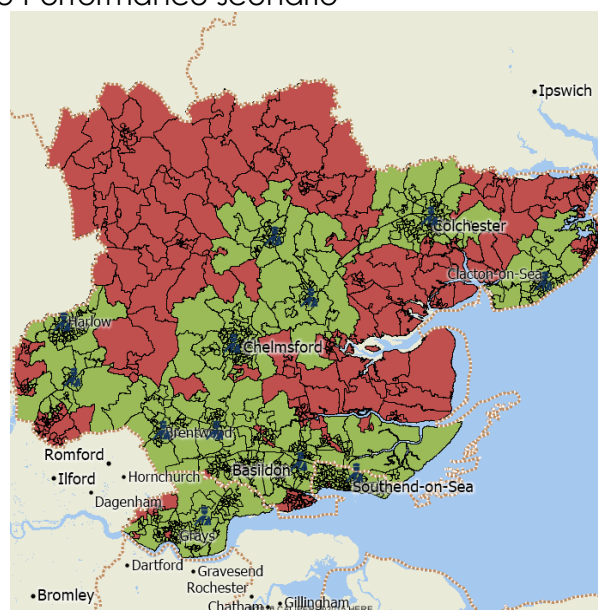
The first set of FLP optimisations uses the current ECFRS estate to find the optimal location for Wholetime appliances. The list of potential bases has been limited to the current 50 stations, while demand has been applied at LSOA level for all incidents over the last 5-year period. Throughout these scenarios, a mobilisation time of 1.76 mins has been used to account for the average time to dispatch (1.26mins) and the average time to mobilise a Wholetime crew (1.5mins)

### 2.2.1 Maximise Performance with Current Bases

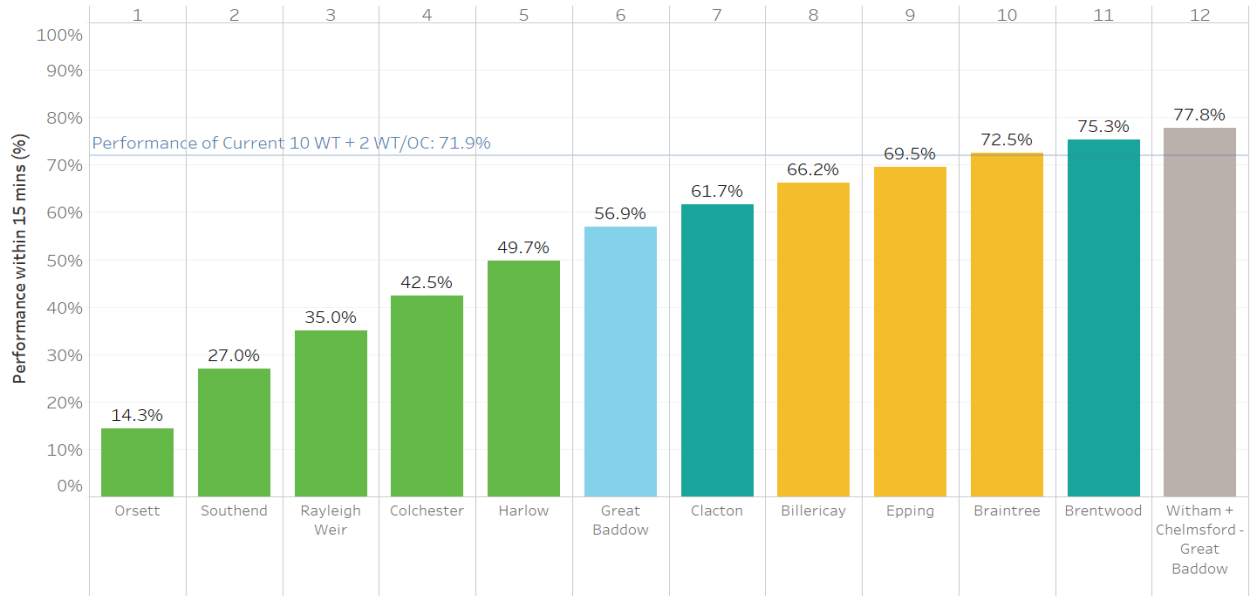
In these scenarios, maximising performance within 15-mins has been selected. The table below shows the order Wholetime stations were selected:

Number of Bases	Base Selected	Notes
1	Orsett	
2	Southend	
3	Rayleigh Weir	
4	Colchester	
5	Harlow	
6	Great Baddow	Selected instead of Chelmsford
7	Clacton-on-Sea	
8	Billericay	
9	Epping	
10	Braintree	
11	Brentwood	
12	Chelmsford / Witham	Great Baddow drops out

The map below shows the stations selected and the areas within target time under the 12 base Maximise Performance scenario



The performance generated by maximising performance scenarios are shown below:  
**FLP Optimisation Outputs - Impact of Wholetime Stations (All Incidents within 15 mins)**

