WINTER 2019: ASSESSMENT OF THE LIKELY IMPACT OF DECLARING THE WISHLIST RUNWAY CAPACITY

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Results of assessment of impact on following metrics:

- Departure taxi out time,

- Departure runway holding delay,

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Findings.

CONTEXT

- The Commission for Aviation Regulation (CAR) is responsible for determining parameters for slot allocation at Dublin Airport.

- To ensure that optimal parameters are set, the Commission has instructed Helios to undertake airfield fast time simulations in preparation for the W19 season at Dublin airport.

- The draft version of this document provided results from two simulated scenarios:

  - W19 flight schedule coordinated by the proposed W19 Wishlist limits and,

  - W19 flight schedule coordinated by the existing W18 limits.

- Following the Coordination Committee pre-meeting, this document was updated with assessment of additional two scenarios proposed by a Coordination Committee member:

  - W19 flight schedule coordinated by the Option 1 limits, and

  - W19 flight schedule coordinated by the Option 2 limits.

- This document also includes the results of the model calibration activities distributed to Coordination Committee members in February 2019.
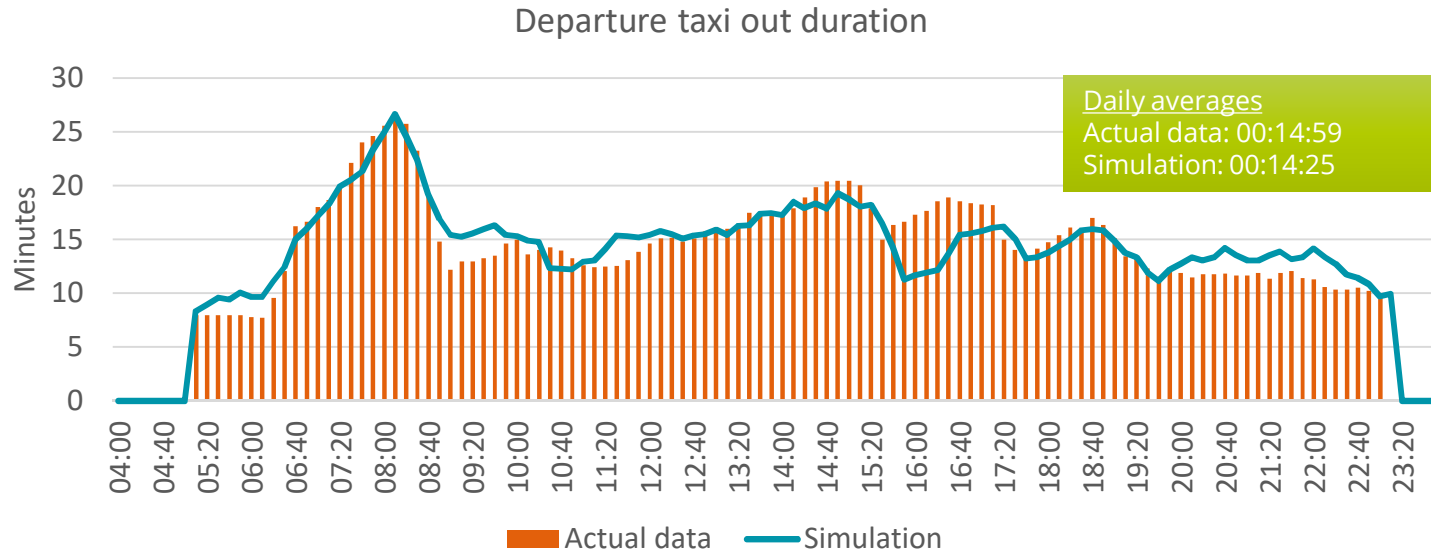
MODEL VALIDATION

MODEL DESCRIPTION

- Based on the model developed in support of coordination of the previous seasons.

- Historically validated against selected S16, S17, W17 and S18 design days.

- Calibrated again, against a single day of W18 operations (30 Nov 2018).

- Run from actual times to take into account all types of delays.

- Comparison against a set of airside metrics provided.

DESIGN DAY SIMULATED (30 NOVEMBER 2018)

- RWY 28 in operations for 100% of the time

- 649 flights total, incl. GA and cargo

  - 323 arrivals and 326 departures,

 - 2 helicopter operations not simulated.

CALIBRATION OF DEPARTURE PERFORMANCE

Departure taxi out duration

Daily averages
Actual data: 00:14:59
Simulation: 00:14:25

Legend: Actual data, Simulation

Metric definition:

Time duration between the off-block time and aircraft lifting off

*This graph is presented as a rolling 10-minute average (value for each time period has been calculated as average of values of all events occurring within the T-10 minutes window from the point of the measurement).

Off-block count

Legend: Actual data, Simulation
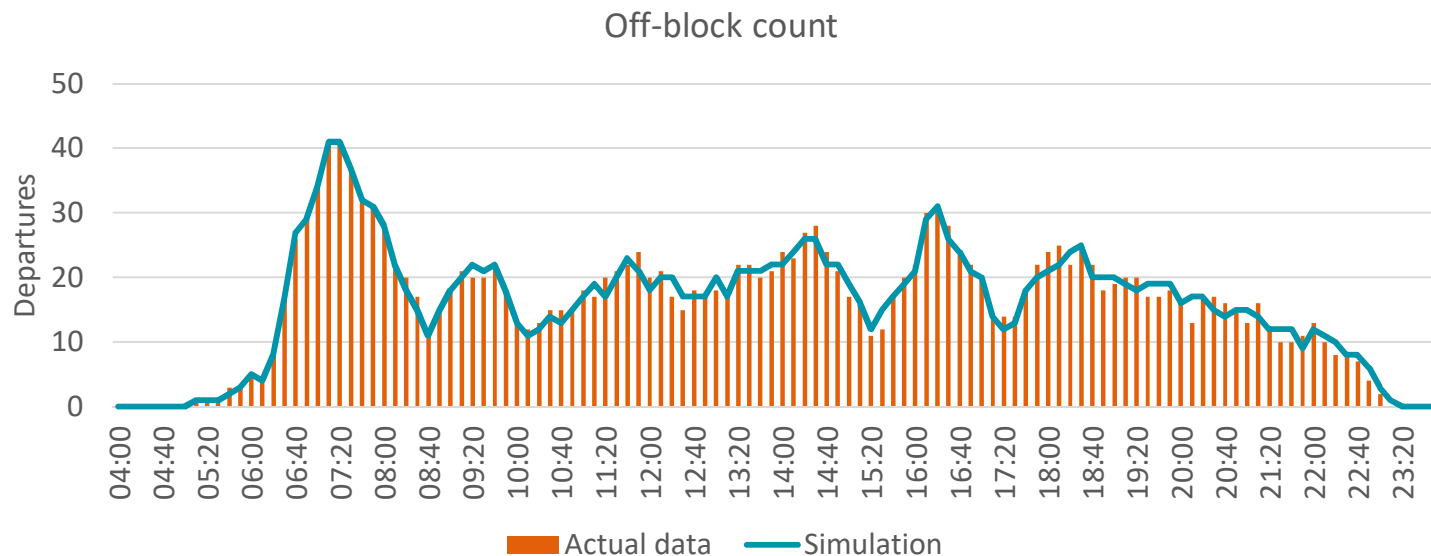
Metric definition:

The number of aircraft that have been pushed back in the last rolling period. The count is incremented when the Aircraft leaves its departure parking position (either being pushed back at gate or taxiing / pulled away from a parking position)

* This graph is presented as a rolling 10-minute average (value for each time period has been calculated as average of values of all events occurring within the T-10 minutes window from the point of the measurement).

CALIBRATION OF ARRIVAL PERFORMANCE

Arrival taxi in duration

Daily averages
Actual data: 00:07:13
Simulation: 00:06:29

- Actual data
- Simulation

Metric definition:

Time duration between touch-down and aircraft parking on-blocks

*This graph is presented as a rolling 10-minute average (value for each time period has been calculated as average of values of all events occurring within the T-10 minutes window from the point of the measurement).
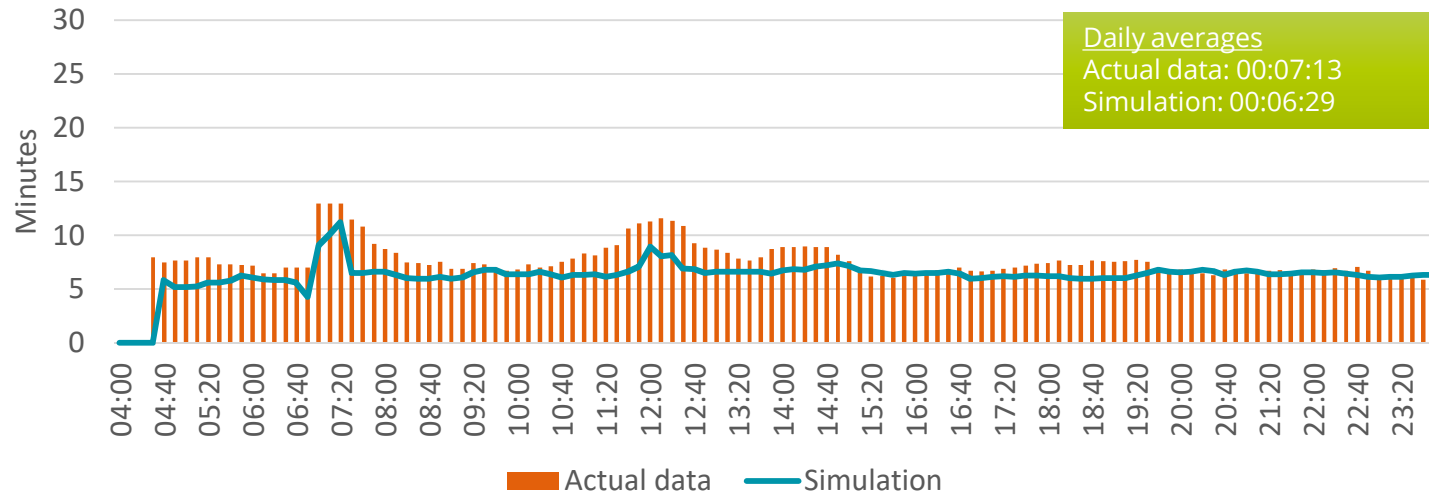
In-block count

- Actual data
- Simulation
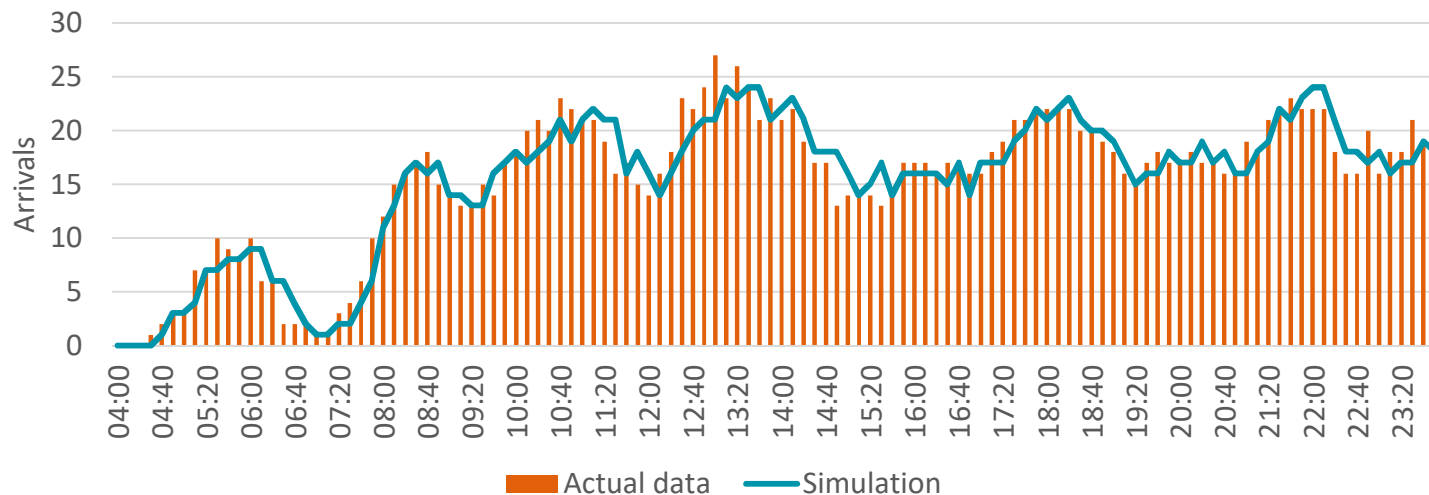
Metric definition:

The number of aircraft that have reached their arrival parking position in the last rolling period. The count is incremented when aircraft reaches its in-blocks position.

