Gatwick Airport Northern Runway Project

Capacity and Operations Summary Paper
Appendix: Airfield Capacity Study

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Appendix - Airfield Capacity Study

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1. Introduction

1.1.1. This appendix sets out the dual runway concept of operation and capacity on the airfield on completion of the Northern Runway project, compared to the current state and the future state with single runway operation. This Paper is not concerned with explaining or justifying forecasted demand – it addresses the operating capacity of the airport and performance based on the forecasted demand.

1.1.2. The content of this paper has been written by London Gatwick's internal Capacity Planning team and Airfield Operations teams. Both teams have detailed knowledge of how the airfield operates and play a vital role in the airport's capacity declaration process which is carried out twice a year.

2. Capacity assessment

2.1.1. The capacity of the airfield has been assessed using experience, assisted by both fast time simulation tool AirTOP[1] and data analysis in excel, the results of which are provided in this document.

2.1.2. AirTOP simulates aircraft movements on the airfield and within the controlled airspace surrounding the airport, demonstrating the overall airfield's ability to process demand presented. The results of the fast time simulation can be found in section 5. The AirTOP fast time simulation model, used as a basis for the future baseline and dual runway operation (DRO) models, was built and calibrated using August 2018 busy day schedule and August 2018 performance data.

2.1.3. Whilst fast time simulation is necessary to assess the overall ground capability, it cannot completely replicate air traffic control's ability to sequence aircraft which is the key to a successful operation at Gatwick. To fully illustrate the performance expected under the Northern Runway scheme addition analysis on runway sequencing has been provided in section 6.

[1] AirTOP is a Transoft Solutions product used for fast time simulation.

3. Growth scenarios

3.1. Introduction

3.1.1. The airfield throughput London Gatwick delivered in 2018 & 2019 is shown in Table 1 in terms of aircraft movements by calendar year and financial year. Financial year[2] movements peaked in 2018 due to COVID impacting traffic in February and March 2020 of FY 2019. All subsequent years have also been impacted by COVID and the recovery period. The Calendar year movements are also provided to illustrate the growth in aircraft movements between 2018 and 2019 prior to the COVID impact. London Gatwick is not predicted to exceed 2018/19 levels of traffic until 2024.

Table 1. Aircraft movements for 2018 & 2019

Aircraft Movements	Calendar Year		Financial Year		Included
	2018	2019	2018	2019	
Commercial (k)	279.7	280.7	281.7	269.5	Scheduled and non-scheduled passenger carrying air transport movements. Excl. aircraft positioning flights.
All (k)	283.9	284.9	285.9	273.9	All

3.1.2. Going forward FY 2018 will be used as a basis for comparison to the growth scenarios as the fast time simulation model was calibrated using August 2018 data.

3.1.3. As shown in Table 2, the Baseline is projected to see a small-scale increase of approximately 29.0k commercial movements by 2029 compared to FY 2018 and 36.7k by 2038. The associated busy day forecasts have an increase of 16 aircraft movements in 2029 and 20 in 2038.

3.1.4. The Dual runway operation (DRO), achieved through the Northern Runway project, is expected to deliver approximately 48.4k additional commercial movements by FY 2029 and 100.0k by FY 2038 in comparison to FY 2018. This is based on an uplift of 102 movements being processed on the airfield on a busy day[3] by 2029 and 198 by 2038.

[2] The Financial year : 1st April of the calendar year referenced until 31st March the following year.
[3] Busy Day is taken as the 3rd Friday in August

Table 2. Growth scenarios

Movement measure	Baseline			DRO	
	2018	2029	2038	2029	2038
FY Annual commercial movements	281.7k	310.8k	318.5k	330.2k	381.8k
Compared 2018 Baseline	-	*+29.0k*	*+36.7k*	*+48.4k*	*+100.0k*
Busy day movements	934	950	954	1036	1132
Compared 2018 Baseline	-	*+16*	*+20*	*+102*	*+198*

3.1.5. The Summer 2018 detailed hourly declaration between 0400 to 2359 is shown in Table 3, there were five hours declared at the maximum capacity of 55 at this point. There continues to be five hours declared at 55 in the Summer 2024 runway declaration although they are not the same five hours. The hours declared at 55 movements per hour have been adapted each season based on the traffic mix, demand and the capability. The scheduled movements on a busy day must fit within the declaration parameters. Between 2200 and 0459 the declared capacity is significantly lower in each hour as these hours are either partially or fully within the night quota period. Further details of the 2018 busy day scheduled demand can be found in 3.2 to follow.

Table 3. Summer 2018 declared capacity

Start of Hour (UTC)	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	17hr (05-21)
Total Limit	29	49	54	52	51	49	55	55	55	53	51	52	55	55	54	46	43	41	29	30	870

3.2. Busy day schedule

3.2.1. Capacity assessments are typically undertaken using a busy day schedule, in the case of London Gatwick the 3rd Friday in August, this is typically a representative peak day. The growth scenario schedules are based on the 2018 busy day schedule with the addition of the forecasted demand.

3.2.2. All scheduled times of operation are based on planned on-block time for arrival, and off-block time for departures. On-block is when the aircraft is in its parking position with the parking brakes applied and off-block is when the aircraft starts to move from its parking position.

3.2.3. The 2018 busy day schedule, used as a basis for the growth schedules, is shown by clock hour in Figure 1. On this day the schedule reached the maximum of 55 movements in two out of the five hours declared at 55, 11 and 12. In total there were 934 movements scheduled on the busy day in 2018.

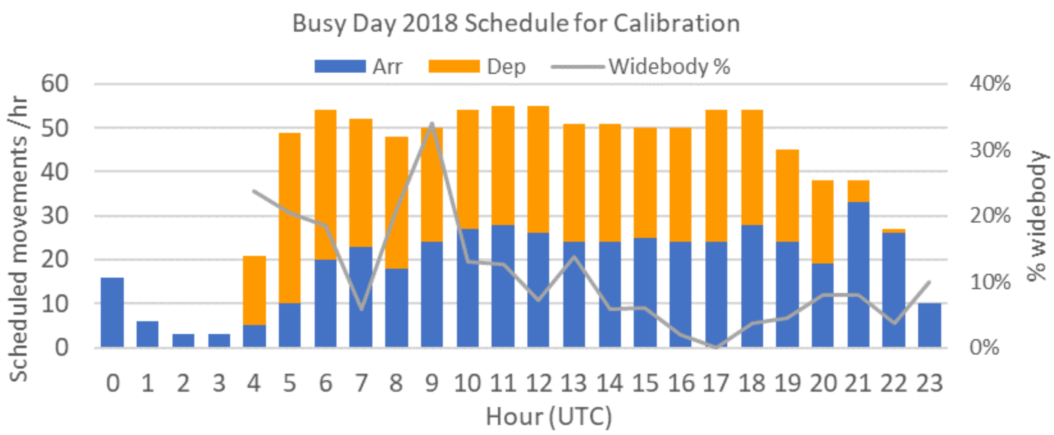


Figure 1. 2018 Busy day scheduled for calibration model

3.3. Future Baseline

3.3.1. The future baseline, forecasted by GAL, maintains a maximum of 55 movements per hour scheduled on 6 occasions, based on clock hour. The UTC hours scheduled at 55 movements are 6, 11, 12, 13, 17 & 18. Figure 2 shows the forecasted profile of movements scheduled in each hour across the 2038 busy day along with the percentage of the movements which are widebody. Widebody aircraft tend to take longer to vacate the runway and may require greater airborne spacing reducing runway throughput. During the core hours the percentage of widebody movements peaks at 42% in 0900 UTC, due to the high percentage of widebody movements forecast in this hour the total movements scheduled is limed to 48, which is the lowest of all the core hours until the arrival heavy period from 1900 onwards. The forecasted percentage of widebody movements has increased by 8% compared to the 2018 peak.

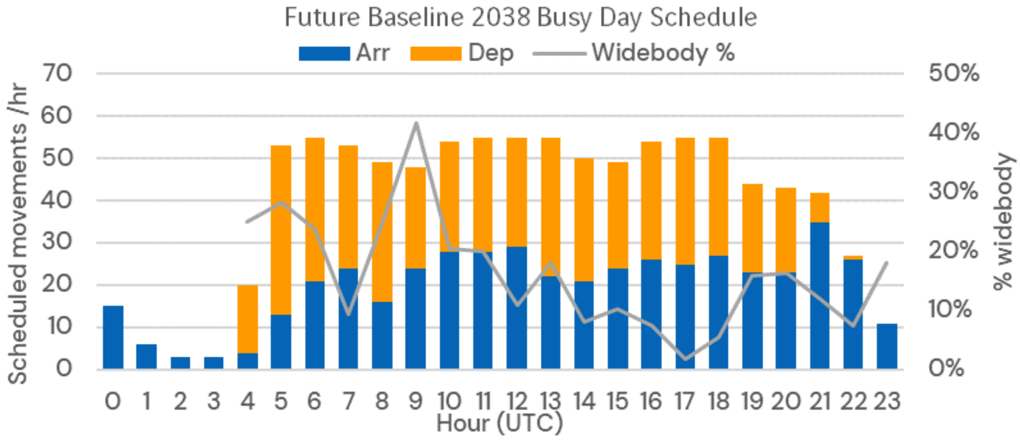


Figure 2. Future Baseline scheduled movements

3.4. Dual runway operation (DRO) (Northern Runway Project)

3.4.1. In DRO GAL has forecast that the busy day reaches a maximum of 69 movements per hour, based on clock hour. The profile of flights forecast across the day by 2038 is illustrated in Figure 3. The percentage of widebody movements peaks at 39% in 0900 UTC, due to the proportion of widebody flights in this hour the total movements scheduled is limited to 54.

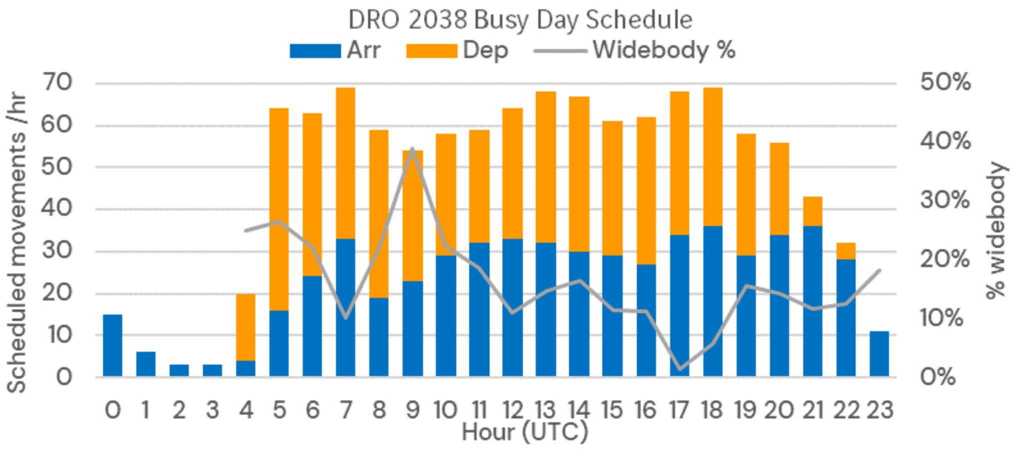


Figure 3. DRO Busy Day Scheduled movements

3.5. Comparison

3.5.1. Figure 4 provides the clock hour scheduled movements for the baseline and DRO scenarios for both 2029 and 2038. In all scenarios the night capacity has been assumed to remain unchanged from current levels, hence the schedule remains unchanged in the night hours. The DRO 2029 schedule reflects an intermediate stage where the capability is available to deliver the 2038 schedule, however the demand is forecasted to reach a maximum of 62 movements in an hour.