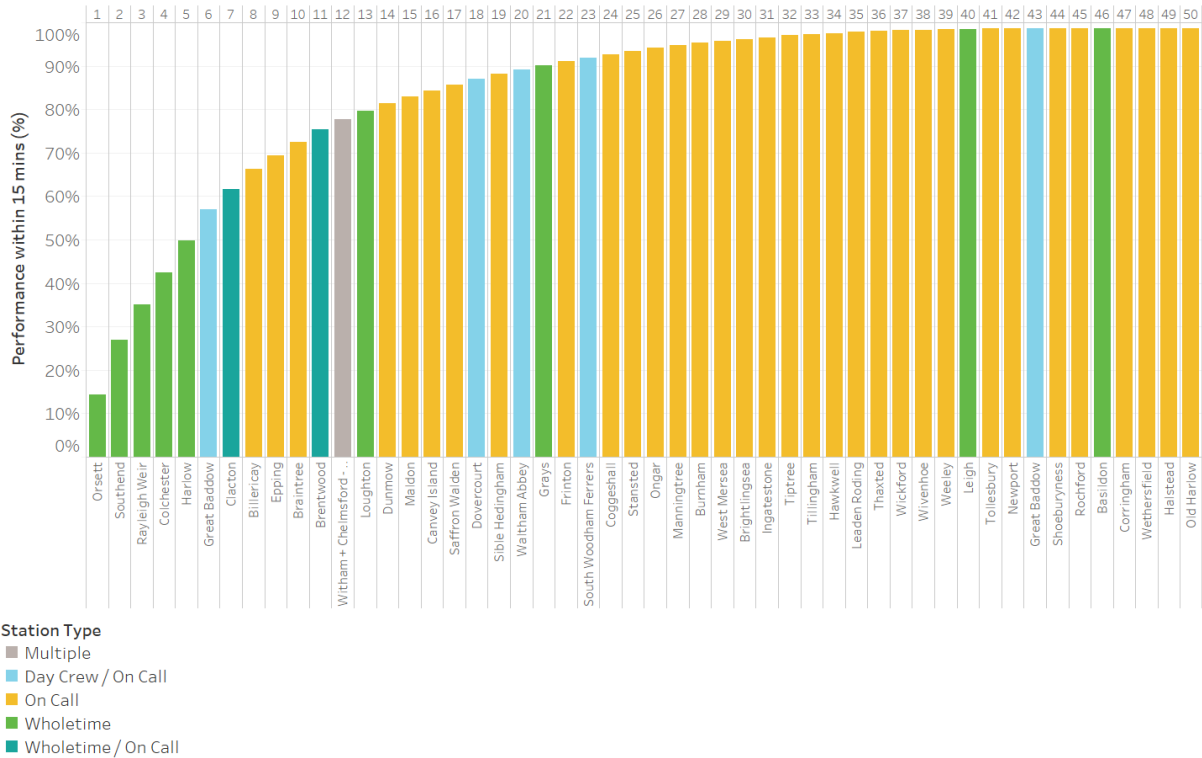


- The first 5 stations selected are all current Wholetime Stations
- 4 existing Wholetime stations, all located in the South of the county don't feature in the optimal 12 Wholetime bases selected (Loughton, Grays, Leigh and Basildon)
- Up until 12<sup>th</sup> station Great Baddow is being chosen rather than Chelmsford suggesting that the current Chelmsford station may not be in the best location to service demand
- The outputs of the optimal 12 Wholetime stations demonstrate an increase in performance of 5.9pts when compared with the current bases
- Assessing coverage from a different perspective the optimal 10 base solution matches the current performance of the 10 Wholetime and 2 Wholetime / On Call stations, suggesting there may be scope to realign capacity in some areas.

## 2.2.2 Impact of Geography

As an exercise to understand the effect that geography has on the current bases, a scenario was tested to show the effect on performance if all stations were to be made Wholetime. The outputs of the built to 50 Wholetime stations is shown below:

### Build of Performance based Optimisations (All Incidents within 15mins)

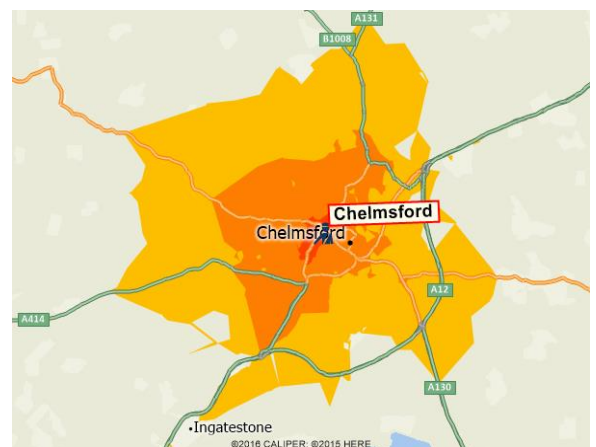


- Even having 50 Wholetime stations located at current stations would only cover 9804% of the demand within the 15-mins target
- This suggests geography does play a key role in response performance for ECFRS and that at that the additional benefit diminishes as extra stations are added

## 2.2.3 Chelmsford Location

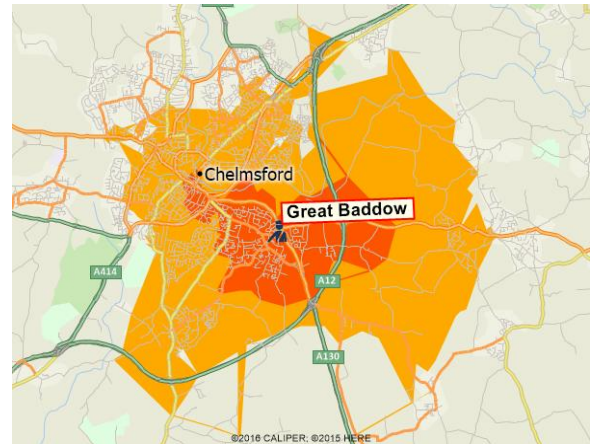
The outputs of Scenario modelling in the section 2.2.1 posed questions as to whether the station at Chelmsford was in the best location to service the Chelmsford station ground. The map to the right shows Chelmsford station located to the West of the city along with drive zone rings for 12-mins from the station. The three coloured drive zone rings indicate an additional 4 mins of travel time.

- The current Chelmsford station can satisfy 84.8% of demand within the Chelmsford station ground



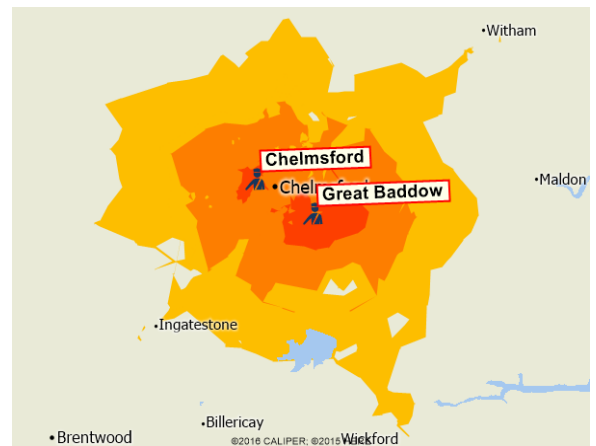
Great Baddow's station is located towards the North of its station ground and is in close proximity to Chelmsford. The drive time rings for Great Baddow demonstrates an ability to get into the Chelmsford station ground within the 12-mins travel time

- A Wholetime pump at Great Baddow could attend 81.5% of demand with the Chelmsford station ground
- Therefore, locating the Wholetime station at Great Baddow would not improve performance for Chelmsford



