

## Appendix K. Train Operations

- HST Phase 1 Service Plan
- Caltrain Operations Schedule
- Concept Level Operations Analysis for San Francisco Terminal



## California High-Speed Train Project



## TECHNICAL MEMORANDUM

Phase 1 Service Plan  
TM 4.2

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PHASE 1 SERVICE PLAN

1. INTRODUCTION

A concept level service plan and hypothetical timetable for the Phase 1 California High Speed Train (HST) project has been developed, which provides a description of the proposed type and quantity of service that is more detailed than had been available previously. The Phase 1 service plan is intended to serve several purposes:

- Confirm the level of service assumptions (travel times and service frequencies between station pairs) used to develop the estimates of system ridership and revenue
- Validate the operational feasibility of the desired level of service at a conceptual level
- Identify operable patterns of train service, particularly the general requirements for non-stop or limited-stop trains to pass slower trains that need to make a greater number of stops along the route (i.e., the locations and frequencies of occurrence of these “overtakes” at various times of day)
- Provide a basis for estimating the number of required train sets and overall rolling stock fleet requirements
- Provide a basis for estimating platform track and storage track capacity needed to support operations at the end terminal stations

2. ANALYTIC METHODOLOGY

A PB-developed spreadsheet-based “static” model for formulating and analyzing concept level operating plans for railroad systems was adapted for the HST network. This model utilizes train performance calculations taken from prior detailed “dynamic” simulation modeling results to identify the running time characteristics of the various types of service and train stopping patterns that are expected to operate on the HST system. The model generates stringline (time-distance) diagrams and tabular outputs describing the timing and scheduled operating performance of every train. It provides a level of detail sufficient to confidently perform “pattern analysis” of the various express, limited stop and all-stop local services that are envisioned, with the objective of identifying a reasonable service pattern that achieves the desired level of service at each station while minimizing both conflicts between trains and the required number of overtakes.

The spreadsheet model provides the ability for trains to be “linked” with subsequent trains and assigned to specific train sets. The resulting train set equipment cycles form the basis for estimating the size of the required rolling stock fleet.

The model also includes a module that compares the forecast level of system ridership with the quantity of service delivered, allocating riders to specific trains and calculating estimated load factors (projected number of riders per train divided by train seating capacity), using station specific boarding and alighting passenger (detail) estimates and peaking factors derived from the ridership forecasts.

This plan, while contributing to confident approximations at the conceptual level, does not yet represent a detailed operating plan for the system, even though the train timetables and stringline (time-distance) diagrams give the impression of a high level of precision. This conceptual plan

analysis is based on optimal ideal operations with trains running exactly on schedule. It does not analyze any randomization, delays or perturbations to the normal schedule and does not address the time required to recover from track blockages or the impacts of delay conditions on the network. A full detailed operating plan supported by dynamic computer simulation modeling of train movements throughout the system will be developed in a subsequent task later in the project, at which time an actual proposed timetable can be confidently prepared and approved.

### 3. ASSUMPTIONS AND GENERAL PRINCIPLES

The following assumptions and general principals guided the development of the Phase 1 service plan:

1. The HST system assumed to operate independently of any other passenger or freight rail services
2. Train sets are assumed to comprise units of 200 meters (m) in length, either singly (200 m train with 500 passengers) or operating as pairs (400 m train with 1,000 passengers)
3. Train running times were obtained from simulated train performance calculations, with an additional time factor added to these times. This added time, sometimes referred to as "schedule pad" or "recovery time" accounts for operator performance, external conditions and minor delays, which result in minimal day-to-day fluctuations in train performance – the additional time factor assumed in this analysis is common in passenger train scheduling, permits trains to recover from time lost due to minor causes, and provides an allowance for the system to maintain a high degree of overall on-time performance when operations are normal. Two different scenarios were analyzed concerning recovery time. The initial base case analysis assumed a recovery time factor of seven percent on top of the minimum train run time. This is consistent with current industry practice in the U.S. and is considered a conservative estimate, since the HST system is expected to operate at a higher level of precision than is "typical." A second service plan variation was developed assuming a recovery time factor of three and one-half percent for most trains. In this second case, certain "premium" services, such as express trains during peak periods were assumed to operate with a recovery time allowance of as little as one percent.
4. The schedule features "clockface" service patterns and regular intervals between trains (headways), which can be easily remembered and is markedly customer friendly
5. The schedule features service patterns that repeat every hour, as opposed to patterns that differ somewhat from hour-to-hour providing for more simplified operations – this makes the service more regular and predictable and reduces the number of different types of overtakes required
6. The minimum spacing between trains following each other past a given point is set at three minutes, based on the assumed practical capacity design attributes of the signal and train control system
7. Express trains are given the highest priority in terms of their schedule paths; limited stop trains and those that travel a longer distance along the network have the next highest priority, and all-stop local trains generally have the lowest priority and, therefore, the highest incidence of overtakes
8. Train overtakes were arranged to utilize station (siding) tracks for express trains to pass local trains making a service stop, while maintaining consistency and reliability in the service stopping patterns.

9. The level of service between Los Angeles and Anaheim is maintained at four trains per hour per direction in the business travel peaks, and three trains per hour per direction at other times of day
10. The service levels and patterns developed as the basis for the ridership and revenue forecasts were taken as a guideline in the development of the Phase 1 service plan; adjustments were made where necessary to improve the operational efficiency and performance of the system; in all cases the level of service provided at each station remains at or better than the level assumed in the ridership forecasts.

The analysis assumed the following station dwell times and minimum terminal layover (turnaround) times. The latter is defined to be the minimum time allowed between the scheduled arrival of a train set at a terminal and the scheduled departure of the same train set in the opposite direction of service.

TABLE 1 – INTERMEDIATE STATION DWELL TIMES

Code	Station	Scheduled Dwell Time (mins)
SFO	Millbrae	1.5
RWC	Redwood City	1.5
SJC	San Jose	2.0
GLY	Gilroy	1.5
FNO	Fresno	1.5
BFD	Bakersfield	1.5
PMD	Palmdale	1.5
SYL	Sylmar	1.5
BUR	Burbank	1.5
LAU	L.A. Union Sta.	2.0
NSF	Norwalk	1.5

TABLE 2 – TERMINAL STATION MINIMUM LAYOVER TIMES

Code	Station	Minimum Scheduled Layover Time (mins)
SFT	S.F.-Transbay	30
LAU	L.A. Union Sta.	40
ANA	Anaheim	40
MCD	Merced	40

### 4. PHASE 1 SERVICE PLAN

#### STOPPING PATTERNS AND SERVICE FREQUENCIES

Table 3 depicts the various train types and stopping patterns that were used to formulate the Phase 1 service plan, along with the average total estimated travel time from the origin station to the final destination station. The "Express" train type makes only one intermediate stop between San Francisco and Los Angeles – at San Jose – and therefore provides the fastest run time between these points and with an assumption of one percent recovery time during the peak period, is estimated to run between San Francisco and Los Angeles in two hours-forty minutes. At the other end of the spectrum are "All Stop" trains that serve every station along the line and therefore take significantly longer to make a run between San Francisco and the Los Angeles basin.

TABLE 3 – TRAIN STOPPING PATTERNS

STOPPING PATTERNS														End-to-End	
Southbound														Run Time	
Train Type/Pattern	SFT	SFO	RWC	SJC	GLY	MCD	FNO	BFD	PMD	SYL	BUR	LAU	NSF	ANA	(mins)
1 Bay Area Limited	X		X	X	X							X	X	X	205
2 Express	X			X								X	X	X	194
4 All-Stop	X	X	X	X	X		X	X	X	X	X	X	X	X	241
7 Central Valley Limited	X	X	X	X	X		X	X				X	X	X	225
9 San Fernando Valley Limited	X	X		X			X	X		X		X			198
10 Central Valley Limited	X	X	X	X	X		X		X		X	X	X	X	228
13 San Fernando Valley Limited	X		X	X				X	X	X	X	X	X	X	216
14 SF-Merced	X	X	X	X	X	X									94
15 LA-Merced						X	X	X	X	X	X	X	X	X	161
16 Central Valley Limited	X	X	X	X	X		X	X				X			200
17 San Fernando Valley Limited	X		X	X	X				X	X	X	X			196
18 Central Valley Limited	X	X	X	X	X		X		X		X	X			203
19 San Fernando Valley Limited	X		X	X	X				X	X		X			191
20 Central Valley Limited	X	X	X	X			X	X		X		X			200
21 San Fernando Valley Limited	X			X	X			X	X	X	X	X			199

Northbound														End-to-End	
Train Type/Pattern														Run Time	
Train Type/Pattern	ANA	NSF	LAU	BUR	SYL	PMD	BFD	FNO	MCD	GLY	SJC	RWC	SFO	SFT	(mins)
1 Bay Area Limited	X	X	X							X	X	X		X	205
2 Express	X	X	X								X			X	194
4 All-Stop	X	X	X	X	X	X	X	X		X	X	X	X	X	240
7 Central Valley Limited	X	X	X				X	X		X	X	X	X	X	223
9 San Fernando Valley Limited			X		X		X	X			X		X	X	197
10 Central Valley Limited	X	X	X	X		X		X		X	X		X	X	221
13 San Fernando Valley Limited	X	X	X	X	X	X					X	X		X	216
14 SF-Merced									X	X	X	X	X	X	94
15 LA-Merced	X	X	X	X	X	X	X	X	X						163
16 Central Valley Limited			X				X	X		X	X	X	X	X	197
17 San Fernando Valley Limited			X	X	X	X				X	X	X		X	196
18 Central Valley Limited			X	X		X		X		X	X	X	X	X	196
19 San Fernando Valley Limited			X		X	X				X	X	X		X	191
20 Central Valley Limited			X		X		X	X			X	X	X	X	198
21 San Fernando Valley Limited			X	X	X	X	X			X	X	X		X	203

In between these two service types are various categories of "Limited Stop" trains that make selected intermediate station stops but skip other stations. Several different limited stop patterns have been defined. They are grouped and named according to the part of the network within which they provide the greatest degree of service to individual intermediate stations. For instance, the "Bay Area Limiteds" make several stops within the Bay Area between San Francisco and Gilroy and then operate non-stop to Los Angeles. The "Central Valley Limiteds" stop at Fresno and/or Bakersfield but skip selected other intermediate stations, and the "San Fernando Valley Limiteds" make most or all of the stops between Los Angeles and Palmdale but skip many of the stations in the Bay Area and Central Valley. These "Limiteds" make up the majority of trains operating on the network and offer a compromise of a relatively fast run time along with connectivity among various groups of intermediate stations along the line.

The on-board travel time between stations varies, depending on the number of intermediate station stops (which is different for each train type) and the time of day (some trains have additional time built into their peak schedules to allow them to be "overtaken" by express or limited-stop trains while en route). The minimum or "fastest" trip times between selected city pair stations is presented in Table 4, based on the mix of train types and stopping patterns included in the Phase 1 service plan.

TABLE 4 – MINIMUM TRIP TIMES BETWEEN SELECTED STATIONS

(Based on Phase 1 Service Plan Train Stopping Patterns)

With Schedule Pad Allowance of 1.0%

		Times in Hours:Minutes				
		SFT	SJC	FNO	LAU	ANA
SFT	San Francisco-Transbay	--	0:27	1:29	2:40	3:04
SJC	San Jose	0:27	--	0:50	2:11	2:35
FNO	Fresno	1:29	0:50	--	1:31	1:55
LAU	Los Angeles Union Station	2:40	2:11	1:31	--	0:22
ANA	Anaheim	3:04	2:35	1:55	0:22	--

With Schedule Pad Allowance of 3.5%

		Times in Hours:Minutes				
		SFT	SJC	FNO	LAU	ANA
SFT	San Francisco-Transbay	--	0:28	1:31	2:44	3:08
SJC	San Jose	0:28	--	0:51	2:14	2:38
FNO	Fresno	1:31	0:51	--	1:33	1:57
LAU	Los Angeles Union Station	2:44	2:14	1:33	--	0:22
ANA	Anaheim	3:08	2:38	1:57	0:22	--

Note: The HST system is expected to operate at a high level of precision, with schedule pad allowances lower than for other intercity passenger rail corridors in the U.S. The development of system timetables will be based on tradeoffs that will need to be made among trip time, service reliability, alignment engineering, capital cost and operations and maintenance cost considerations.

\*Explanation: Table 4 (above) displays estimated timetable travel times between the city pairs presented in the matrix. For example, when reading the first row of the first table (with schedule pad allowance of 1%), the numbers shown represent the trip time between: San Francisco and San Jose (27 minutes); San Francisco and Fresno (1 hour, 29 minutes); San Francisco and Los Angeles (2 hours, 40 minutes); and San Francisco and Anaheim (3 hours and 4 minutes).

Table 5 compares the service levels and stopping patterns originally assumed as the basis for high speed rail ridership and revenue estimates, and the proposed Phase 1 service plan. The original set of stopping patterns proved to be operationally infeasible, resulting in excessive numbers of overtakes and delays to trains being overtaken. Alternative patterns were examined that deliver

approximately the same level of service at each station, in terms of service frequency and the mix of express, limited stop and all-stop local service. Though the mix of stopping patterns has been modified, the number of trains per hour at each terminal and intermediate station is the same as or higher than what was assumed for the ridership demand forecasting purposes. The proposed mix of services offers regular clockface patterns, with each service type leaving at the same time each hour, with relatively limited exceptions. Slightly more service is assumed during the three hour peak periods in the morning and late afternoon.

TABLE 5 – PEAK AND OFF-PEAK SERVICE FREQUENCIES

**ORIGINAL SERVICE PLAN ASSUMPTIONS FOR RIDERSHIP FORECASTING**

**PEAK HOUR STATION STOPS-SOUTHBOUND**

Pattern No. → 2 1 9 10 7 13 14 15

	Super	Exp	Ltd A	Ltd B	NLAX	VX	SF-M	LA-M	
Trains per hour →	1	0.5	2	2	0.5	0.5	1.5	1.5	9.5
	<b>TOTAL</b>								
SFT S.F.-Transbay	1	0.5	2	2	0.5	0.5	1.5		8
SFO Millbrae			2		0.5		1.5		4
RWC Redwood City		0.5		2	0.5	0.5	1.5		5
SJC San Jose	1	0.5	2	2	0.5	0.5	1.5		8
GLY Gilroy		0.5		2	0.5		1.5		4.5
MCD Merced						1.5	1.5		3
FNO Fresno			2		0.5		1.5		4
BFD Bakersfield			2		0.5		1.5		4
PMD Palmdale				2		0.5	1.5		4
SYL Sylmar			2			0.5	1.5		4
BUR Burbank				2		0.5	1.5		4
LAU L.A. Union Sta.	1	0.5	2	2	0.5	0.5	1.5		8
NSF Norwalk		0.5			0.5	0.5	1.5		3
ANA Anaheim		0.5			0.5	0.5	1.5		3

**PROPOSED PHASE 1 SERVICE PLAN Version 10**

**PEAK HOUR STATION STOPS-SOUTHBOUND**

Pattern No. → 2 1 14 15 18 19 20 21 4

	Super	Exp	SF-M	LA-M	CV2	SFV2	CV3	SFV3	Local	
Trains per hour →	1	1	1	1	1	1	1	1	1	9
	<b>TOTAL</b>									
SFT S.F.-Transbay	1	1	1	1	1	1	1	1	1	8
SFO Millbrae			1							4
RWC Redwood City		1	1		1	1	1			6
SJC San Jose	1	1	1		1	1	1	1	1	8
GLY Gilroy		1	1		1	1		1	1	6
MCD Merced			1	1						2
FNO Fresno			1	1			1		1	4
BFD Bakersfield			1				1	1	1	4
PMD Palmdale			1	1	1			1	1	5
SYL Sylmar			1		1	1	1	1	1	5
BUR Burbank			1	1				1	1	4
LAU L.A. Union Sta.	1	1		1	1	1	1	1	1	8
NSF Norwalk		1	1						1	4
ANA Anaheim		1	1		1				1	4