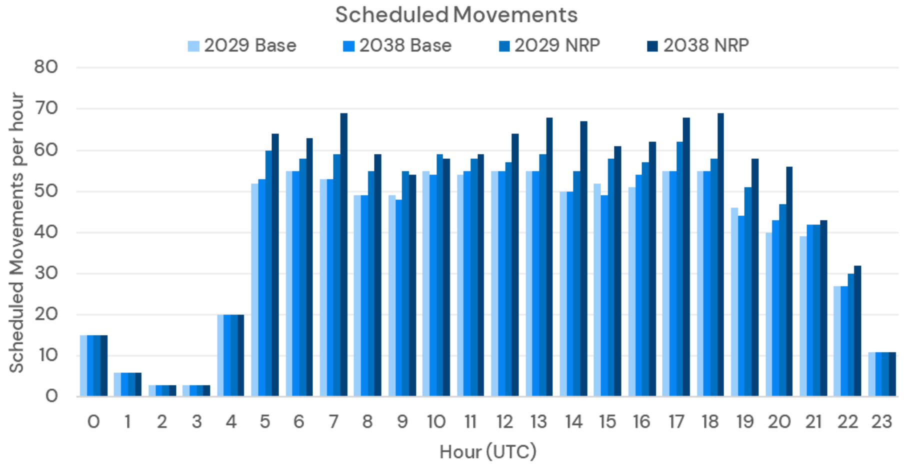


Figure 4. growth scenario schedule comparison

3.6. Capacity Assessment Criteria

3.6.1. The metrics used to determine the viability of accommodating the proposed busy day schedule/capacity are detailed in Table 4.

3.6.2. The total taxi time aircraft are subjected to on arrival and departure is important for the airlines operating at London Gatwick as an allowance for taxi time needs to be built into their planned schedules.

3.6.3. For departing aircraft on stand holding will also impact the ground time required. On stand holding is used if the aircrafts route is impeded or to manage the number of aircraft on active taxiways.

3.6.4. For arrival aircraft airborne holding time is also an important element as an increase in airborne holding will increase fuel burn and needs to be factored into airlines planned schedules..

3.6.5. Modelled taxiway holding is provided for both arriving and departing aircraft along with runway holding for departures, and they are accounted for in the total taxi time in the 2018 actual results.

Table 4. Performance measurement definitions

	Measure	Actual	Simulated
Throughput	**Scheduled**	Number of aircraft movements scheduled in a clock hour.	Number of aircraft movements scheduled in a clock hour.
	Runway	Number of aircraft movements processed on the runway in a 60 minute period base on touch down time for arrival aircraft and wheels up time for departing aircraft.	Number of aircraft movements processed on the runway in a 60 minute period base on touch down time for arrival aircraft and wheels up time for departing aircraft.

Total taxi time (min)	**Departures**	Start of aircraft pushback from stand to take-off (wheels up) time. Excl. aircraft which leave stand more than 20/25 minutes before calculated take-off time (CTOT), when in 26/08 runway direction.	Start of aircraft pushback until take-off time
	Arrivals	Actual landing time to actual on blocks (stand) time.	Landing time to on block time.
Departure holding (min)	**Stand**	Start request to start approval time. Excl. flights with CTOT more the 20/25 minutes after start request time.	Start request to start of pushback.
	Taxiway	Not available due to gaps in data collection systems.	The delay to a taxiing departure aircraft, caused by traffic, resulting in the aircraft to slow down or stop, compared to unimpeded journey time.
	Runway	Runway hold entry to start of take-off minus unimpeded taxi time through hold. Unavailable in 08 runway direction due to gaps in measurement systems.	Duration in departure queue
	Total Holding*	The on stand and runway holding are added up for each individual aircraft to give total holding time.	The holding time on stand, taxiing and at the runway are added up for each individual aircraft to give total holding time.
Arrival holding (min)	**Taxiway**	Not available due to gaps in data collection systems.	The delay to a taxiing arrival aircraft, caused by traffic, resulting in the aircraft to slow down or stop, compared to unimpeded journey time.
	Airborne	Time aircraft spends circling in either of the airport stacks and any delay caused by vectoring to runway compared to direct route.	Time aircraft spends circling in either of the airport stacks and any delay caused by vectoring to runway compared to direct route.

3.6.6. Taxi time and holding time results are summarised as the average and the 95th percentile for each scenario modelled. Typically the average is the focus for performance comparisons due to the fast time simulation not performing well when fairly distributing holding times. The 95th Percentile is provided as representation of the maximum taxing and holding times likely to be experienced, by excluding the outliers.

3.6.7. The fast time simulation measurements are measured over 10 runs with randomisation applied to each run. The average results stabilised with 10 runs, although the 95th Percentile was very varied with each run hence less weighting is place on this metric.

3.6.8. The randomisation parameters applied within the fast time simulation software influence when the aircraft presents for processing and performance characteristics, such as taxi speeds and runway acceleration and deceleration.

The performance characteristics are based on a combination of EUROCONTROL's base of aircraft data (BADA) and data recorded at London Gatwick.

4. Key Inputs and Assumptions

4.1. Base Airfield Infrastructure & Operation

4.1.1. Relevant information on London Gatwick's current airfield infrastructure and how it is operated is detailed below. For further information on London Gatwick's current airfield layout please refer to the Aeronautical Information Publication (AIP), hosted by NATS, under the aerodrome section and EGKK LONDON GATWICK. The AIP is a manual containing local regulations and procedures associated to the aerodrome. The document is standardised and regulated by the Civil Aviation Authority (CAA).

Runways

4.1.2. There are two parallel runways at London Gatwick:

- The Southern runway operates in 26L (Westerly) or 08R (Easterly) configuration.
- The Northern Runway operates in 26R (Westerly) or 08L (Easterly) configuration.

4.1.3. The two runways are currently separated by 198m, and due to the close proximity these runways cannot be operated at the same time. The Southern runway, termed the 'main' runway is the default runway, c. 98% of movements operated on the main runway across 2018 and 2019. The Northern runway, termed the 'standby' or 'emergency' runway is used when the Southern runway is under planned maintenance or under sustained disruption events causing the main runway to close.

4.1.4. The Northern Runway operations is not heavily utilised because it has a lower capacity than the Southern runway due to the runway exit configurations and it conflicts with other taxiways. The exits are at a sharp angle and non-optimal locations resulting in high runway occupancy times. Widebody aircraft cannot taxi freely on Juliet due to conflicts with the Northern Runway operation, significant gaps are required to allow for widebody aircraft taxing to or from, depending on the direction of operation, the runway.

4.1.5. Overall, 26 is the favoured direction of operation based on prevalent wind direction in the region, particularly in peak movement months August and September, as shown in Figure 5. The wind direction is the biggest determinant for runway direction because aircraft should take off and land into the wind.

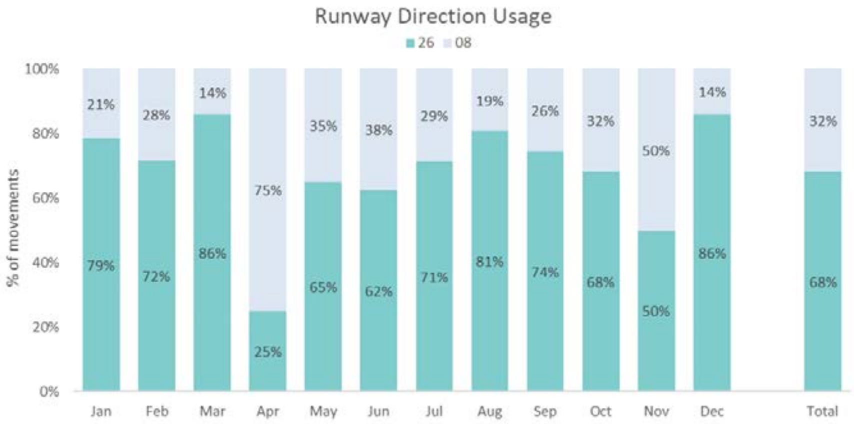


Figure 5. 2019 runway direction utilisation

Runway departure holding locations

4.1.6. Each runway and runway direction utilises different taxiways for holding departure aircraft whilst they wait for their slot on the runway. The holding areas are as follows for each runway/direction:

- 26L: The purple box in Figure 6 highlights the key holding area. This area is referred to as the 'alpha box' and Mike.
- 26R: Taxiways Papa and November
- 08L: Taxiways Juliet and Sierra
- 08R: Taxiway Juliet and the Northern runway.

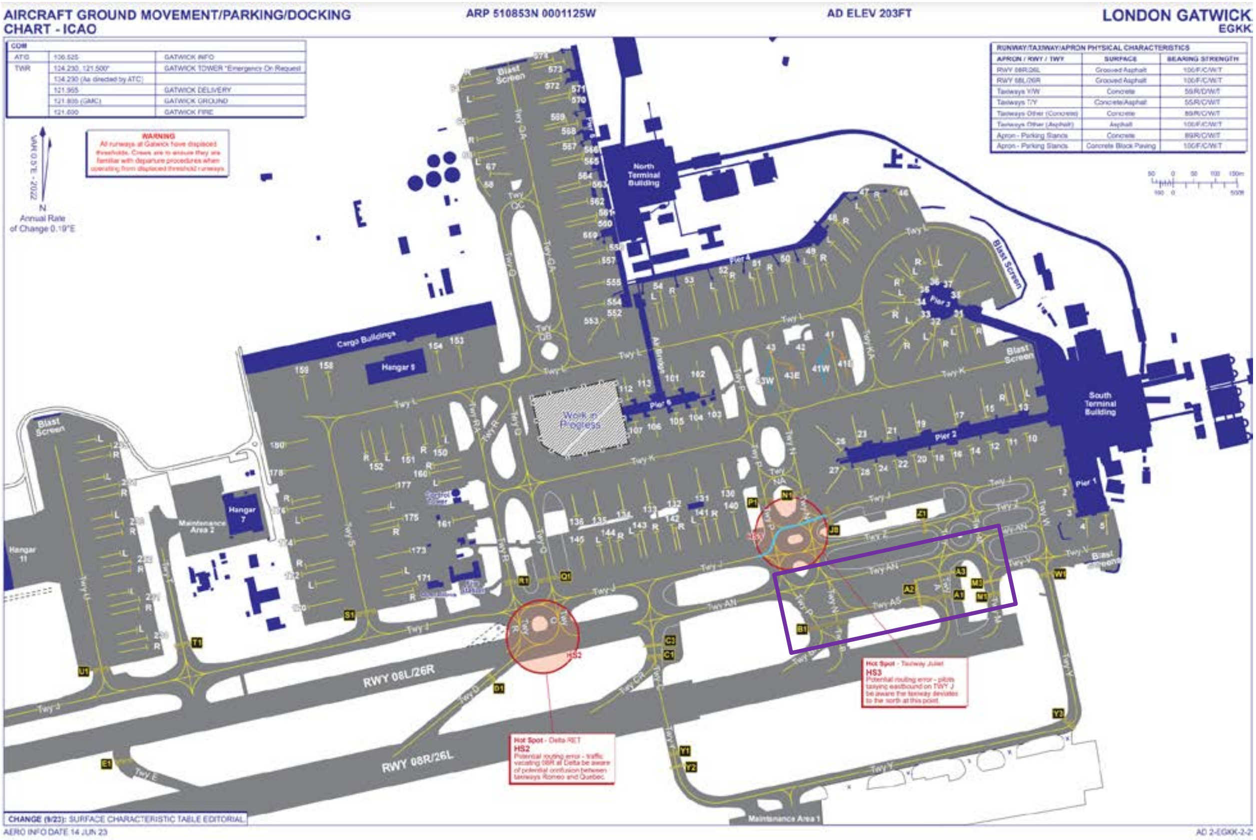


Figure 6. LGW current airfield layout (June 2023)

Departure routes

4.1.7. The departure airspace route usage from August 2018 is shown in Table 5. The departure routes are allocated to the flights in the busy day future schedules using the August 2018 data for the associated runway direction. The most heavily utilised departure route flown by the closest matching flight is allocated, with destination region being the primary decision factor and airline and time of day also being factored in.

