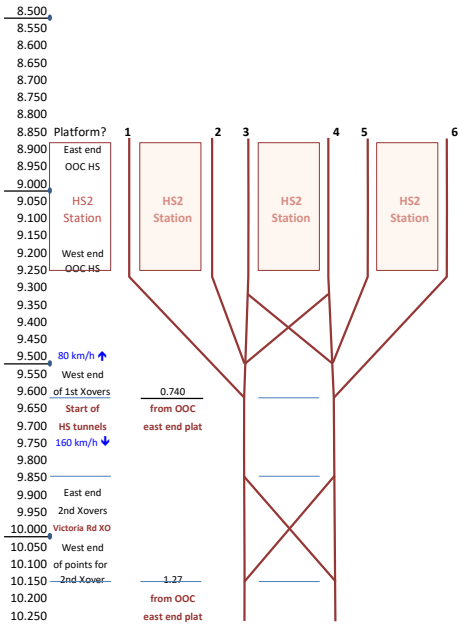
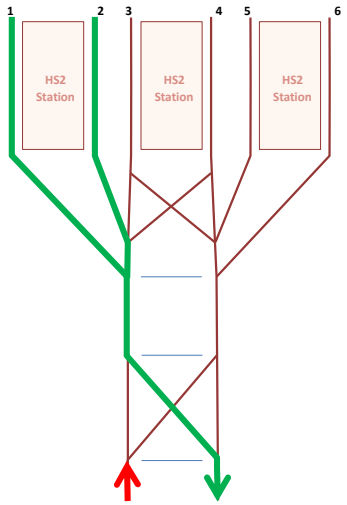
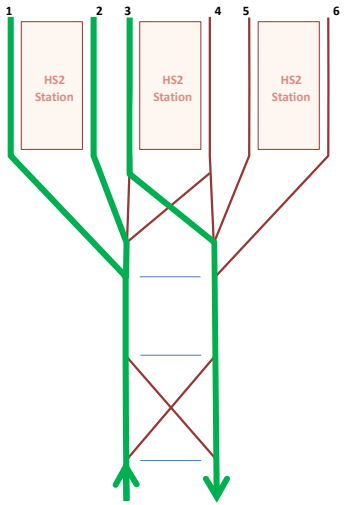
KM from Euston **HS2 planned tracks**

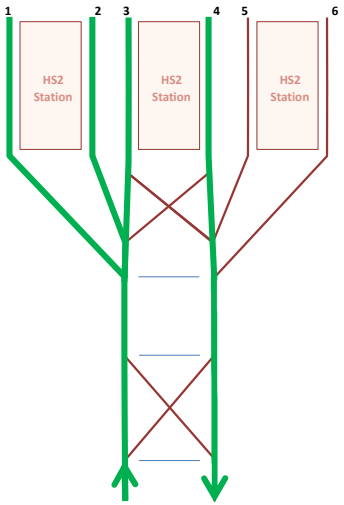




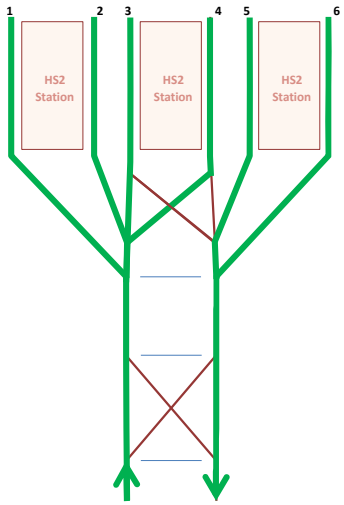
EXIT from Platforms 1 or 2 prevents any parallel move in



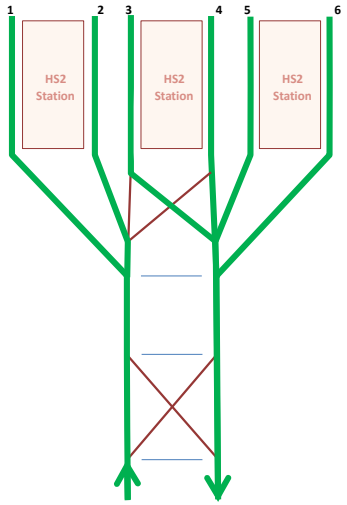
EXIT from Plat. 3 allows parallel entry to Platforms 1 or 2



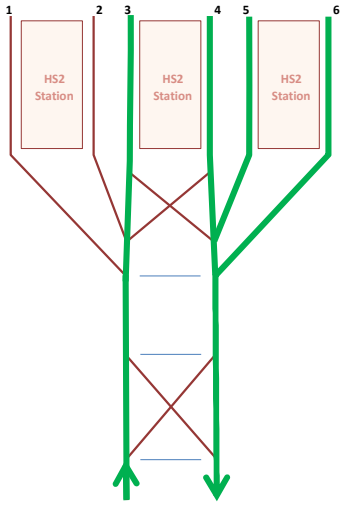
EXIT from Plat. 4 allows parallel entry to Platforms 1, 2, 3



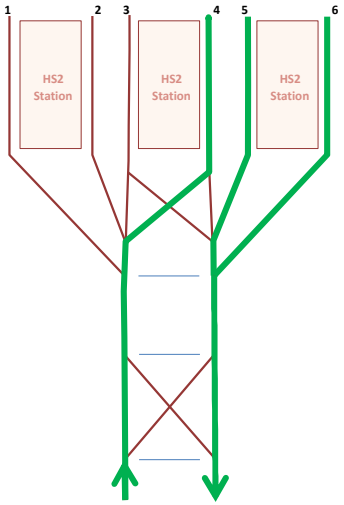
EXIT from Plats. 5 or 6 allows parallel entry to Plats. 1, 2, 3, 4



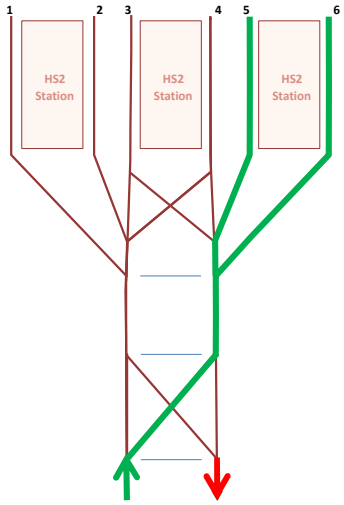
ENTRY to Plats. 1 or 2 allows parallel exit from Plats. 3, 4, 5, 6