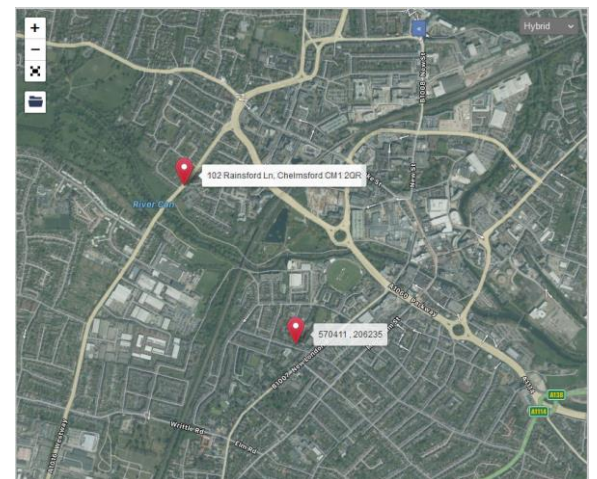
There is significant overlap in the areas that can be served from the Chelmsford and Great Baddow stations. The map to the right shows the large area of dark orange indicating areas that could be served within 4-8mins travel.

- Wholetime stations and both Chelmsford and Great Baddow would provide cover for 96.0% of demand within the Chelmsford Station ground within 15-mins



Using the FLP in an unconstrained way, i.e. no longer relying on the current estate, it is possible to determine the optimal location for the station to be placed, narrowing down to the Lowest Super Output Area (LSOA). The map to the right shows the output from this optimisation.

- The location selected is Chelmsford 010D to the South of the city and just South of the Cricket Ground.
- Moves the location South East by just over 1 mile but increases the proportion of incidents within station ground that can be attended within 15mins from 84.8% to 94.4%



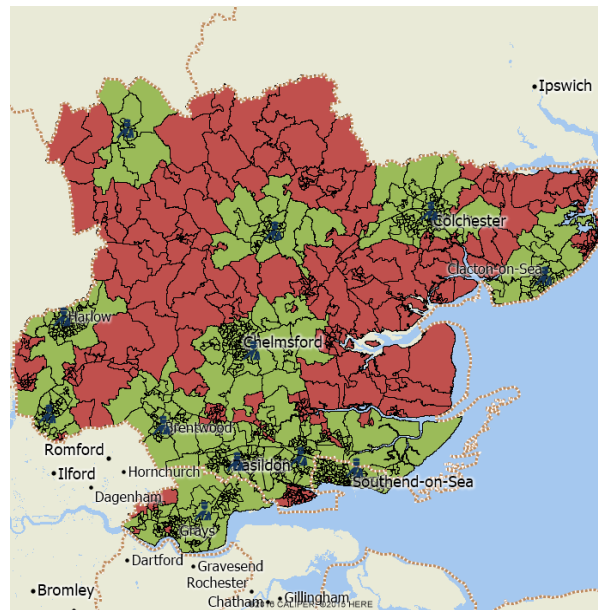
## 2.2.4 Minimising Travel Time with Current Bases

In these scenarios, the option has been taken to place stations in a way that finds the least possible time spent travelling to incidents. The table below shows the order Wholetime stations were selected under the minimising travel time optimisation:

Number of Bases	Base Selected
1	Great Baddow
2	Rayleigh Weir, Coggeshall
3	Rayleigh Weir, Epping and Colchester
4	3 Bases plus Orsett
5	4 Bases plus Southend and Great Baddow, remove Rayleigh Weir
6	5 Bases plus Clacton-on-Sea
7	6 Bases plus Braintree
8	7 Bases plus Rayleigh Weir
9	8 Bases plus Harlow
10	9 Bases plus Saffron Walden
11	10 Bases plus Brentwood and Loughton remove Epping
12	11 Bases plus Basildon

- Within the minimising travel time scenarios, there tends to be more movement in bases chosen. For example, Great Baddow is selected as the first base as it provides a relatively central location to start from. It does not then feature again until the 5 base selection when areas to the South, West and North have already been covered
- The optimal 5 base and optimal 11 base scenarios are examples where rather than just supplementing with an additional base, an improved solution can be found by adding two bases and replacing one of the options chosen in the previous solution (i.e. in the optimal 11 scenario Epping is removed and is instead replaced by the combination of Brentwood and Loughton)

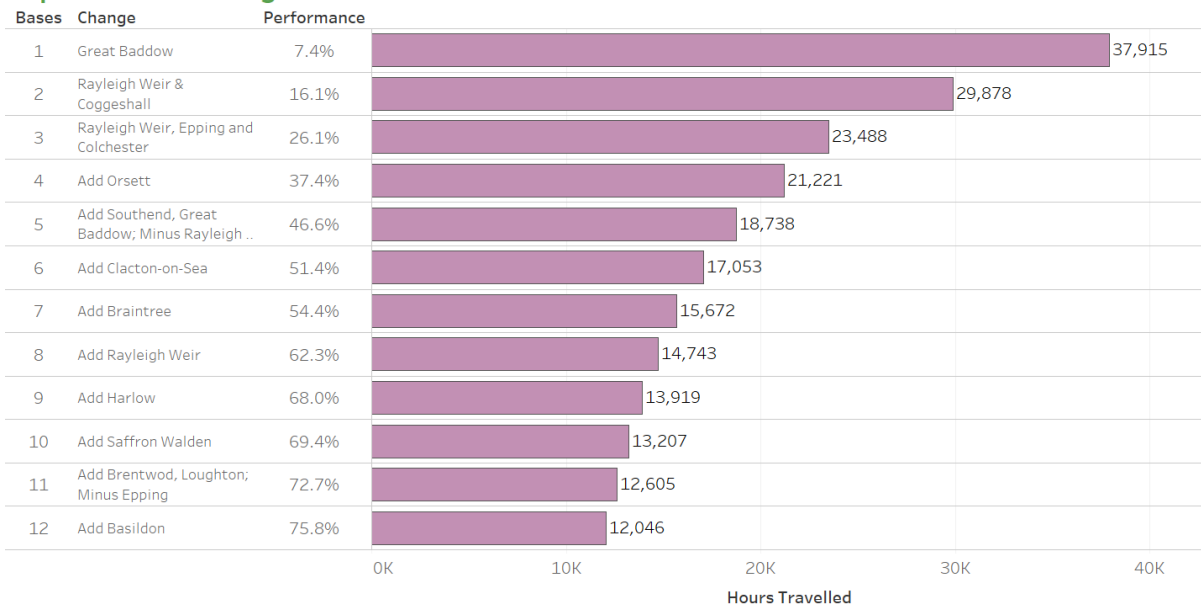
The map below shows the location of the 12 bases selected under the optimal 12 minimise travel time scenario:



8 of the 12 selections are South of HQ, demonstrating the high proportion of the demand in this area and the importance to the performance of the South of the county.