Table 5. Departure route usage for 2019

Runway direction	Route	2019
26	1	26%
	4	34%
	7 & 8	29%
	9	0%
08	2	3%
	3	3%
	5	3%
	6	1%

Piers

4.1.8. There are 6 piers (three in each terminal) connected to the terminals, providing a total of 85 pier served stands, for code C aircraft once Pier 6 extension is completed in 2026. There are a further 61 remote centrelines available for parking aircraft and coached passenger flights.

Taxiway structure

4.1.9. Key taxiways :

- Juliet is a key taxiway in the network. It runs from the West to East of the airfield alongside the runways.
- The Northern Runway is used as a taxiway when not operating as a runway.
- Taxiway Yankee currently exists only to deliver aircraft to the hanger to the South of the Southern runway.

4.2. Modifications to Airfield Infrastructure & Operations

4.2.1. In the future Baseline the only changes to airport infrastructure assumed are the Pier 6 Western extension and the Rapid Exit Taxiway (Echo Romeo) and the associated removal of exit taxiway Echo. These are both currently under construction. Echo Romeo is due to be complete Q1 2024 and Pier 6 Western extension is due to be complete by Q4 2026. Figure 7 shows the simulated layout in AirTOP with the changes described. Further details of the changes and associated operational impact can be found later in this section.

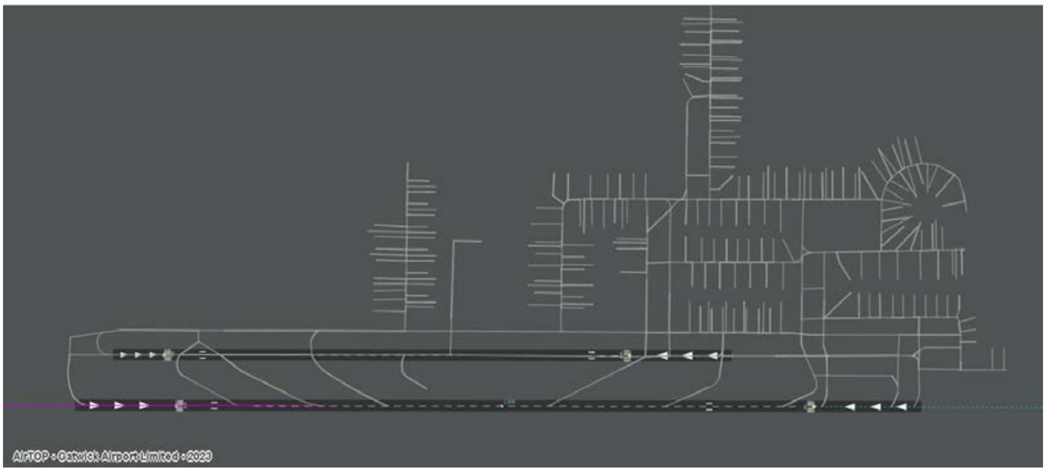


Figure 7. Future baseline simulated layout

4.2.2. In the DRO scenario there are further changes to the airfield including the relocation of the Northern Runway 12m to the North, reconfigurations of the runway exits, removal and addition of stands and changes to certain taxiways.

Further details of the infrastructure changes and resulting impact to the operation are detailed in this section. The overview of the airfield simulated, including the changes described, is shown in Figure 8.

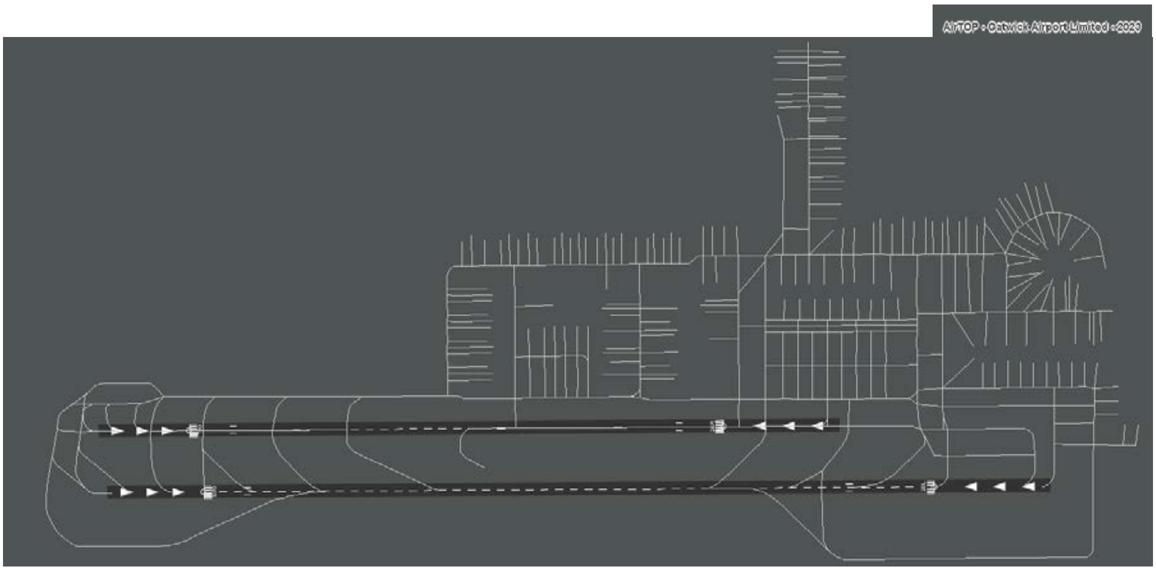


Figure 8. DRO simulated airfield layout

4.2.3. Runway configuration, runway dependencies, runway holding and taxiway dependencies, described below, have been assessed against similar, closely spaced, parallel runway operations elsewhere (e.g. Los Angeles International, San Francisco International, Toronto Pearson, Manchester, London Heathrow). Furthermore, the proposed concept of operation was assessed for safety by the airport and air traffic control teams operating at London Gatwick, with the proposed concept, safety assessment and mitigations being further reviewed by the CAA regulatory team. The CAA have accepted the concept subject to further refinement and implementation of associated safety systems (to achieve the target level of safety) as agreed to date with GAL.

Runways

	Baseline Yrs 2029 & 2038	DRO
Indicative Illustration	n/a	
Infrastructure change	No change	Northern Runway moved 12m North to deconflict from the Southern runway.

Operational change	No change	The two runways will be able to operate as parallel dependant runways (described in further detail later in this section).

Future Baseline Runway Configuration

4.2.4. The future Baseline will operate in a single runway mode, i.e. one runway in operation at a time. The default runway in use will be the main runway and the direction of operation chosen will be based on aircraft flying into the wind. The Northern Runway will be used in single runway operations in the event of disruption or planned maintenance of the main runway.

DRO Runway Configuration

4.2.5. The runways will be operated in dual runway configuration when required for capacity purposes. Otherwise, operation will revert to single runway operations, as in the future Baseline configuration.

4.2.6. The capacity assessments for the dual runway operation (DRO) have been undertaken with the following runway allocation assumptions:

- The dual runway operation runs from 0500 to 2159 UTC; operations between 2200 to 0459 UTC are run as a single runway operation on the Southern runway.
- The Southern runway (26L/08R) is used for both arrivals and departures.
- The Northern Runway (26R/08L) is used for departures which are Code C or smaller.
- As Code C departures can go on either runway they are allocated to a runway based on optimising the sequencing, thereby reducing holding times, and minimising the complexity of routing.

DRO Runway Dependencies

4.2.7. During DRO the runways will be operated as parallel dependant runways. Therefore, departures and arrivals have the same airspace separation constraints as in single runway operations. The benefits are gained through departing an aircraft on the Northern Runway whilst the Southern runway is occupied by an arriving aircraft which in single runway operation would be unutilised time. This results in reduced stress on the main runway and an increase in overall runway capability.

4.2.8. A brief explanation of how a departure is sequenced after an arrival in each situation is described here:

- Same runway: Arrival aircraft must have vacated the runway before departure start of roll.
- Arrival Southern runway & Departure Northern runway: as the arrival aircraft touches down on Southern runway the departing aircraft on the Northern Runway starts rolling, see Figure 9.

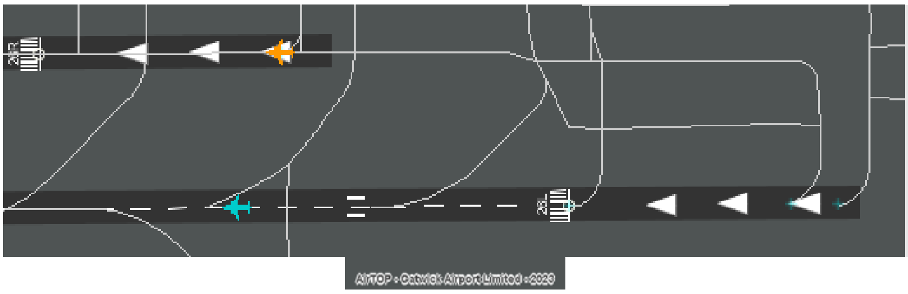
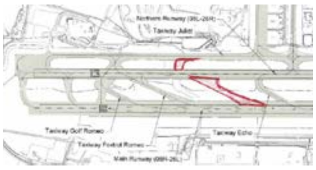
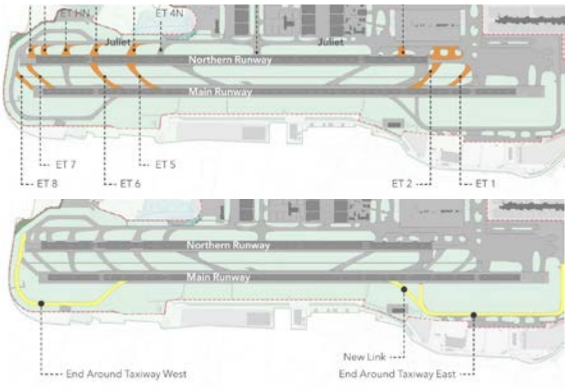


Figure 9. Arrival position when departure starts roll in 2Westerly operations

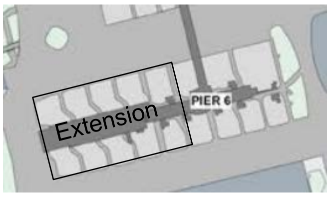
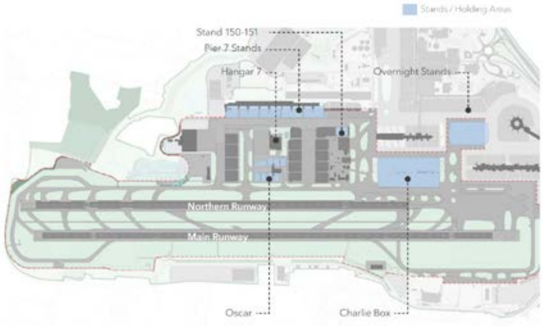
4.2.9. Permission will not be given for a departure on the Northern Runway if:

1. An airborne arrival is less than 2NM from the threshold and not touched down
2. There is an arrival aircraft entering the Northern runway's safety zone to cross the runway.
3. There is a Code E on an exit taxiway or in close proximity to exit (second half of the runway).
4. There is a departure lined up on the Southern runway.