* This graph is presented as a rolling 10-minute average (value for each time period has been calculated as average of values of all events occurring within the T-10 minutes window from the point of the measurement).
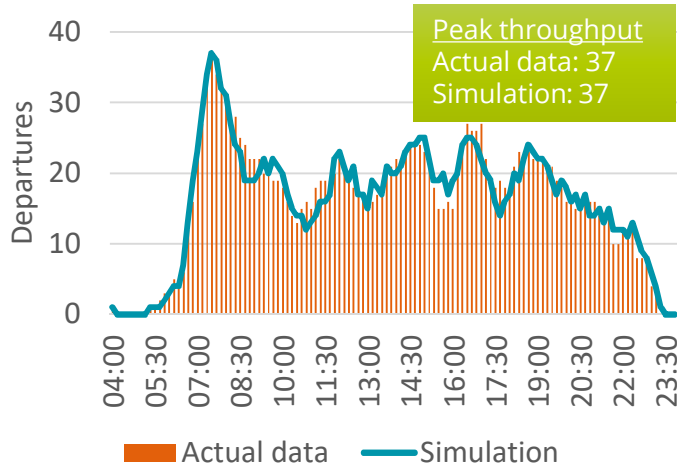
CALIBRATION OF RUNWAY PERFORMANCE

Lift-off count

Peak throughput
Actual data: 37
Simulation: 37

Touch-down count

Peak throughput
Actual data: 25
Simulation: 24

Runway throughput (A+D)

Peak throughput
Actual data: 45
Simulation: 44
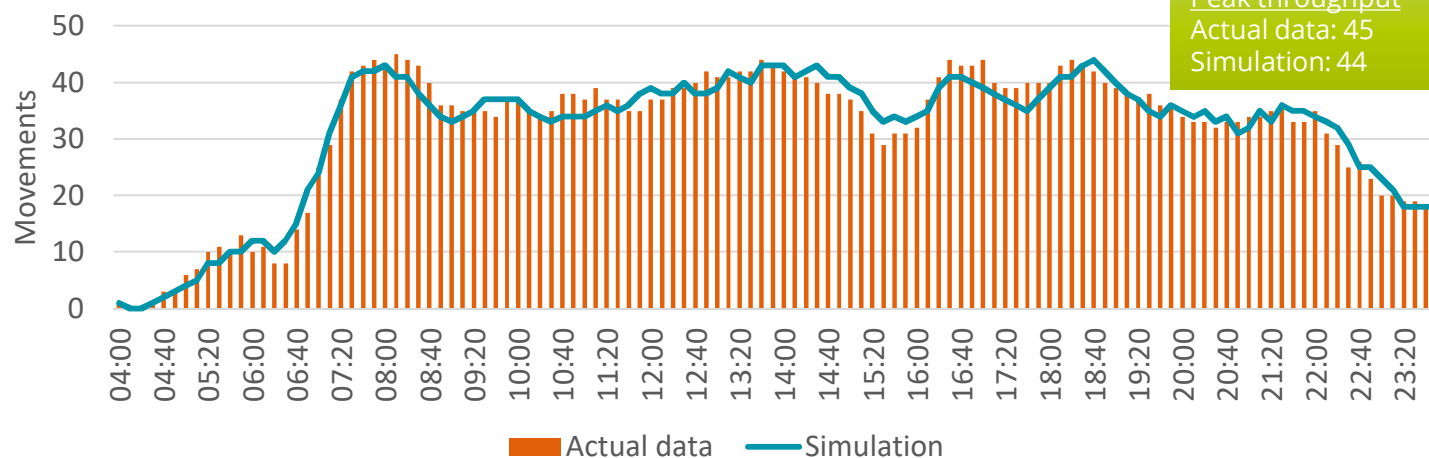
Metric definition:

Lift-off count: The number of aircraft that have lifted off in the last rolling period. The count is incremented when the aircraft passes over the opposite end of runway.

Touch-down count: The number of aircraft that have touched down in the last rolling period.

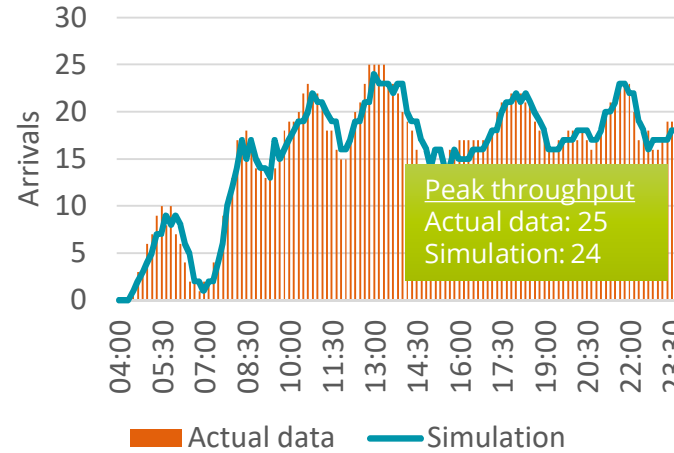Runway throughput: Sum of all aircraft touching down and lifting-off in the last rolling period.

* All graphs are presented as a rolling 60-minute average (value for each time period has been calculated as average of values of all events occurring within the T-60 minutes window from the point of the measurement).

RESULT OF MODEL VALIDATION EXERCISE

- As the metrics calculated through the FTS model closely match the real-world data, both in terms of the magnitude and the shape of profile throughout the day, the model can be considered as a satisfactorily representation of reality for the purpose of evaluating the impact of proposed changes in flight schedules.

- The model is considered to be valid if it is a sufficiently accurate representation of the corresponding real-world problem from the perspective of the intended uses of the model. "Valid" for a simulation does not mean the same as "indistinguishable from the real-world system", even though in this case there is a close match.

W19 - METHODOLOGY

TASK DESCRIPTION

- The purpose of this comparison is to assess the likely effect of either:

  - declaring an increased runway capacity, as per either of the wishlists proposed, or

  - maintaining the Winter 2018 capacity declaration limits.

- In both cases it is presumed that the Winter 2019 schedule of increased demand materialises as expected.

- The same number of movements are modelled in both cases, the difference being the limits to which they are coordinated. This difference is therefore a best current information estimate of the effect of a decision to increase the runway limits on a busy Winter 2019 day.

APPROACH AND KEY CHANGES IN THE MODEL

Data collection

Helios → Consultation → daa, IAA, Airlines

Helios ← Data provision ← daa, IAA, Airlines

↓

Update of existing model with new data and assumptions

↓

Fast time simulations

| W19 flight schedule coordinated by Wishlist W19 declaration | W19 flight schedule coordinated by existing W18 declaration |

↓

Results reviewed by the CC — Feedback received →

↓

Help inform CAR decision

- Runway occupancy times have been updated taking into account Winter 2018 averages to-date.

- Rule-based stand allocation driven by historic data
  - Towing implemented to manage demand for Code E stands

- Changes to the layout of the West Apron

- No changes to operating procedures
  - Departure-departure separation kept at minimum of 84 seconds
  - Arrival-arrival separation kept at minimum of 3.5 NM
  - A-D-A separation kept at 5.5 NM

- No A-CDM assumptions have been included

WINTER 2019 FLIGHT SCHEDULE

- The flight schedule used for modelling of both scenarios:

  - Is based on 30th of November 2018 flight schedule (which was already a busy day before the new services were added)

  - Contains total of 671 flights (330 arrivals and 341 departures)

ADDITIONAL SCENARIOS CONSIDERED

Following the Coordination Committee meeting on 20 March 2019:

- the CAR asked Helios to model three additional scenarios based on suggestions made by the Coordination Committee members:

  - Option 1 Wishlist,

  - Option 2 Wishlist and

  - "All new W19 services removed*"

- Assessment of the Option 1 and Option 2 is provided at the end of this document.

- "All new W19 services removed" scenario is included in all scenario comparison charts as a reference to the current W18 performance.

* This scenario contains only existing W18 services. All new services proposed for W19 were removed from this scenario.

ASSESSMENT OF THE ORIGINAL WISHLIST AS PROPOSED BY DAA

PROPOSED W19 WISHLIST DECLARATION

Hour UTC	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total
Arrivals																									
Existing W18 arrivals capacity	23	23	23	23	23	23	23	21	25	24	23	28	26	24	24	23	24	24	24	23	24	25	29	23	**575**
Proposed W19 arrivals capacity	23	23	23	23	23	23	23	21	24	25	23	26	28	24	24	23	24	24	24	23	24	25	29	23	**575**
Difference (against W18 declaration)	0	0	0	0	0	0	0	0	-1	+1	0	-2	+2	0	0	0	0	0	0	0	0	0	0	0	**0**
Departures																									
Existing W18 departures capacity	23	23	23	23	23	25	35	30	23	25	24	26	28	27	24	27	25	27	26	24	24	23	23	23	**604**
Proposed W19 departures capacity	23	23	23	23	23	25	35	31	23	25	24	26	28	27	24	27	26	27	26	24	24	23	23	23	**606**
Difference (against W18 declaration)	0	0	0	0	0	0	0	+1	0	0	0	0	0	0	0	0	+1	0	0	0	0	0	0	0	**+2**
Totals																									
Existing W18 totals capacity	32	32	32	32	32	32	40	39	44	42	40	48	46	43	40	43	46	46	43	38	39	39	39	32	**939**
Proposed W19 totals capacity	32	32	32	32	32	32	40	40	43	43	41	46	48	43	40	43	46	47	43	38	39	39	39	32	**942**
Difference (against W18 declaration)	0	0	0	0	0	0	0	+1	-1	+1	+1	-2	+2	0	0	0	0	+1	0	0	0	0	0	0	**+3**

W19 COORDINATED TO PROPOSED W19 LIMITS

Hour UTC	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total
Arrivals																									
Wishlist W19 arrivals capacity	23	23	23	23	23	23	23	21	24	25	23	26	28	24	24	23	24	24	24	23	24	25	29	23	**575**
Arrivals in simulated W19 schedule	2	0	0	0	3	9	2	9	20	25	18	18	28	16	17	14	20	20	21	12	21	22	19	14	**330**
Historic	2	0	0	0	3	8	2	9	14	21	18	18	26	16	17	14	19	15	20	12	20	21	19	13	307
Additional arrivals proposed for W19	0	0	0	0	0	1	0	0	6	4	0	0	2	0	0	0	1	5	1	0	1	1	0	1	23
Spare capacity (against W19 wishlist)	21	23	23	23	20	14	21	12	4	0	5	8	0	8	7	9	4	4	3	11	3	3	10	9	**245**
Departures																									
Wishlist W19 Departures capacity	23	23	23	23	23	25	35	31	23	25	24	26	28	27	24	27	26	27	26	24	24	23	23	23	**606**
Departures in simulated W19 schedule	0	1	1	0	0	6	34	31	16	18	23	20	20	22	16	22	26	27	19	19	11	7	2	0	**341**
Historic	0	1	1	0	0	6	31	27	15	12	19	20	18	22	14	22	21	22	18	19	10	6	2	0	306
Additional departures proposed for W19	0	0	0	0	0	0	3	4	1	6	4	0	2	0	2	0	5	5	1	0	1	1	0	0	35
Spare capacity (against W19 wishlist)	23	22	22	23	23	19	1	0	7	7	1	6	8	5	8	5	0	0	7	5	13	16	21	23	**265**
Totals																									
Wishlist W19 Totals capacity	32	32	32	32	32	32	40	40	43	43	41	46	48	43	40	43	46	47	43	38	39	39	39	32	**942**
Totals in simulated W19 schedule	2	1	1	0	3	15	36	40	36	43	41	38	48	38	33	36	46	47	40	31	32	29	21	14	**671**
Historic	2	1	1	0	3	14	33	36	29	33	37	38	44	38	31	36	40	37	38	31	30	27	21	13	613
Additional movements proposed for W19	0	0	0	0	0	1	3	4	7	10	4	0	4	0	2	0	6	10	2	0	2	2	0	1	58
Spare capacity (against W19 wishlist)	30	31	31	32	29	17	4	0	7	0	0	8	0	5	7	7	0	0	3	7	7	10	18	18	**271**

Source: W19 Wishlist based on airline submissions

W19 COORDINATED TO W18 LIMITS

Hour UTC	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total
Arrivals																									
Existing W18 arrivals capacity	23	23	23	23	23	23	23	21	25	24	23	28	26	24	24	23	24	24	24	23	24	25	29	23	**575**
Arrivals in simulated W19 schedule	2	0	0	0	3	9	2	9	21	24	18	20	26	16	17	14	20	20	21	12	21	22	19	14	**330**
Historic	2	0	0	0	3	8	2	9	14	21	18	18	26	16	17	14	19	15	20	12	20	21	19	13	307
Additional arrivals proposed for W19	0	0	0	0	0	1	0	0	7	3	0	2	0	0	0	0	1	5	1	0	1	1	0	1	23
Spare capacity (against W18 declaration	21	23	23	23	20	14	21	12	4	0	5	8	0	8	7	9	4	4	3	11	3	3	10	9	**245**
Departures																									
Existing W18 departures capacity	23	23	23	23	23	25	35	30	23	25	24	26	28	27	24	27	25	27	26	24	24	23	23	23	**604**
Departures in simulated W19 schedule	0	1	1	0	0	6	35	30	16	18	22	21	20	22	16	22	25	26	21	19	11	7	2	0	**341**
Historic	0	1	1	0	0	6	31	27	15	12	20	19	18	22	14	22	21	22	18	19	10	6	2	0	306
Additional departures proposed for W19	0	0	0	0	0	0	4	3	1	6	2	2	2	0	2	0	4	4	3	0	1	1	0	0	35
Spare capacity (against W18 declaration	23	22	22	23	23	19	0	0	7	7	2	5	8	5	8	5	0	1	5	5	13	16	21	23	**263**
Totals																									
Existing W18 totals capacity	32	32	32	32	32	32	40	39	44	42	40	48	46	43	40	43	46	46	43	38	39	39	39	32	**939**
Totals in simulated W19 schedule	2	1	1	0	3	15	37	39	37	42	40	41	46	38	33	36	45	46	42	31	32	29	21	14	**671**
Historic	2	1	1	0	3	14	33	36	29	33	38	37	44	38	31	36	40	37	38	31	30	27	21	13	613
Additional movements proposed for W19	0	0	0	0	0	1	4	3	8	9	2	4	2	0	2	0	5	9	4	0	2	2	0	1	58
Spare capacity (against W18 declaration	30	31	31	32	29	17	3	0	7	0	0	7	0	5	7	7	1	0	1	7	7	10	18	18	**268**