**PEAK HOUR STATION STOPS-NORTHBOUND**

Pattern No. → 2 1 9 10 7 13 14 15

	Super	Exp	Ltd A	Ltd B	NLAX	VX	SF-M	LA-M	
Trains per hour →	1	0.5	2	2	0.5	0.5	1.5	1.5	9.5
	<b>TOTAL</b>								
ANA Anaheim		0.5			0.5	0.5	1.5		3
NSF Norwalk		0.5			0.5	0.5	1.5		3
LAU L.A. Union Sta.	1	0.5	2	2	0.5	0.5	1.5		8
BUR Burbank			2		0.5		1.5		4
SYL Sylmar			2		0.5		1.5		4
PMD Palmdale			2		0.5		1.5		4
BFD Bakersfield			2		0.5		1.5		4
FNO Fresno			2		0.5		1.5		4
MCD Merced						1.5	1.5		3
GLY Gilroy		0.5		2	0.5		1.5		4.5
SJC San Jose	1	0.5	2	2	0.5	0.5	1.5		8
RWC Redwood City		0.5		2	0.5	0.5	1.5		5
SFO Millbrae			2		0.5		1.5		4
SFT S.F.-Transbay	1	0.5	2	2	0.5	0.5	1.5		8

**PEAK HOUR STATION STOPS-NORTHBOUND**

Pattern No. → 2 1 14 15 18 19 20 21 4

	Super	Exp	SF-M	LA-M	CV2	SFV2	CV3	SFV3	Local	
Trains per hour →	1	1	1	1	1	1	1	1	1	9
	<b>TOTAL</b>									
ANA Anaheim		1	1		1					4
NSF Norwalk		1	1		1					4
LAU L.A. Union Sta.	1	1		1	1	1	1	1	1	8
BUR Burbank			1	1				1	1	4
SYL Sylmar			1		1	1	1	1	1	5
PMD Palmdale			1	1	1			1	1	5
BFD Bakersfield			1		1		1	1	1	4
FNO Fresno			1	1		1		1	1	4
MCD Merced			1	1						2
GLY Gilroy		1	1		1	1		1	1	6
SJC San Jose	1	1	1		1	1	1	1	1	8
RWC Redwood City		1	1		1	1	1	1	1	6
SFO Millbrae			1		1			1	1	4
SFT S.F.-Transbay	1	1	1		1	1	1	1	1	8

**OFF-PEAK HOUR STATION STOPS**

Pattern No. → 2 1 9 10 7 13 14 15 4

	Super	Exp	Ltd A	Ltd B	NLAX	VX	SF-M	LA-M	Local	
Trains per hour →	0	0.5	2	2	0.5	0	0.8	0.8	0.5	7.1
	<b>TOTAL</b>									
SFT S.F.-Transbay	0	0.5	2	2	0.5	0	0.8	0.8	0.5	6.3
SFO Millbrae			2		0.5		0.8	0.5		3.8
RWC Redwood City		0.5		2	0.5	0	0.8	0.5		4.3
SJC San Jose	0	0.5	2	2	0.5	0	0.8	0.5		6.3
GLY Gilroy		0.5		2	0.5		0.8	0.5		4.3
MCD Merced							0.8	0.8		1.6
FNO Fresno			2		0.5		0.8	0.5		3.8
BFD Bakersfield			2		0.5		0.8	0.5		3.8
PMD Palmdale				2		0	0.8	0.5		3.3
SYL Sylmar			2			0	0.8	0.5		3.3
BUR Burbank				2		0	0.8	0.5		3.3
LAU L.A. Union Sta.	0	0.5	2	2	0.5	0	0.8	0.5		6.3
NSF Norwalk		0.5			0.5	0	0.8	0.5		2.3
ANA Anaheim		0.5			0.5	0	0.8	0.5		2.3

**OFF-PEAK HOUR STATION STOPS**

Pattern No. → 2 1 14 15 16 17 4

	Super	Exp	SF-M	LA-M	CV2	SFV2	Local	
Trains per hour →	0	1.1	1	1	1.7	1.7		7.6
	<b>TOTAL</b>							
SFT Anaheim		1.1		1				1.1
SFO Norwalk		1.1		1				1.1
RWC L.A. Union Sta.	0	1.1		1	1.7	1.7		1.1
SJC Burbank			1			1.7		1.1
GLY Sylmar			1			1.7		1.1
FNO Palmdale			1			1.7		1.1
BFD Bakersfield			1		1.7			1.1
PMD Fresno			1		1.7			1.1
MCD Merced			1	1				2
SYL Gilroy		1.1	1		1.7	2		1.1
BUR San Jose	0	1.1	1		1.7	1.7		1.1
LAU Redwood City		1.1	1		1.7	1.7		1.1
NSF Millbrae			1		1.7			1.1
ANA S.F.-Transbay	0	1.1	1		1.7	1.7		1.1

The Phase 1 service plan as outlined in this document and its attachments provides a level of service at each station that is generally equivalent to the level of service assumed in the development of the estimates of system ridership and revenue (for Phase 1). A similar methodology is being applied to the service and operations analysis of the HST project to include the extensions of the system to Sacramento and San Diego; the results of the analysis of the system extensions to Sacramento and San Diego will be reported in a separate Technical Memorandum at a later date.

Table 5 indicates a slight increase in the number of peak station stops at Redwood City, Gilroy, Palmdale and Sylmar on the San Fernando Valley and Central Valley Limited services (Patterns 18-21), with a slightly longer running time for these services than indicated in the original service plan for the limited stop services (Patterns 9 and 10). As the HST project studies continue to progress it would be prudent to consider a more detailed ridership estimation to assess the relative merits of these run time and service frequency tradeoffs.

**TRAIN SCHEDULE DEVELOPMENT**

The process of developing a feasible train schedule for the various combinations of stopping patterns, train origins and destinations and service frequencies entailed overlaying the various patterns in a graphical template known as a "stringline" – which is a diagram with clock time on the horizontal axis and location along the rail system on the vertical axis. Each train movement is represented by a line that traces its path along the network in both time and distance. The stringline for a non-stop train has a steeper slope than that of a multiple-stop train. Stringlines in the same direction of flow are not permitted to intersect one another except at locations where there are additional tracks (at passenger stations) available for faster trains to bypass slower or stopped trains. These locations are assumed to be limited to the areas surrounding the stations on the main portion of the HST line between Gilroy and Palmdale – where non-stop trains are permitted to bypass or "overtake" trains operating in the same direction and stopping at the station. It is also worthy to note that with these service levels and consistent stopping patterns, the conceptual analysis revealed that trains are able to run in sequence (without overtakes) north of Gilroy and south of Palmdale. This attribute is subject to further study and validation, and will be examined in detail when the full dispatch computer simulation is performed

Stringline diagrams were constructed in the spreadsheet model by starting with the highest priority trains (express trains running on clockface schedules), and then adding the other stopping patterns and frequencies in a priority order, adjusting the starting times of each subsequent group of trains to minimize the number of required overtakes and to make sure that all overtakes, when required, occur at the appropriate intermediate station locations. Additional station dwell time was added to the schedules of trains being overtaken, as necessary, to ensure that the minimum three minute separation between trains is maintained.

Hypothetical timetables are presented in the appendices. A timetable for the base service plan is presented in Appendix A1. This same schedule is represented in stringline format in Appendix A2, which shows the patterns of train movements during the morning peak, mid-day period, afternoon peak and late evening period. Appendix B presents the same information for the service plan variation based on three and one half percent and one percent recovery time allowances. A hypothetical timetable for this service plan variation is presented in Appendix B1, with this schedule represented in stringline format in Appendix B2.

Table 6 shows the number of scheduled trains, for each stopping pattern/service type, within the morning peak, mid-day, afternoon peak and late evening periods. The daily schedule provides a total of 260 revenue trains.

TABLE 6 – REVENUE TRAINS BY TIME PERIOD AND TRAIN TYPE

Pattern	Train Type	End Points	Daily Trains (both directions)				Total Daily
			Morning Peak 3 Hrs	Mid-Day 7 Hrs	Afternoon Peak 3 Hrs	Late Evening 3+ Hrs	
1	Bay Area Limited	SFT-ANA	6	14	6	8	<b>34</b>
2	Express	SFT-ANA	6	—	6	—	<b>12</b>
4	All-Stop Local	SFT-ANA	6	14	6	8	<b>34</b>
10	Central Valley Limited	SFT-ANA	2	—	2	—	<b>4</b>
14	San Francisco-Merced All-Stop	SFT-MCD	6	14*	6	6	<b>32</b>
15	Anaheim-Merced All-Stop	MCD-ANA	6	14*	6	6	<b>32</b>
16	Central Valley Limited	SFT-LAU	—	28	—	6	<b>34</b>
17	San Fernando Valley Limited	SFT-LAU	—	28	—	6	<b>34</b>
18	Central Valley Limited	SFT-LAU	4	—	4	—	<b>8</b>
19	San Fernando Valley Limited	SFT-LAU	6	—	6	—	<b>12</b>
20	Central Valley Limited	SFT-LAU	6	—	6	—	<b>12</b>
21	San Fernando Valley Limited	SFT-LAU	6	—	6	—	<b>12</b>
<b>Total</b>			<b>54</b>	<b>112</b>	<b>54</b>	<b>40</b>	<b>260</b>

\*Assumes one mid-day interval of 2 hours instead of normal 1 hour headway, during period of lowest ridership demand.

Annual operating costs for HST service, in large measure, are estimated based on the number of train-miles of assumed service operated. Table 7 presents the annual train-miles associated with the Phase 1 service plan. This estimate is based on full daily service for 250 weekdays per year, plus 115 weekend days and holidays with a reduced level of service.

TABLE 7 – DAILY AND ANNUAL TRAIN-MILES

	Daily Train-Miles	Daily Train-Miles (200m equivalent)	Days/Year	Annual Train-Miles (200m equivalent)
Weekday	106,211	140,405	250	35,101,000
Weekend & Holiday	83,760	83,760	115	9,632,000
Total	--	--	365	*44,734,000

\* Average annual train miles per 200 meter trainset is estimated at approximately 426,000, assuming a Phase 1 fleet requirement of 105 trainsets including spares (assumed spare ratio of 10%).

ESTIMATED PASSENGER LOADS AND LOAD FACTORS

In order to estimate train consists and fleet requirements, and verify that the capacity of the Phase 1 service plan approximately matches demand, the estimated daily Phase 1 ridership in 2030 of 159,000 trips was factored to develop an approximation of demand by hour for the peak, peak shoulder and off-peak periods. Ridership projections for daily boardings at each station, and annual region-to-region trips factored down to average daily travel, were used to derive a station-to-station daily trip table, which is presented in Table 8 below. The assumed peaking factors are presented in Table 9.

TABLE 8 – ESTIMATED DAILY STATION-TO-STATION RIDERSHIP IN 2030 (PHASE 1)

Alighting Station...	Boarding Station...													Total	
	San Francisco (Transbay)	Millbrae	Redwood City	San Jose	Gilroy	Merced	Fresno	Bakersfield	Palmdale	Sylmar	Burbank	Los Angeles Union Station	Norwalk		Anaheim
SFT San Francisco (Transbay)	0	262	1,247	3,154	856	1,707	1,654	1,653	3,421	2,586	614	2,256	1,836	11,643	32,890
SFO Millbrae	262	0	352	891	242	68	66	66	137	104	25	91	74	467	2,845
RWC Redwood City	1,247	352	0	40	11	184	178	369	279	66	243	198	1,254	4,599	
SJC San Jose	3,154	891	40	0	50	396	384	383	794	600	142	523	426	2,702	10,485
GLY Gilroy	856	242	11	50	0	306	297	296	615	465	110	405	330	2,092	6,074
MCD Merced	1,707	68	184	396	306	0	405	671	556	420	100	367	298	1,892	7,370
FNO Fresno	1,654	66	178	384	297	405	0	955	365	276	65	241	196	1,242	6,324
BFD Bakersfield	1,653	66	178	383	296	671	955	0	514	389	92	339	276	1,750	7,562
PMD Palmdale	3,421	137	369	794	615	556	365	514	0	135	360	6,473	826	2,499	17,063
SYL Sylmar	2,586	104	279	600	465	420	276	389	135	0	91	1,632	208	630	7,814
BUR Burbank	614	25	66	142	110	100	65	92	360	91	0	1,686	215	651	4,217
LAU Los Angeles Union Station	2,256	91	243	523	405	367	241	339	6,473	1,632	1,686	0	730	2,211	17,197
NSF Norwalk	1,836	74	198	426	330	298	196	276	826	208	215	730	0	0	5,613
ANA Anaheim	11,643	467	1,254	2,702	2,092	1,892	1,242	1,750	2,499	630	651	2,211	0	0	29,034
Total	32,890	2,845	4,599	10,485	6,074	7,370	6,324	7,562	17,063	7,814	4,217	17,197	5,613	29,034	159,087

TABLE 9 – RIDERSHIP PEAKING FACTORS

Origin-Destination Market	Peak Hour	Peak Shoulder Hour	6 peak hours	10 off-peak hours	Directional Peaking Factors	
					PM Peak South-bound	PM Peak North-bound
Inter-regional	12%	10%	54%	46%	1.0	1.0
Within MTC territory	17%	11%	67%	33%	1.2	0.8
Within SCAG territory	15%	10%	61%	39%	0.9	1.1

For the peak hour, average peak shoulder hour and average off-peak hour, station-to-station ridership was allocated among the available trains operating during those hours. Where choices among both express and local trains exist, a higher percentage of trips is allocated to the faster express services. Within each hour, overall demand is constrained by trainset seating capacity. Where the initial allocation of trips resulted in some trains being over capacity, a portion of the affected station-to-station loads were re-assigned to trains with available seating capacity operating within the same hour.

The graphs on the following pages show the estimated passenger loadings on the various train types for each station-to-station segment. In all cases, passenger loads can be kept within the 1,000 seat capacity of a 400 m trainset. The express services require 400 m trainsets all day long. The all-stop local trains, selected limited stop trains, and the Anaheim-Merced local trains all have passenger loads between 500 and 1,000 passengers, necessitating 400 m trainsets. All off-peak trains other than the hourly expresses have passenger loads under 500 and can be accommodated on 200 m trainsets.