ENTRY to Platform 3 allows parallel exit from Plats. 4, 5, 6



ENTRY to Platform 4 allows parallel exit from Plats. 5 or 6



ENTRY to Plats. 5 or 6 prevents any parallel move out

AT 0.962 mph/s/s (Pendolino equivalent)

Speed 80km/h throughout Time (secs)	Speed 80/160 km/h	Status Plats ?
59		ALL
83	79	depends

AT 1.2 mph/s/s (possible HS2 new standard)

Speed 80km/h throughout Time (secs)	Speed 80/160 km/h	Status Plats ?
54		ALL
77.5	73.3	depends

AT 0.7 mph/s/s (all trains)

Speed 80km/h throughout Time (secs)	Speed 80/160 km/h	Status Plats ?
69		ALL
92.5	90	depends

POSSIBLE TRAIN ARRIVALS AND DEPARTURES AT OLD OAK COMMON TERMINUS (OOC)

Mins past the hour 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 00 01 02 03 04 05

Efficient platforming

00 Arr from Birmingham Dep 15 20 Birmingham 35 40 Birmingham 55 00 Birmingham >

03 Manchester 23 28 North West / Glasgow / Edinburgh 58 03 Mcr >

> Glasgow / Edinburgh 29 34 Liverpool 52 57 Glasgow / Edinburgh >

23 Manchester 43

> Mcr 04 09 Nottingham 32 43 Manchester 04

01 06 Liverpool 26 37 Nottingham 01

OOC Arrivals 00 03 06 09 20 23 28 34 37 40 43 57 00 03 etc

OOC Departures 01 04 15 23 26 29 32 35 43 52 55 58 01 04

Based on:- (with minimum 5 minute gap between departure and arrival at the same platform)

3 trains per hour Birmingham arr/dep in 15 minutes

3 trains per hour Manchester arr/dep in 20 minutes

2 trains per hour Liverpool arr/dep in 20 minutes

2 trains per hour North West / Scotland in 30 minutes

HOWEVER THIS NOTIONALLY EFFICIENT PLATFORM SCHEDULE DOES NOT APPEAR TO BE SUPPORTED BY HS2's PROPOSED JUNCTION LAYOUT.

ALTERNATIVE OPTION BELOW IS BASED ON HS2's LAYOUT AND A CAUTIOUS ENTRY/EXIT TIMING TO/FROM VICTORIA ROAD CROSSOVER BOX (using 0.7 mph/sec/sec acceleration / braking).

Mins past the hour 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 00 01 02 03 04 05

25 minute layover Mins+Secs schedule

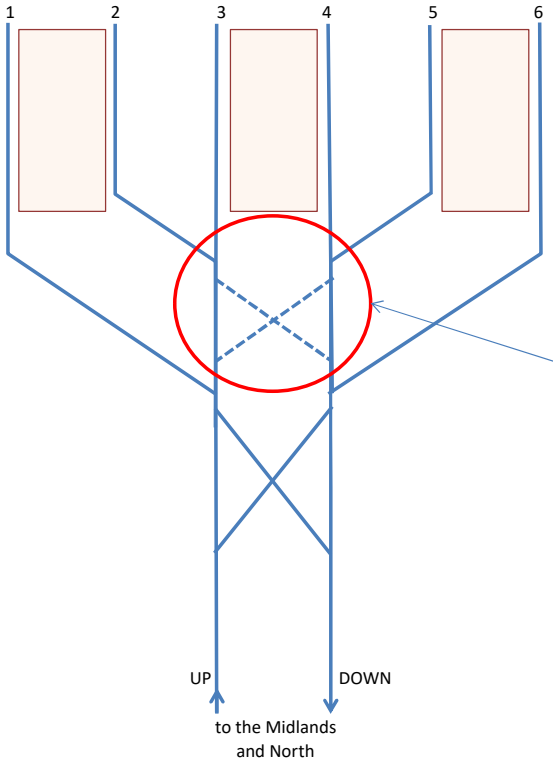
No blocking allowed

| | | |

JRC has assumed that a full service is intended to be operated, reversing at OOC. The junctions then enforce a 2 minute margin (which ***should*** be achievable with digital signalling) between trains heading in different directions.
There will be a high level of reliance on adequately punctual arrivals (it is assumed that world class station operations will achieve punctual departures).
In turn the creation of an HS2 railway must demand high quality operations and punctuality on the West Coast Main Line, as all trains will re-enter or leave the 'classic' network somewhere on their journey.
With rigid arrival / departure times imposed by the junction layout, Manchesters and Birminghams at 20 min intervals have to be 10 mins apart, otherwise other trains at 30 min headways could conflict, or have odd layover times.
Birmingham and Manchester trains interwork at Platforms 1, 2, 3. JRC considers these to be excessive layover times with HS2 segregated tracks, but the services are both at 20" intervals and must use matching slots, so every 10 minutes.
Liverpool trains are also a 25 minute layover, and simplest to keep as a self-contained operation.
Long distance West Coast trains (North West/Scotland) are interworked with shorter journey time Nottingham trains to average the timing margins.
Alternatively there is no Nottingham service, when each NW/Scottish train would still need its own platform. A Nottingham service therefore improves the efficiency of London-Scotland trains.

Note that this train sequencing gives no 'white space' where platforms are spare for trains running late or out-of-course, or have a technical or on-board issue.
Normally Network Rail would prefer 'white space' margins, eg once every half-hour in each direction.
This is possible with two types of action:
(1) the Nottingham trains are not operated, and the paths are left as white space in both directions.
(2) a tunnel continuation east of OOC is used as a reversing and servicing location for at least 2 tph (it doesn't matter which service, but probably easier to look at the shorter distance half-hourlies), Liverpool trains would be simplest operationally, and work those into the EB tunnel within 5 minutes of arrival southbound, for a 15 minute servicing (same as Tokyo ShinKansen servicing time), then work back into the relevant platform for passenger boarding northbound.
The vacated platforms would not normally be used while the train was serviced in the tunnel, however they provide a margin for out-of-course situations, to accommodate an extra train in a platform.
As usual, all services would then require adjustment within the context of the scale of emergency.