Source: W19 Wishlist based on airline submissions

DIFFERENCE BETWEEN EXISTING W18 AND PROPOSED W19 CAPACITY DECLARATION

COORDINATING THE SCHEDULE TO THE W18 LIMITS RESULTS IN FLIGHT TIME CHANGES

Arrivals

* Only new services have been coordinated

1 ARR at 0900 moved to 0850 UTC

2 ARRs from 1210 moved to 1150 UTC
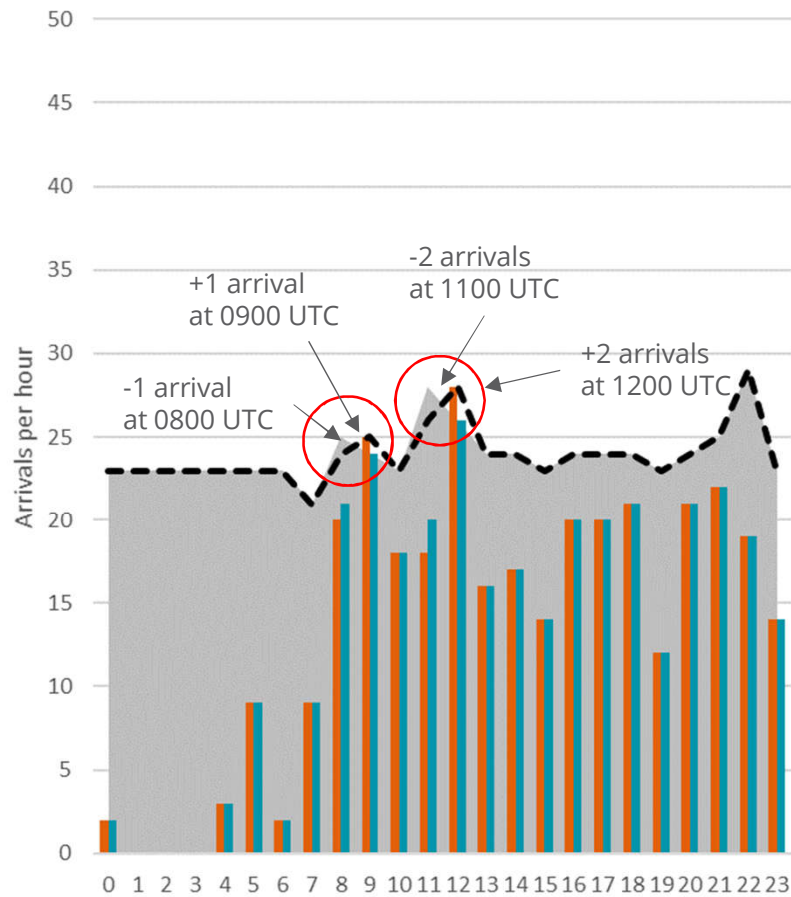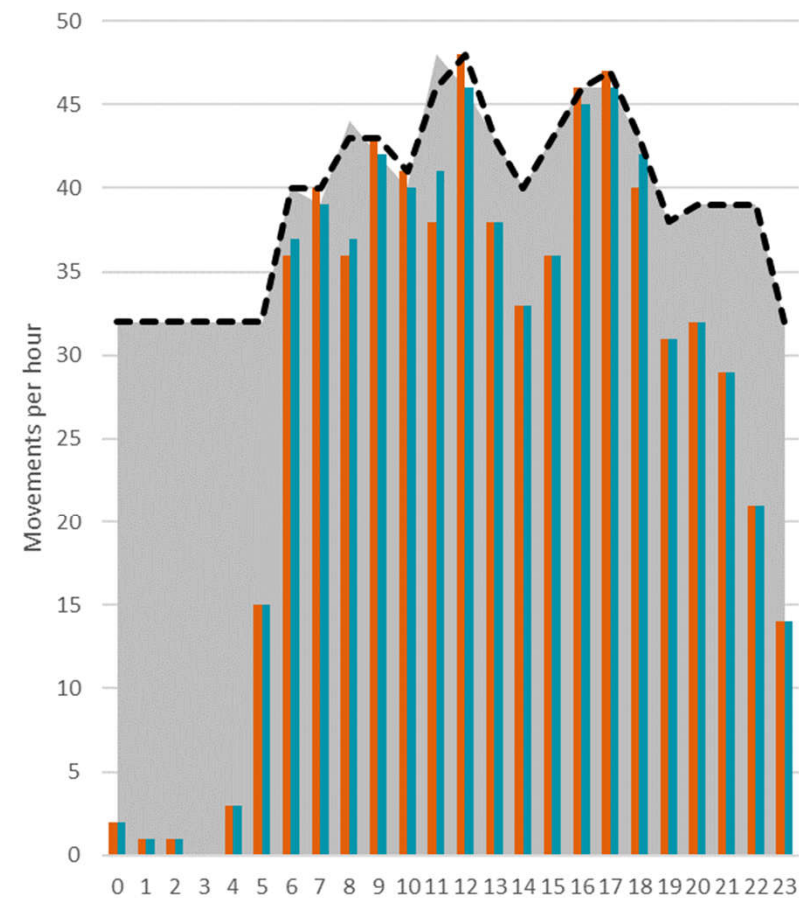
- Declared arrivals capacity (W18)
- Arrivals in simulated W19 flight schedule (W19 limits)
- Arrivals in simulated W19 flight schedule (W18 limits)
- Wishlist arrivals capacity (W19)

Departures

* Only new services have been coordinated

1 DEP at 0740 UTC moved to 0650 UTC

1 DEP at 1040 moved to 1140 UTC

DEPs at 1650 and 1740 UTC moved to 1800 UTC
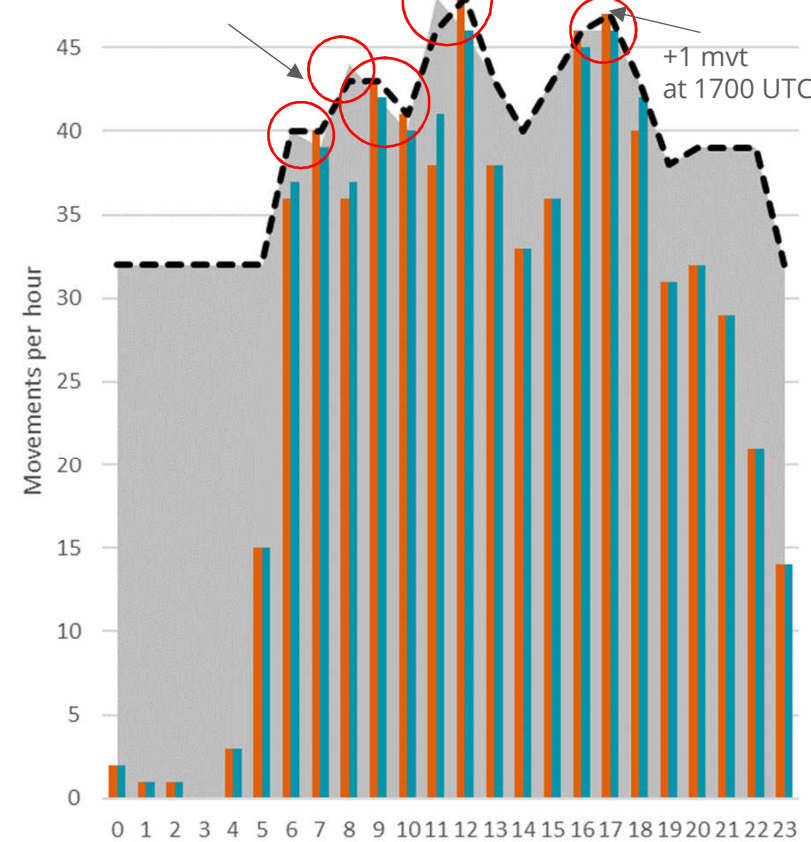
- Declared departures capacity (W18)
- Departures in simulated W19 flight schedule (W19 limits)
- Departures in simulated W19 flight schedule (W18 limits)
- Wishlist departures capacity (W19)

Totals
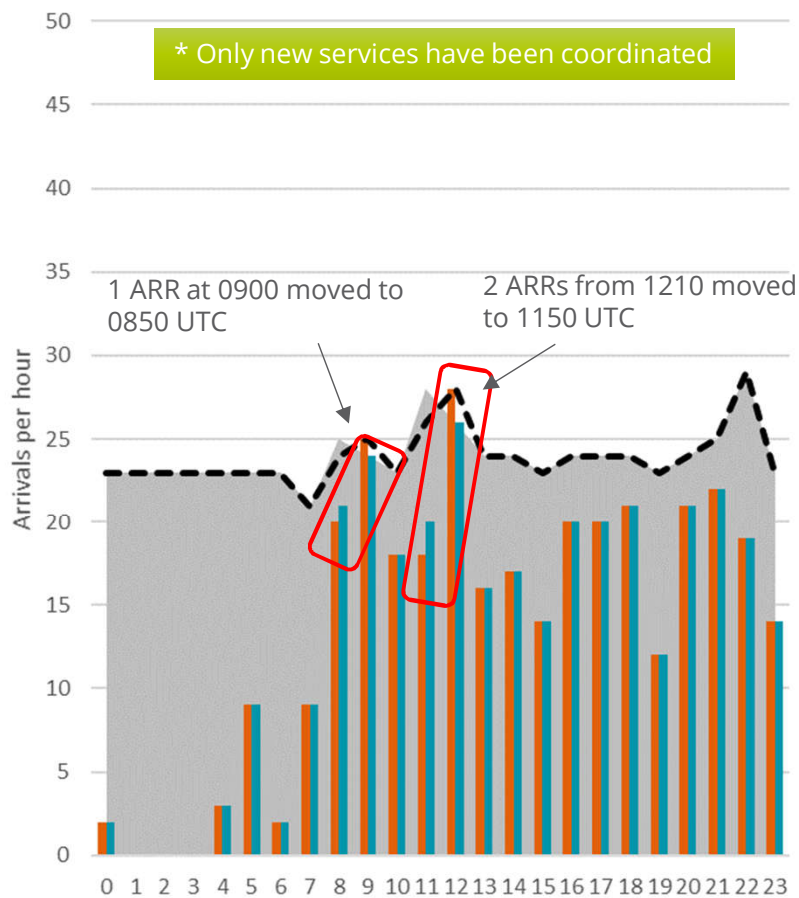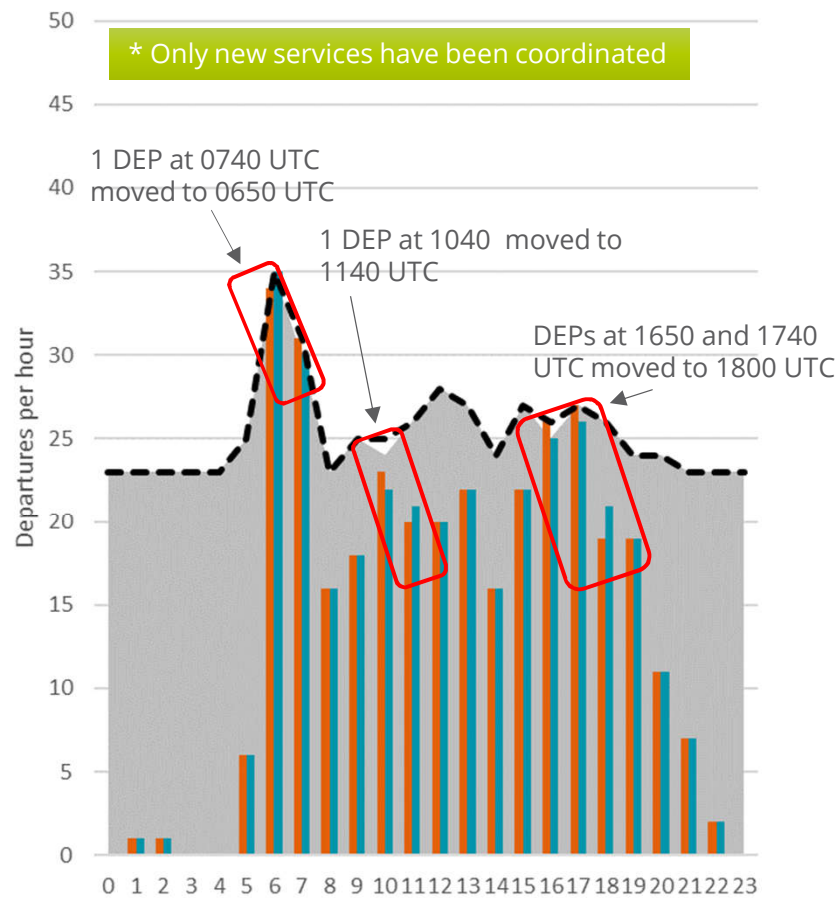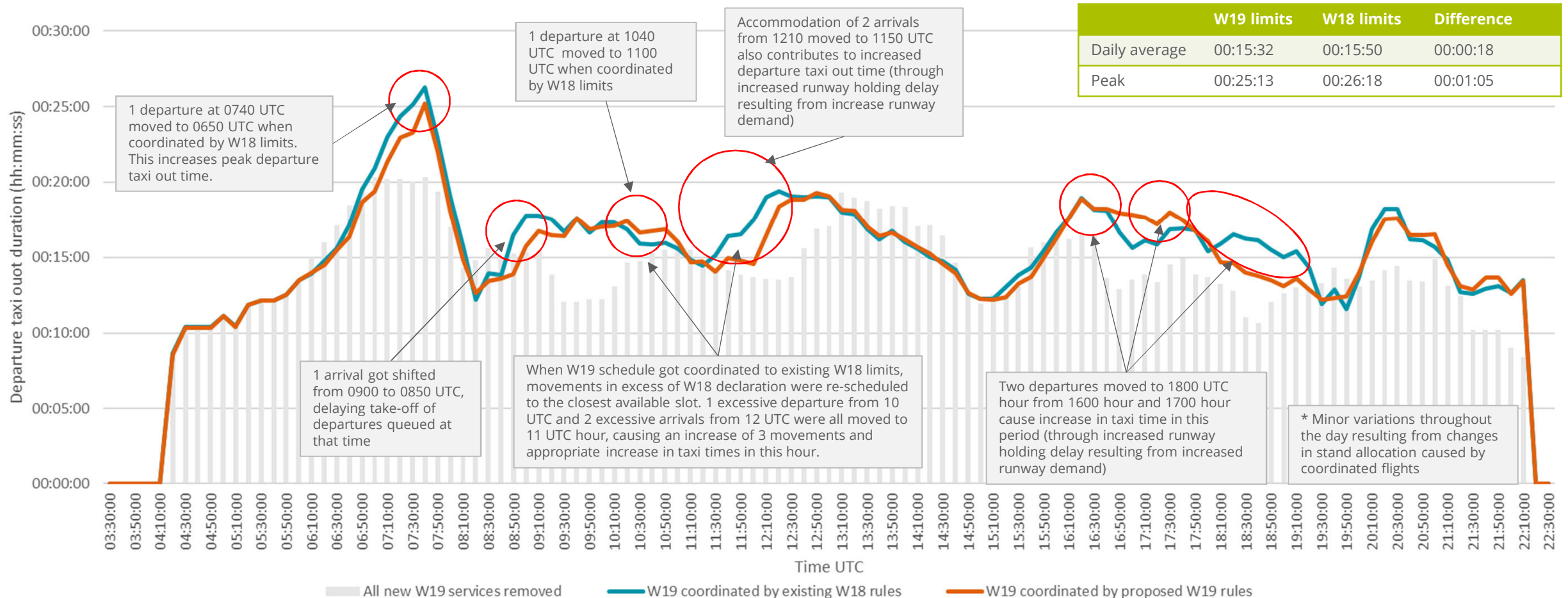
- Declared totals capacity (W18)
- Totals in simulated W19 flight schedule (W19 limits)
- Totals in simulated W19 flight schedule (W18 limits)
- Wishlist totals capacity (W19)

DEPARTURE TAXI OUT TIME

Definition: This metric is defined to be the time period between off-block and the time the aircraft reaches its stop bar for runway entry. This value is updated every second of simulation time when the aircraft is taxiing for departure even if the aircraft is stopped on ground.