FIGURE 1 – ESTIMATED PASSENGER LOADS IN 2030 – EVENING PEAK HOUR SOUTHBOUND

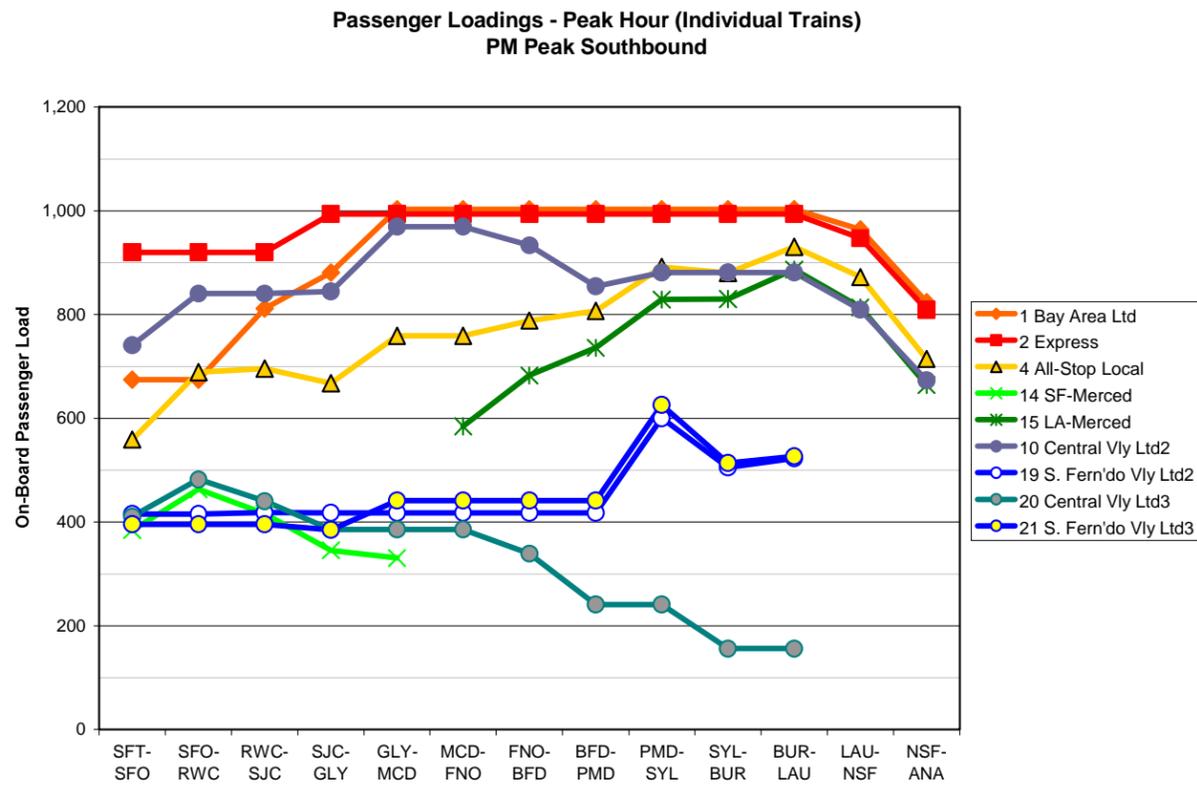


FIGURE 2 – ESTIMATED PASSENGER LOADS IN 2030 – EVENING PEAK SHOULDER HOUR SOUTHBOUND

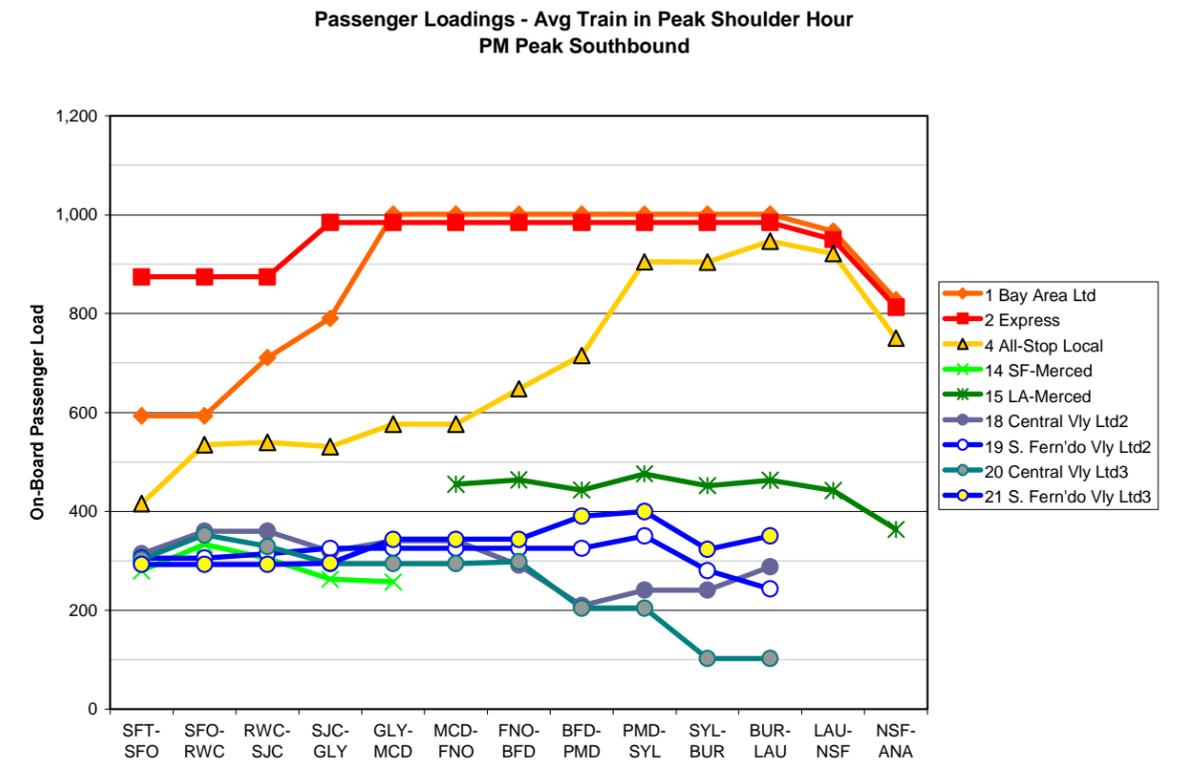


FIGURE 3 – ESTIMATED PASSENGER LOADS IN 2030 – EVENING PEAK HOUR NORTHBOUND

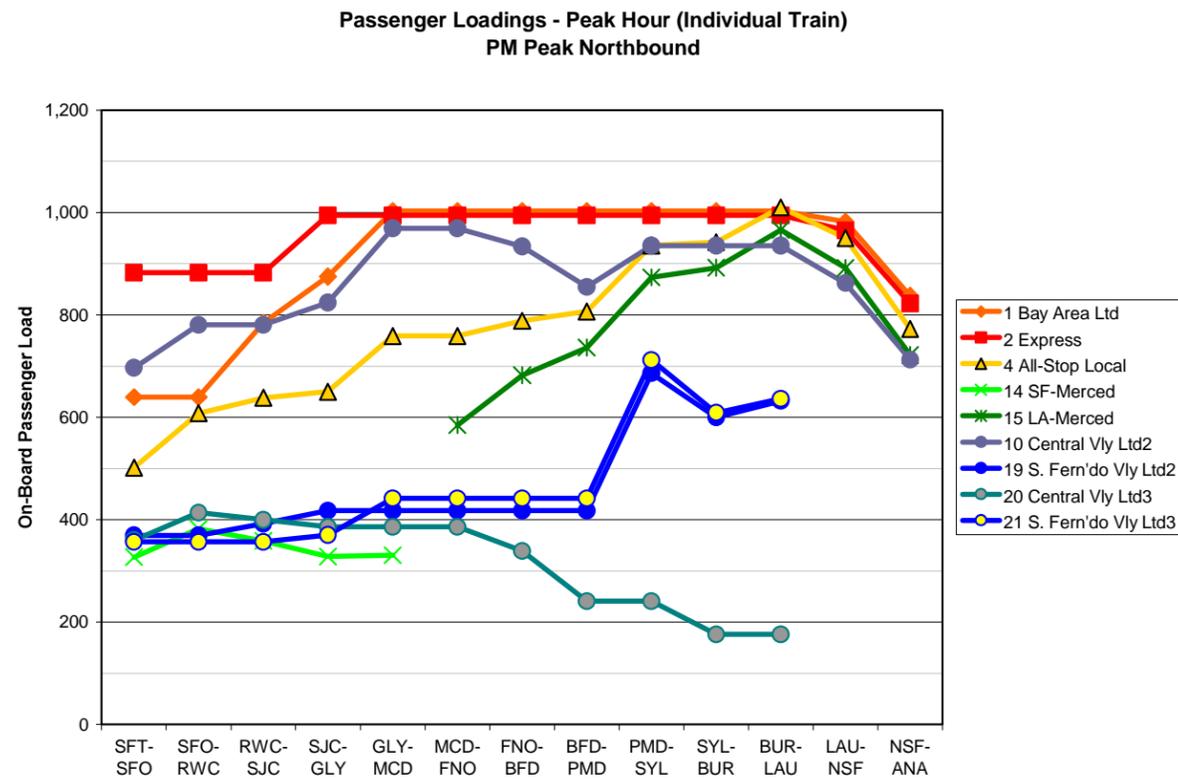


FIGURE 4 – ESTIMATED PASSENGER LOADS IN 2030 – EVENING PEAK SHOULDER HOUR NORTHBOUND

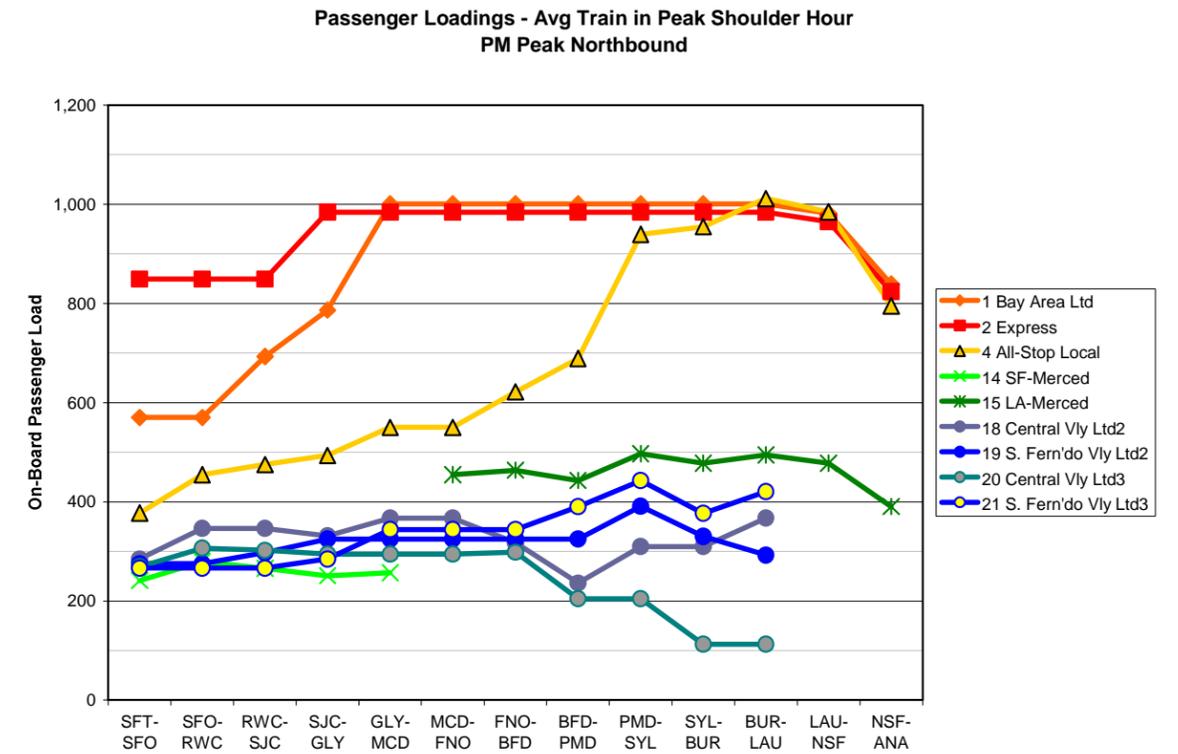
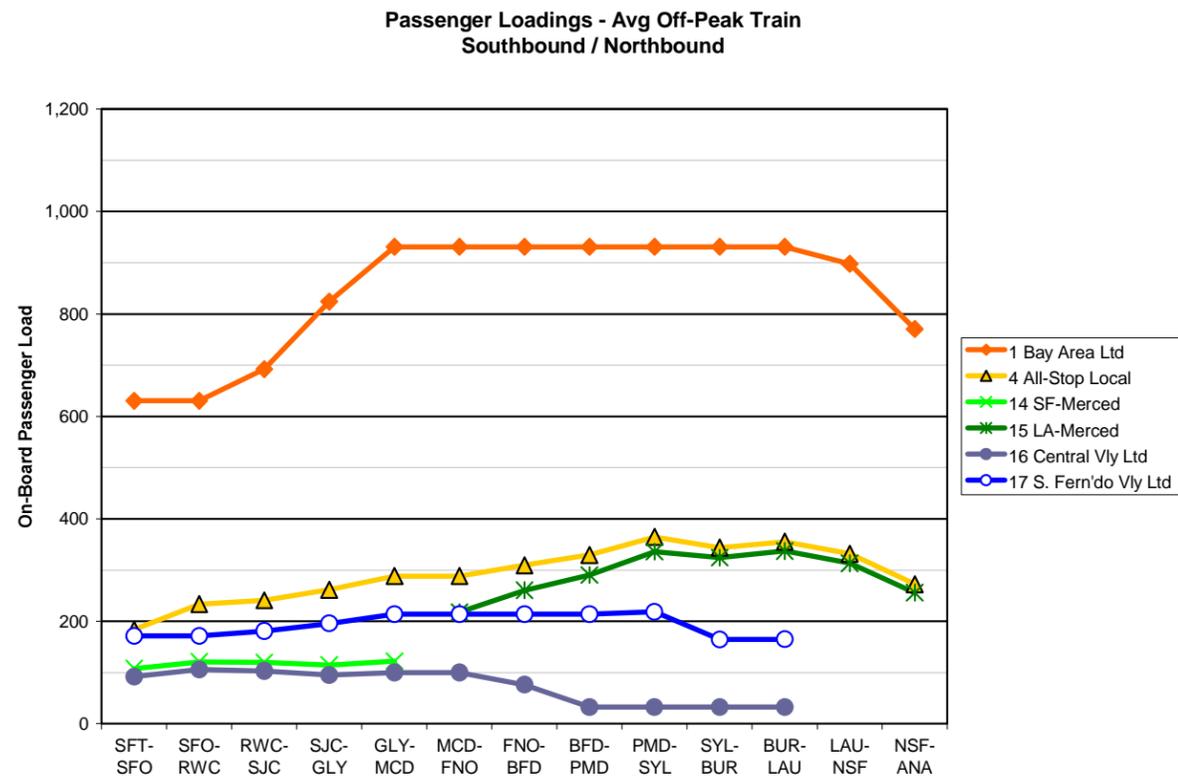


FIGURE 5 – ESTIMATED PASSENGER LOADS IN 2030 – AVERAGE OFF-PEAK



## 5. FLEET REQUIREMENTS

### EQUIPMENT CYCLES

The concept level train schedule presented in Appendix A, which shows 260 daily revenue trains, was analyzed to estimate the number of trainsets based upon the number of 200 m and 400 m trainsets required to meet forecasted 2030 demand. Trains arriving at a terminal station are assumed to lay over at the platform for a certain period of time, for passenger alighting train servicing/inspection and passenger boarding, then depart in the opposite direction as the next available departing revenue train. This analysis generally adhered to the minimum terminal layover times presented in Table 2. In certain cases, shorter layover times were assumed in order to keep the number of trainsets to a reasonable minimum and to avoid inordinately long layovers, which would occupy terminal station or yard tracks for extended periods of time. Except during the late evening time period, train sets are generally available at the SFT and ANA terminals to provide "protection" for short connections from potentially delayed trains. These additional equipment sets would be culled from the 400 m local and limited trains operating during the morning peak period that continue during the mid-day period as 200 m trains. The train turns at the endpoint terminals are balanced during the mid-day and late evening off-peak hours. During the peaks, additional directional service is offered, so a relatively small number of trains are designated for mid-day yard storage in lieu of making a revenue turn.

Most trainsets are able to make 3-4 trips between the Bay area and Los Angeles basin over the course of a service day. Selected trains (one per hour each way) operate to and from Merced. At Merced, these trains then turn for the next available train operating towards the alternate terminal (i.e., a San Francisco-Merced train will lay over at Merced and turn for a Merced-Anaheim train).

### REVENUE TRAINSETS

A "baseline" total of sixty five (65), 200 m trainsets were estimated to operate the 260 daily train schedule in revenue service. An additional twenty-nine (29), 200m sets are required to "fill out" the 400m trainsets that serve the peak periods (and all-day express services), as shown in Table 10.