As additional bases are added to the minimising travel scenario, the total hours of travel required to service the demand reduces. The graph below shows the impact on total hours under each of the solutions:

### Impact of Minimising Travel Time



- As more and more bases are added the total hours travelled reduces

- However as additional bases are added the size of the improvement, i.e. the difference in the number of hours travelled reduces showing a diminishing effect

### 2.2.5 Day Crewing

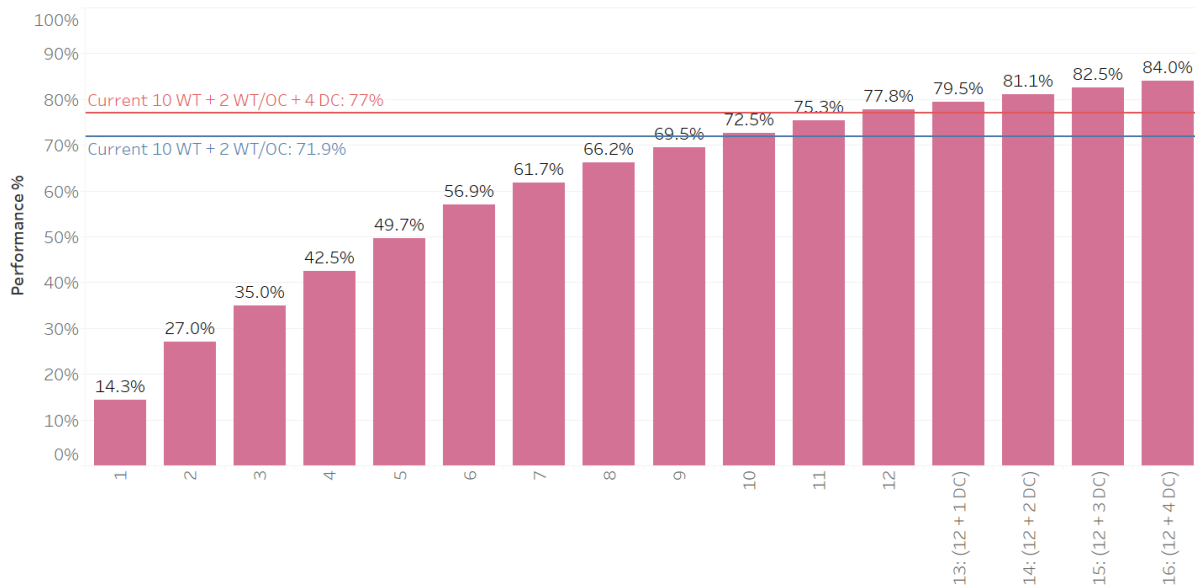
The Day Crewing scenarios start with the outputs from the maximising performance using the optimal 12 Wholetime bases and then looks to find the optimal location for the day crewed stations. In this scenario, all the current bases are available to choose and have been given a mobilisation time of 3.98mins to reflect the average time taken to send and mobilise demonstrated at day crewed stations.

Number of Bases	Base Selected
12	Optimal 12 Bases
13	Optimal 12 + Loughton
14	Optimal 12 + Loughton, Great Dunmow
15	Optimal 12 + Loughton, Great Dunmow, Canvey Island
16	Optimal 12 + Loughton, Great Dunmow, Canvey Island and Maldon

- None of the 4 bases selected within these scenarios is a location that currently has Day Crewing

The impact on performance generated by adding in the Day Crewed stations is shown in the graph below:

#### Performance generated by Optimal Bases (Max Performance 15mins)



- The addition of the Day Crewed stations takes the proportion of demand that could be reached within 15-mins from 77.8% up to 84.0%



## 2.2.6 Comparing Optimal Outputs to Current Bases

The table below illustrates the differences between the stations selected in the Maximising Performance scenarios and the Current stations:

Duty System	Current Bases	Optimal Locations	Notes
Wholetime (6 out of 10 matches)	<b>Chelmsford</b>	<b>Chelmsford</b>	<b>Match</b>
	<b>Colchester</b>	<b>Colchester</b>	<b>Match</b>
	<b>Harlow</b>	<b>Harlow</b>	<b>Match</b>
	<b>Orsett</b>	<b>Orsett</b>	<b>Match</b>
	<b>Rayleigh Weir</b>	<b>Rayleigh Weir</b>	<b>Match</b>
	<b>Southend</b>	<b>Southend</b>	<b>Match</b>
	Basildon	Billericay	Similar area
	Loughton	Epping	Similar area
	Grays	Braintree	Large difference
	Leigh	Witham	Large Difference
Wholetime / On Call (2 out of 2 matches)	<b>Brentwood</b>	<b>Brentwood</b>	<b>Match</b>
	<b>Clacton-on-Sea</b>	<b>Clacton-on-Sea</b>	<b>Match</b>
Day Crewed / On Call (2 out of 4 is similar area)	South Woodham Ferrers	Maldon	Similar area
	Waltham Abbey	Loughton	Similar area
	Great Baddow	Great Dunmow	Large difference
	Dovercourt	Canvey Island	Large Difference

- Overall 8 of the 12 stations that currently have a Wholetime element are selected within the first 12 Wholetime bases, with a further two more being located in the neighbouring station grounds
- The key differences between the two lists are the use of Braintree and Witham as opposed to Grays and Leigh. The rationale for this is that within the optimal solution Southern areas of the county have already been saturated therefore limiting the benefit from locating in Grays and Leigh
- None of the current Day Crewed stations have been selected within the list, however Maldon and Loughton both neighbour current Day Crewed Stations
- The selection of Great Dunmow and Canvey Island would place Day Crewed stations in areas quite different from present locations.