JRC POSSIBLE OOC TERMINUS TRACK LAYOUT



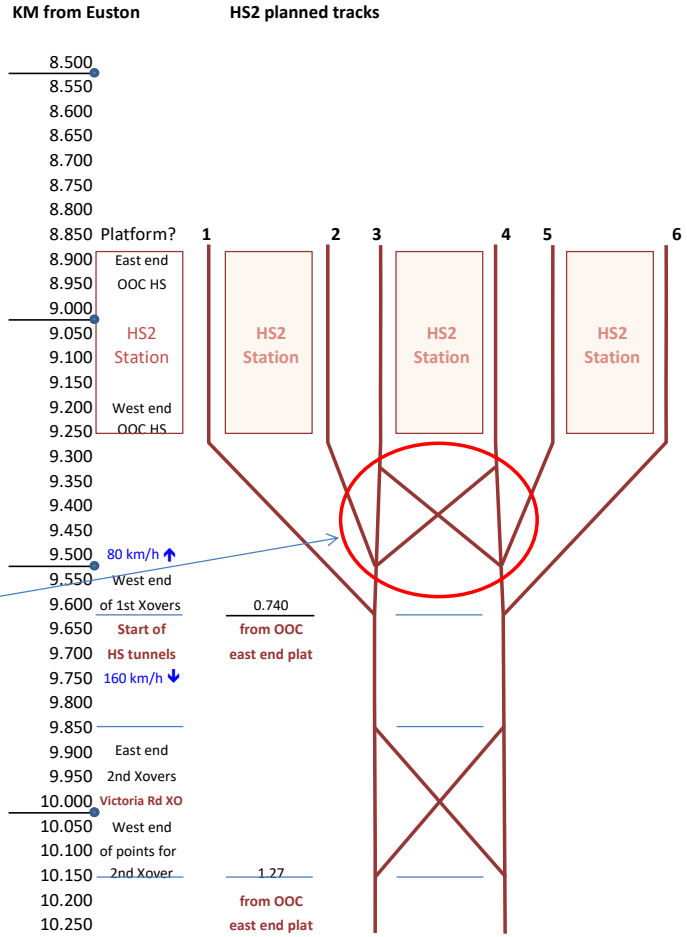
JRC COMMENTS

This possible track layout at OOC (left) permits multiple types of train movements. Parallel train moves in and out are possible simultaneously, apart from conflicting moves in/out of platforms 1 and 6 (from up line into P6, from P1 to down line).

Fewer crossovers closer to the platforms (if dashed lines removed) would allow fewer opportunities for parallel moves, and more occasions when only one train movement at a time is possible.

The extent of amended tunnelling to permit a workable track layout will require consideration. HS2 has already intended to have two station 'throat' junctions - one at each end of the platforms - to enable up and down trains to access different platforms, and for emergency reversing of the HS2 service at OOC if Euston became unavailable becuse of an operational incident or if the line into Euston had to be closed for engineering purposes.

However, HS2 has a different western junction layout at OOC, shown on the right, which offers less flexibility of platform slots, with conflicts arising with P5/6 inwards and P1/2 outwards. There is also a longer distance to the final crossover westwards, which may be unavoidable with local land constraints.
Key difference is later junction with HS2 scheme for Platforms 2, 5
This reduces accessibility to those platforms.



TRAIN ACCELERATION AND BRAKING NEAR OOC TERMINUS

Mph/sec/sec acceleration westbound > 0.962 < Choose between Pendolino (0.962) or faster assumption for new HS2 trains (eg, 1.2)

Seconds	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**
Mph/sec		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962
Permitted maximum speed	0	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Speed at end of sec	0	1	2	3	4	5	6	7	8	9	10	11	12	13	13	14	15	16	17	18	19	20	21.2	22.1	23.1	24.1	25	26	26.9	27.9
Avge speed in sec		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	20.7	21.6	22.6	23.6	24.5	25.5	26.5	27.4
Yards covered in sec		0	1	1	2	2	3	3	4	4	4	5	5	6	6	7	7	8	8	9	9	10	10	10.6	11.1	11.5	12.0	12.5	12.9	13.4
Cumulative **yards** in secs		0	1	2	4	6	8	12	15	19	24	28	34	40	46	53	60	68	76	85	94	104	114	124.4	135.4	147.0	159.0	171.4	184.4	197.8
Cumulative chains in X secs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**3**	**3**	**3**	**4**	**4**	**5**	**5.2**	**5.7**	**6.2**	**6.7**	**7.2**	**7.8**	**8.4**	**9.0**
Km.decimal in X secs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.10**	**0.11**	**0.12**	**0.13**	**0.15**	**0.16**	**0.17**	**0.18**
Miles.decimal in X secs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.06**	**0.07**	**0.08**	**0.08**	**0.09**	**0.10**	**0.10**	**0.11**

Mph/sec/sec braking eastbound < 0.7

Seconds	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**
Mph/sec		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Permitted maximum speed	0	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Speed at end of sec	0	1	1	2	3	4	4	5	6	6	7	8	8	9	10	11	11	12	13	13	14	15	15.4	16.1	16.8	17.5	18.2	18.9	19.6	20.3
Avge speed in sec		0	1	2	2	3	4	5	5	6	7	7	8	9	9	10	11	12	12	13	14	14	15.1	15.8	16.5	17.2	17.9	18.6	19.3	20
Yards covered in sec		0	1	1	1	2	2	2	3	3	3	4	4	4	5	5	5	6	6	6	7	7	7	7.7	8.0	8.4	8.7	9.1	9.4	9.8
Cumulative **yards** in secs		0	1	2	3	4	6	8	11	14	17	21	25	29	34	39	44	49	55	62	68	75	83	90.5	98.6	106.9	115.7	124.7	134.2	143.9
Cumulative chains in X secs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**3**	**3**	**3**	**3**	**3.8**	**4.1**	**4.5**	**4.9**	**5.3**	**5.7**	**6.1**	**6.5**
Km.decimal in X secs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.08**	**0.08**	**0.09**	**0.10**	**0.11**	**0.11**	**0.12**	**0.13**
Miles.decimal in X secs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.05**	**0.05**	**0.06**	**0.06**	**0.07**	**0.07**	**0.08**	**0.08**