TABLE 10 – 200M TRAIN SECTIONS NEEDED TO "FILL OUT" 400M TRAINS

Bay Area Limited	9
Express	6
All-Stop Local	6
Anaheim-LA-Merced	2
Central Valley Limited	2
San Fernando Valley Limited	4
Total	29

## 6. TRAIN STORAGE REQUIREMENTS

The number of trainsets estimated to be stored at each terminal location during both the overnight period and the mid-day off-peak period was calculated for the Phase 1 service plan based on the Phase 1 equipment cycles. The sixty five (65) revenue trainset consists required for Phase 1, includes thirty-six (36) 200m trainsets and twenty-nine (29) 400m trainsets, were distributed among the four terminals for overnight storage as follows:

**TABLE 11 – OVERNIGHT TRAIN STORAGE REQUIREMENTS**

(Revenue Trainsets)

Location	200 m Sets	400 m Sets	Total Trainsets	200 m Equivalents	400 m Yard Tracks*
San Francisco	14	[ 13 ] 4 BayArea Ltd 3 Express 2 SF Vly Ltd 1 CenVly Ltd 3 All-Stop	27	40	20
Los Angeles	13	[ 2 ] 2 SF Vly Ltd	15	17	9
Anaheim	4	[ 13 ] 5 BayArea Ltd 3 Express 1 CenVly Ltd 3 All-Stop 1 LA-Merced	17	30	15
Merced	5	[ 1 ] 1 LA-Merced	6	7	4
<b>Total</b>	<b>36</b>	<b>29</b>	<b>65</b>	<b>94</b>	<b>48</b>

\* Additional tracks will be required at most locations for train maneuvering and to support required maintenance functions. Allowances for extensions to Sacramento and San Diego to satisfy full system needs are not included and will be added later at the conclusion of the Sacramento and San Diego extensions Study which will follow this analysis and report.

The overnight train storage requirements influence the sizes of the required storage yards capacities significantly. Train storage yards can be configured in several different ways, depending upon the size and shape of the available property for yard storage. Yards could be configured as a series of double-ended 400m tracks capable of storing either one 400m train or two 200m trains. Or, yards could comprise a combination of 400m and 200m long tracks. The storage yards are assumed to be located in reasonable proximity to the terminal stations, to minimize the extent of non-revenue or "deadhead" train movements, although the yards do not need to be immediately adjacent to the stations. Detailed operations analysis of the terminal stations, storage yards and connecting trackage have not yet been performed but are planned to be undertaken at a future stage of project development. Utilization of tracks in terminal stations to supplement overnight storage capacity will be examined during this analysis.

All sixty five trainset consists are forecasted to be in active revenue during both the morning and afternoon peak periods. The mid-day off-peak train schedule (between approximately 11:00 AM and 3:00 PM) can be operated with fifty-eight revenue trainsets. The remaining seven trainsets (all 400m long) will be stored in the terminal and yards, along with an additional thirteen (13) 200m sets culled from trains that need to be 400m long to meet peak demand but which can be reduced to 200m long during the mid-day period to reduce the quantity of off-peak empty seat-mileage. The number of required mid-day storage tracks, by location, is presented in the following table.

**TABLE 12 – MID-DAY TRAIN STORAGE REQUIREMENTS**

(Revenue Trainsets)

Location	200 m Extra Sets	400 m Sets	Total Trainsets	200 m Equivalents	400 m Yard Tracks
San Francisco	[ 6 ] 2 SF Vly Ltd 1 CenVly Ltd 3 All-Stop	[ 3 ] 3 Express	9	12	6
Los Angeles	2 SF Vly Ltd		2	2	1
Anaheim	[ 4 ] 3 All-Stop 1 LA-Merced	[ 4 ] 3 Express 1 CenVly Ltd	8	12	6
Merced	1 LA-Merced	--	1	1	1
<b>Total</b>	<b>13</b>	<b>7</b>	<b>20</b>	<b>27</b>	<b>14</b>

## APPENDICES – PHASE 1 SERVICE PLAN CHARACTERISTICS

### [A] BASE, WITH 7.0% RECOVERY TIME ALLOWANCE

To develop the base Phase 1 conceptual service plan and hypothetical train schedules, trains were applied to the schedule in the following sequence:

1. San Francisco-Los Angeles-Anaheim Bay Area Limited service (Pattern #1) - (SFT-RWC-SJC-GLY-LAU-NSF-ANA)
  - Clockface departures on the hour southbound from SFT, with first departure at 5:00 AM and last departure at 9:00 PM
  - Clockface hourly departures northbound, from ANA at :35 and departing LAU at :00, with first departure at 4:35 AM and last departure at 8:35 PM
2. San Francisco-Los Angeles Express service (Pattern #2) - (SFT-SJC-LAU)
  - Service provided only during the 3-hour morning and afternoon business travel peaks, one train per hour in each direction in each peak period
  - Clockface departures on the half hour southbound from SFT and northbound from LAU, with morning departures at approximately 5:30 AM, 6:30 AM and 7:30 AM and afternoon departures from Los Angeles at approximately 3:30 PM, 4:30 PM and 5:30 PM, and from Anaheim at :05 past the hour.
  - These trains are assumed to operate to Anaheim in Phase 1, in order to spread the peak period demand between the Bay Area and Anaheim among a greater number of trains.
3. San Fernando Valley Ltd. (Patterns #19 and #21 peak, #17 off-peak) – Limited stop service between San Francisco and L.A., stopping at San Fernando Valley stations and generally bypassing Central Valley stops
  - 30-minute headways in both directions of travel all day long
  - Off-peak, southbound departures from SFT at :03 and :33; northbound departures from LAU at :10 and :40
  - Service operates without being overtaken
  - Service tapers after 7:00 pm
4. Central Valley Ltd. (Patterns #18 and #20 peak, #16 off-peak) – Limited stop service between San Francisco and L.A. stopping at Fresno and Bakersfield and making limited stops within the San Fernando Valley
  - 30-minute headways in both directions of travel all day long
  - Off-peak, southbound departures from SFT at :08 and :38; northbound departures from LAU at :03 and :33
  - During off-peak hours, service operates without being overtaken
  - During peak hours, one of the two trains in each hour is overtaken in each direction (southbound at Fresno, northbound at Gilroy)
  - Peak train in each peak period operates to/from Anaheim (ANA) to provide additional required seating capacity at the height of the peak at Anaheim.

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- Service tapers after 7:00 pm
5. All-stop service, to ensure direct train service connectivity among all possible station pairs (Pattern #4)
    - Hourly service with clockface departure times, San Francisco to Anaheim all day long (Pattern #4, SFT-SFO-RWC-SJC-GLY-FNO-BFD-PMD-SYL-BUR-LAU-NSF-ANA)
    - Southbound trains depart SFT at :14
    - Northbound trains depart Anaheim (ANA) at :52, except during AM and PM business travel peaks, when these trains depart ANA at :46
    - During off-peak hours, the All-Stop trains are overtaken once per trip by limited stop trains, southbound at Bakersfield and northbound at Palmdale
    - During business travel peaks, southbound trains are overtaken twice, by the Super Express service, at Gilroy and by a limited stop train at Fresno; northbound All-Stop trains are overtaken once, at Bakersfield.
  6. Anaheim-Los Angeles-Merced local service (Pattern #15)
    - Hourly service with clockface departure times, San Francisco to Merced making all intermediate stops (MCD-FNO-BFD-PMD-SYL-BUR-LAU-NSF-ANA)
    - Off-peak trains depart Merced southbound at :02 and depart Anaheim northbound at :20.
    - Peak period trains have slightly different departure times on account of different overtake patterns: southbound from Merced at :19 and northbound from Anaheim at :19.
    - Provides for equipment rotations to/from storage and maintenance facility at Merced
    - These trains could be extended in the system expansions to Sacramento and San Diego
    - During off-peak times, these trains are overtaken by two closely-spaced express trains – northbound at Palmdale and southbound at Bakersfield (extra 6 minutes of dwell time)
    - During business travel peaks, southbound trains have the same double overtake at Bakersfield, and northbound trains are overtaken twice – at Palmdale and Fresno.
  7. San Francisco-Merced local service (Pattern #14)
    - Hourly service with clockface departure times, San Francisco to Merced making all intermediate stops (SFT-SFO-RWC-SJC-GLY-MCD)
    - Southbound trains depart SFT at :47; northbound trains depart Merced at :37
    - Provides for equipment rotations to/from storage and maintenance facility at Merced
    - These trains could be extended in the system expansions to Sacramento and San Diego
    - The relatively short distance of operation for this train on the San Francisco-Los Angeles network makes it easier to “slot in” around other trains without triggering an overtake – hence its position at the end of the priority sequence.

A hypothetical daily timetable for this service plan is presented in Appendix A1. This same schedule is presented in stringline (time-distance) diagram format in Appendix A2. Equipment cycles and the patterns of movement of each trainset throughout the day are documented in Appendix A3.

## A1. Hypothetical Timetable

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CALIFORNIA HIGH-SPEED RAIL  
**PHASE 1 TIMETABLE**  
**BASE SERVICE PLAN** Turns from →

**APPENDIX A1**

		Reg	Peak O/T	Peak O/T	Reg	Reg	Reg	Peak O/T	Peak O/T	Peak O/T	Reg	Peak O/T	Peak O/T	Reg	Night	Reg	Reg	Reg	Night	Reg	Reg	Night													
Direction →	Trainset	SB	SB	SB	SB	SB	SB	SB	SB	SB	SB	SB	SB	SB	SB	SB	SB	SB	SB	SB	SB	SB	SB	SB	SB	SB	SB	SB	SB	SB	SB				
Train No. →	Pattern →	70	M4	17	16	21	43	63	64	27	24	M6	25	66	16	47	42	68	44	61	62	50	66	11	52	46	71	73	74	51	3	20	55		
Train No. →	Pattern →	S021629	S211633	S201637	S151647	S141802	S011700	S191704	S181708	S041714	S021729	S211733	S201737	S151747	S141902	S011800	S171803	S161808	S041814	S171833	S161838	S151847	S142002	S011900	S171910	S041914	S161935	S151947	S012000	S042014	S152047	S012100	S042114		
Pattern →	Service Type →	2	21	20	15	14	1	19	18	4	2	21	20	15	14	1	17	16	4	17	16	15	14	1	17	4	16	15	1	4	15	1	4		
Service Type →	Service Type →	Express	Limited	Limited	Local	Local	Limited	Limited	Limited	Local	Express	Limited	Limited	Local	Local	Limited	Limited	Limited	Local	Limited	Limited	Local	Local	Limited	Limited	Local	Limited	Local	Limited	Local	Local	Limited	Local		
Mile	Station																																		
0.0 SFT	S.F.-Transbay	Dep	16:29	16:33	16:37	16:47		17:00	17:04	17:08	17:14	17:29	17:33	17:37	17:47		18:00	18:03	18:08	18:14	18:33	18:38	18:47		19:00	19:10	19:14	19:35	19:47	20:00	20:14	20:47	21:00	21:14	
14.7 SFO	Millbrae	Dep	--	--	16:53	17:03		--	--	17:24	17:30	--	--	17:53	18:03		--	--	18:24	18:30	--	18:54	19:03		--	--	19:30	19:51	20:03	--	20:30	21:03	--	21:30	
26.4 RWC	Redwood City	Dep	--	--	17:03	17:13		--	--	17:34	17:40	--	--	18:03	18:13		18:20	18:23	18:34	18:40	18:53	19:04	19:13		19:20	19:30	19:40	20:01	20:13	20:20	20:40	21:13	21:20	21:40	
48.0 SJC	San Jose	Dep	17:00	17:05	17:19	17:29		17:36	17:40	17:50	17:56	18:00	18:05	18:19	18:29		18:36	18:39	18:50	18:56	19:09	19:20	19:29		19:36	19:46	19:56	20:17	20:29	20:36	20:56	21:29	21:36	21:56	
77.7 GLY	Gilroy	Arr																																	
		Dep		17:21		17:46		17:53	17:57	18:07	18:16		18:21		18:46		18:53	18:56	19:07	19:13	19:26	19:37	19:46		19:53	20:03	20:13	20:34	20:46	20:53	21:13	21:46	21:53	22:13	
187.5 MCD	Merced	Arr																																	
		Dep				18:02									19:02								20:02												
191.5 FNO	Fresno	Arr																																	
		Dep			18:14		18:25		18:48	18:52	19:03				19:25				19:50	19:56		20:20		20:25				20:56	21:17			21:56		22:56	
302.8 BFD	Bakersfield	Arr																																	
		Dep		18:38	18:54		19:04							20:04					20:35	20:39		21:00		21:04											
387.4 PMD	Palmdale	Arr																																	
		Dep		19:11	--		19:44		19:40	19:59	20:15		20:11	--	20:44		20:39		21:13	21:09		21:00		21:44		21:46	22:09				23:09			0:09	
425.7 SYL	Sylmar	Dep		19:33	19:44		20:06		20:02	--	20:36		20:33	20:44		21:06		21:01		21:35	21:31		22:06		22:08	22:31					23:31			0:31	
436.3 BUR	Burbank	Arr																																	
		Dep		19:42	--		20:15		--	20:25	20:45		20:42	--	21:15		21:10		21:44	21:40		22:15		22:17	22:40					23:40			0:40		
446.6 LAU	L.A. Union Sta.	Arr	19:18	19:51	19:57		20:23	20:00	20:15	20:34	20:54	20:18	20:51	20:57		21:23	21:00	21:19	21:27	21:52	21:49	21:57		22:23	22:00	22:26	22:48	22:54		23:00	23:48	0:00	0:48		
		Dep	19:20				20:25	20:02			20:56	20:20			21:25	21:02			21:54				22:25	22:02		22:50				23:02	23:50	0:02	0:50		
461.8 NSF	Norwalk	Arr	19:32				20:37	20:14			21:08	20:32			21:37	21:14			22:06				22:37	22:14		23:02				23:14	0:02	0:14	1:02		
476.9 ANA	Anaheim	Arr	19:43				20:48	20:25			21:19	20:43			21:48	21:25			22:17				22:48	22:25		23:13				23:25	0:13	0:25	1:13		

Available →	20:23	20:31	20:37	19:01	21:28	21:05	20:55	21:14	21:59	21:23	21:31	21:37	20:01	22:28	22:05	21:59	22:07	22:57	22:29	22:37	21:01	23:28	23:05	23:06	23:53	23:34	22:01	0:05	0:53	23:01	1:05	1:53
Turns for →																																