	W19 limits	W18 limits	Difference
Daily average	00:15:32	00:15:50	00:00:18
Peak	00:25:13	00:26:18	00:01:05

Annotations on chart:

1 departure at 0740 UTC moved to 0650 UTC when coordinated by W18 limits. This increases peak departure taxi out time.

1 departure at 1040 UTC moved to 1100 UTC when coordinated by W18 limits

Accommodation of 2 arrivals from 1210 moved to 1150 UTC also contributes to increased departure taxi out time (through increased runway holding delay resulting from increase runway demand)

1 arrival got shifted from 0900 to 0850 UTC, delaying take-off of departures queued at that time

When W19 schedule got coordinated to existing W18 limits, movements in excess of W18 declaration were re-scheduled to the closest available slot. 1 excessive departure from 10 UTC and 2 excessive arrivals from 12 UTC were all moved to 11 UTC hour, causing an increase of 3 movements and appropriate increase in taxi times in this hour.

Two departures moved to 1800 UTC hour from 1600 hour and 1700 hour cause increase in taxi time in this period (through increased runway holding delay resulting from increased runway demand)

* Minor variations throughout the day resulting from changes in stand allocation caused by coordinated flights

Chart axis: Departure taxi ouot duration (hh:mm:ss) vs Time UTC

Legend: All new W19 services removed | W19 coordinated by existing W18 rules | W19 coordinated by proposed W19 rules

DEPARTURE TAXI OUT TIME

Definition: This metric is defined to be the time period between off-block and the time the aircraft reaches its stop bar for runway entry. This value is updated every second of simulation time when the aircraft is taxiing for departure even if the aircraft is stopped on ground.

Local averages
W19 by W19 limits: 00:17:52
W19 by W18 limits: 00:18:37
W19 minus new: 00:16:57

Local averages
W19 by W19 limits: 00:16:21
W19 by W18 limits: 00:16:37
W19 minus new: 00:14:11

Local averages
W19 by W19 limits: 00:16:04
W19 by W18 limits: 00:16:29
W19 minus new: 00:15:45

Local averages
W19 by W19 limits: 00:15:14
W19 by W18 limits: 00:15:32
W19 minus new: 00:13:45

All new W19 services removed — W19 coordinated by existing W18 rules — W19 coordinated by proposed W19 rules

RUNWAY HOLDING DELAY AND DEPARTURE GROUND DELAY

Runway holding delay: The delay experienced while the aircraft is queueing for runway entry. The delay can be caused by other aircraft (being slowed down or stopped) or when waiting at runway stop-bar (because the runway is not free for lining up). This metric is defined to be the time period between joining the back end of the queue and the time the aircraft reaches its stop bar for runway entry.

Departure ground delay: Total delay of departing aircraft accumulated between off-block and entering the runway. It is effectively the sum of runway holding delay and other delays.

ARRIVAL TAXI IN TIME AND ARRIVAL GROUND DELAY

Arrival taxi-in time: The time duration the arriving aircraft has been taxiing on the ground of its arrival airport. This value is updated every second of simulation time when the arriving aircraft is taxiing even if the aircraft is stopped on ground.
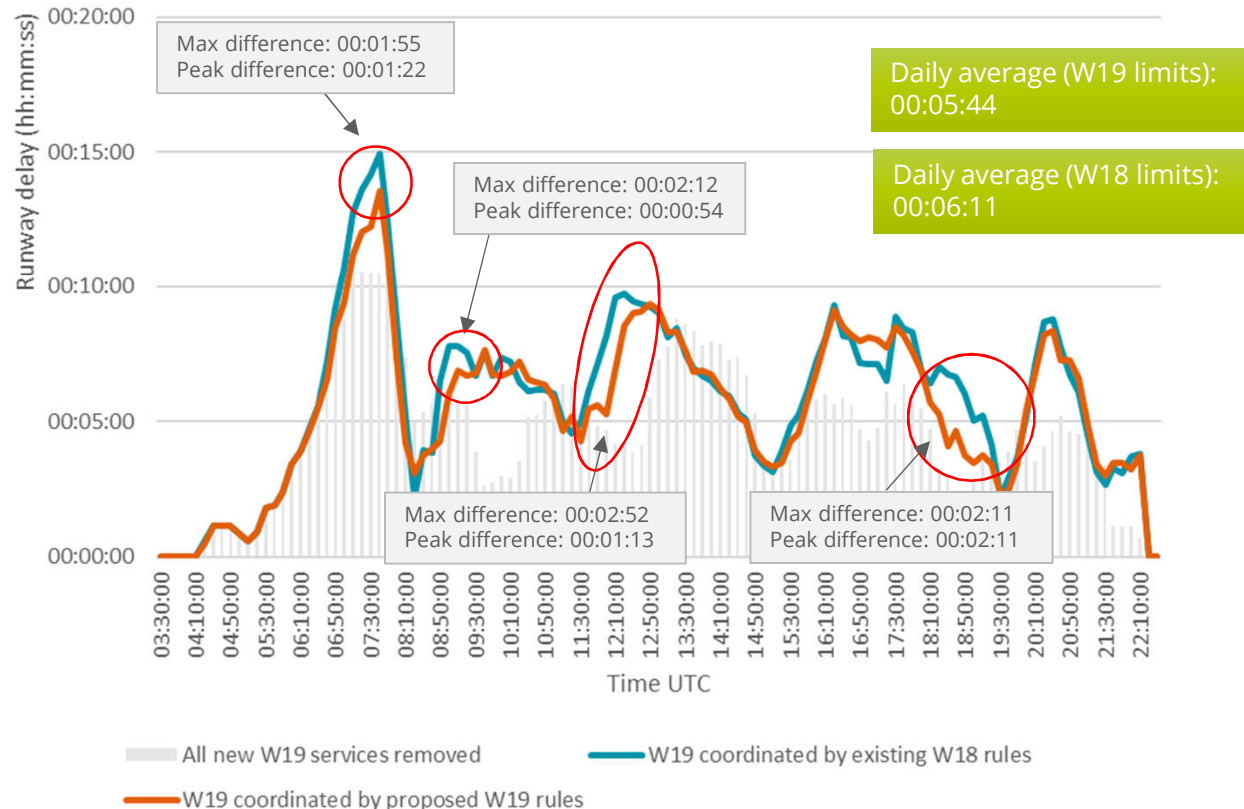
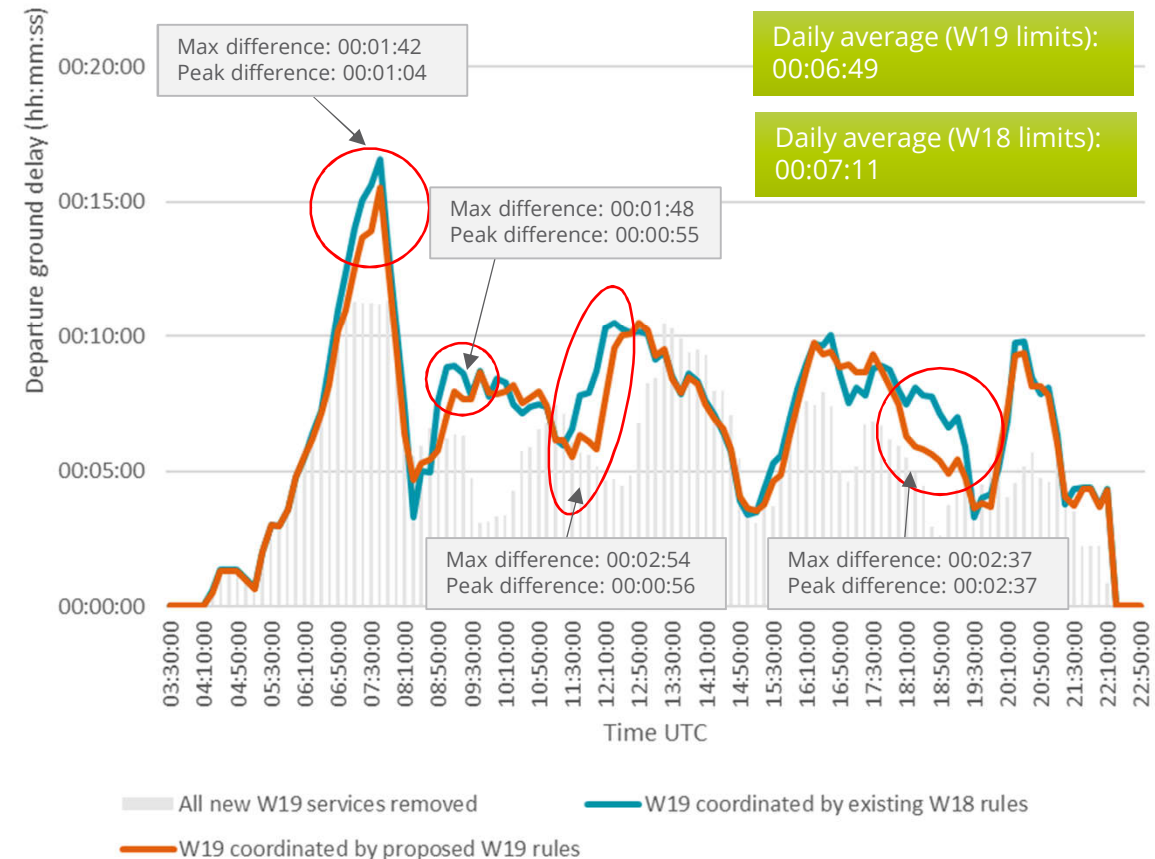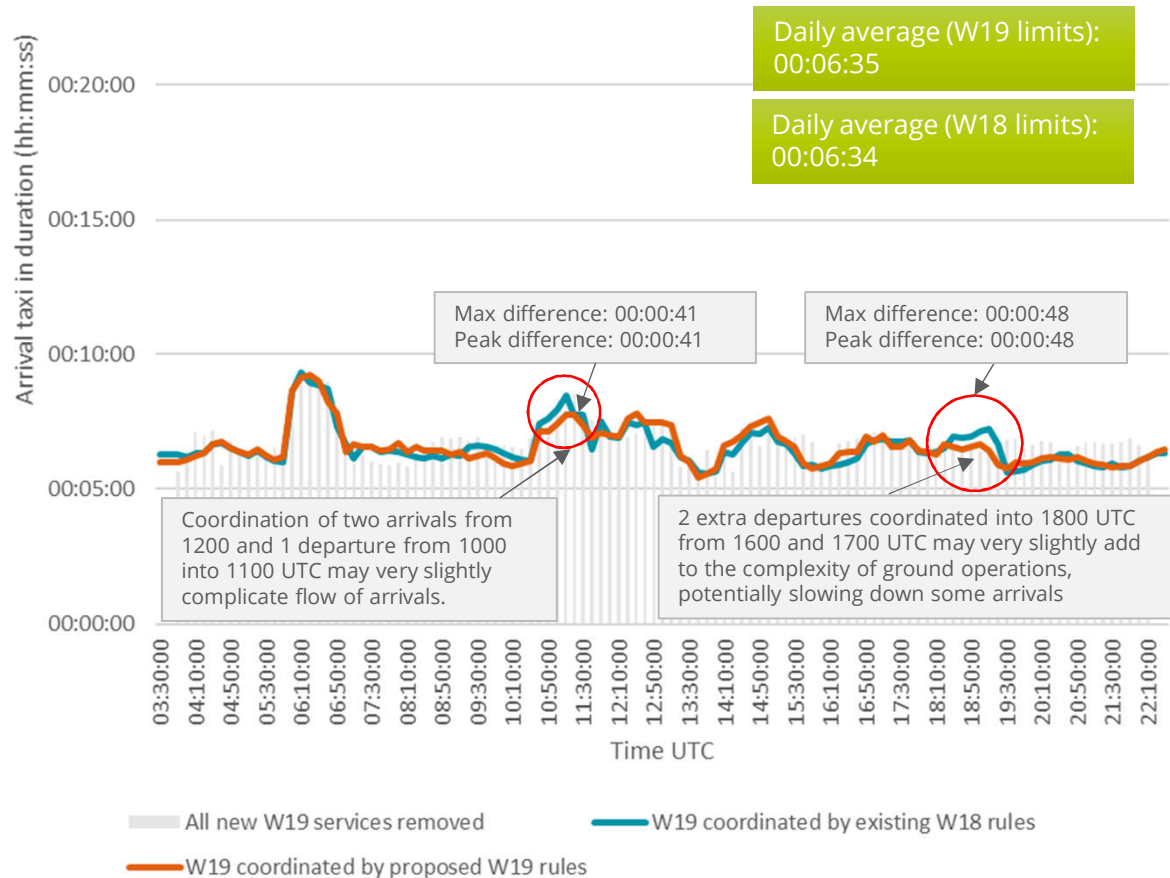**Arrival ground delay:** The delay caused by traffic (slowing down or being stopped) while the aircraft is taxiing to its arrival stand. Every second of simulation time the aircraft is stopped on ground due to other traffic, the delay is increased accordingly. Additionally, if the aircraft is forced to slow-down due to other traffic, a proportional delay is calculated.