30	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**
0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962
50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
28.9	29.8	30.8	31.7	32.7	33.7	34.6	35.6	36.6	37.5	38.5	39.4	40.4	41.4	42.3	43.3	44.3	45.2	46.2	47.1	48.1	49.062	50
28.4	29.3	30.3	31.3	32.2	33.2	34.2	35.1	36.1	37	38	39	39.9	40.9	41.8	42.8	43.8	44.7	45.7	46.7	47.619	48.581	49.543
13.9	14.3	14.8	15.3	15.8	16.2	16.7	17.2	17.6	18.1	18.6	19.0	19.5	20.0	20.5	20.9	21.4	21.9	22.3	22.8	23.3	23.8	24.2
211.6	226.0	240.8	256.1	271.8	288.1	304.8	321.9	339.6	357.7	376.2	395.3	414.8	434.8	455.3	476.2	497.6	519.5	541.8	564.6	587.9	611.6	635.9
9.6	**10.3**	**10.9**	**11.6**	**12.4**	**13.1**	**13.9**	**14.6**	**15.4**	**16.3**	**17.1**	**18.0**	**18.9**	**19.8**	**20.7**	**21.6**	**22.6**	**23.6**	**24.6**	**25.7**	**26.7**	**27.8**	**28.9**
0.19	**0.21**	**0.22**	**0.23**	**0.25**	**0.26**	**0.28**	**0.29**	**0.31**	**0.33**	**0.34**	**0.36**	**0.38**	**0.40**	**0.42**	**0.44**	**0.45**	**0.47**	**0.50**	**0.52**	**0.54**	**0.56**	**0.58**
0.12	**0.13**	**0.14**	**0.15**	**0.15**	**0.16**	**0.17**	**0.18**	**0.19**	**0.20**	**0.21**	**0.22**	**0.24**	**0.25**	**0.26**	**0.27**	**0.28**	**0.30**	**0.31**	**0.32**	**0.33**	**0.35**	**0.36**

30	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**
0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
21	21.7	22.4	23.1	23.8	24.5	25.2	25.9	26.6	27.3	28	28.7	29.4	30.1	30.8	31.5	32.2	32.9	33.6	34.3	35	35.7	36.4
20.7	21.4	22.1	22.8	23.5	24.2	24.9	25.6	26.3	27	27.7	28.4	29.1	29.8	30.5	31.2	31.9	32.6	33.3	34	34.65	35.35	36.05
10.1	10.4	10.8	11.1	11.5	11.8	12.1	12.5	12.8	13.2	13.5	13.9	14.2	14.5	14.9	15.2	15.6	15.9	16.3	16.6	16.9	17.3	17.6
154.0	164.4	175.2	186.3	197.8	209.6	221.8	234.3	247.1	260.3	273.8	287.6	301.8	316.4	331.3	346.5	362.1	378.0	394.2	410.8	427.8	445.1	462.7
7.0	**7.5**	**8.0**	**8.5**	**9.0**	**9.5**	**10.1**	**10.6**	**11.2**	**11.8**	**12.4**	**13.1**	**13.7**	**14.4**	**15.1**	**15.8**	**16.5**	**17.2**	**17.9**	**18.7**	**19.4**	**20.2**	**21.0**
0.14	**0.15**	**0.16**	**0.17**	**0.18**	**0.19**	**0.20**	**0.21**	**0.23**	**0.24**	**0.25**	**0.26**	**0.28**	**0.29**	**0.30**	**0.32**	**0.33**	**0.35**	**0.36**	**0.38**	**0.39**	**0.41**	**0.42**
0.09	**0.09**	**0.10**	**0.11**	**0.11**	**0.12**	**0.13**	**0.13**	**0.14**	**0.15**	**0.16**	**0.16**	**0.17**	**0.18**	**0.19**	**0.20**	**0.21**	**0.21**	**0.22**	**0.23**	**0.24**	**0.25**	**0.26**

Speed limit may change at 9.6 km (=0.74 km from OOC east end). shown here for 0.962 rate,

53	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**
0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962
50	50	50	50	50	50	50	100	100	100	100	100	100	100	100	100
50	50	50	50	50	50	50	50.962	51.924	52.886	53.848	54.81	55.772	56.734	57.696	58.658
50	50	50	50	50	50	50	50.481	51.443	52.405	53.367	54.329	55.291	56.253	57.215	58.177
24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.7	25.1	25.6	26.1	26.6	27.0	27.5	28.0	28.4
660.3	684.7	709.2	733.6	758.1	782.5	807.0	831.7	856.8	882.4	908.5	935.1	962.1	989.6	1017.6	1046.0
30.0	**31.1**	**32.2**	**33.3**	**34.5**	**35.6**	**36.7**	**37.8**	**38.9**	**40.1**	**41.3**	**42.5**	**43.7**	**45.0**	**46.3**	**47.5**
0.60	**0.63**	**0.65**	**0.67**	**0.69**	**0.72**	**0.74**	**0.76**	**0.78**	**0.81**	**0.83**	**0.85**	**0.88**	**0.90**	**0.93**	**0.96**
0.38	**0.39**	**0.40**	**0.42**	**0.43**	**0.44**	**0.46**	**0.47**	**0.49**	**0.50**	**0.52**	**0.53**	**0.55**	**0.56**	**0.58**	**0.59**