The map below compares the location of Wholetime stations against those chosen in the maximising performance optimal 12 Wholetime stations scenario.

### Comparison of WT Crewing Selections (Current vs Optimal)



**WT Now**

- WT in Both
- WT in Optimal 12 but not currently
- Current WT but not in Optimal
- Not WT in either

- The 8 station grounds highlighted above in orange are current Wholetime stations that appear in the optimal list
- The 4 stations shown in Green are the existing Wholetime stations that do not appear with the optimal list. Interestingly each of these is in the South of the county with Leigh and Grays, in particular, being removed and not replaced. This suggests that when optimising in terms of maximising performance based on 15-min target incidents within these station grounds sit within the catchment area of other stations; i.e. from Southend and Rayleigh Weir stations would be able to travel to the majority of incidents within Leigh station ground within the target
- Of the 4 stations that appear within the optimal list but are not currently Wholetime stations, 2 neighbour current Wholetime stations that have been removed; Epping being the next station ground to Loughton and Billerica bordering Basildon. The other two station grounds that are not currently Wholetime, Braintree and Witham, give coverage to the Central and Northern areas of the county but are substantially different to the locations that have dropped from the list



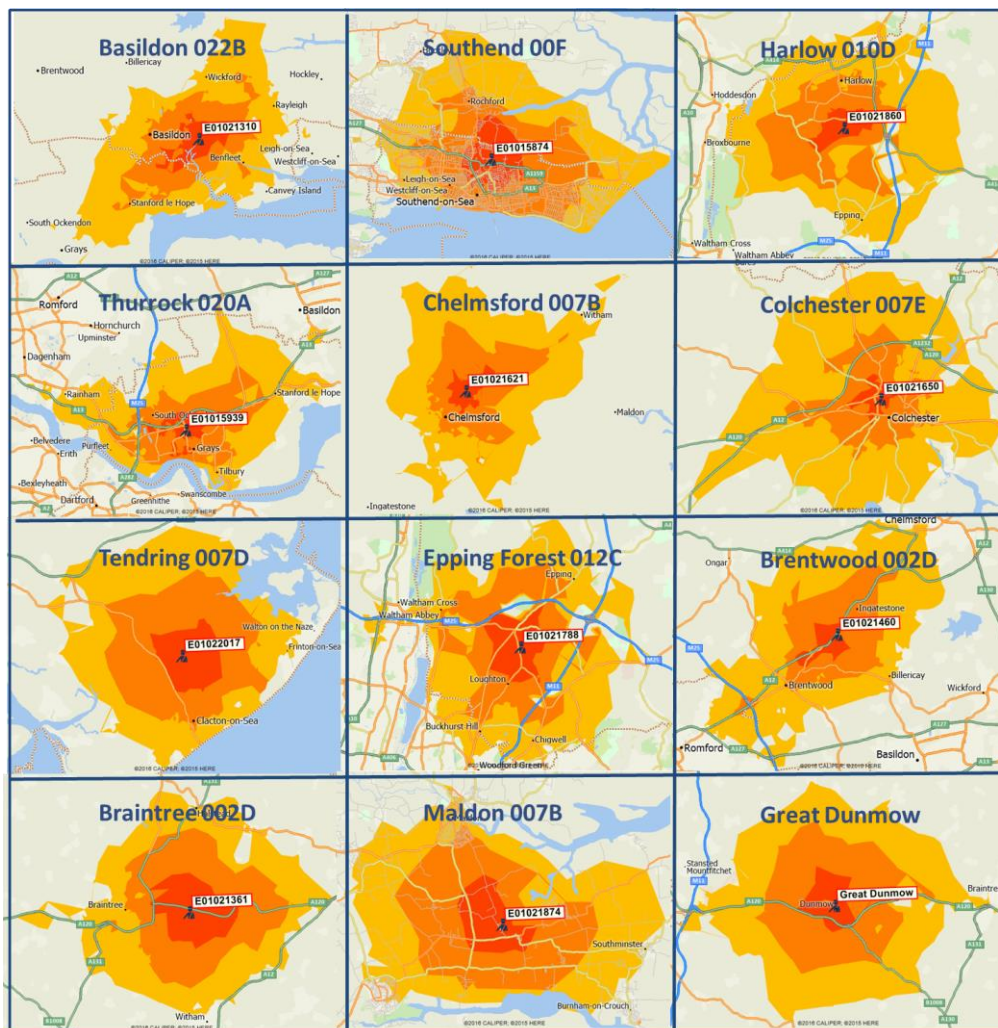
### 2.3 Maximising Performance using 'Blank Canvas'

During the previous optimisations shown earlier, the decisions on the optimal location were based on the list of ECFRS's 50 bases. However, this can be seen to constrain thinking, and a separate question could be posed as to where would the best location for the service to have their stations if they could choose anywhere in the county?

Although this perspective may not seem completely realistic, it gives an idea of where the optimal would be and generates an understanding of the impact that current constraints, i.e. estates are having. This approach has been undertaken by a number of Fire and Rescue Services and has helped to augment long-term planning on estates.

In order to generate the 'blank canvas' approach, the county of Essex has been broken down into just over 1,000 areas, known as Lowest Super Outputs areas (LSOAs). For each of these LSOAs the incident hotspot has been identified (the average location of incidents within this area over the last 5-years). Using these inputs, the optimisation has then been conducted in the same way shown previously with the aim to maximise performance within 15-mins.