Runway Exits

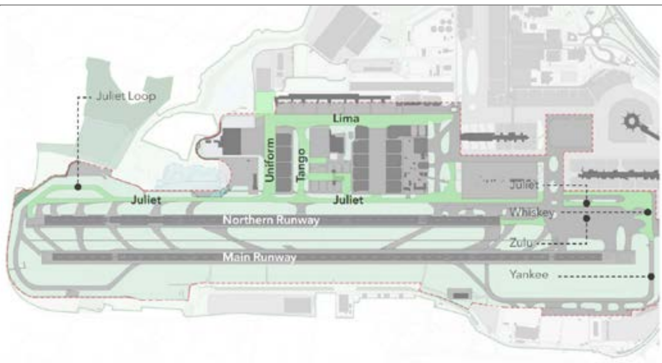
	Baseline Yrs 2029 & 2038	DRO
Indicative Illustration		
Infrastructure change	- New rapid exit taxiway Echo Romeo (illustrated in red) & removal of exit echo. - No change to 08 direction operations.	- Echo Romeo remains, although it will not be used in during dual runway operations. - All other rapid exit taxiways are reconfigured, to an angle which provides required lines of sight to allow crossing of a live runway, and connected to Juliet (illustrated in orange). - In addition to the reconfigured runway exits, there are end around taxiways at each end of the runway (illustrated in yellow).
Operational change	- 47% of medium arriving aircraft assumed to use Echo-Romeo when in 26L operations. c.3 second reduction in average arrival runway occupancy time expected.	- Arrival aircraft runway occupancy time increases by c.5 seconds as a minimum due to the change in angle of the exit resulting in a reduced exit speed for aircraft. Code C aircraft can hold on certain exits without infringing on the Southern runway if required, although optimised sequencing will result in arriving aircraft crossing behind a departing aircraft on Northern without the need to hold on the Southern runway exit. Code D and above aircraft can hold on the exit although they will infringe on the Southern runway pausing operations. - The end around taxiways should only be used as a contingency, in the event of aircraft not being able to cross the Northern runway, or for access to Pier 1.

Aircraft Stands & Holds

	Baseline Yrs 2029 & 2038	DRO
Indicative illustration		
Hold Infrastructure change	- No change.	- Stands previously known as 130's and 140's reconfigured into an intermediate holding area, Charlie Box, for runway direction 26 operations. Charlie Box provides 16 holding positions with access to the runway. - Juliet has a bypass at the Western end to assist with delivery of aircraft to the Southern runway and sequencing.
Hold operational changes	- No change. Alpha box remains the primary holding area for 26L operations and Juliet is used for 08R operations.	- The alpha box and Mike remain the primary holding areas for the Southern runway when operating in 26 direction. - Charlie box, the reconfigured 130 & 140 centrelines, provides a major gain in holding capacity for 26 direction operations with 16 additional holding points for aircraft, each with direct access to the Northern Runway and in close proximity to both the Northern Runway and Southern runway. This will enable optimised sequencing and therefore maximise runway throughput. - For 08 direction runway operations, where optimal sequencing of departures is less vital due to the departure route structure, Juliet and Juliet loop are used for sequencing. On route sequencing is also used, as in the current operation, with the new Lima extension providing additional routes to the West of Juliet.

Stand Infrastructure changes	- 8 additional pier served stands provided by pier 6 extension completion (independent of DCO).	- 8 additional pier served stands provided by pier 6 extension (independent of DCO). - Pier 7 providing 23 centrelines (14 Code C / 9 Code E) north of taxiway Lima. - Provision of a new area of remote stands to be known as Oscar stands in the area to the north of Taxiway Juliet, between Taxiways Tango and Sierra. - Reconfiguration of existing areas of remote stands to allow for the reconfigured Taxiway Lima while retaining stands suitable for Code C aircraft. - Conversion of existing stands located to the west of Pier 3 to eight Code C fully serviced stands. - Removal and reduction of existing stands to allow for relocation of Taxiway Juliet East.
Stand operational change	- The 8 additional pier served stands are in close proximity to the runway resulting in short taxi times for the aircraft utilising these stands.	- The 8 additional pier served stands, provided by Pier 6, are in close proximity to the runway resulting in short taxi times for the aircraft utilising the stands. - Pier 7 will provide additional pier served stands in a location optimised for minimising airfield congestion, whilst staying close to the terminals. - All other additional stands will be used for overnight parking and remote activity.

Taxiways

	Baseline Yrs 2029 & 2038	DRO
Indicative Illustration	N/A	
Infrastructure change	No change	- Lima has been extended between Sierra and Uniform and linked to Tango. - Juliet realigned to allow for taxiway clearances from Northern runway. Including an additional loop at the Western end of for widebody aircraft clearance. - Taxiways Whiskey, Victor and Zulu are reconfigured to accommodate Code E aircraft. - Kilo reconfigured between Quebec and Papa to allow dual code C or single larger aircraft.
Operational change	No change	- Lima extension will be used to optimise taxiway flows and reduce taxiway conflicts. - Juliet will remain a core taxiway for the airfield. Code E and F aircraft will be diverted from Juliet when required to avoid conflict with the Northern runway. - Juliet loop is used for wide body aircraft and sequencing when in 08 direction operations. - Changes to taxiways Whiskey, Victor and Zulu are to provide a route for Code E aircraft from the end around taxiway East to the code airfield. - Kilo Southern code C route main purpose is to provide access to Charlie box, whereas the Northern code C route's main purpose is to provide access to the Southern side of Pier 6.

Taxiway Dependencies

4.2.10. The new taxiway dependencies created through the changes in layout/procedure are as follows:

- Code F aircraft must use the Juliet loop to be independent from Northern Runway Code C departure operations.
- Code E aircraft cannot travel on Juliet between Sierra and Whiskey when an aircraft is departing on the Northern runway.

- Code F aircraft cannot travel on Juliet between Uniform and Whiskey when an aircraft is departing on the Northern runway.
- The dual aircraft section on Kilo can only accommodate a single code D/E/F or dual code Cs.
- In 08 operations sections of Zulu, Mike and the Alpha box are in the Northern Runway safety zone. This area was previously impacted when on 08L & 26R operations although this is now routinely the case and the area impacted has changed due to the repositioning of the centreline. As a mitigation the Charlie Box can be used as an arrival route.

4.2.11. Removal of dependencies due to airfield infrastructure changes:

- Code E aircraft can now travel on Juliet, between the Westerly end of the runway and Sierra, independent from departures on Northern. Code F's can use Juliet until Uniform, when using the Juliet loop independent of Northern Runway operations.

4.3. Current Performance

4.3.1. The current performance data, used as a basis for both the future baseline and DRO scenarios modelling, is based on 2018 actual airfield performance data. The current performance has been used as a basis for the capacity assessment in response to concerns raised in the consultation regarding assumptions about using improved departure performance.

4.3.2. The actual arrivals and departures holding time figures for 2018, including 95th percentile, for both the busy day and the August monthly average are shown in the Table below. The busy day for 2018 was on runway direction 26L, a representative busy day was selected for 08R based on the maximum daily movements on a non-disrupted day. The busy day for 26L direction was the 17th August with 934 movements scheduled based on stand time (on/off block) and 931 actual runway throughput delivered. There were only three days in August 2018 which were predominantly 08R runway operations, and one of which was heavily disrupted leaving only two days of data. 30th August was used as the busy day representation for the 08R data, which had a scheduled demand of 922 movements and actual runway demand of 918. Maximum sustained hourly throughput achieved on these days was 55 movements per hour on both directions, although 56 movements were processed each day in a single 60 minute period. Please note taxiway holding is not available for actual data for either direction of operation, and that departure runway holding time, and therefore total holding time, have not been included for 08R due to data capture limitation. The data recording system is not currently set up to record full aircraft holding time for 08 departures.

Table 6. 2018 actual performance

Measure	Category	Type	2018			
			26L Busy day	26L Aug	08R Busy day	08R Aug
Demand/Throughput (movements per hour)	Scheduled	Max	55	55	55	55
	Runway	Sustained Max	55	55	55	55
Total taxi time (min)	Departures	ave.	20.9	19.6	21.6	20.2
		95th Percentile	31.0	29.0	30.0	28.0
	Arrivals	ave.	8.0	8.2	5.8	5.8
		95th Percentile	11.0	12.0	10.0	10.0
Departure holding (min)	Stand	ave.	2.3	2.1	2.5	1.6
		95th Percentile	9.6	11.0	12.0	9.0
	Taxiway	ave.	-	-	-	-
		95th Percentile	-	-	-	-
	Runway	ave.	10.6	9.7	-	-
		95th Percentile	18.7	18.0	-	-
	Total Holding*	ave.	12.9	11.8	7.4	6.0
		95th Percentile	25.0	25.0	19.9	16.5
Arrival holding (min)	Taxiway	ave.	-	-	-	-
		95th Percentile	-	-	-	-
	Airborne	ave.	5.3	4.4	6.9	5.3
		95th Percentile	13.8	14.1	17.0	16.1

Departure separation current performance

4.3.3. During departure heavy pressurised hours, aircraft with the same wake turbulence category achieved 60 seconds separation for consecutive departures travelling down different routes and an average of 106 seconds separation for successive departures travelling on the similar route in 26 direction operations, and 113 seconds in 08 direction. Baseline and DRO modelling, using current performance parameters, have used these assumptions. Further modelling has also been undertaken to understand the impact of future performance initiatives currently underway at London Gatwick on both growth scenarios. Details can be found in Performance Initiatives section to follow.

4.4. Performance Initiatives

4.4.1. As the world's most efficient single runway airport, London Gatwick constantly seeks to improve operations when there is a significant gap between optimal and achieved performance. Whilst increased pressure on the operation typically leads to improved separation performance there are also three live projects underway at GAL, in collaboration with NATS, that will assist in improving performance characteristics and resilience for certain flights: the addition of a new rapid exit taxiway (RET), reduced departure separation and improved sequencing capability. The 'current performance' fast time simulations include only the new RET (section 5). The 'future performance' fast time simulations include the New

RET and reduced departure separation (section 5). The data analytics model includes the New RET, reduced departure separation and improved sequencing capability. The improved sequencing capability will only be captured in the data analytics model due to limitations of the fast time simulation software detail in section 6.

4.4.2. Another future initiative at London Gatwick is time-based separation for arriving aircraft, although any associated performance benefits have not been included in any of the modelled scenarios. Time based flow has not been included because it is expected to have the biggest impact on performance in poorer weather conditions which isn't considered in the busy day modelling. The benefits will be fully quantified once operational.