53	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**
0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
37.1	37.8	38.5	39.2	39.9	40.6	41.3	42	42.7	43.4	44.1	44.8	45.5	46.2	46.9	47.6
36.75	37.45	38.15	38.85	39.55	40.25	40.95	41.65	42.35	43.05	43.75	44.45	45.15	45.85	46.55	47.25
18.0	18.3	18.7	19.0	19.3	19.7	20.0	20.4	20.7	21.0	21.4	21.7	22.1	22.4	22.8	23.1
480.7	499.0	517.6	536.6	555.9	575.6	595.6	616.0	636.7	657.8	679.1	700.9	722.9	745.4	768.1	791.2
21.8	**22.7**	**23.5**	**24.4**	**25.3**	**26.2**	**27.1**	**28.0**	**28.9**	**29.9**	**30.9**	**31.9**	**32.9**	**33.9**	**34.9**	**36.0**
0.44	**0.46**	**0.47**	**0.49**	**0.51**	**0.53**	**0.54**	**0.56**	**0.58**	**0.60**	**0.62**	**0.64**	**0.66**	**0.68**	**0.70**	**0.72**
0.27	**0.28**	**0.29**	**0.30**	**0.32**	**0.33**	**0.34**	**0.35**	**0.36**	**0.37**	**0.39**	**0.40**	**0.41**	**0.42**	**0.44**	**0.45**

but timing of change would be sooner with faster acceleration

69	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**	**81**	**82**
0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962
100	100	100	100	100	100	100	100	100	100	100	100	100	100
59.62	60.582	61.544	62.506	63.468	64.43	65.392	66.354	67.316	68.278	69.24	70.202	71.164	72.126
59.139	60.101	61.063	62.025	62.987	63.949	64.911	65.873	66.835	67.797	68.759	69.721	70.683	71.645
28.9	29.4	29.9	30.3	30.8	31.3	31.7	32.2	32.7	33.1	33.6	34.1	34.6	35.0
1074.9	1104.3	1134.2	1164.5	1195.3	1226.5	1258.3	1290.5	1323.2	1356.3	1389.9	1424.0	1458.6	1493.6
48.9	**50.2**	**51.6**	**52.9**	**54.3**	**55.8**	**57.2**	**58.7**	**60.1**	**61.7**	**63.2**	**64.7**	**66.3**	**67.9**
0.98	**1.01**	**1.04**	**1.06**	**1.09**	**1.12**	**1.15**	**1.18**	**1.21**	**1.24**	**1.27**	**1.30**	**1.33**	**1.37**
0.61	**0.63**	**0.64**	**0.66**	**0.68**	**0.70**	**0.71**	**0.73**	**0.75**	**0.77**	**0.79**	**0.81**	**0.83**	**0.85**

Speed limit can change at 9.6 km (=0.74 km from OOC east end)

69	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**	**81**	**82**
0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
50	100	100	100	100	100	100	100	100	100	100	100	100	100
48.3	49	49.7	50.4	51.1	51.8	52.5	53.2	53.9	54.6	55.3	56	56.7	57.4
47.95	48.65	49.35	50.05	50.75	51.45	52.15	52.85	53.55	54.25	54.95	55.65	56.35	57.05
23.4	23.8	24.1	24.5	24.8	25.2	25.5	25.8	26.2	26.5	26.9	27.2	27.5	27.9
814.7	838.4	862.6	887.0	911.9	937.0	962.5	988.3	1014.5	1041.0	1067.9	1095.1	1122.7	1150.6
37.0	**38.1**	**39.2**	**40.3**	**41.4**	**42.6**	**43.8**	**44.9**	**46.1**	**47.3**	**48.5**	**49.8**	**51.0**	**52.3**
0.74	**0.77**	**0.79**	**0.81**	**0.83**	**0.86**	**0.88**	**0.90**	**0.93**	**0.95**	**0.98**	**1.00**	**1.03**	**1.05**
0.46	**0.48**	**0.49**	**0.50**	**0.52**	**0.53**	**0.55**	**0.56**	**0.58**	**0.59**	**0.61**	**0.62**	**0.64**	**0.65**

83	**84**	**85**	**86**	**87**	**88**	**89**	**90**	**91**	**92**	**93**	**94**	**95**	**96**
0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962
100	100	100	100	100	100	100	100	100	100	100	100	100	100
73.088	74.05	75.012	75.974	76.936	77.898	78.86	79.822	80.784	81.746	82.708	83.67	84.632	85.594
72.607	73.569	74.531	75.493	76.455	77.417	78.379	79.341	80.303	81.265	82.227	83.189	84.151	85.113
35.5	36.0	36.4	36.9	37.4	37.8	38.3	38.8	39.3	39.7	40.2	40.7	41.1	41.6
1529.1	1565.1	1601.5	1638.4	1675.8	1713.6	1751.9	1790.7	1830.0	1869.7	1909.9	1950.6	1991.7	2033.3
69.5	**71.1**	**72.8**	**74.5**	**76.2**	**77.9**	**79.6**	**81.4**	**83.2**	**85.0**	**86.8**	**88.7**	**90.5**	**92.4**
1.40	**1.43**	**1.46**	**1.50**	**1.53**	**1.57**	**1.60**	**1.64**	**1.67**	**1.71**	**1.75**	**1.78**	**1.82**	**1.86**
0.87	**0.89**	**0.91**	**0.93**	**0.95**	**0.97**	**1.00**	**1.02**	**1.04**	**1.06**	**1.09**	**1.11**	**1.13**	**1.16**

83	**84**	**85**	**86**	**87**	**88**	**89**	**90**	**91**	**92**	**93**	**94**	**95**	**96**
0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
100	100	100	100	100	100	100	100	100	100	100	100	100	100
58.1	58.8	59.5	60.2	60.9	61.6	62.3	63	63.7	64.4	65.1	65.8	66.5	67.2
57.75	58.45	59.15	59.85	60.55	61.25	61.95	62.65	63.35	64.05	64.75	65.45	66.15	66.85
28.2	28.6	28.9	29.3	29.6	29.9	30.3	30.6	31.0	31.3	31.7	32.0	32.3	32.7
1178.8	1207.4	1236.3	1265.5	1295.1	1325.1	1355.4	1386.0	1417.0	1448.3	1479.9	1511.9	1544.3	1577.0
53.6	**54.9**	**56.2**	**57.5**	**58.9**	**60.2**	**61.6**	**63.0**	**64.4**	**65.8**	**67.3**	**68.7**	**70.2**	**71.7**
1.08	**1.10**	**1.13**	**1.16**	**1.18**	**1.21**	**1.24**	**1.27**	**1.30**	**1.32**	**1.35**	**1.38**	**1.41**	**1.44**
0.67	**0.69**	**0.70**	**0.72**	**0.74**	**0.75**	**0.77**	**0.79**	**0.81**	**0.82**	**0.84**	**0.86**	**0.88**	**0.90**