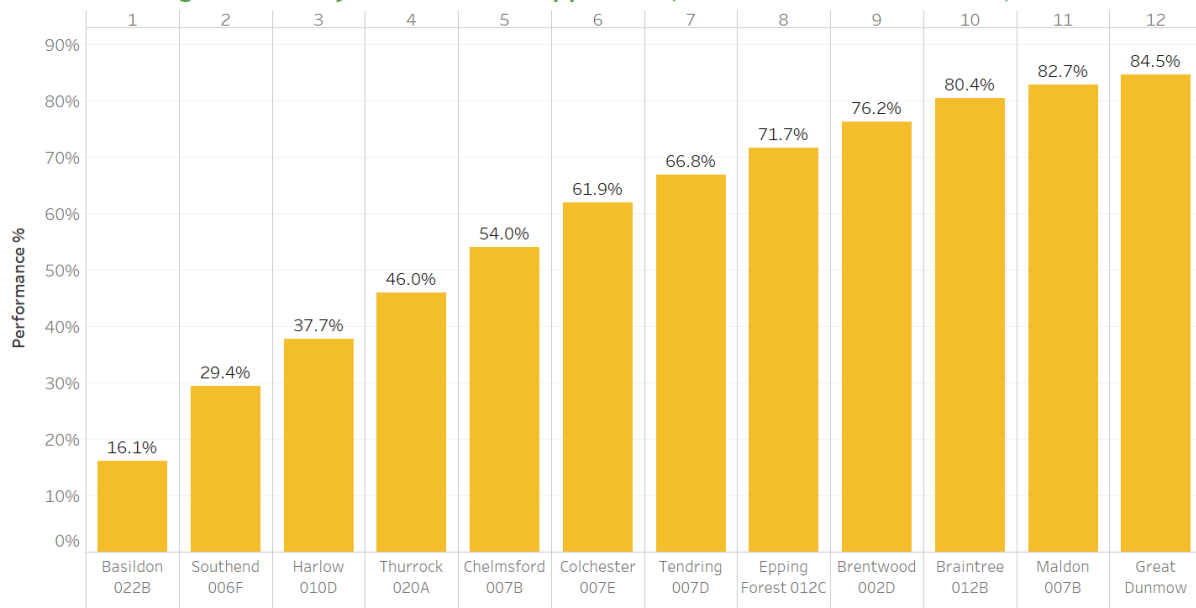
The locations selected for optimal 12 bases using blank canvas are shown below:



- Using the blank canvas approach, the first two bases are placed in the South of the county, the first to the East of Basildon the second in Southend
- Only one of the current stations is chosen as being an optimal location, that is Great Dunmow, but many of the LSOAs selected are in the vicinity of existing stations. This is typical as the optimiser has been given over 1,000 options and as such may find locations nearby existing stations that provide a marginal improvement on performance.

The performance generated by the optimal 12 Wholetime stations scenario using Blank Canvas is shown below:

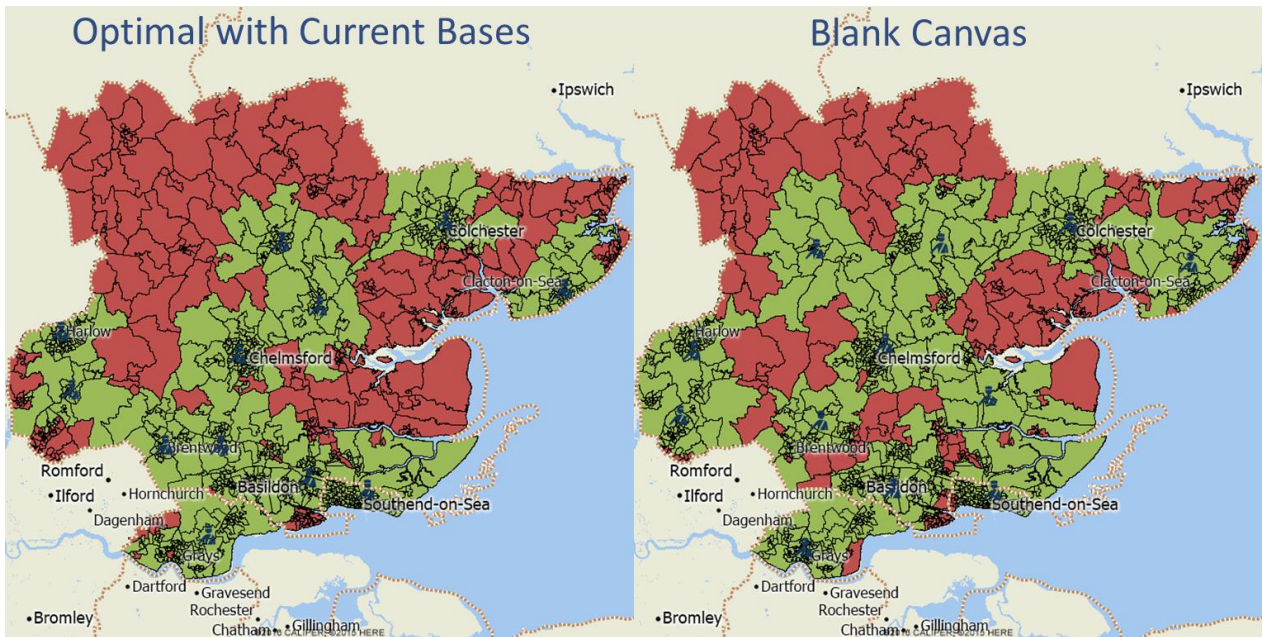
**Performance generated by Blank Canvas Approach (Max Performance 15mins)**



- If the county were only to be served by 1 Fire station the optimal position of this would be to be in Basildon 022B, which would mean 16.1% of demand sits within 15-mins of the station
- As the number of bases increases, the marginal improvement of each additional base does decrease, with 12 bases giving a performance of 84.5%