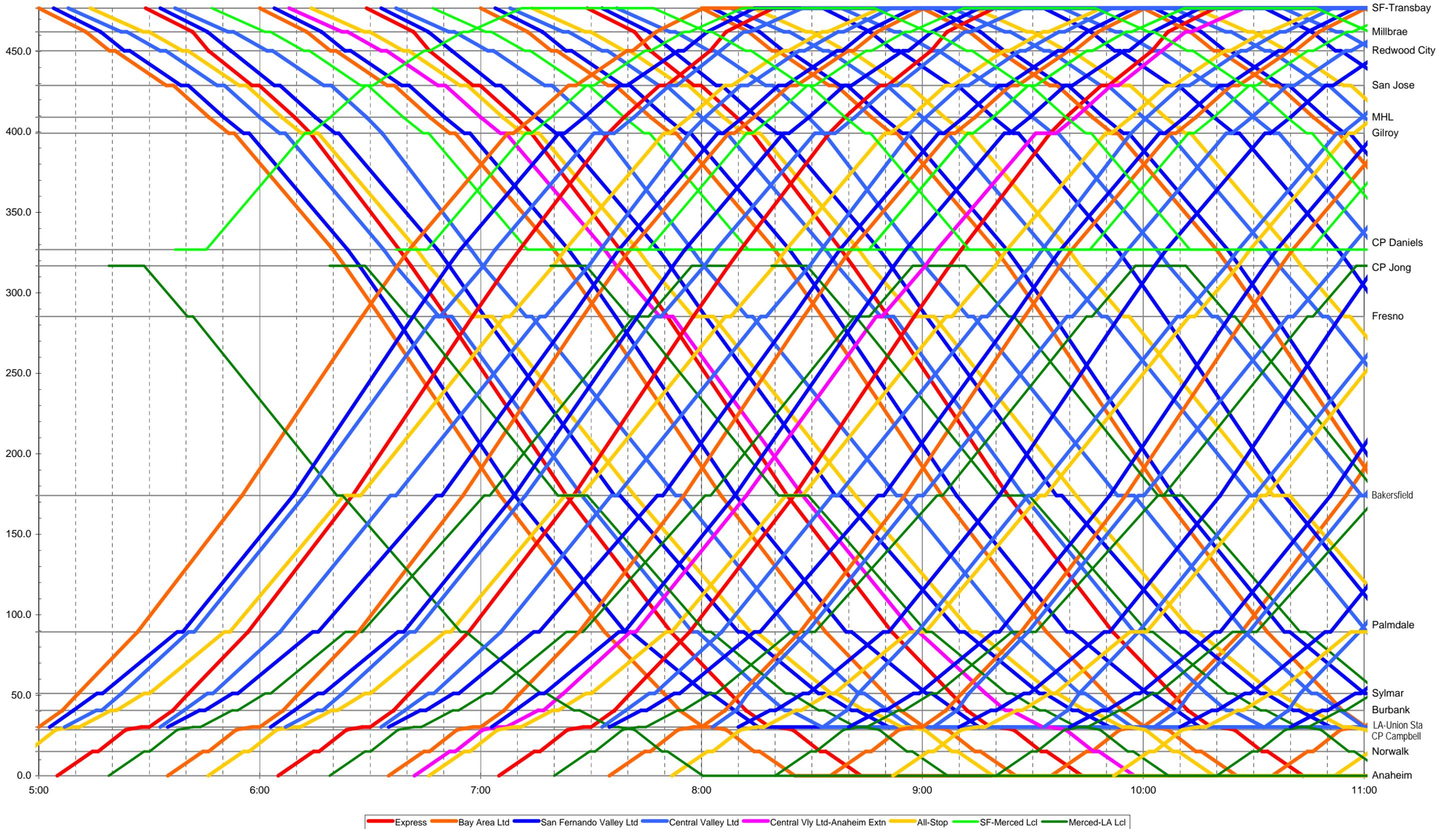
		Reg	Peak O/T	Peak O/T	Reg	Reg	Reg	Peak O/T	Peak O/T	Peak O/T	Reg	Peak O/T	Peak O/T	Reg	Night	Reg	Reg	Reg	Night	Reg	Reg	Night															
Direction →	Trainset	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB					
Train No. →	Pattern →	12	75	53	72	49	69	3	20	55	6	7	56	2	54	72	4	14	M1	15	NB	1	10	NB	2	19	NB	23	18	NB	67	5	NB	70	13		
Train No. →	Pattern →	N021605	N201633	N211635	N141619	N011635	N151837	N191703	N101642	N041646	N021705	N201733	N211735	N141720	N011735	N151937	N161803	N171810	N041752	N161833	N171840	N141820	N011835	N152037	N161913	N041852	N171940	N141920	N011935	N041952	N142020	N012035	N042052				
Pattern →	Service Type →	2	20	21	14	1	15	19	10	4	2	20	21	14	1	15	16	17	4	16	17	14	1	15	16	4	17	14	1	4	14	1	4				
Service Type →	Service Type →	Express	Limited	Limited	Local	Limited	Local	Limited	Limited	Local	Express	Limited	Limited	Local	Limited	Local	Limited	Limited	Local	Limited	Limited	Local	Local	Limited	Local	Limited	Local										
Mile	Station																																				
0.0 ANA	Anaheim	Dep	16:05			16:19	16:35			16:42	16:46	17:05		17:20	17:35							17:52		18:20	18:35					18:52	19:20	19:35	19:52	20:20	20:35	20:52	
15.0 NSF	Norwalk	Dep	16:16			16:30	16:46			16:53	16:57	17:16		17:31	17:46							18:03		18:31	18:46					19:03		19:31	19:46	20:03	20:31	20:46	21:03
30.3 LAU	L.A. Union Sta.	Arr	16:28			16:42	16:58			17:05	17:09	17:28		17:43	17:58							18:15		18:43	18:58					19:15		19:43	19:58	20:15	20:43	20:58	21:15
		Dep	16:30	16:33	16:35	16:44	17:00		17:03	17:07	17:11	17:30	17:33	17:35	17:45	18:00		18:03	18:10	18:17	18:33	18:40	18:45	19:00		19:13	19:17	19:40	19:45	20:00	20:17	20:45	21:00	21:17			
40.6 BUR	Burbank	Dep		--	16:45	16:54			--	17:17	--		--	17:45	17:55							18:27	18:27	18:57	18:55					19:27	19:57	19:55	20:27	20:55	21:27		
51.1 SYL	Sylmar	Dep		16:47	16:54	17:03			17:17	--	17:30		17:47	17:54	18:04							18:29	18:36		18:59	19:04				19:36	19:59	20:04		20:36	21:04	21:36	
89.4 PMD	Palmdale	Arr																																			
		Dep			17:26	17:29			17:39	17:42	17:51		--	18:26	18:30							18:56		19:24						20:24		21:24					
174.1 BFD	Bakersfield	Arr																																			
		Dep		17:37	17:49	18:04				--	18:27		18:37	18:49	19:05		19:00		19:33	19:30		20:05		20:10	20:30		21:05		21:30	22:05		21:30	22:05		22:30		
285.4 FNO	Fresno	Arr																																			
		Dep		18:17		18:45				18:49	19:08			19:17		19:46						20:14	20:10		20:46					20:50	21:11		21:46		22:11	22:46	23:11
354.4 MCD	Merced	Arr																																			
		Dep				19:06									20:07								21:07								22:07			23:07			
399.2 GLY	Gilroy	Arr																																			
		Dep			19:06		19:09	19:13	19:23	19:36	19:51				20:06		20:09	20:13	20:24	20:34	20:57	20:54	21:04	</													

## A2. Stringline Diagrams

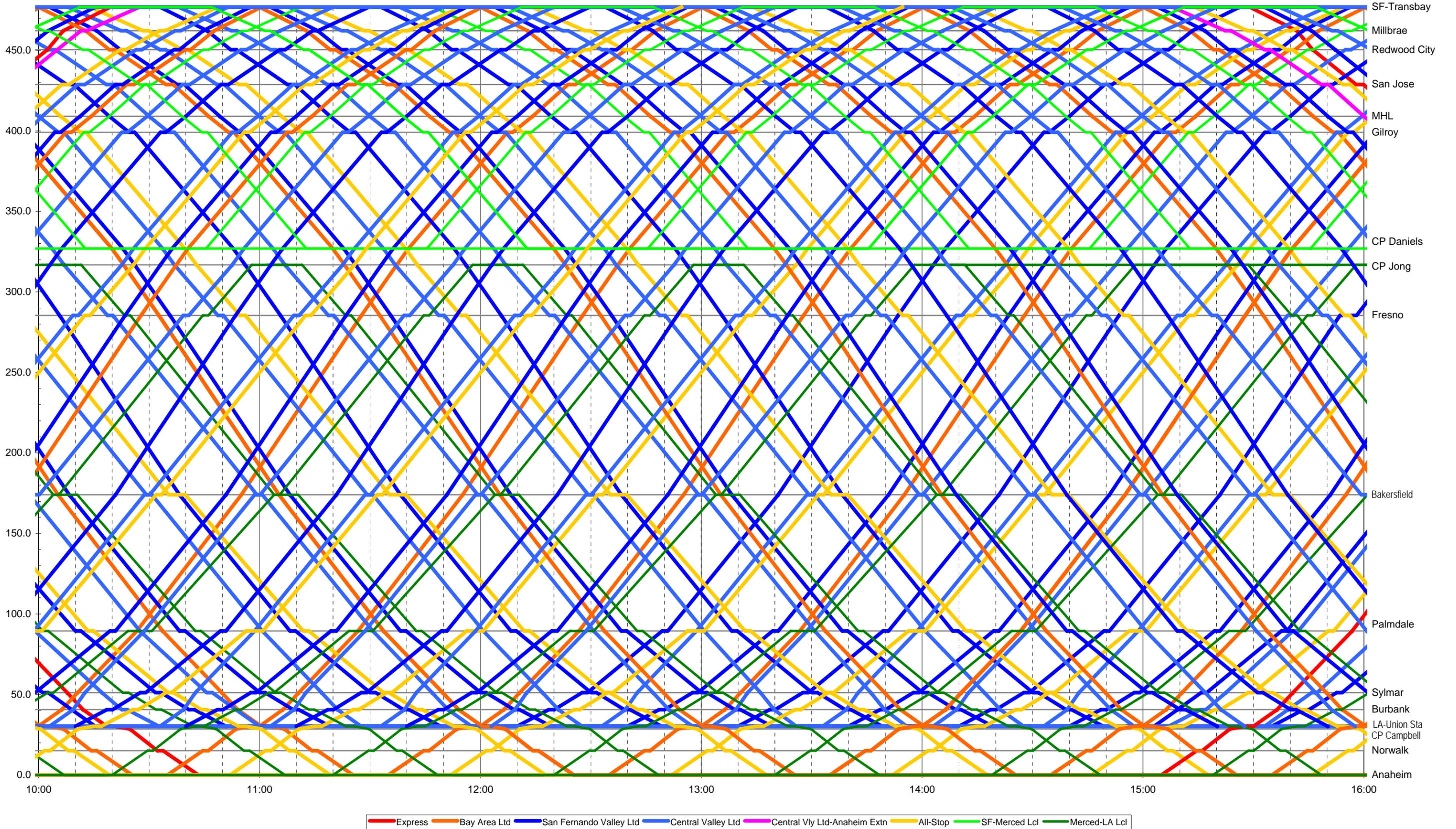
- Morning Peak Period
- Mid-Day Period
- Afternoon Peak Period
- Evening and Late Night Period

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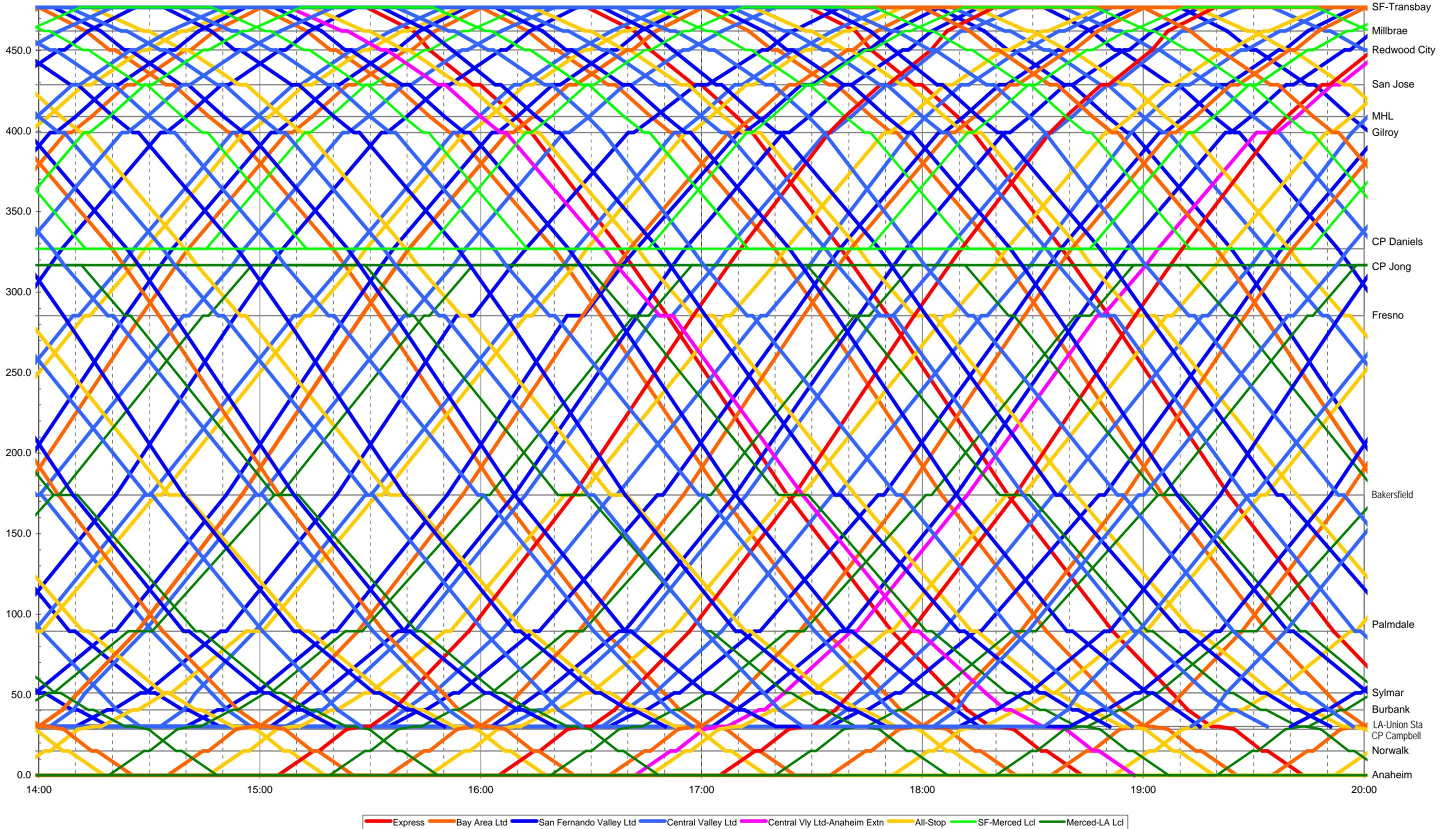
Appendix A2 - HST PHASE 1 SERVICE PLAN - BASE (Version 10) - MORNING PEAK



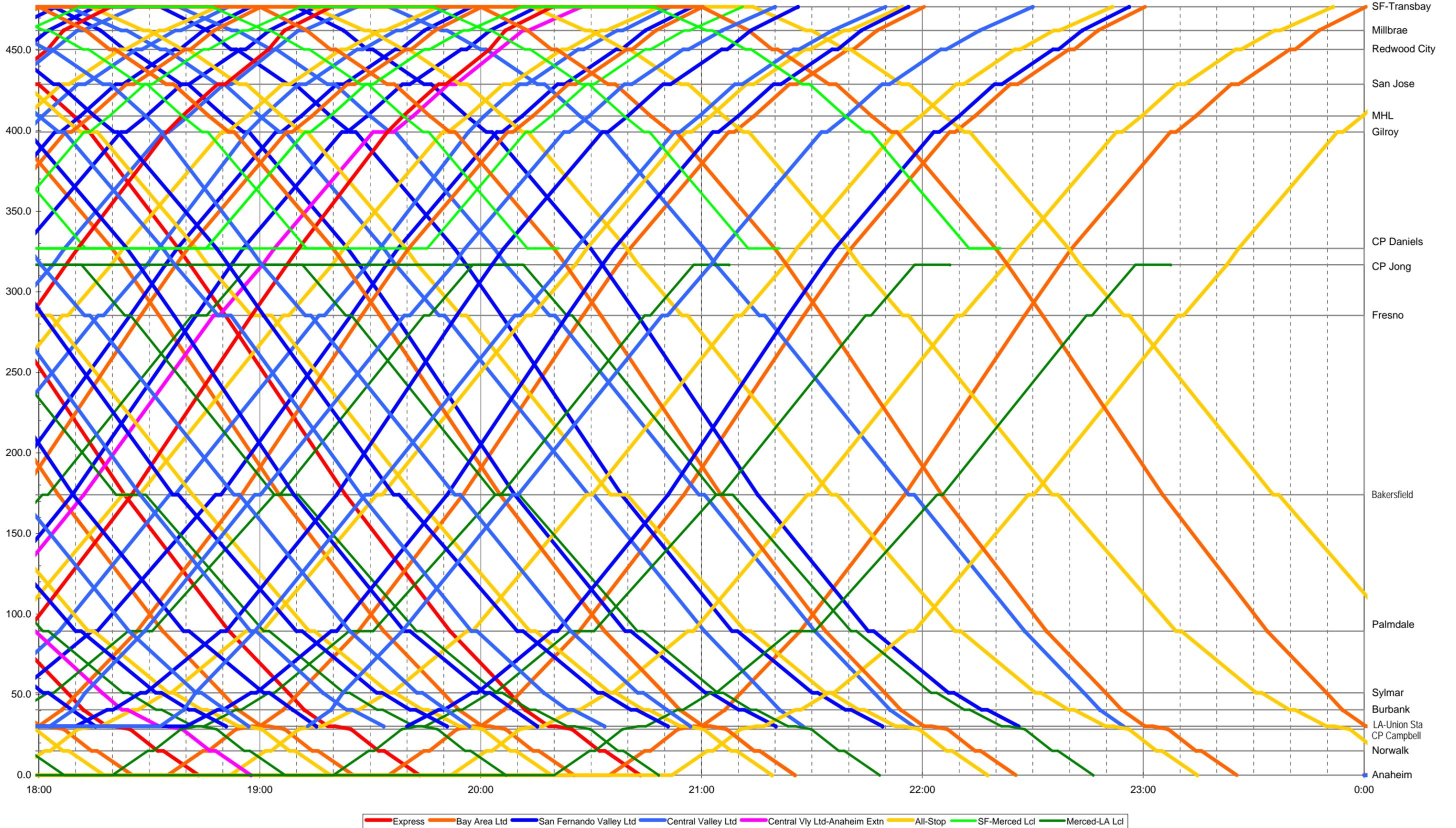
Appendix A2 - HST PHASE 1 SERVICE PLAN - BASE (Version 10) - MID-DAY