4.4.3. A summary of which future initiatives are included in each of the models is shown in Table 7.

Table 7. Summary of future initiative inclusion in modelling

Future Performance initiatives	Fast time simulation Future Baseline & DRO Current Performance	 Future Performance	Data Analytics Model *(Section 6)*	Notes
New RET (Echo Romeo)	✓	✓	✓	Echo Romeo included in all scenarios, although it's not utilised during DRO as the angle is not suitable for crossing the Northern Runway whilst active.
Reduced Departure separation (RDS)	×	✓	✓	Without RDS: - Minimum different route consecutive departure separation = 60 seconds - Minimum similar route consecutive departure separation = 106 seconds in 26 direction and 113 in 08). With RDS: - Minimum different route consecutive departure separation = 60 seconds - Minimum similar route consecutive departure separation = 90 seconds.
Sequencing capability	×	×	✓	Fast time simulation does not allow for optimal control of sequencing which the sequencing capability project is set to deliver. The data analytics model is the only model to account for this.
Time based separation (optimised mixed mode & advanced mixed mode)	×	×	×	Any associated performance benefits have not been included in the future performance assumptions. Primary benefit expected to be reliability of performance – peak performance to be sustained across fleet mix and wind conditions. The benefits will be fully quantified once operational.

Rapid exit taxiway (RET)

4.4.4. The first project is the new RET, called Echo Romeo (ER), which will replace the Echo € exit when operating in single runway mode on 26L. When planning arrival gaps on the runway, controllers must make decisions on the size of the gap based on outlier performance rather than average performance, and the typical behaviour of outliers on 26L is that they plan to exit at E (a medium speed exit) but are going slightly too fast, then by the time they can exit at Foxtrot Romeo (FR), a RET 500m further along the runway, they are moving very slowly, and have a very high runway occupancy time which prevents an aircraft behind being given clearance to land or depart. As the next arrival will already be lined up with the runway centreline expecting to land, any significant delay from the previous runway movement is likely to cause the following arrival to perform a 'go around' manoeuvre (safely aborting the landing, which is inefficient and can be alarming to passengers). Air traffic controllers therefore plan arrival spacing as close as is comfortable while being confident that there will be few go arounds. To improve consistency, a rapid exit (ER) is being constructed in the natural position for pilots' braking behaviours, expected to open in early 2024.

4.4.5. The RET project will affect the Future Baseline by making 55 movements/hr achievable under a wider set of conditions, and facilitates delivery of 56 movements if required. In the future baseline, the ability to process 56 movements on the runway is used to increase the resilience of delivering a schedule with hours declared at 55 movements, as whilst 55 movements is declared on a clock hour on/off stand basis, the number of aircraft presenting to the runway exceeds 55 at certain times of day.

4.4.6. In the case of DRO, it is assumed ER cannot be used when both runways are in operation due to the angle it meets the active Northern Runway not providing the correct lines of sight for crossing an active runway. However, when going back to single runway operations on the 26L for any reason, ER will improve the operation by enabling use of a rapid exit taxiway, which improves resilience as the fallback mode will have a higher throughput than it would do if there was no RETs.

Reduced departure separation

4.4.7. The second project will reduce the time between successive departures on similar routes. While flights going in completely different directions after taking off must be separated by at least 60 seconds (unless visual separation can be achieved) and flights following identical routes must be separated by at least 120 seconds, flights following similar but not identical routes have a different separation standard which is based on ensuring the next air traffic controller will easily maintain a horizontal separation of at least 3 nautical miles (this is the minimum separation requirement when only using radar tools for separation). Currently the average performance achieved for consecutive departures on the same and similar routes is 106 seconds when operating on runway 26L and 113 seconds when operating on 08R.

4.4.8. The reduced departure separation project will provide ‘tool support’ for the Tower Controllers in the form of a line on a radar screen. Once the leading aircraft passes the line, the following aircraft can be cleared for departure while safely providing the required space for the next air traffic controller in the process to give them the flexibility they need. As of January 2024, the technical side of the project has been completed and the change will be implemented with all air traffic controllers receiving training in the coming months.

4.4.9. London Gatwick’s Tower controllers currently deliver an average of 20% more distance between similar direction departures than required, but with this tool support expect to achieve consistent performance at just above the requirement (with typical similar direction performance around 90 seconds, vs existing 106 seconds). The impact of this project is included under the future initiative modelling – the benefit will be small on normal days both with and without NRP development, but on challenging days where the airspace or runway sequence is more constrained than normal, the impact is larger, meaning the main benefit is in resilience rather than capacity.

Sequencing capability

4.4.10. The third project will reduce the number of times that London Gatwick needs to send two successive departures in similar directions. Currently, air traffic controllers controlling the runway (in the Air position) make sequencing decisions one or two departures in advance based on what is available at the runway holds, and other air traffic controllers (Ground and Delivery) make and execute a plan to load the runway holds in a way which gives the Air controller enough flexibility to create an efficient sequence.

4.4.11. While runway sequencing for the Air controller is complicated, controllers are exceptionally well trained, and under normal conditions the runway sequences controllers create cannot be made more efficient. However, when conditions are changing or challenging (e.g. local weather changes, or significant restrictions in European airspace that constrain when high volumes of flights can take off), the process can lead to reduced sequencing efficiency because humans cannot process all the information available to them in a short time. DMAN (‘Departure

MANanager') was originally used to send better quality data (than is available from flight plans, the historical data standard) to EUROCONTROL (who coordinate airspace management across Europe). Over the last 12 months (as of January 2024), GAL have worked with NATS, Frequentis, and University of Nottingham to improve DMAN by making it respond more similarly to how a controller would respond if they could process all the information available, and its outputs will be used from early 2024 to assist controllers.

4.4.12. In normal conditions there will be no significant impact to sequence efficiency, but this project will improve resilience when conditions are changing/challenging by assisting in efficient runway sequencing with reasonable fairness between flights. The impact of this project is not included in the AirTOP modelling for any scenarios, but this project supports the argument that human-generated sequences (which will have additional tool support from DMAN) are likely to achieve a better balance of fairness and efficiency than the AirTOP modelling suggests – see section 6 on Optimised Sequencing for further discussion and an upper bound on sequencing efficiency.

5. Fast Time Simulation (FTS) Results

5.1. Introduction

5.1.1. In response to concerns and challenges raised on the modelling assumptions in the NRP DCO application, all simulations have been rerun twice, firstly to demonstrate the capacity under ‘current performance’ parameters (with consecutive departures on similar routes set at a minimum of 106 seconds on 26 direction and 113 seconds on 08 direction), and secondly again to demonstrate the impact of ‘future performance’ initiatives under more conservative performance improvements (with consecutive departures on similar routes set at a minimum of 90 seconds compared to the 60 seconds originally assumed). The future performance scenario should be taken as the lead scenario and the current performance as a sensitivity.

5.1.2. In both current performance and future performance scenarios there is a difference in separation requirements between similar route and different route departures. The difference in separation requirements drives a greater need for sequence optimisation compared to the original modelling undertaken. The requirements for increased sequencing capability led to an increase in the number of aircraft using the Northern runway, in peak periods, to improve the sequencing capability within the simulation. As a result, the Northern Runway was also utilised more heavily outside of the peak periods altering the results across the day from the original assessment.

5.1.3. The scheduled demand for both the baseline and DRO growth scenarios year 2029 and 2038 between 0500 to 2259 are shown in Table 8 for reference.

Table 8. Scheduled demand by hour for all growth scenarios simulated

Growth Scenario	Year	Hour (UTC)																	
		5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Baseline	2029	52	55	53	49	49	55	54	55	55	50	52	51	55	55	46	40	39	27
	2038	53	55	53	49	48	54	55	55	55	50	49	54	55	55	44	43	42	27
DRO	2029	60	58	59	55	55	59	58	57	59	55	58	57	62	58	51	47	42	30
	2038	64	63	69	59	54	58	59	64	68	67	61	62	68	69	58	56	43	32

5.2. Growth Scenarios - Westerly Direction

5.2.1. Table 9 provides the fast time simulation results for both the baseline and dual runway growth scenarios, whilst in 26 runway direction operations. Both growth scenarios are also modelled under current performance parameters and with future performance assumptions based on the initiatives described previously (section 4.4 table 7). Further details of different periods within the day can be found in the appendix.

5.2.2. As a comparison actual data for August 2018 is also provided, where available, and the colours indicate how each growth scenario performs in relation to August 2018. The numbers shown in green indicate a 10% or higher performance improvement compared to 2018, blue indicates similar (between -10% and +10% difference) performance to 2018 and orange indicates a reduced performance by 10% or more in comparison to 2018. Black illustrates where no comparison is available due to lack of actual data.

Table 9. 26 runway direction fast time modelling results for future baseline & dual runway operation

Measure	Category	Type	2018	2029				2038			
			Current performance	Current performance		Future performance		Current performance		Future performance	
			Baseline	Baseline	DRO	Baseline	DRO	Baseline	DRO	Baseline	DRO
Throughput (mph)	Scheduled	Max	55	55	62	55	62	55	69	55	69
	Runway	Sustained Max	55	56	64	56	64	56	70	56	70
Total taxi time (min)	Departures	ave.	19.6	17.2	13.2	17.2	12.8	17.1	15.3	17.2	13.9
		95th Percentile	29.0	26.4	23.7	26.7	21.8	27	30.8	26.7	25.5
	Arrivals	ave.	8.2	8.2	8.8	8.2	8.8	8.6	9.1	8.7	9.0
		95th Percentile	12.0	12.8	12.2	13	12.3	13.3	12.8	13.6	12.9
Departure holding (min)	Stand	ave.	2.1	0.5	0.9	0.5	1.0	0.7	1.2	0.7	1.1
		95th Percentile	11.0	3.7	5.3	3.4	5.4	4.8	6.3	4.6	6.0
	Taxiway	ave.	-	0.2	0.8	0.1	0.8	0.2	0.8	0.2	0.8
		95th Percentile	-	1.2	2.5	0.9	2.2	1.1	3.1	1.2	3.1
	Runway	ave.	9.7	6.3	3.1	6.4	2.7	6.4	5.2	6.4	3.8
		95th Percentile	18.0	14.4	11.9	15.2	9.6	15.5	20.2	15.3	14.4
	Total Holding*	ave.	11.8	7.0	4.8	7.0	4.5	7.2	7.2	7.2	5.7
		95th Percentile	25.0	15.8	14.5	16.3	13.0	17.0	22.4	16.8	17.4
Arrival holding (min)	Taxiway	ave.	-	0.7	0.5	0.7	0.5	0.8	0.6	0.9	0.6
		95th Percentile	-	4.5	3.0	4.6	3.0	4.8	3.3	5.0	3.4
	Airborne	ave.	4.4	3.2	3.3	3.2	3.2	3.0	3.4	3.0	3.4
		95th Percentile	14.1	9.3	8.4	9.5	8.4	8.9	8.3	9.2	8.4

Future Baseline compared to 2018 Baseline

5.2.3. The future baseline, with the new Rapid Exit Taxiway, simulated runway throughput reaching 56 movements per hour in 2038, with a schedule declared at 55. The additional runway capability improves the runway's capability of absorbing the 20 additional flights from the future baseline schedule compared to 2018 whilst not degrading performance.

5.2.4. In all scenarios the average departure taxi time improved compared to August 2018 average and the 95th percental either improved or was similar to 2018. The improvements are mainly driven by the new RET reducing departure holding time. The departure performance improvements compared to 2018 demonstrate the future baseline schedules are deliverable in all cases. The arrival taxi time remains within 10% of the 2018 performance whilst the airborne hold reduced in all scenarios, also demonstrating the scheduled demand is deliverable.

DRO compared to 2018 Baseline

5.2.5. The DRO fast time simulation results confirm the airfield's ability to process 70 movements per hour with the forecasted schedule peaking at 69 movements based on stand time. The simulation results also demonstrate an improvement in total departure and arrival holding compared to August 2018. This is due to the increase in runway capability gained from the Northern runway. Further performance improvements are made through the introduction of the future initiative, reduced departure separation, although the sustained maximum throughput did not increase.