### 2.3.1 Comparing the outputs from Blank Canvas with other approaches

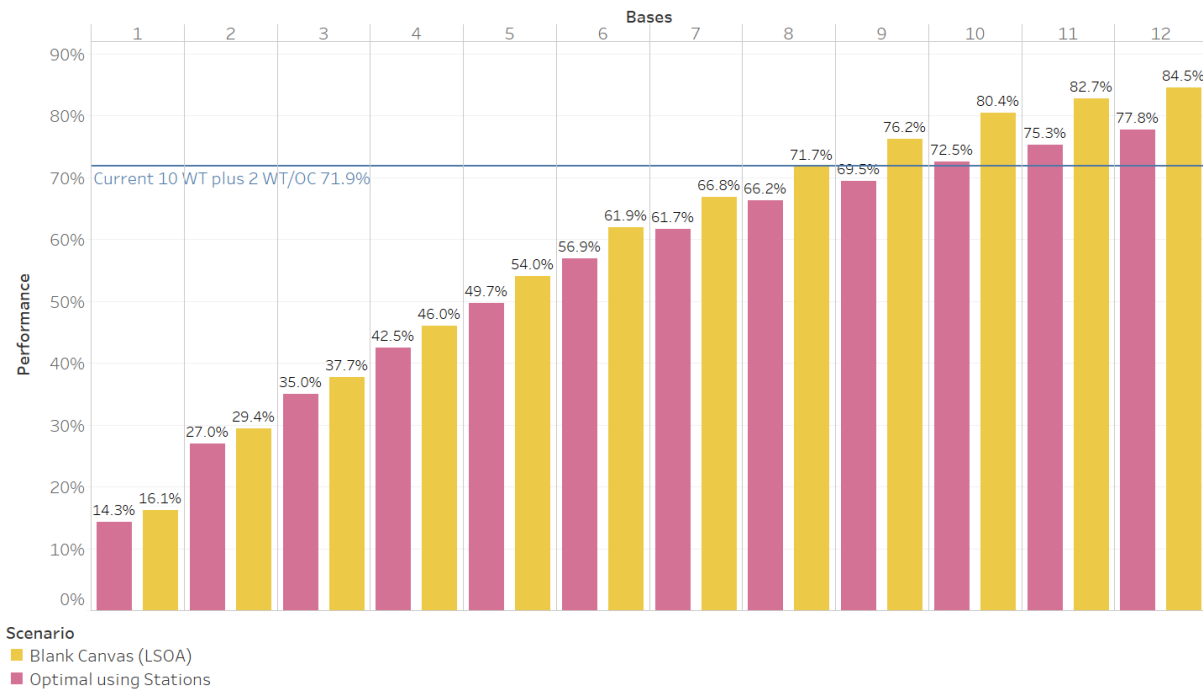
The maps below show the coverage within 15-mins for the two methods:



- Both methods focus coverage on South of the County; however, the Blank Canvas approach does so using fewer bases.
- Blank Canvas approach provides coverage for Maldon and Great Dunmow

The graph below compares the performance from the 'Blank Canvas' approach with the optimal base approach:

#### Comparison of Optimal Bases vs Blank Canvas Method



- Blank canvas approach gives better performance with 12 bases showing 84.5%

## 2.4 Degradation List

One of the key aims of the project, highlighted within the request for quotation, was to "Identify the order of priority for resources in order to maintain the highest possible level of performance". This would typically be referred to as a Degradation list, mapping out the impact that losing the next base would have on overall ability to respond to Incidents

In building up the Degradation list the process starts by selecting the optimal 49 bases of the 50 bases based on performance. The base that wasn't chosen is then frozen out, or 'Denied' from the selection set. This approach is then repeated until only 1 base is left. The full degradation list is shown below with the colouring consistent indicating the current duty system in place in each station (**Yellow** or On Call, **Blue** for Day Crewed and **Green** for Wholetime element):

### Degradation List - Impact of Removing the base as % vs.50 base solution

50	All	0.0%	25	Manningtree	-4.8%
49	Corringham	0.0%	24	Ongar	-5.5%
48	Ingatestone	0.0%	23	Stansted	-6.3%
47	Wickford	0.0%	22	Frinton	-7.1%
46	Wethersfield	0.0%	21	Tiptree	-7.9%
45	Old Harlow	0.0%	20	South Woodham Ferrers	-8.7%
44	Weeley	0.0%	19	Billericay	-9.6%
43	Rochford	0.0%	18	Dovercourt	-10.8%
42	Shoeburyness	0.0%	17	Canvey Island	-12.0%
41	Wivenhoe	0.0%	16	Halstead	-13.2%
40	Leigh	-0.1%	15	Saffron Walden	-14.6%
39	Newport	-0.1%	14	Maldon	-16.1%
38	Tollesbury	-0.2%	13	Epping	-17.6%
37	Hawkwell	-0.3%	12	Dunmow	-19.2%
36	Tillingham	-0.5%	11	Witham	-21.0%
35	Leaden Roding	-0.8%	10	Basildon	-23.3%
34	Sible Hedingham	-1.1%	9	Braintree	-26.0%
33	Great Baddow	-1.4%	8	Brentwood	-29.8%
32	Coggeshall	-1.7%	7	Loughton	-34.1%
31	Thaxted	-2.1%	6	Clacton	-39.2%
30	Waltham Abbey	-2.5%	5	Chelmsford	-46.5%
29	West Mersea	-2.9%	4	Harlow	-53.9%
28	Brightlingsea	-3.3%	3	Colchester	-61.7%
27	Orsett	-3.8%	2	Southend	-70.8%
26	Burnham	-4.3%	1	Grays	-81.2%
			0	Rayleigh Weir	-100.0%

It is worth noting that in the case of ECFRS removing the first few bases have had zero or negligible impact on overall performance as the incidents these stations would have attended already sit within the catchment zone of another station ground.

The Wholetime Stations of Leigh and Orsett are seen to have limited impact on overall performance as their station grounds can be covered by other appliances.

Braintree and Witham feature high on the list of prioritised stations, areas with relatively high demand that would not receive support in time to impact the performance standard.

## 2.5 Summary of Station Location Optimisation

Although the Blank Canvas approach outperforms the Optimal using Stations, analysis shows that both methods would generate considerable benefits in 15-min response performance compared with the current setup.

### 2.5.1 [Maximising Performance](#)

Using current bases to maximise performance, the first 3 bases selected were all in the South of the county, emphasising how important it is to cover the demand in this region adequately. The fact that some of the current Wholetime stations weren't selected until far later into the process demonstrates that it may be possible under a 15min target to saturate demand within the South of the county with fewer Wholetime stations.

The maximise performance scenarios showed the potential to improve performance with current bases, as the 10 optimal Wholetime Stations gave similar performance to the current 10 Wholetime, 2 WT/OC. If the optimal 12 Wholetime bases were used, this would show an increase in performance of 5.9pts compared with the status-quo.

### 2.5.2 [Minimising Travel Time](#)

In the scenarios that looked at minimising overall Travel Time using the current bases, 8 of the 12 selections are South of HQ location. This was due to a high proportion of the total demand sits within these areas and once again demonstrating the importance of having an adequate response to the South of the county.

### 2.5.3 [Day Crewing](#)

The analysis of the Day Crewing suggested that two of the Day Crewed stations are in the right area but overall poses questions around coverage and performance of the others.