Appendix A2 - HST PHASE 1 SERVICE PLAN - BASE (Version 10) - AFTERNOON PEAK



Appendix A2 - HST PHASE 1 SERVICE PLAN - BASE (Version 10) - LATE EVENING



### A3. Equipment Cycles

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**CALIFORNIA HIGH SPEED RAIL**  
**APPENDIX A3 -- EQUIPMENT CYCLES -- PHASE 1 BASE SERVICE PLAN (Version 10)**

ID	OverkScheme	Dir	Set	Set2	Consist	Train No.	Pattern	Train Type	Orig	OrigTime	Dest	DestTime	RunTime	MinLay	Avail	Layover	Excess	DestArr	DestDep	T	TrnMi	200m SetMi	Wkend	Yd
2	Reg	SB	1	X11	400	S010500	1	Bay Area Ltd	SFT	5:00	ANA	8:25	3:25	40	9:05	0:55	15	8:25	9:20		476.9	953.8	476.9	
174	Peak O/T	NB	1			N140920	14	LA-Merced	ANA	9:20	MCD	12:08	2:48	30	12:38	0:29	(1)	12:08	12:37		354.3	354.3	354.3	
184	Reg	NB	1			N151237	15	SF-Merced	MCD	12:37	SFT	14:11	1:34	40	14:51	0:27	(13)	14:11	14:38	*	161.2	161.2	161.2	
83	Reg	SB	1			S161438	16	Central Vly. Ltd	SFT	14:38	LAU	17:57	3:19	40	18:37	0:43	3	17:57	18:40		446.6	446.6	0	
248	Reg	NB	1			N171840	17	S.Fernando Vly. Ltd	LAU	18:40	SFT	21:56	3:16	30	22:26	--	--	21:56	--		446.6	446.6	446.6	
3	Peak O/T	SB	2			S190504	19	S.Fernando Vly. Ltd	SFT	5:04	LAU	8:15	3:11	40	8:55	0:48	8	8:15	9:03		446.6	446.6	446.6	
169	Reg	NB	2			N160903	16	Central Vly. Ltd	LAU	9:03	SFT	12:21	3:18	30	12:51	0:39	9	12:21	13:00		446.6	446.6	0	
70	Reg	SB	2	X5	400	S011300	1	Bay Area Ltd	SFT	13:00	ANA	16:25	3:25	40	17:05	0:55	15	16:25	17:20		476.9	953.8	476.9	
241	Reg	NB	2		400	N141720	14	LA-Merced	ANA	17:20	MCD	20:07	2:47	30	20:37	0:30	0	20:07	20:37		354.3	708.6	354.3	
251	Reg	NB	2			N152037	15	SF-Merced	MCD	20:37	SFT	22:11	1:34	40	22:51	--	--	22:11	--		161.2	161.2	161.2	
5	Peak O/T	SB	3			S180508	18	Central Vly. Ltd	SFT	5:08	LAU	8:34	3:26	40	9:14	0:36	(4)	8:34	9:10		446.6	446.6	446.6	
170	Reg	NB	3			N170910	17	S.Fernando Vly. Ltd	LAU	9:10	SFT	12:26	3:16	30	12:56	0:37	7	12:26	13:03		446.6	446.6	446.6	
71	Peak O/T	SB	3			S171303	17	S.Fernando Vly. Ltd	SFT	13:03	LAU	16:19	3:16	40	16:59	0:44	4	16:19	17:03		446.6	446.6	446.6	
235	Peak O/T	NB	3		400	N191703	19	S.Fernando Vly. Ltd	LAU	17:03	SFT	20:15	3:12	30	20:45	0:32	2	20:15	20:47		446.6	893.2	446.6	
128	Reg	SB	3			S152047	15	SF-Merced	SFT	20:47	MCD	22:21	1:34	40	23:01	--	--	22:21	--		161.2	161.2	161.2	
6	Peak O/T	SB	4			S040514	4	All-Stop	SFT	5:14	ANA	9:19	4:05	40	9:59	0:51	11	9:19	10:10		476.9	476.9	476.9	
178	Reg	NB	4			N171010	17	S.Fernando Vly. Ltd	LAU	10:10	SFT	13:26	3:16	30	13:56	0:37	7	13:26	14:03		446.6	446.6	446.6	
78	Peak O/T	SB	4			S171403	17	S.Fernando Vly. Ltd	SFT	14:03	LAU	17:19	3:16	40	17:59	0:44	4	17:19	18:03		446.6	446.6	446.6	
244	Reg	NB	4			N161803	16	Central Vly. Ltd	LAU	18:03	SFT	21:21	3:18	30	21:51	--	--	21:21	--		446.6	446.6	0	
7	Reg	SB	5	SX1	400	S020529	2	Express	SFT	5:29	ANA	8:43	3:14	40	9:23	0:52	12	8:43	9:35		446.6	893.2	0	
175	Reg	NB	5	X11	400	N010935	1	Bay Area Ltd	ANA	9:35	SFT	13:00	3:25	30	13:30	0:47	17	13:00	13:47		476.9	953.8	476.9	
76	Reg	SB	5			S151347	15	SF-Merced	SFT	13:47	MCD	15:21	1:34	40	16:01	0:58	18	15:21	16:19		161.2	161.2	161.2	
87	Peak O/T	SB	5			S141619	14	LA-Merced	MCD	16:19	ANA	19:07	2:48	40	19:47	0:45	5	19:07	19:52		354.3	354.3	354.3	
257	Night	NB	5			N041952	4	All-Stop	ANA	19:52	SFT	23:51	3:59	30	0:21	--	--	23:51	--		476.9	476.9	476.9	
8	Peak O/T	SB	6			S210533	21	S.Fernando Vly. Ltd	SFT	5:33	LAU	8:51	3:18	40	9:31	0:42	2	8:51	9:33		446.6	446.6	446.6	
172	Reg	NB	6			N160933	16	Central Vly. Ltd	LAU	9:33	SFT	12:51	3:18	30	13:21	0:17	(13)	12:51	13:08	*	446.6	446.6	0	
72	Reg	SB	6			S161308	16	Central Vly. Ltd	SFT	13:08	LAU	16:27	3:19	40	17:07	0:38	(2)	16:27	17:05		446.6	446.6	0	
238	Reg	NB	6	SX6	400	N021705	2	Express	ANA	17:05	SFT	20:19	3:14	30	20:49	--	--	20:19	--		446.6	893.2	0	
9	Peak O/T	SB	7			S200537	20	Central Vly. Ltd	SFT	5:37	LAU	8:57	3:20	40	9:37	0:43	3	8:57	9:40		446.6	446.6	446.6	
173	Reg	NB	7			N170940	17	S.Fernando Vly. Ltd	LAU	9:40	SFT	12:56	3:16	30	13:26	0:37	7	12:56	13:33		446.6	446.6	446.6	
74	Reg	SB	7			S171333	17	S.Fernando Vly. Ltd	SFT	13:33	LAU	16:49	3:16	40	17:29	0:44	4	16:49	17:33		446.6	446.6	446.6	
239	Peak O/T	NB	7			N201733	20	Central Vly. Ltd	LAU	17:33	SFT	20:51	3:18	30	21:21	--	--	20:51	--		446.6	446.6	446.6	
10	Reg	SB	8			S150547	15	SF-Merced	SFT	5:47	MCD	7:21	1:34	40	8:01	0:58	18	7:21	8:19		161.2	161.2	161.2	
22	Peak O/T	SB	8			S140819	14	LA-Merced	MCD	8:19	ANA	11:07	2:48	40	11:47	0:45	5	11:07	11:52		354.3	354.3	354.3	
195	Reg	NB	8			N041152	4	All-Stop	ANA	11:52	SFT	15:54	4:02	30	16:24	0:20	(10)	15:54	16:14	*	476.9	476.9	476.9	
98	Peak O/T	SB	8		400	S041614	4	All-Stop	SFT	16:14	ANA	20:19	4:05	40	20:59	--	--	20:19	--		476.9	953.8	476.9	
11	Reg	SB	9	X12	400	S010600	1	Bay Area Ltd	SFT	6:00	ANA	9:25	3:25	40	10:05	0:55	15	9:25	10:20		476.9	953.8	476.9	
182	Reg	NB	9			N141020	14	LA-Merced	ANA	10:20	MCD	13:07	2:47	30	13:37	0:30	0	13:07	13:37		354.3	354.3	354.3	
192	Reg	NB	9			N151337	15	SF-Merced	MCD	13:37	SFT	15:11	1:34	40	15:51	0:26	(14)	15:11	15:37	*	161.2	161.2	161.2	
92	Peak O/T	SB	9			S201537	20	Central Vly. Ltd	SFT	15:37	LAU	18:57	3:20	40	19:37	--	--	18:57	--		446.6	446.6	446.6	
12	Peak O/T	SB	10			S190604	19	S.Fernando Vly. Ltd	SFT	6:04	LAU	9:15	3:11	40	9:55	0:48	8	9:15	10:03		446.6	446.6	446.6	
177	Reg	NB	10			N161003	16	Central Vly. Ltd	LAU	10:03	SFT	13:21	3:18	30	13:51	0:39	9	13:21	14:00		446.6	446.6	0	
77	Reg	SB	10	X11	400	S011400	1	Bay Area Ltd	SFT	14:00	ANA	17:25	3:25	40	18:05	0:55	15	17:25	18:20		476.9	953.8	476.9	
249	Reg	NB	10			N141820	14	LA-Merced	ANA	18:20	MCD	21:07	2:47	30	21:37	--	--	21:07	--		354.3	354.3	354.3	
14	Peak O/T	SB	11		400	S100608	10	Central Vly. Ltd Ext.	SFT	6:08	ANA	9:59	3:51	40	10:39	5:06	266	9:59	15:05		476.9	953.8	0	YAN
220	Reg	NB	11	SX4	400	N021505	2	Express	ANA	15:05	SFT	18:19	3:14	30	18:49	0:41	11	18:19	19:00		446.6	893.2	0	
121	Reg	SB	11	X2	400	S011900	1	Bay Area Ltd	SFT	19:00	ANA	22:25	3:25	40	23:05	--	--	22:25	--		476.9	953.8	476.9	
15	Peak O/T	SB	12		400	S040614	4	All-Stop	SFT	6:14	ANA	10:19	4:05	40	10:59	5:46	306	10:19	16:05		476.9	953.8	476.9	YAN
229	Reg	NB	12	SX5	400	N021605	2	Express	ANA	16:05	SFT	19:19	3:14	30	19:49	--	--	19:19	--		446.6	893.2	0	
16	Reg	SB	13	SX2	400	S020629	2	Express	SFT	6:29	ANA	9:43	3:14	40	10:23	0:52	12	9:43	10:35		446.6	893.2	0	
183	Reg	NB	13	X12	400	N011035	1	Bay Area Ltd	ANA	10:35	SFT	14:00	3:25	30	14:30	0:47	17	14:00	14:47		476.9	953.8	476.9	