5.2.6. There is a slight increase in arrival taxi time (maximum 0.9 minutes) in certain DRO scenarios, compared to 2018, which is offset by the improvements in airborne holding.

5.2.7. Overall, the results demonstrate the deliverability on the forecasted schedule, whilst also delivering improved performance for passengers.

5.2.8. In the DRO scenario 37% of movements were processed on the Northern Runway reducing the total number of movements the main runway needs to process from 934 in 2018 to approximately 713 in the DRO. The reduction in utilisation of the main runway adds resilience to the operation.

Future Baseline compared to DRO

5.2.9. Transitioning from the single runway, baseline scenario, to dual runway operation, by 2029 the dual runway operation is significantly outperforming the baseline scenario in departure taxi time and overall holding. This is due to the delivered increase in runway capability delivered by the dual runway operation not being fully utilised with the level of demand scheduled. Airborne holding remains similar to the baseline scenario in 2029 and there is a minor increase in arrival taxi time due to the introduction of the runway crossing.

5.2.10. By 2038 the DRO busy day capacity is filled, at this point the DRO is still outperforming the equivalent Baseline scenario in average departure taxi time. The benefits for departure holding are reduced although the future performance initiatives provide a greater benefit in the DRO. In the case of arrivals performance, the Baseline slightly out performs the DRO scenario.

5.2.11. Overall, the simulation results demonstrate the future forecasts are filling the airfield capacity to similar levels by 2038, demonstrating a fair comparison in growth. Prior to the DRO capacity being filled in 2038, the performance improvements would be even greater.

5.2.12. In the DRO scenario 37% of movements were processed on the Northern Runway reducing the total number of movements the main runway needs to process from 954 in the baseline to approximately 713 in the DRO. The reduction in utilisation of the main runway adds resilience to the operation.

5.3. Growth Scenarios - Easterly Direction

5.3.1. Table 10 illustrates the performance of both the baseline and dual runway growth scenarios for 2029 and 2038 in comparison to 2018 performance for 08 runway direction operations. It should be noted that this is not the preferred direction of operation and in August 2019 this was used for only c.19% of flights in August 2018 it was only c.10%. It should also be noted that there were only two days of data available for August 2018 08R operations and the busiest day had 918 movements which is not as high as 26L which peaked at 934 scheduled movements. It is likely that the 2018 taxi time results would be higher than shown in the table at Busy Day levels of demand.

Table 10. 08 runway direction fast time modelling results for future baseline & dual runway operation

Measure	Category	Type	2018	2029				2038			
			Current performance	Current performance		Future performance		Current performance		Future performance	
			Baseline	Baseline	DRO	Baseline	DRO	Baseline	DRO	Baseline	DRO
Throughput (mph)	Scheduled Max		55	55	62	55	62	55	69	55	69
	Runway	Sustained Max	55	55	67	55	67	55	70	55	70
Total taxi time (min)	Departures	ave.	20.2	24.5	20.9	24.4	20.1	24.3	23.4	24.1	21.9
		95th Percentile	28	38.5	29.9	38.4	29.0	38.0	33.2	37.3	30.9
	Arrivals	ave.	5.8	5.0	6.0	5.0	6.0	5.1	6.1	5.0	6.0
		95th Percentile	10.0	8.8	9.9	8.7	10.1	9.4	9.9	9.1	9.7
Departure holding (min)	Stand	ave.	1.6	0.4	1.4	0.4	1.5	0.6	1.6	0.6	1.7
		95th Percentile	9.0	2.9	8.3	2.9	8.4	3.9	7.6	3.8	8.0
	Taxiway	ave.	-	0.5	1.6	0.4	1.4	0.6	1.7	0.6	1.5
		95th Percentile	-	3.3	5.8	3.1	5.3	4.0	6.6	3.7	5.6
	Runway	ave.	-	8.9	3.3	8.8	2.7	8.1	5.7	7.9	4.3
		95th Percentile	-	22.2	10.3	22.3	9.0	21.7	14.4	21.3	11.7
	Total Holding*	ave.	-	9.8	6.4	9.7	5.6	9.3	9.0	9.1	7.5
		95th Percentile	-	23.2	15.7	23.5	14.2	22.8	19.2	22.3	16.8
Arrival holding (min)	Taxiway	ave.	-	0.6	0.7	0.6	0.8	0.8	0.8	0.7	0.7
		95th Percentile	-	4.0	4.1	4.0	4.2	4.7	4.0	4.5	3.8
	Airbourne	ave.	5.3	4.8	4.1	4.9	4.1	4.9	5.4	4.9	5.0
		95th Percentile	16.1	11.6	9.7	11.7	9.7	10.9	12.1	11	11.2

Future Baseline compared to 2018 Baseline

5.3.2. The future baseline scenario in 08R operations exhibited worse departure performance than August 2018 actuals due to the increase in scheduled demand in this scenario, the schedule representing the busy day and the actuals not representing a busy day, as well as there being no new RET to absorb the additional movements in this direction. Arrivals performance remained at a similar level.

DRO compared to 2018 Baseline

5.3.3. The DRO fast time simulation results confirm the airfield's ability to also process 70 ATM/hour from runway 08, when the scheduled demand reaches 69 movements.

5.3.4. In this growth scenario 2029 exhibits similar levels of departure performance to 2018 and small improvements to arrival airborne holding. By 2038 there is a slight increase in departure taxi time compared to 2018. As with the Baseline scenario, this is partially due to the 08 actual data not reflecting a busy day, although it is recognised that sequencing in the 08 direction will require additional planning compared to 26L direction and the simulation software struggled to deliver the optimised sequencing required.

5.3.5. There was no significant change to arrival taxi time or airborne holding compared to 2018.

Future Baseline compared to DRO

5.3.6. Moving from single runway in the future baseline to DRO, the departure performance forecasted improves. Overall departure taxi time is reduced by between 0.9 and 4.3 minutes in DRO compared to the equivalent future baseline scenario.

5.3.7. Arrival taxi time is higher in the DRO due to the runway crossing and changes to taxiway dependencies, although this remains similar to 2018 performance. There is no significant variation in airborne holding.

5.3.8. Overall, these results demonstrate the 08 direction performance is likely to remain equivalent to current performance in DRO when delivering equivalent levels of demand. Whilst the future baseline will likely experience a slightly poorer performance than 2018. In any case 08 isn't expected to be the main direction of operation for the peak period.

6. Optimised Sequencing

6.1.1. Fast time simulation is a useful modelling technique for demonstrating the operational complexity of airfield process and infrastructure changes, but it is not as good at adapting to the inherent variability in presentation of demand when optimising the sequencing of aircraft. As a result, the modelled sequencing is often suboptimal and the resultant holding times are more variable resulting in higher 95th percentile holding times than might be expected in practice.

6.1.2. The reason fast time simulation can struggle with variation in highly complicated environments is that the rules applied by the modeller are unable to accommodate every eventuality which could occur based on the application of randomisation. Additionally, there is very little ability for the simulation to forward plan, to optimise sequencing and runway allocation based on variation in demand.

6.1.3. At most airports this does not have a significant impact– when London Gatwick is using a single runway, the departure sequence can typically be 'first come, first served' without any efficiency loss as long as there is an arrival in between. In the case of London Gatwick's Dual Runway Operation, the runway system becomes more complicated in a way that means the controller's decisions will have a high impact on both fairness and efficiency. The controller is expected to make good sequencing decisions, and they will also have tools to support this from DMAN to ensure consistent good decision-making even in challenging/changing conditions. The ground controller who directs aircraft between the stand and the runway currently has a highly complex task, but this will be made significantly less complex by the addition of the Charlie Box sequencing area, meaning the ground controller does not need to think as strategically about runway sequencing.

6.1.4. Validating an air traffic controller at any specific airport takes months because local rules exist which may be broken/misinterpreted if you try to follow them without appropriate training, and because parts of an air traffic controlling job are complex and the controller needs to develop their own understanding and strategies to deal with local complexity. In all cases, complexity is designed out of the operation when it could be dangerous (e.g. around take-off and landing). In the case of London Gatwick's Dual Runway Operations, the runway controller has more variables to manage but the complexity of managing this is reduced because at any time, the rules exist to make clear what the appropriate and safe decision is. It is simply not possible to properly reflect this within the AirTOP simulation rule base.

6.1.5. In order to better understand what levels of performance might be achieved when sequencing is optimised, a data analytics sequencing exercise has been undertaken in Excel to demonstrate the DRO runway performance under optimised sequencing, whilst applying an upper bound for holding to ensure that no individual flights are significantly disadvantaged when resequencing for optimal throughput. This is reflective of how well controllers will balance runway sequence efficiency and fairness, and this model aligns with all other capacity expectations.

6.1.6. The data analytics sequencing method used replicates all of the rules/constraints of the dual runway system including all departure route constraints, although it does not replicate the full ground operation and expected variation in performance. As such, the data model demonstrates a sequence that is optimised based on the rule set provided. The actual performance of the system is expected to lie between the results from the data analytics model and the fast time simulation model.

6.1.7. Figure 10 is one of the scenarios extracted with the dual runway operations in 2038 with current performance. It compares the result from fast time simulation with the data analytics optimised sequencing model. Assumptions between both models are the same, except the similar route separations are broken down further into different standard instrument departure routes (SID) and same SID instead of using the average performance for similar route.

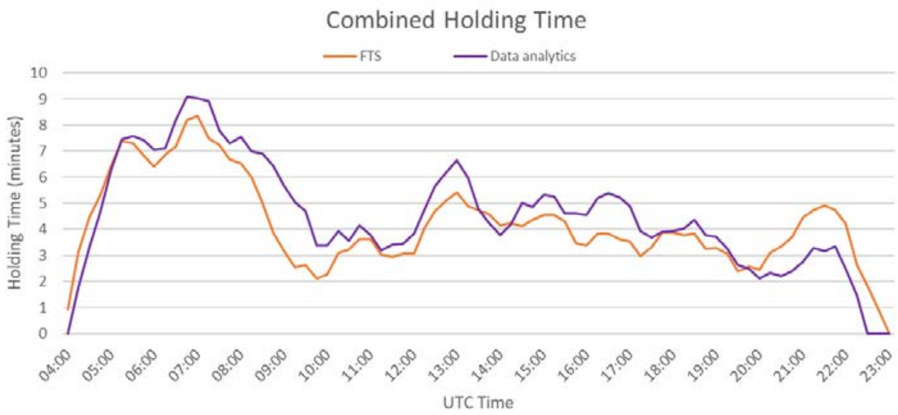


Figure 10. Optimised vs. simulated modelling

6.1.8. The graph shows the average combined (weighted average of arrival and departure) holding time of the fast time simulation and sequencing through data analytics (excel). Throughout the day, the simulation and data analytics result share similar profile with peak holding time between 8.3 to 9 mins at 7am. However, the table below indicates that although the average runway holding time are comparable, the 95th percentile from FTS is relatively high compared to manual sequencing due to the reason stated above. During first wave, the variance between simulation modelling and data analytics model is greater, for instance 14.1 minutes compared to 25.6 minutes. First-wave is usually departure dominant and the impact with FTS sequencing will be more significant. For the rest of the day, when the departures and arrivals demand are more balanced, the gap of 95th percentile between excel and simulation is closer. Overall, for the day, the FTS 95th percentile holding time is higher than the manual sequencing results because of the variance from the first wave.