97	**98**	**99**	**100**	**101**	**102**	**103**	**104**	**105**	**106**	**107**	**108**	**109**	**110**
0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962
100	100	100	100	100	100	100	100	100	100	100	100	100	100
86.556	87.518	88.48	89.442	90.404	91.366	92.328	93.29	94.252	95.214	96.176	97.138	98.1	99.062
86.075	87.037	87.999	88.961	89.923	90.885	91.847	92.809	93.771	94.733	95.695	96.657	97.619	98.581
42.1	42.6	43.0	43.5	44.0	44.4	44.9	45.4	45.8	46.3	46.8	47.3	47.7	48.2
2075.4	2118.0	2161.0	2204.5	2248.5	2292.9	2337.8	2383.2	2429.0	2475.3	2522.1	2569.4	2617.1	2665.3
94.3	**96.3**	**98.2**	**100.2**	**102.2**	**104.2**	**106.3**	**108.3**	**110.4**	**112.5**	**114.6**	**116.8**	**119.0**	**121.1**
1.90	**1.94**	**1.98**	**2.02**	**2.06**	**2.10**	**2.14**	**2.18**	**2.22**	**2.26**	**2.31**	**2.35**	**2.39**	**2.44**
1.18	**1.20**	**1.23**	**1.25**	**1.28**	**1.30**	**1.33**	**1.35**	**1.38**	**1.41**	**1.43**	**1.46**	**1.49**	**1.51**

97	**98**	**99**	**100**	**101**	**102**	**103**	**104**	**105**	**106**	**107**	**108**	**109**	**110**
0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
100	100	100	100	100	100	100	100	100	100	100	100	100	100
67.9	68.6	69.3	70	70.7	71.4	72.1	72.8	73.5	74.2	74.9	75.6	76.3	77
67.55	68.25	68.95	69.65	70.35	71.05	71.75	72.45	73.15	73.85	74.55	75.25	75.95	76.65
33.0	33.4	33.7	34.1	34.4	34.7	35.1	35.4	35.8	36.1	36.4	36.8	37.1	37.5
1610.0	1643.4	1677.1	1711.1	1745.5	1780.2	1815.3	1850.7	1886.5	1922.6	1959.1	1995.8	2033.0	2070.4
73.2	**74.7**	**76.2**	**77.8**	**79.3**	**80.9**	**82.5**	**84.1**	**85.8**	**87.4**	**89.0**	**90.7**	**92.4**	**94.1**
1.47	**1.50**	**1.53**	**1.56**	**1.60**	**1.63**	**1.66**	**1.69**	**1.72**	**1.76**	**1.79**	**1.82**	**1.86**	**1.89**
0.91	**0.93**	**0.95**	**0.97**	**0.99**	**1.01**	**1.03**	**1.05**	**1.07**	**1.09**	**1.11**	**1.13**	**1.16**	**1.18**

111	**112**	**113**	**114**	**115**	**116**	**117**	**118**	**119**	**120**	**121**	**122**	**123**	**124**
0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962
100	100	100	100	100	100	100	100	100	100	100	100	100	100
100	100	100	100	100	100	100	100	100	100	100	100	100	100
99.543	100	100	100	100	100	100	100	100	100	100	100	100	100
48.7	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9
2713.9	2762.8	2811.7	2860.6	2909.5	2958.4	3007.3	3056.2	3105.1	3153.9	3202.8	3251.7	3300.6	3349.5
123.4	**125.6**	**127.8**	**130.0**	**132.2**	**134.5**	**136.7**	**138.9**	**141.1**	**143.4**	**145.6**	**147.8**	**150.0**	**152.2**
2.48	**2.53**	**2.57**	**2.62**	**2.66**	**2.70**	**2.75**	**2.79**	**2.84**	**2.88**	**2.93**	**2.97**	**3.02**	**3.06**
1.54	**1.57**	**1.60**	**1.63**	**1.65**	**1.68**	**1.71**	**1.74**	**1.76**	**1.79**	**1.82**	**1.85**	**1.88**	**1.90**

111	**112**	**113**	**114**	**115**	**116**	**117**	**118**	**119**	**120**	**121**	**122**	**123**	**124**
0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
100	100	100	100	100	100	100	100	100	100	100	100	100	100
77.7	78.4	79.1	79.8	80.5	81.2	81.9	82.6	83.3	84	84.7	85.4	86.1	86.8
77.35	78.05	78.75	79.45	80.15	80.85	81.55	82.25	82.95	83.65	84.35	85.05	85.75	86.45
37.8	38.2	38.5	38.8	39.2	39.5	39.9	40.2	40.6	40.9	41.2	41.6	41.9	42.3
2108.3	2146.4	2184.9	2223.8	2262.9	2302.5	2342.3	2382.6	2423.1	2464.0	2505.2	2546.8	2588.7	2631.0
95.8	**97.6**	**99.3**	**101.1**	**102.9**	**104.7**	**106.5**	**108.3**	**110.1**	**112.0**	**113.9**	**115.8**	**117.7**	**119.6**
1.93	**1.96**	**2.00**	**2.03**	**2.07**	**2.10**	**2.14**	**2.18**	**2.22**	**2.25**	**2.29**	**2.33**	**2.37**	**2.41**
1.20	**1.22**	**1.24**	**1.26**	**1.29**	**1.31**	**1.33**	**1.35**	**1.38**	**1.40**	**1.42**	**1.45**	**1.47**	**1.49**

125	**126**	**127**	**128**	**129**	**130**	**131**	**132**	**133**	**134**	**135**	**136**	**137**	**138**
0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962
100	100	100	100	100	100	100	100	100	100	100	100	100	100
100	100	100	100	100	100	100	100	100	100	100	100	100	100
100	100	100	100	100	100	100	100	100	100	100	100	100	100
48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9
3398.4	3447.3	3496.2	3545.1	3593.9	3642.8	3691.7	3740.6	3789.5	3838.4	3887.3	3936.2	3985.1	4033.9
154.5	**156.7**	**158.9**	**161.1**	**163.4**	**165.6**	**167.8**	**170.0**	**172.2**	**174.5**	**176.7**	**178.9**	**181.1**	**183.4**
3.11	**3.15**	**3.20**	**3.24**	**3.29**	**3.33**	**3.37**	**3.42**	**3.46**	**3.51**	**3.55**	**3.60**	**3.64**	**3.69**
1.93	**1.96**	**1.99**	**2.01**	**2.04**	**2.07**	**2.10**	**2.13**	**2.15**	**2.18**	**2.21**	**2.24**	**2.26**	**2.29**