Daily average (W19 limits): 00:06:35
Daily average (W18 limits): 00:06:34

Max difference: 00:00:41
Peak difference: 00:00:41

Max difference: 00:00:48
Peak difference: 00:00:48

Coordination of two arrivals from 1200 and 1 departure from 1000 into 1100 UTC may very slightly complicate flow of arrivals.

2 extra departures coordinated into 1800 UTC from 1600 and 1700 UTC may very slightly add to the complexity of ground operations, potentially slowing down some arrivals

Daily average (W19 limits): 00:00:31
Daily average (W18 limits): 00:00:33

Max difference: 00:00:37
Peak difference: 00:00:37

Max difference: 00:00:44
Peak difference: 00:00:44

All new W19 services removed — W19 coordinated by existing W18 rules — W19 coordinated by proposed W19 rules
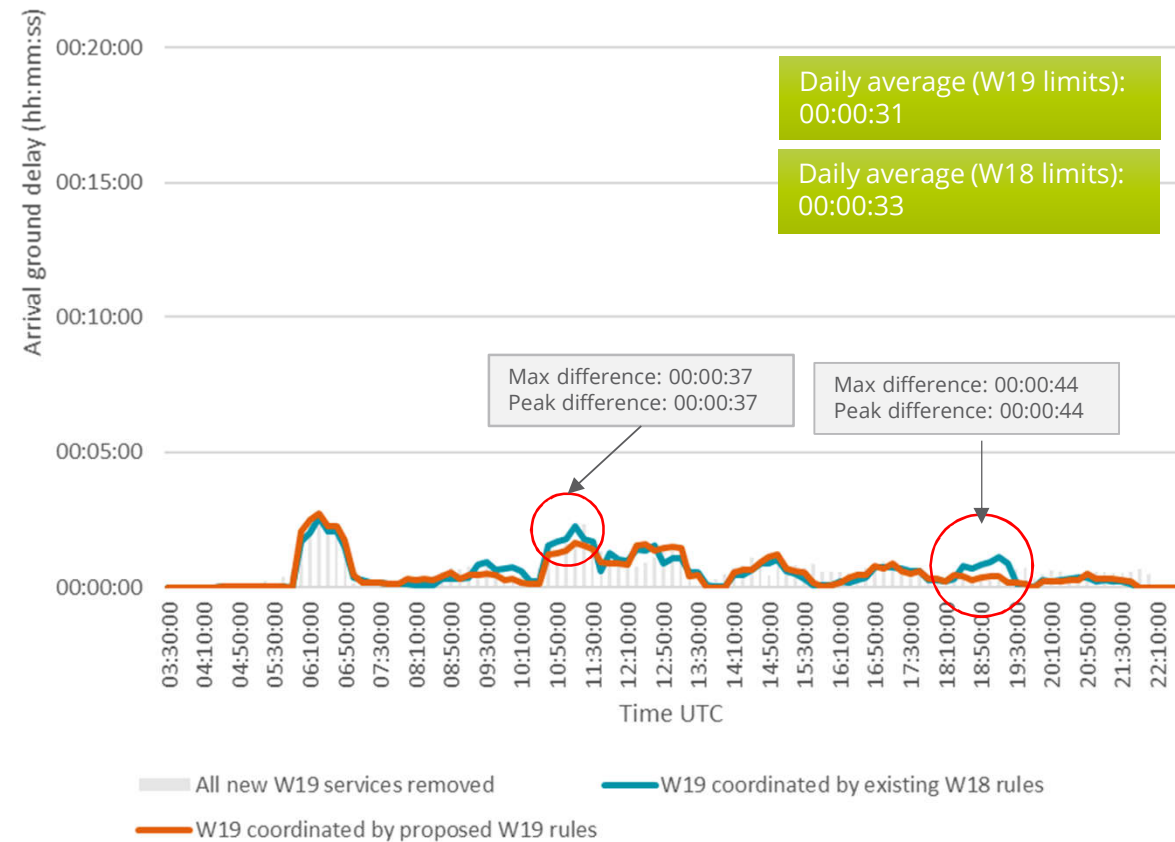
INCREASING THE RUNWAY LIMITS IN LINE WITH THE W19 WISHLIST

Increasing the Runway Limits in line with the W19 Wishlist:

- Is unlikely to bring any major change in average daily departure taxi out time across the day as a whole, however, it is likely to cause a minor increase of departure taxi out time in several hours of the day:

    - The average increase in departure taxi out time in 1000 UTC hour is likely to be less than a minute per flight,

    - The average increase in departure taxi out time for flights operating between the end of 1600 hour until 1800 UTC is likely to be increased by more than a minute per flight operating in this period.

- Is unlikely to introduce any major changes to either arrival taxi in duration or arrival ground delay.

- Is likely to lead to 0700, 0900, 1000,1200, 1600 and 1700 UTC hours being scheduled up to the limits, with 0600 hour being just one movement from reaching the limit, assuming the W19 schedule materializes as expected.

MAINTAINING THE RUNWAY LIMITS IN LINE WITH THE W18 DECLARATION

Maintaining the Runway Limits in line with the W18 declaration:

- Is likely to lead to redistribution of delays from periods where increases for W19 season were proposed into periods with any spare capacity left.

- Is likely to increase the existing peak departure taxi out time (and associated runway /ground delays) during the early morning period only marginally.

- However, due to the need to move 1 departure from 1000 hour to 1100 hour and due to the need to move two arrivals from 1200 hour also to 1100 hour, the 1100 UTC hour is likely to see increase in departure taxi out time, primarily due to the longer queue of departing aircraft and secondarily, due to increased number of arrivals trying to land in that hour.

- May introduce very minor increases of arrival taxi duration in 1100 and 1800 UTC hour.

- Is likely to lead to 0600, 0700, 0900, 1000, 1200, 1600 and 1700 UTC hours being scheduled up to the limits, with 1800 hour being just one movement from reaching the limit, assuming the W19 schedule materializes as expected.

ASSESSMENT OF THE
OPTION 1 DECLARATION

PROPOSED OPTION 1 DECLARATION

Hour UTC	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total
Arrivals																									
Existing W18 arrivals capacity	23	23	23	23	23	23	23	21	25	24	23	28	26	24	24	23	24	24	24	23	24	25	29	23	**575**
Proposed Option 1 arrivals capacity	23	23	23	23	23	23	23	21	25	24	23	28	26	24	24	23	24	24	24	23	24	25	29	23	**575**
Difference (against W18 declaration)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Departures																									
Existing W18 departures capacity	23	23	23	23	23	25	35	30	23	25	24	26	28	27	24	27	25	27	26	24	24	23	23	23	**604**
Proposed Option 1 departures capacity	23	23	23	23	23	25	35	31	23	25	24	26	28	27	24	27	26	27	26	24	24	23	23	23	**606**
Difference (against W18 declaration)	0	0	0	0	0	0	0	+1	0	0	0	0	0	0	0	0	+1	0	0	0	0	0	0	0	**+2**
Totals																									
Existing W18 totals capacity	32	32	32	32	32	32	40	39	44	42	40	48	46	43	40	43	46	46	43	38	39	39	39	32	**939**
Proposed Option 1 totals capacity	32	32	32	32	32	32	40	40	44	42	41	48	46	43	40	43	46	47	43	38	39	39	39	32	**942**
Difference (against W18 declaration)	0	0	0	0	0	0	0	+1	0	0	+1	0	0	0	0	0	0	+1	0	0	0	0	0	0	**+3**

*Option 1 is based on the original W19 Wishlist with changes in arrivals limits removed.
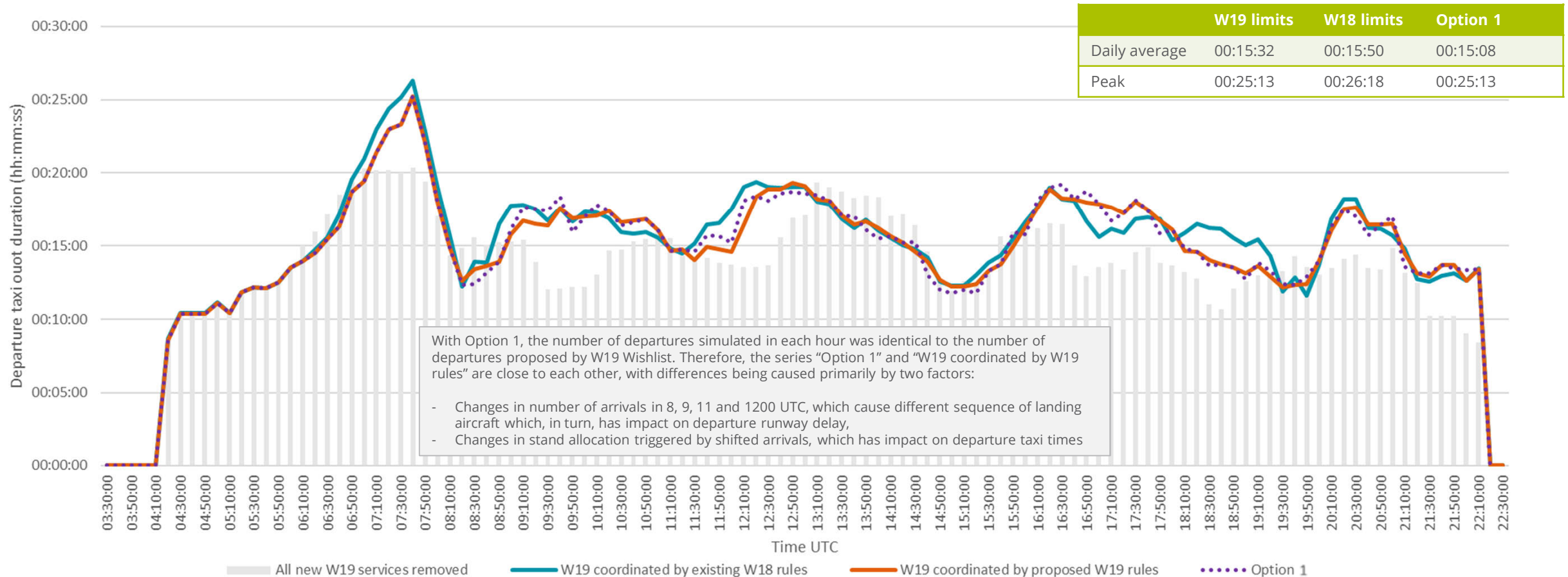
W19 COORDINATED TO PROPOSED OPTION 1 LIMITS

Hour UTC	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total
Arrivals																									
Option 1 arrivals capacity	23	23	23	23	23	23	23	21	25	24	23	28	26	24	24	23	24	24	24	23	24	25	29	23	**575**
Arrivals in simulated Option 1 schedule	2	0	0	0	3	9	2	9	21	24	18	20	26	16	17	14	20	20	21	12	21	22	19	14	**330**
Historic	2	0	0	0	3	8	2	9	14	21	18	18	26	16	17	14	19	15	20	12	20	21	19	13	307
Additional arrivals proposed for Option 1	0	0	0	0	0	1	0	0	7	3	0	2	0	0	0	0	1	5	1	0	1	1	0	1	23
Spare capacity (against Option 1 wishlist)	21	23	23	23	20	14	21	12	4	0	5	8	0	8	7	9	4	4	3	11	3	3	10	9	**245**
Departures																									
Option 1 departures capacity	23	23	23	23	23	25	35	31	23	25	24	26	28	27	24	27	26	27	26	24	24	23	23	23	**606**
Departures in simulated W19 schedule	0	1	1	0	0	6	34	31	16	18	23	20	20	22	16	22	26	27	19	19	11	7	2	0	**341**
Historic	0	1	1	0	0	6	31	27	15	12	19	20	18	22	14	22	21	22	18	19	10	6	2	0	306
Additional departures proposed for Option 1	0	0	0	0	0	0	3	4	1	6	4	0	2	0	2	0	5	5	1	0	1	1	0	0	35
Spare capacity (against Option 1 wishlist)	23	22	22	23	23	19	1	0	7	7	1	6	8	5	8	5	0	0	7	5	13	16	21	23	**265**
Totals																									
Option 1 totals capacity	32	32	32	32	32	32	40	40	44	42	41	48	46	43	40	43	46	47	43	38	39	39	39	32	**942**
Totals in simulated Option 1 schedule	2	1	1	0	3	15	36	40	37	42	41	40	46	38	33	36	46	47	40	31	32	29	21	14	**671**
Historic	2	1	1	0	3	14	33	36	29	33	37	38	44	38	31	36	40	37	38	31	30	27	21	13	613
Additional movements proposed for Option 1	0	0	0	0	0	1	3	4	8	9	4	2	2	0	2	0	6	10	2	0	2	2	0	1	58
Spare capacity (against Option 1 wishlist)	30	31	31	32	29	17	4	0	7	0	0	8	0	5	7	7	0	0	3	7	7	10	18	18	**271**

* Flights in hours, where the W19 flight schedule contained more flights than the Option 1 Wishlist were moved to the closest available slot