Table 11. Summary of data analytics vs. simulated holding times

	Runway Holding	**0500 – 0900 UTC**	**1200 – 1600 UTC**	**06:00 - 22:00 UTC**	**24hr**
Data analytics	**ave.**	8.1	6.5	6.0	6.0
	95th Percentile	14.1	11.4	12.4	12.2
Fast time simulation	**ave.**	8.8	5.1	5.0	5.2
	95th Percentile	25.6	18.5	19.5	20.2

7. Performance by time of day – Runway direction 26

7.1.1. The charts in this paper summarise the fast time simulation results for the DRO and Future Baseline scenarios for runway direction 26 compared to August 2018 actuals. Results are presented on an hourly basis, including departures taxi time, departures runway holding time, departures total holding time, arrivals taxi time, arrivals holding time and combined holding time.

7.2. Departure performance by time of day

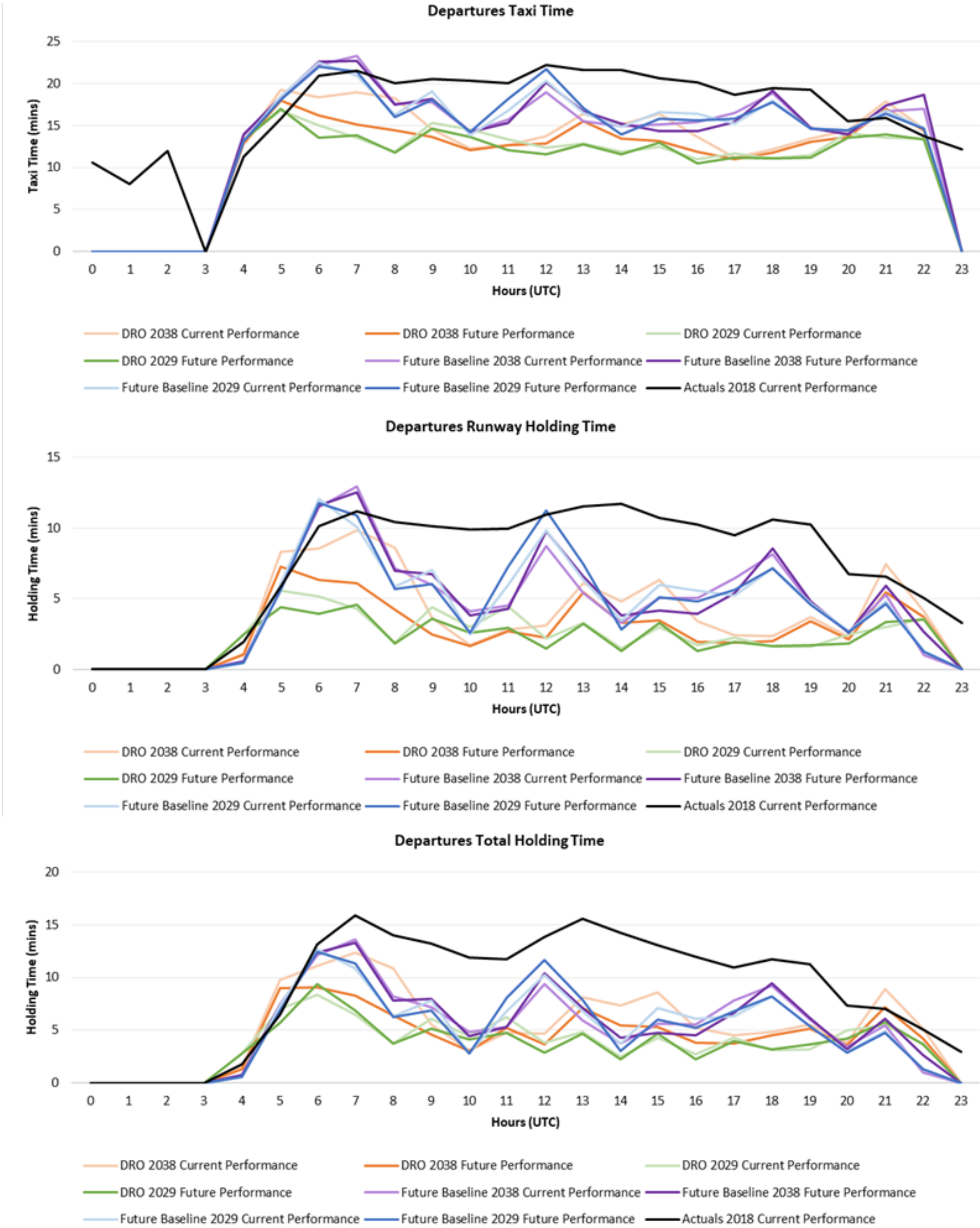


Figure 11. Departure simulation results and August 2018 actual

7.2.1. The departure results in figure 11 illustrate that total holding (holding at the runway + taxiway holding where available + on stand holding) is improved in all growth scenario compared to August 2018. Particular attention should be paid to the improvement in the first wave where the peak is reduced by between 14% and 47% depending on the scenario, with the greatest reductions observed in the DRO 2029 scenarios followed by the DRO 2038 scenarios.

7.2.2. The average departure taxi time for all growth scenarios is less than 25 mins throughout the day. The DRO scenarios demonstrate the best departure performance with average taxi time remaining below 20 minutes throughout the day and the peak is almost 3 minutes lower than August 2018 actuals.

7.2.3. To summarise, the departure taxi time and departure holding time are considered to be within an acceptable range and this aligns with the planning standard for capacity declaration.

7.3. Arrival performance by time of day

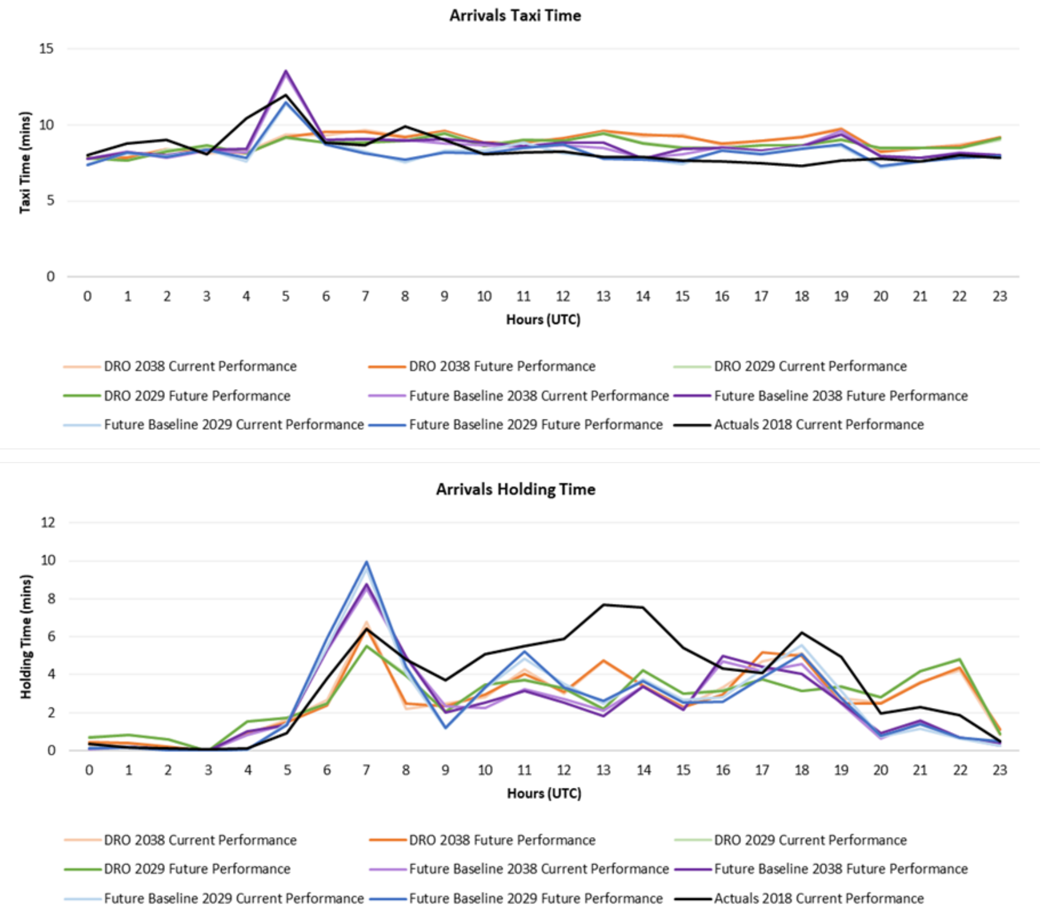


Figure 12. Simulated arrival taxi and holding time compared to August 2018 actual data

7.3.1. As illustrated in figure 12, the arrival taxi time is relatively stable across the day with the exception of 0400 & 0500 in the actuals and 0500 in the future baseline scenarios. At this time there are only a small number of wide body arrivals which often conflict with departing aircraft. In DRO, Lima extension and Pier 7 supports with deconflicting the arrivals from departures taxiing reducing this peak.

7.3.2. The average arrival holding time remains below 10 minutes in all scenarios. In August 2018 actual data the holding times remain artificially low in the 0700 hour due to delays at origin. In the future scenarios arrivals present around their scheduled time of arrival, as a result the future baseline arrival holding peaks in excess of the August 2018 results in 0700 hour, although still within 10 minutes. The DRO scenario reduces the 0700 arrival holding peak due to the increase in availability of the main runway as narrow body aircraft depart on the Northern runway.

7.4. Overall performance by time of day

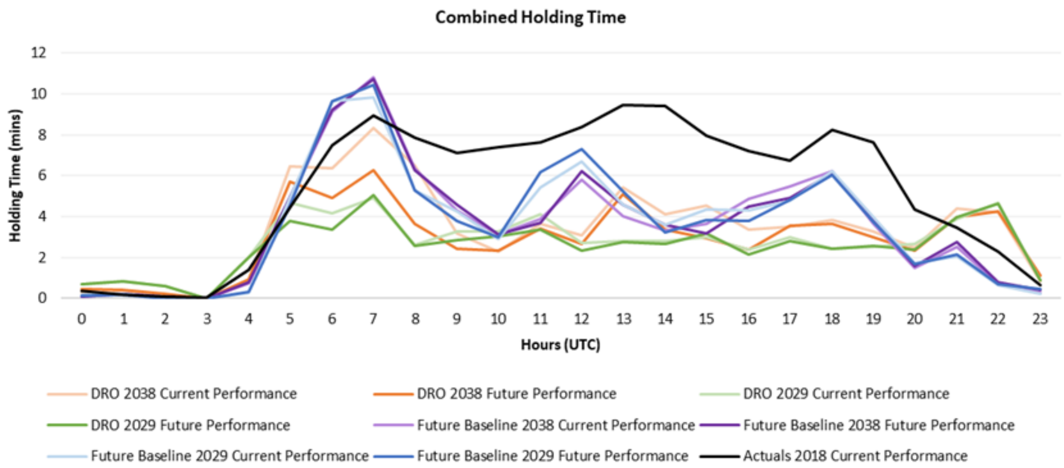


Figure 13. Simulated combined departure and arrival holding time compared to August 2018 actual

7.4.1. The combined holding time chart illustrates the benefits with DRO as it has lower combined holding time compared to 2018 actuals throughout the day. To define, the combined holding time is the holding time considered both departures and arrivals based on the weighting of the mixture of the movement.