**CALIFORNIA HIGH SPEED RAIL**  
**APPENDIX A3 -- EQUIPMENT CYCLES -- PHASE 1 BASE SERVICE PLAN (Version 10)**

ID	OverkScheme	Dir	Set	Set2	Consist	Train No.	Pattern	Train Type	Orig	OrigTime	Dest	DestTime	RunTime	MinLay	Avail	Layover	Excess	DestArr	DestDep	T	TrnMi	200m SetMi	Wkend	Yd
84	Reg	SB	13			S151447	15	SF-Merced	SFT	14:47	MCD	16:21	1:34	40	17:01	0:58	18	16:21	17:19		161.2	161.2	161.2	
96	Peak O/T	SB	13		400	S141719	14	LA-Merced	MCD	17:19	ANA	20:07	2:48	40	20:47	0:45	5	20:07	20:52		354.3	708.6	354.3	
260	Night	NB	13			N042052	4	All-Stop	ANA	20:52	SFT	0:51	3:59	30	1:21	--	--	0:51	--		476.9	476.9	476.9	
17	Peak O/T	SB	14		400	S210633	21	S.Fernando Vly. Ltd	SFT	6:33	LAU	9:51	3:18	40	10:31	0:42	2	9:51	10:33		446.6	893.2	446.6	
180	Reg	NB	14			N161033	16	Central Vly. Ltd	LAU	10:33	SFT	13:51	3:18	30	14:21	0:17	(13)	13:51	14:08	*	446.6	446.6	0	
80	Reg	SB	14			S161408	16	Central Vly. Ltd	SFT	14:08	LAU	17:27	3:19	40	18:07	0:43	3	17:27	18:10		446.6	446.6	0	
245	Reg	NB	14			N171810	17	S.Fernando Vly. Ltd	LAU	18:10	SFT	21:26	3:16	30	21:56	--	--	21:26	--		446.6	446.6	446.6	
18	Peak O/T	SB	15			S200637	20	Central Vly. Ltd	SFT	6:37	LAU	9:57	3:20	40	10:37	0:43	3	9:57	10:40		446.6	446.6	446.6	
181	Reg	NB	15			N171040	17	S.Fernando Vly. Ltd	LAU	10:40	SFT	13:56	3:16	30	14:26	0:37	7	13:56	14:33		446.6	446.6	446.6	
82	Reg	SB	15			S171433	17	S.Fernando Vly. Ltd	SFT	14:33	LAU	17:49	3:16	40	18:29	0:44	4	17:49	18:33		446.6	446.6	446.6	
247	Reg	NB	15			N161833	16	Central Vly. Ltd	LAU	18:33	SFT	21:51	3:18	30	22:21	--	--	21:51	--		446.6	446.6	0	
19	Reg	SB	16			S150647	15	SF-Merced	SFT	6:47	MCD	8:21	1:34	40	9:01	0:41	1	8:21	9:02		161.2	161.2	161.2	
29	Reg	SB	16			S140902	14	LA-Merced	MCD	9:02	ANA	11:48	2:46	40	12:28	0:47	7	11:48	12:35		354.3	354.3	354.3	
199	Reg	NB	16	X14	400	N011235	1	Bay Area Ltd	ANA	12:35	SFT	16:00	3:25	30	16:30	0:47	17	16:00	16:47		476.9	953.8	476.9	
102	Reg	SB	16			S151647	15	SF-Merced	SFT	16:47	MCD	18:21	1:34	40	19:01	0:41	1	18:21	19:02		161.2	161.2	161.2	
112	Reg	SB	16			S141902	14	LA-Merced	MCD	19:02	ANA	21:48	2:46	40	22:28	--	--	21:48	--		354.3	354.3	354.3	
20	Reg	SB	17	X13	400	S010700	1	Bay Area Ltd	SFT	7:00	ANA	10:25	3:25	40	11:05	0:55	15	10:25	11:20		476.9	953.8	476.9	
190	Reg	NB	17			N141120	14	LA-Merced	ANA	11:20	MCD	14:07	2:47	30	14:37	0:30	0	14:07	14:37		354.3	354.3	354.3	
200	Reg	NB	17			N151437	15	SF-Merced	MCD	14:37	SFT	16:11	1:34	40	16:51	0:26	(14)	16:11	16:37	*	161.2	161.2	161.2	
101	Peak O/T	SB	17			S201637	20	Central Vly. Ltd	SFT	16:37	LAU	19:57	3:20	40	20:37	--	--	19:57	--		446.6	446.6	446.6	
21	Peak O/T	SB	18		400	S190704	19	S.Fernando Vly. Ltd	SFT	7:04	LAU	10:15	3:11	40	10:55	0:48	8	10:15	11:03		446.6	893.2	446.6	
185	Reg	NB	18			N161103	16	Central Vly. Ltd	LAU	11:03	SFT	14:21	3:18	30	14:51	0:39	9	14:21	15:00		446.6	446.6	0	
85	Reg	SB	18	X12	400	S011500	1	Bay Area Ltd	SFT	15:00	ANA	18:25	3:25	40	19:05	0:55	15	18:25	19:20		476.9	953.8	476.9	
255	Reg	NB	18			N141920	14	LA-Merced	ANA	19:20	MCD	22:07	2:47	30	22:37	--	--	22:07	--		354.3	354.3	354.3	
23	Peak O/T	SB	19			S180708	18	Central Vly. Ltd	SFT	7:08	LAU	10:34	3:26	40	11:14	0:36	(4)	10:34	11:10		446.6	446.6	446.6	
186	Reg	NB	19			N171110	17	S.Fernando Vly. Ltd	LAU	11:10	SFT	14:26	3:16	30	14:56	0:38	8	14:26	15:04		446.6	446.6	446.6	
86	Peak O/T	SB	19			S191504	19	S.Fernando Vly. Ltd	SFT	15:04	LAU	18:15	3:11	40	18:55	0:58	18	18:15	19:13		446.6	446.6	446.6	
252	Reg	NB	19			N161913	16	Central Vly. Ltd	LAU	19:13	SFT	22:31	3:18	30	23:01	--	--	22:31	--		446.6	446.6	0	
24	Peak O/T	SB	20		400	S040714	4	All-Stop	SFT	7:14	ANA	11:19	4:05	40	11:59	5:23	283	11:19	16:42		476.9	953.8	476.9	YAN
236	Peak O/T	NB	20		400	N101642	10	Central Vly. Ltd Ext.	ANA	16:42	SFT	20:27	3:45	30	20:57	0:33	3	20:27	21:00		476.9	953.8	0	
129	Reg	SB	20	X4	400	S012100	1	Bay Area Ltd	SFT	21:00	ANA	0:25	3:25	40	1:05	--	--	0:25	--		476.9	953.8	476.9	
25	Reg	SB	21	SX3	400	S020729	2	Express	SFT	7:29	ANA	10:43	3:14	40	11:23	0:52	12	10:43	11:35		446.6	893.2	0	
191	Reg	NB	21	X13	400	N011135	1	Bay Area Ltd	ANA	11:35	SFT	15:00	3:25	30	15:30	0:47	17	15:00	15:47		476.9	953.8	476.9	
93	Reg	SB	21			S151547	15	SF-Merced	SFT	15:47	MCD	17:21	1:34	40	18:01	0:41	1	17:21	18:02		161.2	161.2	161.2	
103	Reg	SB	21			S141802	14	LA-Merced	MCD	18:02	ANA	20:48	2:46	40	21:28	--	--	20:48	--		354.3	354.3	354.3	
26	Peak O/T	SB	22			S210733	21	S.Fernando Vly. Ltd	SFT	7:33	LAU	10:51	3:18	40	11:31	0:42	2	10:51	11:33		446.6	446.6	446.6	
188	Reg	NB	22			N161133	16	Central Vly. Ltd	LAU	11:33	SFT	14:51	3:18	30	15:21	0:17	(13)	14:51	15:08	*	446.6	446.6	0	
88	Peak O/T	SB	22		400	S101508	10	Central Vly. Ltd Ext.	SFT	15:08	ANA	18:59	3:51	40	19:39	--	--	18:59	--		476.9	953.8	0	
27	Peak O/T	SB	23			S200737	20	Central Vly. Ltd	SFT	7:37	LAU	10:57	3:20	40	11:37	0:43	3	10:57	11:40		446.6	446.6	446.6	
189	Reg	NB	23			N171140	17	S.Fernando Vly. Ltd	LAU	11:40	SFT	14:56	3:16	30	15:26	0:37	7	14:56	15:33		446.6	446.6	446.6	
91	Peak O/T	SB	23			S211533	21	S.Fernando Vly. Ltd	SFT	15:33	LAU	18:51	3:18	40	19:31	0:49	9	18:51	19:40		446.6	446.6	446.6	
254	Reg	NB	23			N171940	17	S.Fernando Vly. Ltd	LAU	19:40	SFT	22:56	3:16	30	23:26	--	--	22:56	--		446.6	446.6	446.6	
28	Reg	SB	24			S150747	15	SF-Merced	SFT	7:47	MCD	9:21	1:34	40	10:01	0:41	1	9:21	10:02		161.2	161.2	161.2	
37	Reg	SB	24			S141002	14	LA-Merced	MCD	10:02	ANA	12:48	2:46	40	13:28	0:47	7	12:48	13:35		354.3	354.3	354.3	
207	Reg	NB	24	X1	400	N011335	1	Bay Area Ltd	ANA	13:35	SFT	17:00	3:25	30	17:30	0:29	(1)	17:00	17:29		476.9	953.8	476.9	
108	Reg	SB	24	SX6	400	S021729	2	Express	SFT	17:29	ANA	20:43	3:14	40	21:23	--	--	20:43	--		446.6	893.2	0	
30	Reg	SB	25	X14	400	S010800	1	Bay Area Ltd	SFT	8:00	ANA	11:25	3:25	40	12:05	0:55	15	11:25	12:20		476.9	953.8	476.9	
198	Reg	NB	25			N141220	14	LA-Merced	ANA	12:20	MCD	15:07	2:47	30	15:37	0:30	0	15:07	15:37		354.3	354.3	354.3	
208	Reg	NB	25			N151537	15	SF-Merced	MCD	15:37	SFT	17:11	1:34	40	17:51	0:26	(14)	17:11	17:37	*	161.2	161.2	161.2	
110	Peak O/T	SB	25			S201737	20	Central Vly. Ltd	SFT	17:37	LAU	20:57	3:20	40	21:37	--	--	20:57	--		446.6	446.6	446.6	
32	Reg	SB	26			S160808	16	Central Vly. Ltd	SFT	8:08	LAU	11:27	3:19	40	12:07	0:43	3	11:27	12:10		446.6	446.6	0	

**CALIFORNIA HIGH SPEED RAIL**  
**APPENDIX A3 -- EQUIPMENT CYCLES -- PHASE 1 BASE SERVICE PLAN (Version 10)**

ID	OverkScheme	Dir	Set	Set2	Consist	Train No.	Pattern	Train Type	Orig	OrigTime	Dest	DestTime	RunTime	MinLay	Avail	Layover	Excess	DestArr	DestDep	T	TrnMi	200m SetMi	Wkend	Yd
194	Reg	NB	26			N171210	17	S.Fernando Vly. Ltd	LAU	12:10	SFT	15:26	3:16	30	15:56	0:38	8	15:26	16:04		446.6	446.6	446.6	
95	Peak O/T	SB	26			S191604	19	S.Fernando Vly. Ltd	SFT	16:04	LAU	19:15	3:11	40	19:55	--	--	19:15	--		446.6	446.6	446.6	
33	Reg	SB	27		400	S040814	4	All-Stop	SFT	8:14	ANA	12:17	4:03	40	12:57	0:35	(5)	12:17	12:52		476.9	953.8	476.9	
203	Reg	NB	27			N041252	4	All-Stop	ANA	12:52	SFT	16:54	4:02	30	17:24	0:20	(10)	16:54	17:14	*	476.9	476.9	476.9	
107	Peak O/T	SB	27		400	S041714	4	All-Stop	SFT	17:14	ANA	21:19	4:05	40	21:59	--	--	21:19	--		476.9	953.8	476.9	
132	Reg	NB	41	X1	400	N010435	1	Bay Area Ltd	ANA	4:35	SFT	8:00	3:25	30	8:30	0:33	3	8:00	8:33		476.9	953.8	476.9	
34	Reg	SB	41			S170833	17	S.Fernando Vly. Ltd	SFT	8:33	LAU	11:49	3:16	40	12:29	0:44	4	11:49	12:33		446.6	446.6	446.6	
196	Reg	NB	41			N161233	16	Central Vly. Ltd	LAU	12:33	SFT	15:51	3:18	30	16:21	0:17	(13)	15:51	16:08	*	446.6	446.6	0	
97	Peak O/T	SB	41			S181608	18	Central Vly. Ltd	SFT	16:08	LAU	19:34	3:26	40	20:14	--	--	19:34	--		446.6	446.6	446.6	
136	Peak O/T	NB	42			N040446	4	All-Stop	ANA	4:46	SFT	8:48	4:02	30	9:18	0:26	(4)	8:48	9:14		476.9	476.9	476.9	
41	Reg	SB	42			S040914	4	All-Stop	SFT	9:14	ANA	13:17	4:03	40	13:57	0:35	(5)	13:17	13:52		476.9	476.9	476.9	
211	Reg	NB	42			N041352	4	All-Stop	ANA	13:52	SFT	17:54	4:02	30	18:24	0:09	(21)	17:54	18:03	*	476.9	476.9	476.9	
114	Reg	SB	42			S171803	17	S.Fernando Vly. Ltd	SFT	18:03	LAU	21:19	3:16	40	21:59	--	--	21:19	--		446.6	446.6	446.6	
137	Reg	NB	43	SX1	400	N020505	2	Express	ANA	5:05	SFT	8:19	3:14	30	8:49	0:44	14	8:19	9:03		446.6	893.2	0	
39	Reg	SB	43			S170903	17	S.Fernando Vly. Ltd	SFT	9:03	LAU	12:19	3:16	40	12:59	0:44	4	12:19	13:03		446.6	446.6	446.6	
201	Reg	NB	43			N161303	16	Central Vly. Ltd	LAU	13:03	SFT	16:21	3:18	30	16:51	0:39	9	16:21	17:00		446.6	446.6	0	
104	Reg	SB	43	X14	400	S011700	1	Bay Area Ltd	SFT	17:00	ANA	20:25	3:25	40	21:05	--	--	20:25	--		476.9	953.8	476.9	
140	Peak O/T	NB	44			N140519	14	LA-Merced	ANA	5:19	MCD	8:07	2:48	30	8:37	0:30	0	8:07	8:37		354.3	354.3	354.3	
151	Reg	NB	44			N150837	15	SF-Merced	MCD	8:37	SFT	10:11	1:34	40	10:51	0:27	(13)	10:11	10:38	*	161.2	161.2	161.2	
51	Reg	SB	44			S161038	16	Central Vly. Ltd	SFT	10:38	LAU	13:57	3:19	40	14:37	0:43	3	13:57	14:40		446.6	446.6	0	
213	Reg	NB	44			N171440	17	S.Fernando Vly. Ltd	LAU	14:40	SFT	17:56	3:16	30	18:26	0:18	(12)	17:56	18:14		446.6	446.6	446.6	
116	Reg	SB	44			S041814	4	All-Stop	SFT	18:14	ANA	22:17	4:03	40	22:57	--	--	22:17	--		476.9	476.9	476.9	
141	Reg	NB	45	X2	400	N010535	1	Bay Area Ltd	ANA	5:35	SFT	9:00	3:25	30	9:30	0:47	17	9:00	9:47		476.9	953.8	476.9	
44	Reg	SB	45			S150947	15	SF-Merced	SFT	9:47	MCD	11:21	1:34	40	12:01	0:41	1	11:21	12:02		161.2	161.2	161.2	
53	Reg	SB	45			S141202	14	LA-Merced	MCD	12:02	ANA	14:48	2:46	40	15:28	0:47	7	14:48	15:35		354.3	354.3	354.3	
224	Reg	NB	45	X3	400	N011535	1	Bay Area Ltd	ANA	15:35	SFT	19:00	3:25	30	19:30	--	--	19:00	--		476.9	953.8	476.9	
145	Peak O/T	NB	46		400	N040546	4	All-Stop	ANA	5:46	SFT	9:48	4:02	30	10:18	0:26	(4)	9:48	10:14		476.9	953.8	476.9	
49	Reg	SB	46			S041014	4	All-Stop	SFT	10:14	ANA	14:17	4:03	40	14:57	0:29	(11)	14:17	14:46	*	476.9	476.9	476.9	
219	Peak O/T	NB	46		400	N041446	4	All-Stop	ANA	14:46	SFT	18:48	4:02	30	19:18	0:26	(4)	18:48	19:14		476.9	953.8	476.9	
123	Night	SB	46			S041914	4	All-Stop	SFT	19:14	ANA	23:13	3:59	40	23:53	--	--	23:13	--		476.9	476.9	476.9	
146	Reg	NB	47	SX2	400	N020605	2	Express	ANA	6:05	SFT	9:19	3:14	30	9:49	0:49	19	9:19	10:08		446.6	893.2	0	
48	Reg	SB	47			S161008	16	Central Vly. Ltd	SFT	10:08	LAU	13:27	3:19	40	14:07	0:43	3	13:27	14:10		446.6	446.6	0	
210	Reg	NB	47			N171410	17	S.Fernando Vly. Ltd	LAU	14:10	SFT	17:26	3:16	30	17:56	0:34	4	17:26	18:00		446.6	446.6	446.6	
113	Reg	SB	47	X1	400	S011800	1	Bay Area Ltd	SFT	18:00	ANA	21:25	3:25	40	22:05	--	--	21:25	--		476.9	953.8	476.9	
149	Peak O/T	NB	48		400	N140619	14	LA-Merced	ANA	6:19	MCD	9:07	2:48	30	9:37	0:30	0	9:07	9:37		354.3	708.6	354.3	
160	Reg	NB	48			N150937	15	SF-Merced	MCD	9:37	SFT	11:11	1:34	40	11:51	0:27	(13)	11:11	11:38	*	161.2	161.2	161.2	
59	Reg	SB	48			S161138	16	Central Vly. Ltd	SFT	11:38	LAU	14:57	3:19	40	15:37	0:38	(2)	14:57	15:35		446.6	446.6	0	
222	Peak O/T	NB	48			N211535	21	S.Fernando Vly. Ltd	LAU	15:35	SFT	18:57	3:22	30	19:27	--	--	18:57	--		446.6	446.6	446.6	
150	Reg	NB	49	X3	400	N010635	1	Bay Area Ltd	ANA	6:35	SFT	10:00	3:25	30	10:30	0:47	17	10:00	10:47		476.9	953.8	476.9	
52	Reg	SB	49			S151047	15	SF-Merced	SFT	10:47	MCD	12:21	1:34	40	13:01	0:41	1	12:21	13:02		161.2	161.2	161.2	
61	Reg	SB	49			S141302	14	LA-Merced	MCD	13:02	ANA	15:48	2:46	40	16:28	0:47	7	15:48	16:35		354.3	354.3	354.3	
233	Reg	NB	49	X4	400	N011635	1	Bay Area Ltd	ANA	16:35	SFT	20:00	3:25	30	20:30	--	--	20:00	--		476.9	953.8	476.9	
153	Peak O/T	NB	50		400	N100642	10	Central Vly. Ltd Ext.	ANA	6:42	SFT	10:27	3:45	30	10:57	0:36	6	10:27	11:03		476.9	953.8	0	
55	Reg	SB	50			S171103	17	S.Fernando Vly. Ltd	SFT	11:03	LAU	14:19	3:16	40	14:59	0:44	4	14:19	15:03		446.6	446.6	446.6	
217	Peak O/T	NB	50			N191503	19	S.Fernando Vly. Ltd	LAU	15:03	SFT	18:15	3:12	30	18:45	0:32	2	18:15	18:47		446.6	446.6	446.6	
119	Reg	SB	50			S151847	15	SF-Merced	SFT	18:47	MCD	20:21	1:34	40	21:01	--	--	20:21	--		161.2	161.2	161.2	
154	Peak O/T	NB	51		400	N040646	4	All-Stop	ANA	6:46	SFT	10:48	4:02	30	11:18	0:26	(4)	10:48	11:14		476.9	953.8	476.9	
57	Reg	SB	51			S041114	4	All-Stop	SFT	11:14	ANA	15:17	4:03	40	15:57	0:29	(11)	15:17	15:46	*	476.9	476.9	476.9	
228	Peak O/T	NB	51		400	N041546	4	All-Stop	ANA	15:46	SFT	19:48	4:02	30	20:18	0:26	(4)	19:48	20:14		476.9	953.8	476.9	
127	Night	SB	51			S042014	4	All-Stop	SFT	20:14	ANA	0:13	3:59	40	0:53	--	--	0:13	--		476.9	476.9	476.9	
155	Reg	NB	52	SX3	400	N020705	2	Express	ANA	7:05	SFT	10:19	3:14	30	10:49	0:49	19	10:19	11:08		446.6	893.2	0	
56	Reg	SB	52			S161108	16	Central Vly. Ltd	SFT	11:08	LAU	14:27	3:19	40	15:07	0:40	0	14:27	15:07		446.6	446.6	0	