Source: Wishlist based on an alternative proposal made by a CC member after the pre-meeting
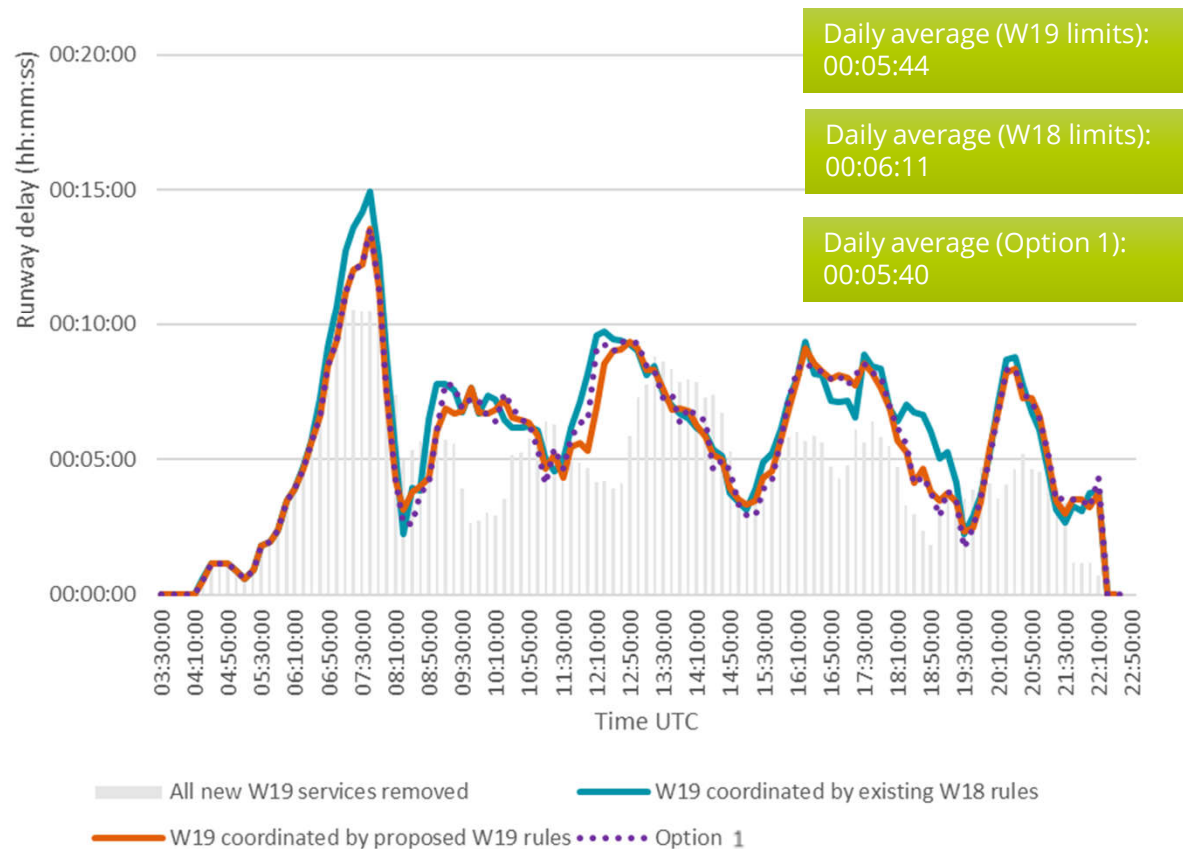
OPTION 1: DEPARTURE TAXI OUT TIME

Definition: This metric is defined to be the time period between off-block and the time the aircraft reaches its stop bar for runway entry. This value is updated every second of simulation time when the aircraft is taxiing for departure even if the aircraft is stopped on ground.

	W19 limits	W18 limits	Option 1
Daily average	00:15:32	00:15:50	00:15:08
Peak	00:25:13	00:26:18	00:25:13

With Option 1, the number of departures simulated in each hour was identical to the number of departures proposed by W19 Wishlist. Therefore, the series "Option 1" and "W19 coordinated by W19 rules" are close to each other, with differences being caused primarily by two factors:

- Changes in number of arrivals in 8, 9, 11 and 1200 UTC, which cause different sequence of landing aircraft which, in turn, has impact on departure runway delay,
- Changes in stand allocation triggered by shifted arrivals, which has impact on departure taxi times

Legend: All new W19 services removed — W19 coordinated by existing W18 rules — W19 coordinated by proposed W19 rules — Option 1
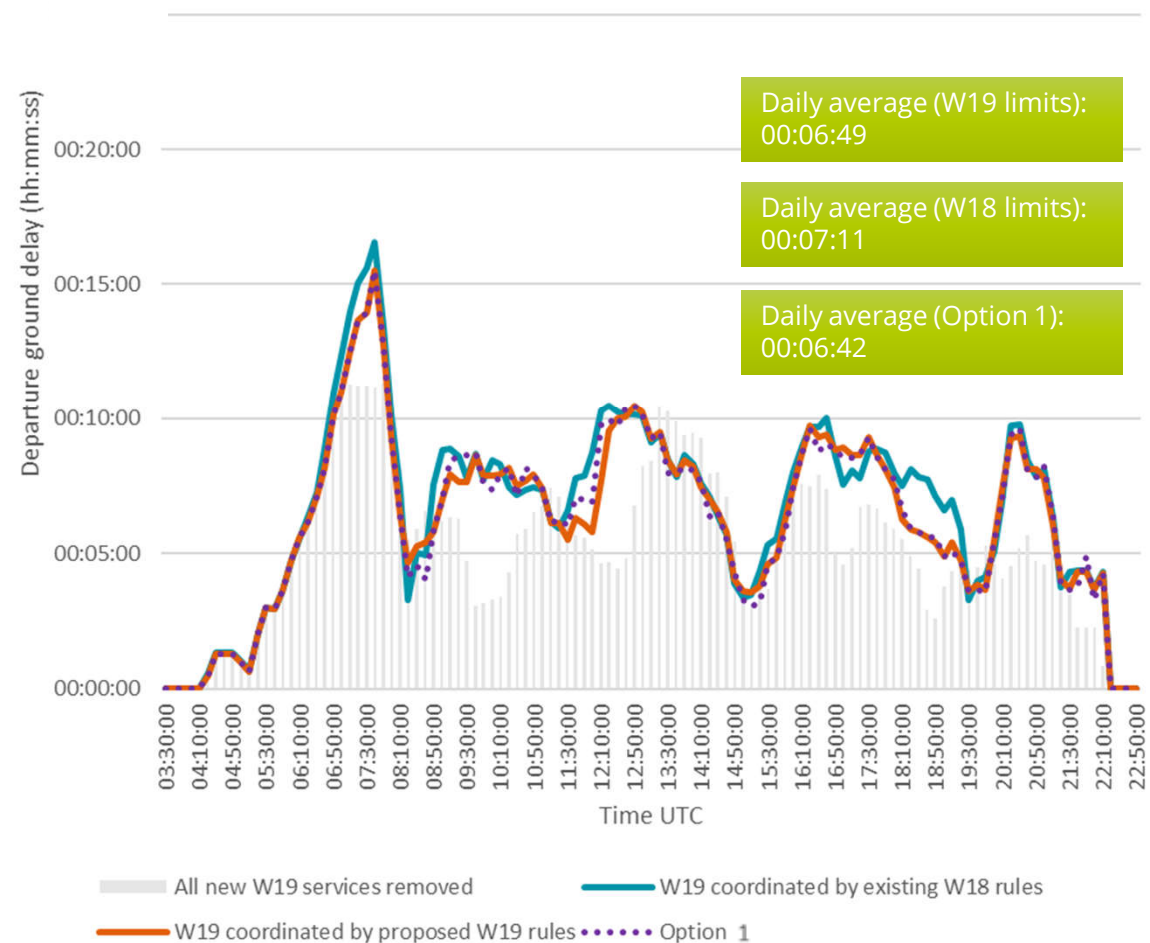
OPTION 1: RUNWAY HOLDING DELAY AND DEPARTURE GROUND DELAY

Runway holding delay: The delay experienced while the aircraft is queueing for runway entry. The delay can be caused by other aircraft (being slowed down or stopped) or when waiting at runway stop-bar (because the runway is not free for lining up). This metric is defined to be the time period between joining the back end of the queue and the time the aircraft reaches its stop bar for runway entry.

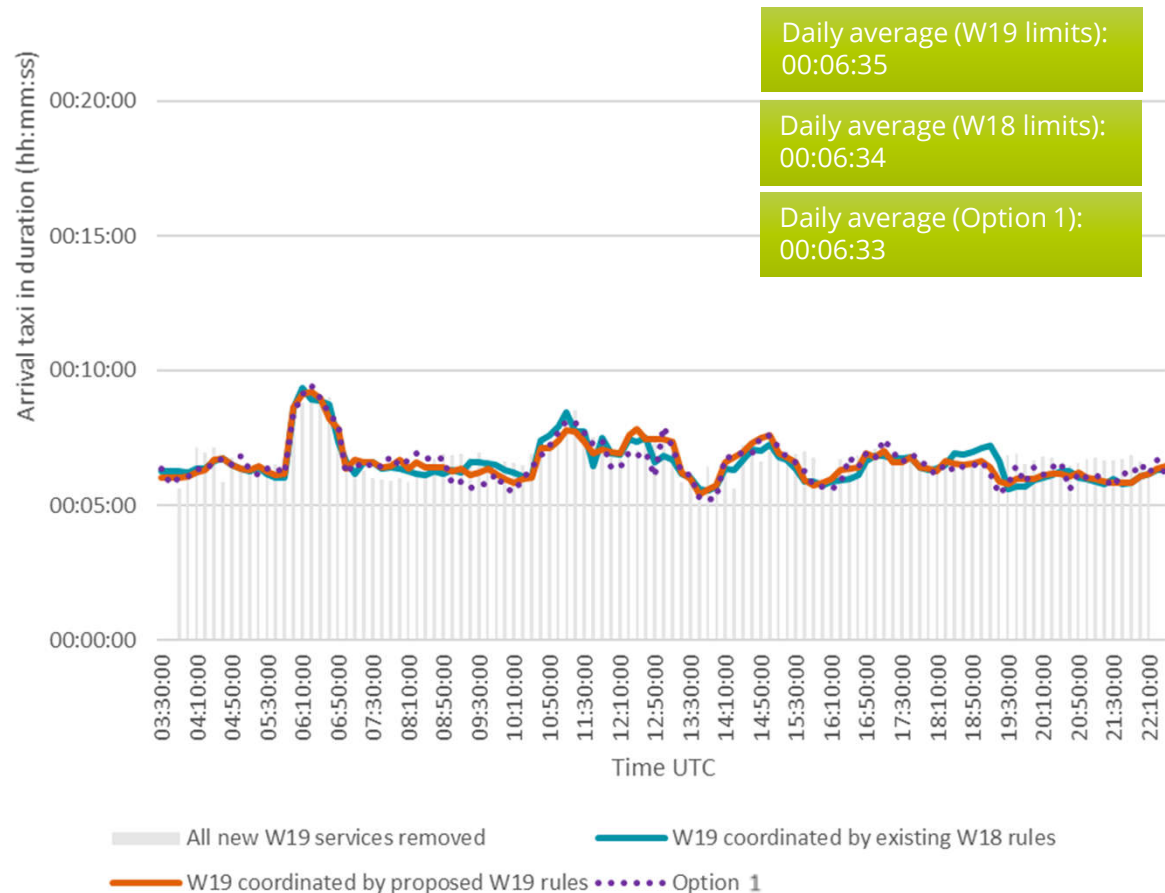**Departure ground delay:** Total delay of departing aircraft accumulated between off-block and entering the runway. It is effectively the sum of runway holding delay and other delays.
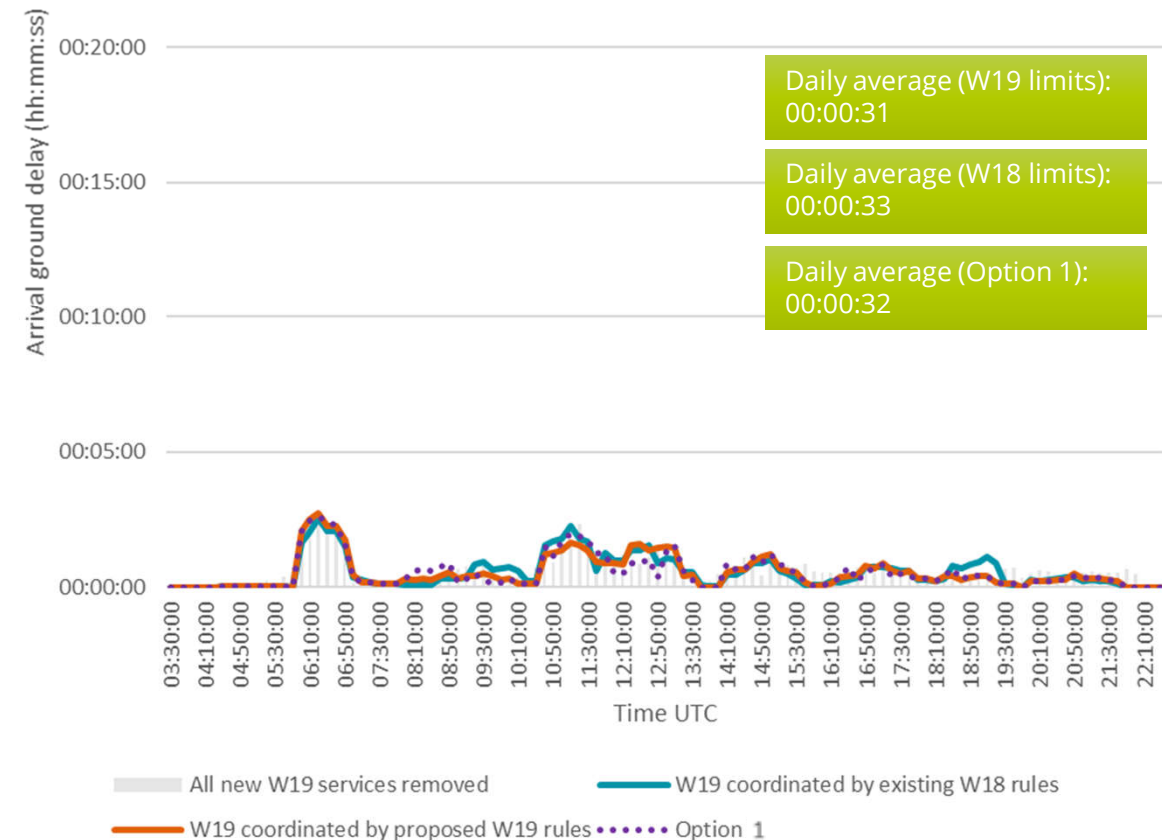

Daily average (W19 limits): 00:05:44

Daily average (W18 limits): 00:06:11

Daily average (Option 1): 00:05:40

Daily average (W19 limits): 00:06:49

Daily average (W18 limits): 00:07:11

Daily average (Option 1): 00:06:42

OPTION 1: ARRIVAL TAXI IN TIME AND ARRIVAL GROUND DELAY

Arrival taxi-in time: The time duration the arriving aircraft has been taxiing on the ground of its arrival airport. This value is updated every second of simulation time when the arriving aircraft is taxiing even if the aircraft is stopped on ground.