125	**126**	**127**	**128**	**129**	**130**	**131**	**132**	**133**	**134**	**135**	**136**	**137**	**138**
0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
100	100	100	100	100	100	100	100	100	100	100	100	100	100
87.5	88.2	88.9	89.6	90.3	91	91.7	92.4	93.1	93.8	94.5	95.2	95.9	96.6
87.15	87.85	88.55	89.25	89.95	90.65	91.35	92.05	92.75	93.45	94.15	94.85	95.55	96.25
42.6	42.9	43.3	43.6	44.0	44.3	44.7	45.0	45.3	45.7	46.0	46.4	46.7	47.1
2673.6	2716.6	2759.9	2803.5	2847.5	2891.8	2936.4	2981.4	3026.8	3072.5	3118.5	3164.9	3211.6	3258.6
121.5	**123.5**	**125.4**	**127.4**	**129.4**	**131.4**	**133.5**	**135.5**	**137.6**	**139.7**	**141.8**	**143.9**	**146.0**	**148.1**
2.44	**2.48**	**2.52**	**2.56**	**2.60**	**2.64**	**2.68**	**2.73**	**2.77**	**2.81**	**2.85**	**2.89**	**2.94**	**2.98**
1.52	**1.54**	**1.57**	**1.59**	**1.62**	**1.64**	**1.67**	**1.69**	**1.72**	**1.75**	**1.77**	**1.80**	**1.82**	**1.85**

139	**140**	**141**	**142**	**143**	**144**	**145**	**146**	**147**	**148**	**149**	**150**	**151**	**152**
0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962
100	100	100	100	100	100	100	100	100	100	100	100	100	100
100	100	100	100	100	100	100	100	100	100	100	100	100	100
100	100	100	100	100	100	100	100	100	100	100	100	100	100
48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9
4082.8	4131.7	4180.6	4229.5	4278.4	4327.3	4376.2	4425.1	4473.9	4522.8	4571.7	4620.6	4669.5	4718.4
185.6	**187.8**	**190.0**	**192.2**	**194.5**	**196.7**	**198.9**	**201.1**	**203.4**	**205.6**	**207.8**	**210.0**	**212.2**	**214.5**
3.73	**3.78**	**3.82**	**3.87**	**3.91**	**3.96**	**4.00**	**4.05**	**4.09**	**4.13**	**4.18**	**4.22**	**4.27**	**4.31**
2.32	**2.35**	**2.38**	**2.40**	**2.43**	**2.46**	**2.49**	**2.51**	**2.54**	**2.57**	**2.60**	**2.63**	**2.65**	**2.68**

139	**140**	**141**	**142**	**143**	**144**	**145**	**146**	**147**	**148**	**149**	**150**	**151**	**152**
0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
100	100	100	100	100	100	100	100	100	100	100	100	100	100
97.3	98	98.7	99.4	100	100	100	100	100	100	100	100	100	100
96.95	97.65	98.35	99.05	99.75	100	100	100	100	100	100	100	100	100
47.4	47.7	48.1	48.4	48.8	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9
3306.0	3353.8	3401.9	3450.3	3499.1	3547.9	3596.8	3645.7	3694.6	3743.5	3792.4	3841.3	3890.2	3939.1
150.3	**152.4**	**154.6**	**156.8**	**159.0**	**161.3**	**163.5**	**165.7**	**167.9**	**170.2**	**172.4**	**174.6**	**176.8**	**179.0**
3.02	**3.07**	**3.11**	**3.15**	**3.20**	**3.24**	**3.29**	**3.33**	**3.38**	**3.42**	**3.47**	**3.51**	**3.56**	**3.60**
1.88	**1.91**	**1.93**	**1.96**	**1.99**	**2.02**	**2.04**	**2.07**	**2.10**	**2.13**	**2.15**	**2.18**	**2.21**	**2.24**

153	**154**	**155**	**156**	**157**	**158**	**159**	**160**	**161**	**162**	**163**	**164**	**165**	**166**
0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962
100	100	100	100	100	100	100	100	100	100	100	100	100	100
100	100	100	100	100	100	100	100	100	100	100	100	100	100
100	100	100	100	100	100	100	100	100	100	100	100	100	100
48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9
4767.3	4816.2	4865.1	4913.9	4962.8	5011.7	5060.6	5109.5	5158.4	5207.3	5256.2	5305.1	5353.9	5402.8
216.7	**218.9**	**221.1**	**223.4**	**225.6**	**227.8**	**230.0**	**232.2**	**234.5**	**236.7**	**238.9**	**241.1**	**243.4**	**245.6**
4.36	**4.40**	**4.45**	**4.49**	**4.54**	**4.58**	**4.63**	**4.67**	**4.72**	**4.76**	**4.81**	**4.85**	**4.89**	**4.94**
2.71	**2.74**	**2.76**	**2.79**	**2.82**	**2.85**	**2.88**	**2.90**	**2.93**	**2.96**	**2.99**	**3.01**	**3.04**	**3.07**

153	**154**	**155**	**156**	**157**	**158**	**159**	**160**	**161**	**162**	**163**	**164**	**165**	**166**
0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
100	100	100	100	100	100	100	100	100	100	100	100	100	100
100	100	100	100	100	100	100	100	100	100	100	100	100	100
100	100	100	100	100	100	100	100	100	100	100	100	100	100
48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9
3987.9	4036.8	4085.7	4134.6	4183.5	4232.4	4281.3	4330.2	4379.1	4427.9	4476.8	4525.7	4574.6	4623.5
181.3	**183.5**	**185.7**	**187.9**	**190.2**	**192.4**	**194.6**	**196.8**	**199.0**	**201.3**	**203.5**	**205.7**	**207.9**	**210.2**
3.65	**3.69**	**3.74**	**3.78**	**3.82**	**3.87**	**3.91**	**3.96**	**4.00**	**4.05**	**4.09**	**4.14**	**4.18**	**4.23**
2.27	**2.29**	**2.32**	**2.35**	**2.38**	**2.40**	**2.43**	**2.46**	**2.49**	**2.52**	**2.54**	**2.57**	**2.60**	**2.63**