7.4.2. In 2018, the combined holding time sustained between 7-9 mins during 0600-1900 in which with DRO, it trends between 2-6 mins and 1st wave peaks at 8 mins. Thus, the modelling result shows improvement with the DRO.

7.4.3. Overall, the combined holding times are below 10 mins for all scenarios, except for the Future Baseline scenario which peaks at 10.8 mins at 0700 only, for the rest of the day this is aligned with London Gatwick's planning standard.

7.5. FTS results broken down into time buckets

7.5.1. The results tables in this section provide the August 2018 actual performance and the 2038 FTS results for each scenario divided into time buckets, as requested during the consultation by York Aviation. The numbers shown in green indicate a 10% or higher performance improvement compared to 2018, blue indicates similar (between -10% and +10% difference) performance to 2018 and orange indicates a reduced performance by 10% or more in comparison to 2018. Black illustrates where no comparison is available due to lack of actual data.

Table 12. Detailed 26L 2018 actual performance

Measure	Category	Type	Busy Day				August 26L			
			0500 – 0900 UTC	1200 – 1600 UTC	06:00 - 22:00 UTC	24hr	0500 – 0900 UTC	1200 – 1600 UTC	06:00 - 22:00 UTC	24hr
Total taxi time (min)	Departures	ave.	19.7	23.6	21.6	20.9	19.5	21.6	20.1	19.6
		95th Percentile	27.4	31.0	31.0	31.0	29.0	31.0	30.0	29.0
	Arrivals	ave.	9.1	7.7	7.8	8.0	9.6	7.9	8.1	8.2
		95th Percentile	13.8	10.0	11.0	11.0	17.0	11.0	12.0	12.0
Departure holding (min)	Stand	ave.	1.9	5.2	2.5	2.3	2.7	2.9	2.2	2.1
		95th Percentile	8.0	12.0	10.0	9.6	13.0	12.0	11.0	11.0
	Taxiway	ave.	-	-	-	-	-	-	-	-
		95th Percentile	-	-	-	-	-	-	-	-
	Runway	ave.	9.4	12.8	11.4	10.6	9.2	11.2	10.2	9.7
		95th Percentile	15.9	18.7	18.8	18.7	17.1	19.0	18.2	18.0
	Total Holding*	ave.	11.2	18.3	14.0	12.9	12.0	14.2	12.5	11.8
		95th Percentile	21.6	26.3	25.3	25.0	26.0	27.5	25.4	25.0
Arrival holding (min)	Taxiway	ave.	-	-	-	-	-	-	-	-
		95th Percentile	-	-	-	-	-	-	-	-
	Airbourne	ave.	2.2	8.9	6.3	5.3	4.4	6.7	5.1	4.4
		95th Percentile	5.8	14.5	14.1	13.8	12.9	17.1	14.8	14.1

7.5.2. Table 13 shows the 2038 baseline FTS results when operating on 26L using current performance parameters. The results in this table demonstrate that departure taxi time has improved across the majority of the day due to the increase in throughput capability from the new rapid exit taxiway. In the first wave (0500-0900 UTC) performance is similar to 2018 other than an increase in airborne holding.

Table 13. 2038 Future Baseline simulation result for 26 Direction (Current Performance)

Measure	Category	Type	2038 Baseline on 26L Current performance			
			0500-0900 UTC	1200-1600 UTC	0600-2200 UTC	24 hrs
Total taxi time (min)	Departures	ave.	20.0	16.2	17.2	17.1
		95th Percentile	29.8	24.3	27.0	27.0
	Arrivals	ave.	9.6	8.2	8.5	8.6
		95th Percentile	15.3	12.2	13.0	13.3
Departure holding (min)	Stand	ave.	0.7	0.5	0.7	0.7
		95th Percentile	4.9	4.0	4.7	4.8
	Taxiway	ave.	0.3	0.1	0.1	0.2
		95th Percentile	2.1	0.5	0.8	1.1
	Runway	ave.	9.0	5.7	6.6	6.4
		95th Percentile	18.7	12.4	15.8	15.5
	Total Holding*	ave.	10.0	6.2	7.3	7.2
		95th Percentile	19.6	13.5	17.3	17.0
Arrival holding (min)	Taxiway	ave.	1.5	0.6	0.9	0.8
		95th Percentile	6.6	4.0	4.7	4.8
	Airbourne	ave.	5.7	2.6	3.4	3.0
		95th Percentile	12.2	6.5	9.2	8.9

7.5.3. Table 14 shows the 2038 baseline FTS results when operating on 26L using future performance parameters. The results in this table demonstrate that the impact of the future performance initiatives are minimal on the busy day when in dual runway operations as the main benefits are resilience.

Table 14. 2038 Future Baseline simulation result for 26 Direction (Future Performance)

Measure	Category	Type	2038 Baseline on 26L Future performance			
			0500-0900 UTC	1200-1600 UTC	0600-2200 UTC	24 hrs
Total taxi time (min)	Departures	ave.	20	16.6	17.2	17.2
		95th Percentile	29.5	25.5	27	26.7
	Arrivals	ave.	9.5	8.4	8.6	8.7
		95th Percentile	15.4	12.9	13.2	13.6
Departure holding (min)	Stand	ave.	0.7	0.4	0.6	0.7
		95th Percentile	4.5	3.4	4.6	4.6
	Taxiway	ave.	0.3	0.1	0.1	0.2
		95th Percentile	2.3	0.5	0.9	1.2
	Runway	ave.	8.9	6.2	6.6	6.4
		95th Percentile	18.1	13.8	15.6	15.3
	Total Holding*	ave.	9.9	6.7	7.3	7.2
		95th Percentile	19.2	14.7	17	16.8
Arrival holding (min)	Taxiway	ave.	1.5	0.8	0.9	0.9
		95th Percentile	6.4	4.8	4.9	5.0
	Airbourne	ave.	5.8	2.5	3.4	3.0
		95th Percentile	12.6	6.8	9.5	9.2

7.5.4. Table 15 shows the 2038 dual runway FTS results when operating on 26 using current performance parameters. The results in this table demonstrate there is an improvement in departure taxi time and holding across the full day. In the first wave the difference is less than 10% although there is still a 48 seconds decrease in average departure taxi time and 1.1 minute decrease in total holding time from departures when compare to August 2018. In regards to the 95th percentile results, further information can be found on the performance of the simulation compared to expected performance in section 6. There is an increase in arrival taxi-time due to the runway crossing although the impact of this to airlines is offset by the improvements in airborne holding.

Table 15. 2038 Dual runway operations FTS result for 26 Direction (Current Performance)

Measure	Category	Type	2038 DRO on 26 Current performance			
			0500-0900 UTC	1200-1600 UTC	0600-2200 UTC	24 hrs
Total taxi time (min)	Departures	ave.	18.7	15.4	15.1	15.3
		95th Percentile	35.5	30.8	30.3	30.8
	Arrivals	ave.	9.5	9.3	9.1	9.1
		95th Percentile	14.1	12.8	13.0	12.8
Departure holding (min)	Stand	ave.	1.3	1.2	1.2	1.2
		95th Percentile	6.7	7.1	6.7	6.3
	Taxiway	ave.	0.8	0.9	0.9	0.8
		95th Percentile	3.1	3.4	3.2	3.1
	Runway	ave.	8.8	5.1	5.0	5.2
		95th Percentile	25.6	18.5	19.5	20.2
	Total Holding*	ave.	10.9	7.2	7.1	7.2
		95th Percentile	27.9	21.8	22.1	22.4
Arrival holding (min)	Taxiway	ave.	0.9	0.6	0.6	0.6
		95th Percentile	4.0	3.4	3.4	3.3
	Airbourne	ave.	3.8	3.4	3.7	3.4
		95th Percentile	10.2	7.7	8.4	8.3

7.5.5. Table 16 shows the 2038 dual runway FTS results when operating on 26 using future performance parameters. This is the lead scenario for dual runway operation performance. The results demonstrate an improved departure performance across the day by the reduction in average departure taxi time and runway holding. The increase in arrival taxi-time is still illustrated although the decrease in airborne holding again offsets this increase.

7.5.6. The results demonstrate the future performance parameters provide a further benefit to the dual runway operation. As departures are more frequent the benefits of the reduce depart separation are higher.

Table 16. 2038 Dual runway operations FTS result for 26 Direction (Future Performance)

Measure	Category	Type	2038 DRO on 26 Future performance			
			0500-0900 UTC	1200-1600 UTC	0600-2200 UTC	24 hrs
Total taxi time (min)	Departures	ave.	16.0	13.8	13.5	13.9
		95th Percentile	29.2	25.8	24.5	25.5
	Arrivals	ave.	9.4	9.3	9.1	9.0
		95th Percentile	13.5	13.0	13.0	12.9
Departure holding (min)	Stand	ave.	1.3	1.0	1.2	1.1
		95th Percentile	6.4	5.7	6.3	6.0
	Taxiway	ave.	0.8	0.8	0.8	0.8
		95th Percentile	3.0	3.2	3.2	3.1
	Runway	ave.	6.1	3.6	3.5	3.8
		95th Percentile	19.3	14.1	13.2	14.4
	Total Holding*	ave.	8.2	5.4	5.5	5.7
		95th Percentile	22.5	16.5	16.3	17.4
Arrival holding (min)	Taxiway	ave.	0.8	0.7	0.6	0.6
		95th Percentile	3.7	3.5	3.5	3.4
	Airbourne	ave.	3.7	3.4	3.6	3.4
		95th Percentile	9.8	7.5	8.5	8.4

8. Summary

8.1.1. The performance in 2018 has demonstrated GAL's ability to consistently deliver 55 movements per hour when required. The baseline forecast for the future years remains limited to 55 scheduled movements in an hour although the 26L runway throughput delivered is expected to increase to 56, due to the benefit of the new rapid exit taxiway (Echo Romeo). In the baseline forecast the additional capability is used for resilience rather than capacity release. The growth on the busy day is forecasted to increase the total demand from 934 movements in 2018 to 950 in 2029 and 954 in 2038.

8.1.2. In the DRO scenario the airfield capacity assessment demonstrated the airfield's ability to deliver 70 movements per hour when the forecast reaches a maximum of 69 movements scheduled in a clock hour. The DRO busy day capacity is forecast to be fully utilised by 2038, delivering an increase in busy day ATMs of 198, from 934 in 2018 to 1132 in 2038, while modelled holding times are maintained at or below current levels. Leading up to the point the capacity is filled, there are significant performance benefits as demonstrated by modelling results for 2029.

8.1.3. In response to concerns and challenges raised on the modelling assumptions in the NRP DCO application, the modelling has been undertaken both with current performance parameters and the future initiatives. The future initiative scenario remains as the lead scenarios, the current performance scenario is provided for reference.

8.1.4. Under both the current and future performance scenarios, the dual runway operation delivers a runway throughput of 70 per hour with the expected traffic mix and concept of operation. The proposed schedule is limited to 69 declared movements in a clock hour keeping within the 70 movement capability. In 26 direction runway operation the DRO capability leads to improvements in average departure taxi time and holding, and airborne holding compared to 2018. Whilst arrival taxi time remains similar to 2018.

8.1.5. The manual sequencing results demonstrate the impact that optimised sequencing can have on balancing holding time fairly between aircraft. It is expected that air traffic control will optimise sequencing to minimise the average holding time whilst also not allowing certain aircraft to hold for an unacceptable level of time representing an improvement over the FTS results.

8.1.6. The FTS results across the day demonstrate there are performance improvements throughout the day including in the first wave.