Arrival ground delay: The delay caused by traffic (slowing down or being stopped) while the aircraft is taxiing to its arrival stand. Every second of simulation time the aircraft is stopped on ground due to other traffic, the delay is increased accordingly. Additionally, if the aircraft is forced to slow-down due to other traffic, a proportional delay is calculated.

Daily average (W19 limits): 00:06:35
Daily average (W18 limits): 00:06:34
Daily average (Option 1): 00:06:33

Daily average (W19 limits): 00:00:31
Daily average (W18 limits): 00:00:33
Daily average (Option 1): 00:00:32

All new W19 services removed
W19 coordinated by existing W18 rules
W19 coordinated by proposed W19 rules
Option 1

ASSESSMENT OF THE OPTION 2 DECLARATION

Hour UTC	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total
Arrivals																									
Existing W18 arrivals capacity	23	23	23	23	23	23	23	21	25	24	23	28	26	24	24	23	24	24	24	23	24	25	29	23	**575**
Proposed Option 2 arrivals capacity	23	23	23	23	23	23	23	21	24	25	23	26	28	24	24	23	24	24	24	23	24	25	29	23	**575**
Difference (against W18 declaration)	0	0	0	0	0	0	0	0	-1	+1	0	-2	+2	0	0	0	0	0	0	0	0	0	0	0	**0**
Departures																									
Existing W18 departures capacity	23	23	23	23	23	25	35	30	23	25	24	26	28	27	24	27	25	27	26	24	24	23	23	23	**604**
Proposed Option 2 departures capacity	23	23	23	23	23	25	35	30	23	25	24	26	28	27	24	27	25	27	26	24	24	23	23	23	**604**
Difference (against W18 declaration)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Totals																									
Existing W18 totals capacity	32	32	32	32	32	32	40	39	44	42	40	48	46	43	40	43	46	46	43	38	39	39	39	32	**939**
Proposed Option 2 totals capacity	32	32	32	32	32	32	40	39	43	43	40	46	48	43	40	43	46	46	43	38	39	39	39	32	**939**
Difference (against W18 declaration)	0	0	0	0	0	0	0	0	-1	+1	0	-2	+2	0	0	0	0	0	0	0	0	0	0	0	**0**

*Option 2 is based on the original W19 Wishlist with changes in departures limits removed.
  Option 2 assumes no growth of capacity declaration for W19.
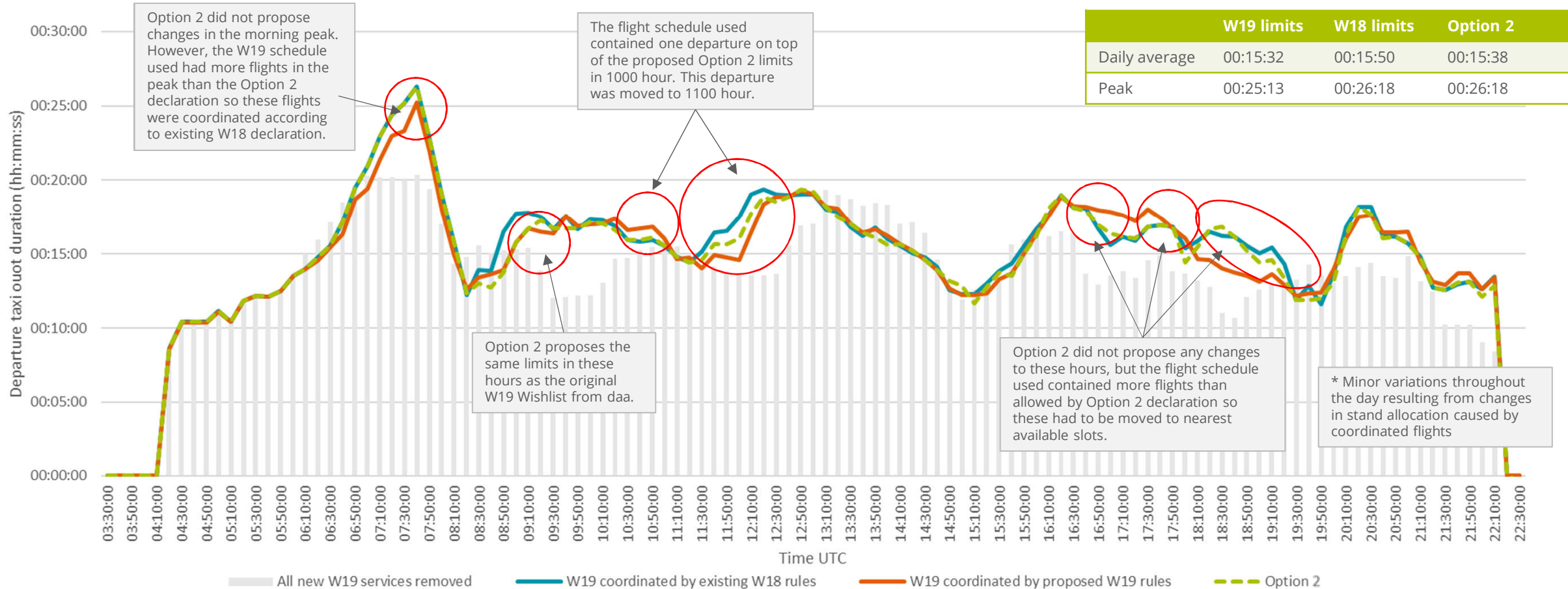
W19 COORDINATED TO PROPOSED OPTION 2 LIMITS

Hour UTC	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total
Arrivals																									
Option 2 arrivals capacity	23	23	23	23	23	23	23	21	24	25	23	26	28	24	24	23	24	24	24	23	24	25	29	23	**575**
Arrivals in simulated Option 2 schedule	2	0	0	0	3	9	2	9	20	25	18	18	28	16	17	14	20	20	21	12	21	22	19	14	**330**
Historic	2	0	0	0	3	8	2	9	14	21	18	18	26	16	17	14	19	15	20	12	20	21	19	13	307
Additional arrivals proposed for Option 2	0	0	0	0	0	1	0	0	6	4	0	0	2	0	0	0	1	5	1	0	1	1	0	1	23
Spare capacity (against Option 2 wishlist)	21	23	23	23	20	14	21	12	4	0	5	8	0	8	7	9	4	4	3	11	3	3	10	9	**245**
Departures																									
Option 2 departures capacity	23	23	23	23	23	25	35	30	23	25	24	26	28	27	24	27	25	27	26	24	24	23	23	23	**604**
Departures in simulated Option 2 schedul	0	1	1	0	0	6	35	30	16	18	22	21	20	22	16	22	25	26	21	19	11	7	2	0	**341**
Historic	0	1	1	0	0	6	31	27	15	12	19	20	18	22	14	22	21	22	18	19	10	6	2	0	306
Additional departures proposed for Option 2	0	0	0	0	0	0	4	3	1	6	3	1	2	0	2	0	4	4	3	0	1	1	0	0	35
Spare capacity (against Option 2 wishlist)	23	22	22	23	23	19	0	0	7	7	2	5	8	5	8	5	0	1	5	5	13	16	21	23	**263**
Totals																									
Option 2 totals capacity	32	32	32	32	32	32	40	39	43	43	40	46	48	43	40	43	46	46	43	38	39	39	39	32	**939**
Totals in simulated Option 2 schedule	2	1	1	0	3	15	37	39	36	43	40	39	48	38	33	36	45	46	42	31	32	29	21	14	**671**
Historic	2	1	1	0	3	14	33	36	29	33	37	38	44	38	31	36	40	37	38	31	30	27	21	13	613
Additional movements proposed for Option 2	0	0	0	0	0	1	4	3	7	10	3	1	4	0	2	0	5	9	4	0	2	2	0	1	58
Spare capacity (against Option 2 wishlist)	30	31	31	32	29	17	3	0	7	0	0	7	0	5	7	7	1	0	1	7	7	10	18	18	**268**

* Flights in hours, where the W19 flight schedule contained more flights than the Option 2 Wishlist were moved to the closest available slot

Source: Wishlist based on an alternative proposal made by a CC member after the pre-meeting
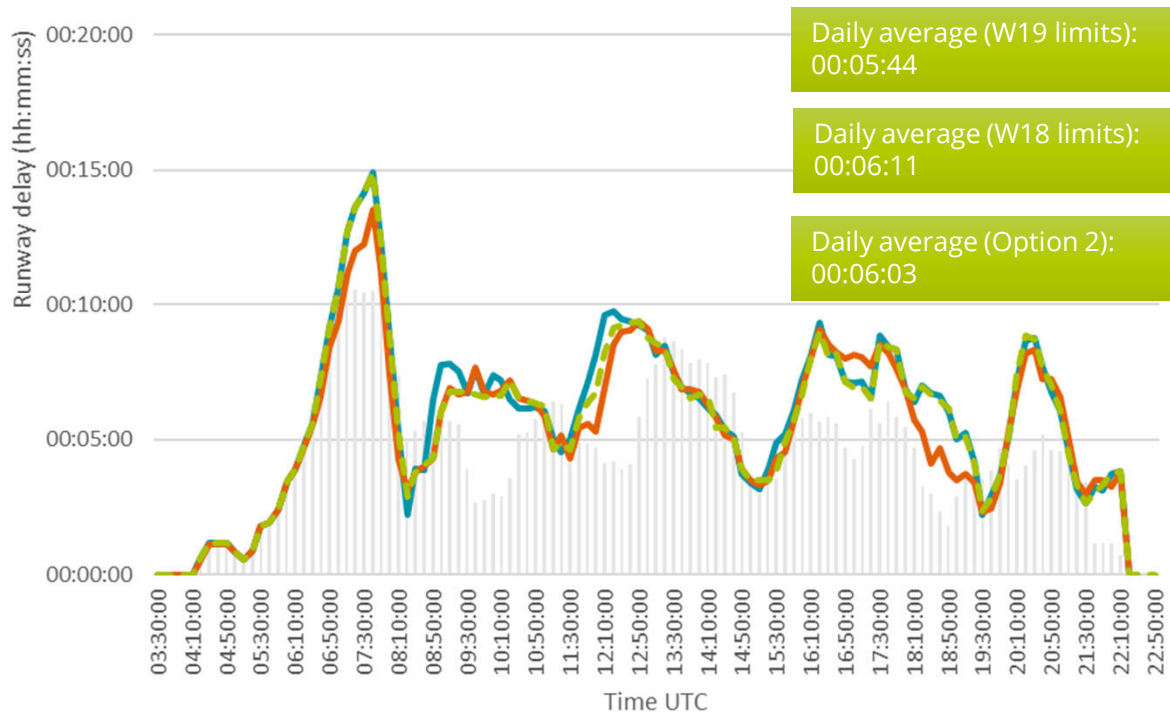
OPTION 2: DEPARTURE TAXI OUT TIME

Definition: This metric is defined to be the time period between off-block and the time the aircraft reaches its stop bar for runway entry. This value is updated every second of simulation time when the aircraft is taxiing for departure even if the aircraft is stopped on ground.
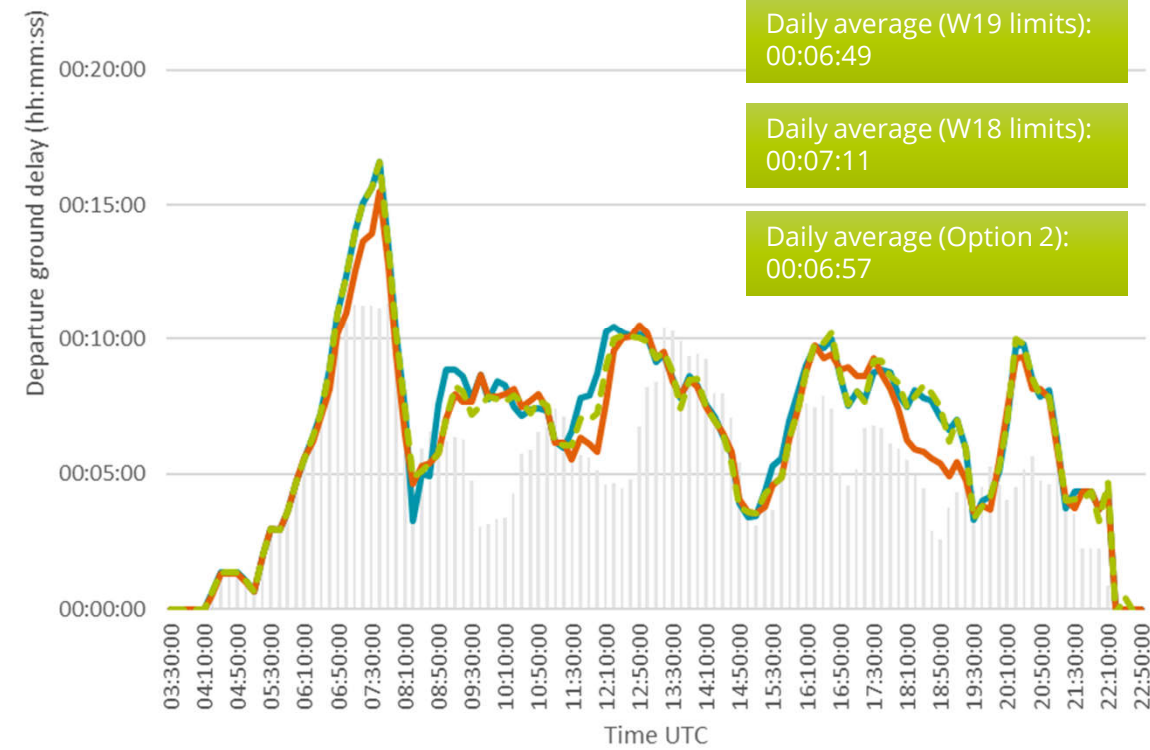
Runway holding delay: The delay experienced while the aircraft is queueing for runway entry. The delay can be caused by other aircraft (being slowed down or stopped) or when waiting at runway stop-bar (because the runway is not free for lining up). This metric is defined to be the time period between joining the back end of the queue and the time the aircraft reaches its stop bar for runway entry.