### 2.5.4 [Blank Canvas approach](#)

Using the blank canvas approach, the optimiser has far more options to choose from and as such, is able to select locations that provide improved performance. With 12 bases the blank canvas approach demonstrates performance of 84.5%, a 6.7pt improvement on the optimal base solution and a 12.6pts gain on the current setup.

### 2.5.5 [Degradation list](#)

The degradation list demonstrates the relative importance of stations for coverage, Braintree and Witham with relatively high demand don't receive support in time to impact the performance standard while Leigh and Orsett have a much greater degree of replaceability.

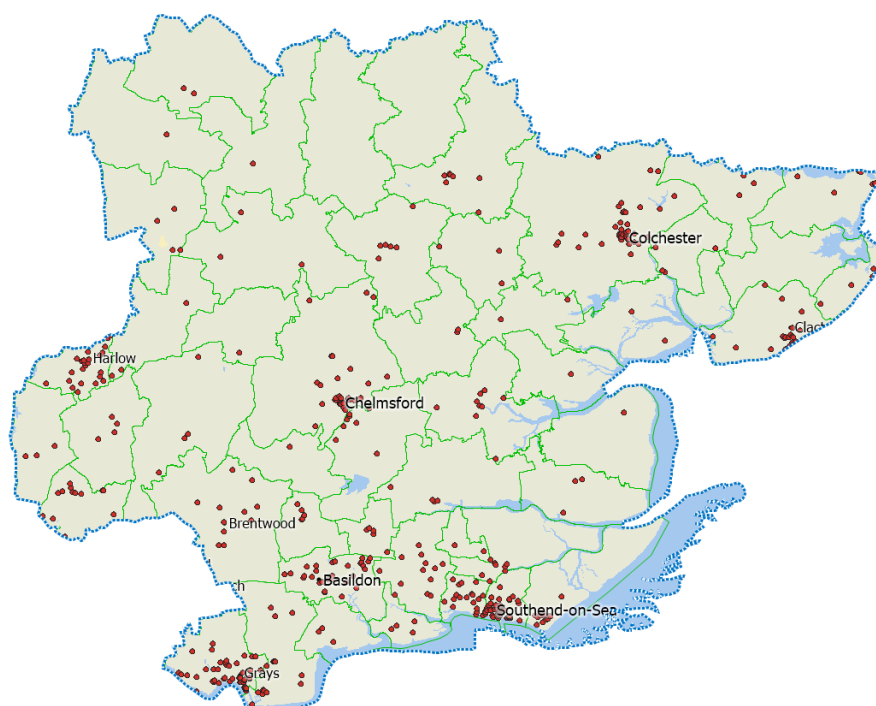


### 3 Specialist Appliances

Essex County Fire and Rescue Service currently have Aerial appliances located at 4 stations:

- Colchester
- Southend
- Chelmsford
- Grays

The map below shows the location of all incidents which the Aerial appliances have been deployed to over the course of the last 5 years:



Using the same settings as the optimisation of Wholetime appliances to maximise performance, the optimal locations for Aerial appliances would be:

Current Aerial Location	Optimal 4 Base Location	Notes
Southend	Southend	Match
Colchester	Colchester	Match
Chelmsford	Great Baddow	Similar Area
Grays	Orsett	Similar Area

This shows that 2 Aerial appliances are already at the optimal locations, while the remaining 2 are in locations that are very close to the optimal (Grays 3.5miles, Chelmsford 2.6miles). There is also an argument that although moving the Grays appliance to Orsett would improve performance within 15mins, it would move the appliance away from the majority of the demand it serves increasing average travel times.

Based on these findings, there is no recommendation to move Aerial Appliances.

## 4 Interpreting Location Based Optimisation

The analysis within this report has focused on location-based optimisation to identify the optimal locations for stations and appliances. One of the key themes that have come out of this analysis has been highlighting the potential to change the way in which demand within the South of the county is served, with the option to increase coverage to other parts of the county.

A key element to understand when considering this will be the impact that any changes would have on the workload and utilisation of the appliances in the South of the county. The accurate estimation of the effect of these changes will have, requires the population and validation of our Fire Incident Response Simulator model

### 4.1 Fire Incident Response Simulator (FIRS)

FIRS is a computer simulation model that accurately mimics the behaviour of a real-life fire service's incident response processes. The purpose of FIRS is to enable evaluation of a range of 'what-if?' scenarios in the context of responding to incidents.

Types of scenarios that FIRS has been used to evaluate include:

- Changing appliance availability
- Changing the location of stations
- Closing stations or adding new stations
- Merging stations (either to an existing or new site)
- Removing appliances altogether or adjusting their status (e.g. to retained) at certain times of day
- Testing alternative response standards
- Evaluation of 'blank canvas' designs

The next stage of the project will be to configure and validate the FIRS tool with ECFRS's data and then to work with the IRMP Review team to understand the areas in which they would wish to test.

## Appendix Two – Key/Joint Key Stations

<b>Key Stations</b>	<b>Joint Key Stations</b>
<b>10 Colchester</b>	<b>12 Clacton &amp; 19 Weeley</b>
<b>11 Dovercourt</b>	<b>35 Rayleigh &amp; 47 Hawkwell</b>
<b>30 Southend</b>	<b>43 Burnham &amp; 44 Tillingham</b>
<b>34 Chelmsford</b>	<b>67 Ingatestone &amp; 51 Brentwood</b>
<b>46 Maldon</b>	<b>80 Sible Hedingham &amp; 81 Halstead</b>
<b>50 Grays</b>	<b>83 Stansted &amp; 87 Dunmow</b>
<b>52 Basildon</b>	<b>72 Loughton &amp; 73 Waltham Abbey</b>
<b>54 Canvey Island</b>	
<b>70 Harlow</b>	
<b>78 Braintree</b>	
<b>85 Saffron Walden</b>	

Service Control will mobilise an appliance to standby at a key/ joint key station under the following criteria:

- When an appliance(s) from a key station or both joint key stations will be detained at incident in excess of 30 minutes or are off the run.
- When an appliance(s) from a key station or both joint key stations are mobilised to an incident as part of a 'make up'.
- When appliances from a key station or both joint key stations have been ordered out of the Service area.
- When the Fire Control Officer believes operational cover will be enhanced, taking into account global availability.

Service Control may pick any of the locations listed above for an appliance to standby at, based on providing maximum emergency cover.