167	**168**	**169**	**170**	**171**	**172**	**173**	**174**	**175**	**176**	**177**	**178**	**179**	**180**
0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962
100	100	100	100	100	100	100	100	100	100	100	100	100	100
100	100	100	100	100	100	100	100	100	100	100	100	100	100
100	100	100	100	100	100	100	100	100	100	100	100	100	100
48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9
5451.7	5500.6	5549.5	5598.4	5647.3	5696.2	5745.1	5793.9	5842.8	5891.7	5940.6	5989.5	6038.4	6087.3
247.8	**250.0**	**252.2**	**254.5**	**256.7**	**258.9**	**261.1**	**263.4**	**265.6**	**267.8**	**270.0**	**272.2**	**274.5**	**276.7**
4.98	**5.03**	**5.07**	**5.12**	**5.16**	**5.21**	**5.25**	**5.30**	**5.34**	**5.39**	**5.43**	**5.48**	**5.52**	**5.57**
3.10	**3.13**	**3.15**	**3.18**	**3.21**	**3.24**	**3.26**	**3.29**	**3.32**	**3.35**	**3.38**	**3.40**	**3.43**	**3.46**

167	**168**	**169**	**170**	**171**	**172**	**173**	**174**	**175**	**176**	**177**	**178**	**179**	**180**
0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
100	100	100	100	100	100	100	100	100	100	100	100	100	100
100	100	100	100	100	100	100	100	100	100	100	100	100	100
100	100	100	100	100	100	100	100	100	100	100	100	100	100
48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9
4672.4	4721.3	4770.2	4819.1	4867.9	4916.8	4965.7	5014.6	5063.5	5112.4	5161.3	5210.2	5259.1	5307.9
212.4	**214.6**	**216.8**	**219.0**	**221.3**	**223.5**	**225.7**	**227.9**	**230.2**	**232.4**	**234.6**	**236.8**	**239.0**	**241.3**
4.27	**4.32**	**4.36**	**4.41**	**4.45**	**4.49**	**4.54**	**4.58**	**4.63**	**4.67**	**4.72**	**4.76**	**4.81**	**4.85**
2.65	**2.68**	**2.71**	**2.74**	**2.77**	**2.79**	**2.82**	**2.85**	**2.88**	**2.90**	**2.93**	**2.96**	**2.99**	**3.02**

181	**182**	**183**	**184**	**185**	**186**	**187**	**188**	**189**	**190**	**191**	**192**	**193**	**194**
0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962	0.962
100	100	100	100	100	100	100	100	100	100	100	100	100	100
100	100	100	100	100	100	100	100	100	100	100	100	100	100
100	100	100	100	100	100	100	100	100	100	100	100	100	100
48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9
6136.2	6185.1	6233.9	6282.8	6331.7	6380.6	6429.5	6478.4	6527.3	6576.2	6625.1	6673.9	6722.8	6771.7
278.9	**281.1**	**283.4**	**285.6**	**287.8**	**290.0**	**292.2**	**294.5**	**296.7**	**298.9**	**301.1**	**303.4**	**305.6**	**307.8**
5.61	**5.65**	**5.70**	**5.74**	**5.79**	**5.83**	**5.88**	**5.92**	**5.97**	**6.01**	**6.06**	**6.10**	**6.15**	**6.19**
3.49	**3.51**	**3.54**	**3.57**	**3.60**	**3.63**	**3.65**	**3.68**	**3.71**	**3.74**	**3.76**	**3.79**	**3.82**	**3.85**

181	**182**	**183**	**184**	**185**	**186**	**187**	**188**	**189**	**190**	**191**	**192**	**193**	**194**
0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
100	100	100	100	100	100	100	100	100	100	100	100	100	100
100	100	100	100	100	100	100	100	100	100	100	100	100	100
100	100	100	100	100	100	100	100	100	100	100	100	100	100
48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9
5356.8	5405.7	5454.6	5503.5	5552.4	5601.3	5650.2	5699.1	5747.9	5796.8	5845.7	5894.6	5943.5	5992.4
243.5	**245.7**	**247.9**	**250.2**	**252.4**	**254.6**	**256.8**	**259.0**	**261.3**	**263.5**	**265.7**	**267.9**	**270.2**	**272.4**
4.90	**4.94**	**4.99**	**5.03**	**5.08**	**5.12**	**5.17**	**5.21**	**5.25**	**5.30**	**5.34**	**5.39**	**5.43**	**5.48**
3.04	**3.07**	**3.10**	**3.13**	**3.15**	**3.18**	**3.21**	**3.24**	**3.27**	**3.29**	**3.32**	**3.35**	**3.38**	**3.40**

195	**196**	**197**	**198**	**199**	**200**
0.962	0.962	0.962	0.962	0.962	0.962
100	100	100	100	100	100
100	100	100	100	100	100
100	100	100	100	100	100
48.9	48.9	48.9	48.9	48.9	48.9
6820.6	6869.5	6918.4	6967.3	7016.2	7065.1
310.0	**312.2**	**314.5**	**316.7**	**318.9**	**321.1**
6.24	**6.28**	**6.32**	**6.37**	**6.41**	**6.46**
3.88	**3.90**	**3.93**	**3.96**	**3.99**	**4.01**

195	**196**	**197**	**198**	**199**	**200**
0.7	0.7	0.7	0.7	0.7	0.7
100	100	100	100	100	100
100	100	100	100	100	100
100	100	100	100	100	100
48.9	48.9	48.9	48.9	48.9	48.9
6041.3	6090.2	6139.1	6187.9	6236.8	6285.7
274.6	**276.8**	**279.0**	**281.3**	**283.5**	**285.7**
5.52	**5.57**	**5.61**	**5.66**	**5.70**	**5.75**
3.43	**3.46**	**3.49**	**3.52**	**3.54**	**3.57**