**Departure ground delay:** Total delay of departing aircraft accumulated between off-block and entering the runway. It is effectively the sum of runway holding delay and other delays.

Daily average (W19 limits): 00:05:44

Daily average (W18 limits): 00:06:11

Daily average (Option 2): 00:06:03

Daily average (W19 limits): 00:06:49

Daily average (W18 limits): 00:07:11

Daily average (Option 2): 00:06:57

OPTION 2: ARRIVAL TAXI IN TIME AND ARRIVAL GROUND DELAY

Arrival taxi-in time: The time duration the arriving aircraft has been taxiing on the ground of its arrival airport. This value is updated every second of simulation time when the arriving aircraft is taxiing even if the aircraft is stopped on ground.
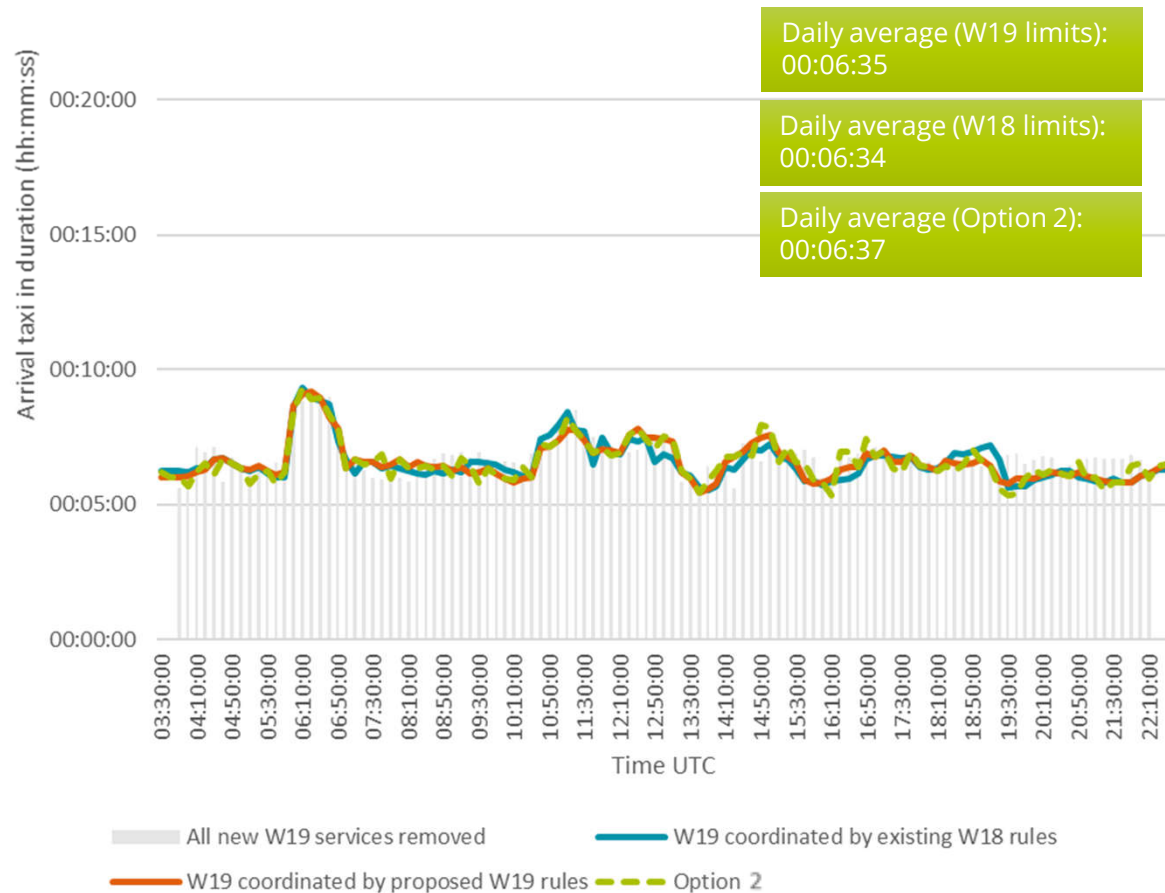
Arrival ground delay: The delay caused by traffic (slowing down or being stopped) while the aircraft is taxiing to its arrival stand. Every second of simulation time the aircraft is stopped on ground due to other traffic, the delay is increased accordingly. Additionally, if the aircraft is forced to slow-down due to other traffic, a proportional delay is calculated.
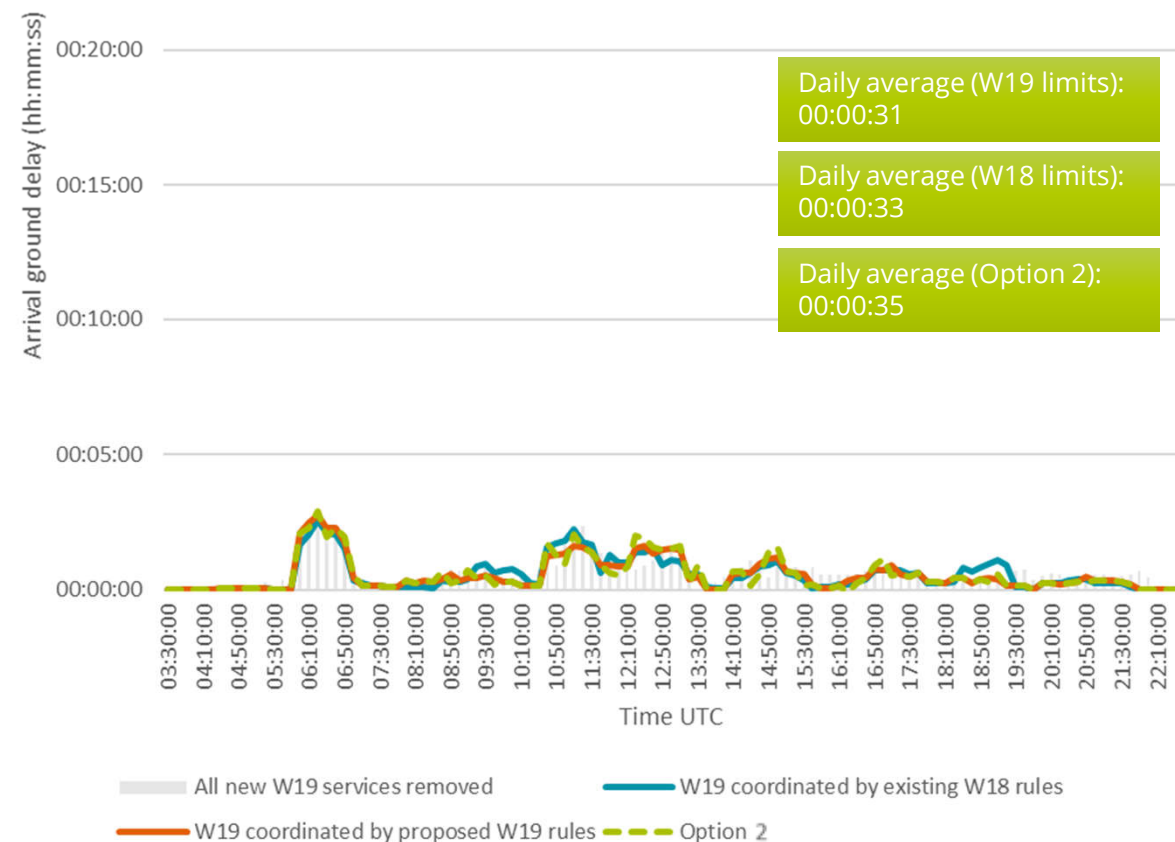
SUMMARY

SUMMARY OF OPTIONS ANALYSED

Hour UTC	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total
Arrivals																									
Existing W18 arrivals capacity	23	23	23	23	23	23	23	21	25	24	23	28	26	24	24	23	24	24	24	23	24	25	29	23	**575**
Proposed W19 Wishlist capacity	23	23	23	23	23	23	23	21	24	25	23	26	28	24	24	23	24	24	24	23	24	25	29	23	**575**
Proposed Option 1 arrivals capacity	23	23	23	23	23	23	23	21	25	24	23	28	26	24	24	23	24	24	24	23	24	25	29	23	**575**
Proposed Option 2 arrivals capacity	23	23	23	23	23	23	23	21	24	25	23	26	28	24	24	23	24	24	24	23	24	25	29	23	**575**
Departures																									
Existing W18 departures capacity	23	23	23	23	23	25	35	30	23	25	24	26	28	27	24	27	25	27	26	24	24	23	23	23	**604**
Proposed W19 Wishlist capacity	23	23	23	23	23	25	35	31	23	25	24	26	28	27	24	27	26	27	26	24	24	23	23	23	**606**
Proposed Option 1 departures capacity	23	23	23	23	23	25	35	31	23	25	24	26	28	27	24	27	27	27	26	24	24	23	23	23	**607**
Proposed Option 2 departures capacity	23	23	23	23	23	25	35	30	23	25	24	26	28	27	24	27	25	27	26	24	24	23	23	23	**604**
Totals																									
Existing W18 totals capacity	32	32	32	32	32	32	40	39	44	42	40	48	46	43	40	43	46	46	43	38	39	39	39	32	**939**
Proposed W19 Wishlist capacity	32	32	32	32	32	32	40	40	43	43	41	46	48	43	40	43	46	47	43	38	39	39	39	32	**942**
Proposed Option 1 totals capacity	32	32	32	32	32	32	40	40	44	42	41	48	46	43	40	43	46	47	43	38	39	39	39	32	**942**
Proposed Option 2 totals capacity	32	32	32	32	32	32	40	39	43	43	40	46	48	43	40	43	46	46	43	38	39	39	39	32	**939**

increase compared to W18 declaration
decrease compared to W18 declaration

NUMBER OF FLIGHTS SIMULATED IN EACH HOUR

Hour UTC	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total
Arrivals																									
Coordinated to existing W18 limits	2	0	0	0	3	9	2	9	21	24	18	20	26	16	17	14	20	20	21	12	21	22	19	14	330
Coordinated to W19 Wishlist	2	0	0	0	3	9	2	9	20	25	18	18	28	16	17	14	20	20	21	12	21	22	19	14	**330**
Coordinated to Option 1 limits	2	0	0	0	3	9	2	9	21	24	18	20	26	16	17	14	20	20	21	12	21	22	19	14	**330**
Coordinated to Option 2 limits	2	0	0	0	3	9	2	9	20	25	18	18	28	16	17	14	20	20	21	12	21	22	19	14	**330**
Departures																									
Coordinated to existing W18 limits	0	1	1	0	0	6	35	30	16	18	22	21	20	22	16	22	25	26	21	19	11	7	2	0	341
Coordinated to W19 Wishlist	0	1	1	0	0	6	34	31	16	18	23	20	20	22	16	22	26	27	19	19	11	7	2	0	**341**
Coordinated to Option 1 limits	0	1	1	0	0	6	34	31	16	18	23	20	20	22	16	22	26	27	19	19	11	7	2	0	**341**
Coordinated to Option 2 limits	0	1	1	0	0	6	35	30	16	18	22	21	20	22	16	22	25	26	21	19	11	7	2	0	**341**
Totals																									
Coordinated to existing W18 limits	2	1	1	0	3	15	37	39	37	42	40	41	46	38	33	36	45	46	42	31	32	29	21	14	671
Coordinated to W19 Wishlist	2	1	1	0	3	15	36	40	36	43	41	38	48	38	33	36	46	47	40	31	32	29	21	14	**671**
Coordinated to Option 1 limits	2	1	1	0	3	15	36	40	37	42	41	40	46	38	33	36	46	47	40	31	32	29	21	14	**671**
Coordinated to Option 2 limits	2	1	1	0	3	15	37	39	36	43	40	39	48	38	33	36	45	46	42	31	32	29	21	14	**671**

OVERVIEW OF RESULTS

Scenario	Average departure taxi out time	Peak departure taxi out time	Average departure runway holding delay	Average departure ground delay	Average arrival taxi in time	Average arrival ground delay
Existing W18 limits	00:15:50	00:26:18	00:06:11	00:07:11	00:06:34	00:00:33
Wishlist W19 limits	00:15:32	00:25:13	00:05:44	00:06:49	00:06:35	00:00:31
Option 1 limits	00:15:08	00:25:13	00:05:40	00:06:42	00:06:33	00:00:32
Option 2 limits	00:15:38	00:26:18	00:06:03	00:06:57	00:06:37	00:00:35

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