**CALIFORNIA HIGH SPEED RAIL  
APPENDIX A3 -- EQUIPMENT CYCLES -- PHASE 1 BASE SERVICE PLAN (Version 10)**

ID	OverkScheme	Dir	Set	Set2	Consist	Train No.	Pattern	Train Type	Orig	OrigTime	Dest	DestTime	RunTime	MinLay	Avail	Layover	Excess	DestArr	DestDep	T	TrnMi	200m SetMi	Wkend	Yd
218	Peak O/T	NB	52			N181507	18	Central Vly. Ltd	LAU	15:07	SFT	18:27	3:20	30	18:57	0:43	13	18:27	19:10		446.6	446.6	446.6	
122	Reg	SB	52			S171910	17	S.Fernando Vly. Ltd	SFT	19:10	LAU	22:26	3:16	40	23:06	--	--	22:26	--		446.6	446.6	446.6	
158	Reg	NB	53			N140720	14	LA-Merced	ANA	7:20	MCD	10:07	2:47	30	10:37	0:30	0	10:07	10:37		354.3	354.3	354.3	
168	Reg	NB	53			N151037	15	SF-Merced	MCD	10:37	SFT	12:11	1:34	40	12:51	0:27	(13)	12:11	12:38	*	161.2	161.2	161.2	
67	Reg	SB	53			S161238	16	Central Vly. Ltd	SFT	12:38	LAU	15:57	3:19	40	16:37	0:38	(2)	15:57	16:35		446.6	446.6	0	
231	Peak O/T	NB	53		400	N211635	21	S.Fernando Vly. Ltd	LAU	16:35	SFT	19:57	3:22	30	20:27	--	--	19:57	--		446.6	893.2	446.6	
159	Reg	NB	54	X4	400	N010735	1	Bay Area Ltd	ANA	7:35	SFT	11:00	3:25	30	11:30	0:47	17	11:00	11:47		476.9	953.8	476.9	
60	Reg	SB	54			S151147	15	SF-Merced	SFT	11:47	MCD	13:21	1:34	40	14:01	0:41	1	13:21	14:02		161.2	161.2	161.2	
69	Reg	SB	54			S141402	14	LA-Merced	MCD	14:02	ANA	16:48	2:46	40	17:28	0:47	7	16:48	17:35		354.3	354.3	354.3	
242	Reg	NB	54	X5	400	N011735	1	Bay Area Ltd	ANA	17:35	SFT	21:00	3:25	30	21:30	--	--	21:00	--		476.9	953.8	476.9	
163	Reg	NB	55		400	N040752	4	All-Stop	ANA	7:52	SFT	11:54	4:02	30	12:24	0:20	(10)	11:54	12:14	*	476.9	953.8	476.9	
65	Reg	SB	55			S041214	4	All-Stop	SFT	12:14	ANA	16:17	4:03	40	16:57	0:29	(11)	16:17	16:46	*	476.9	476.9	476.9	
237	Peak O/T	NB	55		400	N041646	4	All-Stop	ANA	16:46	SFT	20:48	4:02	30	21:18	0:26	(4)	20:48	21:14		476.9	953.8	476.9	
130	Night	SB	55			S042114	4	All-Stop	SFT	21:14	ANA	1:13	3:59	40	1:53	--	--	1:13	--		476.9	476.9	476.9	
166	Peak O/T	NB	56			N140820	14	LA-Merced	ANA	8:20	MCD	11:08	2:48	30	11:38	0:29	(1)	11:08	11:37		354.3	354.3	354.3	
176	Reg	NB	56			N151137	15	SF-Merced	MCD	11:37	SFT	13:11	1:34	40	13:51	0:27	(13)	13:11	13:38	*	161.2	161.2	161.2	
75	Reg	SB	56			S161338	16	Central Vly. Ltd	SFT	13:38	LAU	16:57	3:19	40	17:37	0:38	(2)	16:57	17:35		446.6	446.6	0	
240	Peak O/T	NB	56			N211735	21	S.Fernando Vly. Ltd	LAU	17:35	SFT	20:57	3:22	30	21:27	--	--	20:57	--		446.6	446.6	446.6	
167	Reg	NB	57	X5	400	N010835	1	Bay Area Ltd	ANA	8:35	SFT	12:00	3:25	30	12:30	0:47	17	12:00	12:47		476.9	953.8	476.9	
68	Reg	SB	57			S151247	15	SF-Merced	SFT	12:47	MCD	14:21	1:34	40	15:01	0:58	18	14:21	15:19		161.2	161.2	161.2	
79	Peak O/T	SB	57			S141519	14	LA-Merced	MCD	15:19	ANA	18:07	2:48	40	18:47	0:28	(12)	18:07	18:35		354.3	354.3	354.3	
250	Reg	NB	57	X11	400	N011835	1	Bay Area Ltd	ANA	18:35	SFT	22:00	3:25	30	22:30	--	--	22:00	--		476.9	953.8	476.9	
134	Peak O/T	NB	61			N190503	19	S.Fernando Vly. Ltd	LAU	5:03	SFT	8:15	3:12	30	8:45	0:32	2	8:15	8:47		446.6	446.6	446.6	
36	Reg	SB	61			S150847	15	SF-Merced	SFT	8:47	MCD	10:21	1:34	40	11:01	0:41	1	10:21	11:02		161.2	161.2	161.2	
45	Reg	SB	61			S141102	14	LA-Merced	MCD	11:02	ANA	13:48	2:46	40	14:28	0:47	7	13:48	14:35		354.3	354.3	354.3	
215	Reg	NB	61	X2	400	N011435	1	Bay Area Ltd	ANA	14:35	SFT	18:00	3:25	30	18:30	0:33	3	18:00	18:33		476.9	953.8	476.9	
117	Reg	SB	61			S171833	17	S.Fernando Vly. Ltd	SFT	18:33	LAU	21:49	3:16	40	22:29	--	--	21:49	--		446.6	446.6	446.6	
135	Peak O/T	NB	62			N180507	18	Central Vly. Ltd	LAU	5:07	SFT	8:27	3:20	30	8:57	0:33	3	8:27	9:00		446.6	446.6	446.6	
38	Reg	SB	62	X1	400	S010900	1	Bay Area Ltd	SFT	9:00	ANA	12:25	3:25	40	13:05	0:55	15	12:25	13:20		476.9	953.8	476.9	
206	Reg	NB	62			N141320	14	LA-Merced	ANA	13:20	MCD	16:07	2:47	30	16:37	0:30	0	16:07	16:37		354.3	354.3	354.3	
216	Reg	NB	62			N151637	15	SF-Merced	MCD	16:37	SFT	18:11	1:34	40	18:51	0:27	(13)	18:11	18:38		161.2	161.2	161.2	
118	Reg	SB	62			S161838	16	Central Vly. Ltd	SFT	18:38	LAU	21:57	3:19	40	22:37	--	--	21:57	--		446.6	446.6	0	
138	Peak O/T	NB	63			N200533	20	Central Vly. Ltd	LAU	5:33	SFT	8:51	3:18	30	9:21	0:17	(13)	8:51	9:08	*	446.6	446.6	446.6	
40	Reg	SB	63			S160908	16	Central Vly. Ltd	SFT	9:08	LAU	12:27	3:19	40	13:07	0:43	3	12:27	13:10		446.6	446.6	0	
202	Reg	NB	63			N171310	17	S.Fernando Vly. Ltd	LAU	13:10	SFT	16:26	3:16	30	16:56	0:38	8	16:26	17:04		446.6	446.6	446.6	
105	Peak O/T	SB	63		400	S191704	19	S.Fernando Vly. Ltd	SFT	17:04	LAU	20:15	3:11	40	20:55	--	--	20:15	--		446.6	893.2	446.6	
139	Peak O/T	NB	64			N210535	21	S.Fernando Vly. Ltd	LAU	5:35	SFT	8:57	3:22	30	9:27	0:36	6	8:57	9:33		446.6	446.6	446.6	
42	Reg	SB	64			S170933	17	S.Fernando Vly. Ltd	SFT	9:33	LAU	12:49	3:16	40	13:29	0:44	4	12:49	13:33		446.6	446.6	446.6	
204	Reg	NB	64			N161333	16	Central Vly. Ltd	LAU	13:33	SFT	16:51	3:18	30	17:21	0:17	(13)	16:51	17:08	*	446.6	446.6	0	
106	Peak O/T	SB	64			S181708	18	Central Vly. Ltd	SFT	17:08	LAU	20:34	3:26	40	21:14	--	--	20:34	--		446.6	446.6	446.6	
143	Peak O/T	NB	65			N190603	19	S.Fernando Vly. Ltd	LAU	6:03	SFT	9:15	3:12	30	9:45	0:45	15	9:15	10:00		446.6	446.6	446.6	
46	Reg	SB	65	X2	400	S011000	1	Bay Area Ltd	SFT	10:00	ANA	13:25	3:25	40	14:05	0:54	14	13:25	14:19		476.9	953.8	476.9	
214	Peak O/T	NB	65			N141419	14	LA-Merced	ANA	14:19	MCD	17:07	2:48	30	17:37	0:30	0	17:07	17:37		354.3	354.3	354.3	
225	Reg	NB	65			N151737	15	SF-Merced	MCD	17:37	SFT	19:11	1:34	40	19:51	--	--	19:11	--		161.2	161.2	161.2	
144	Peak O/T	NB	66			N180607	18	Central Vly. Ltd	LAU	6:07	SFT	9:27	3:20	30	9:57	0:36	6	9:27	10:03		446.6	446.6	446.6	
47	Reg	SB	66			S171003	17	S.Fernando Vly. Ltd	SFT	10:03	LAU	13:19	3:16	40	13:59	0:44	4	13:19	14:03		446.6	446.6	446.6	
209	Reg	NB	66			N161403	16	Central Vly. Ltd	LAU	14:03	SFT	17:21	3:18	30	17:51	0:26	(4)	17:21	17:47		446.6	446.6	0	
111	Reg	SB	66			S151747	15	SF-Merced	SFT	17:47	MCD	19:21	1:34	40	20:01	0:41	1	19:21	20:02		161.2	161.2	161.2	
120	Reg	SB	66			S142002	14	LA-Merced	MCD	20:02	ANA	22:48	2:46	40	23:28	--	--	22:48	--		354.3	354.3	354.3	YSF
147	Peak O/T	NB	67			N200633	20	Central Vly. Ltd	LAU	6:33	SFT	9:51	3:18	30	10:21	5:38	308	9:51	15:29		446.6	446.6	446.6	
90	Reg	SB	67	SX4	400	S021529	2	Express	SFT	15:29	ANA	18:43	3:14	40	19:23	0:52	12	18:43	19:35		446.6	893.2	0	
256	Reg	NB	67	X12	400	N011935	1	Bay Area Ltd	ANA	19:35	SFT	23:00	3:25	30	23:30	--	--	23:00	--		476.9	953.8	476.9	

**CALIFORNIA HIGH SPEED RAIL  
APPENDIX A3 -- EQUIPMENT CYCLES -- PHASE 1 BASE SERVICE PLAN (Version 10)**

ID	OvertrkScheme	Dir	Set	Set2	Consist	Train No.	Pattern	Train Type	Orig	OrigTime	Dest	DestTime	RunTime	MinLay	Avail	Layover	Excess	DestArr	DestDep	T	TrnMi	200m SetMi	Wkend	Yd
148	Peak O/T	NB	68		400	N210635	21	S.Fernando Vly. Ltd	LAU	6:35	SFT	9:57	3:22	30	10:27	0:36	6	9:57	10:33		446.6	893.2	446.6	
50	Reg	SB	68			S171033	17	S.Fernando Vly. Ltd	SFT	10:33	LAU	13:49	3:16	40	14:29	0:44	4	13:49	14:33		446.6	446.6	446.6	
212	Reg	NB	68			N161433	16	Central Vly. Ltd	LAU	14:33	SFT	17:51	3:18	30	18:21	0:17	(13)	17:51	18:08		446.6	446.6	0	
115	Reg	SB	68			S161808	16	Central Vly. Ltd	SFT	18:08	LAU	21:27	3:19	40	22:07	--	--	21:27	--		446.6	446.6	0	
152	Peak O/T	NB	69		400	N190703	19	S.Fernando Vly. Ltd	LAU	7:03	SFT	10:15	3:12	30	10:45	0:45	15	10:15	11:00		446.6	893.2	446.6	
54	Reg	SB	69	X3	400	S011100	1	Bay Area Ltd	SFT	11:00	ANA	14:25	3:25	40	15:05	0:54	14	14:25	15:19		476.9	953.8	476.9	
223	Reg	NB	69			N141519	14	LA-Merced	ANA	15:19	MCD	18:06	2:47	30	18:36	0:31	1	18:06	18:37		354.3	354.3	354.3	
234	Reg	NB	69			N151837	15	SF-Merced	MCD	18:37	SFT	20:11	1:34	40	20:51	--	--	20:11	--		161.2	161.2	161.2	YSF
156	Peak O/T	NB	70			N200733	20	Central Vly. Ltd	LAU	7:33	SFT	10:51	3:18	30	11:21	5:38	308	10:51	16:29		446.6	446.6	446.6	
99	Reg	SB	70	SX5	400	S021629	2	Express	SFT	16:29	ANA	19:43	3:14	40	20:23	0:52	12	19:43	20:35		446.6	893.2	0	
259	Reg	NB	70	X13	400	N012035	1	Bay Area Ltd	ANA	20:35	SFT	0:00	3:25	30	0:30	--	--	0:00	--		476.9	953.8	476.9	
157	Peak O/T	NB	71			N210735	21	S.Fernando Vly. Ltd	LAU	7:35	SFT	10:57	3:22	30	11:27	0:36	6	10:57	11:33		446.6	446.6	446.6	
58	Reg	SB	71			S171133	17	S.Fernando Vly. Ltd	SFT	11:33	LAU	14:49	3:16	40	15:29	0:44	4	14:49	15:33		446.6	446.6	446.6	
221	Peak O/T	NB	71			N201533	20	Central Vly. Ltd	LAU	15:33	SFT	18:51	3:18	30	19:21	0:44	14	18:51	19:35		446.6	446.6	446.6	
124	Reg	SB	71			S161935	16	Central Vly. Ltd	SFT	19:35	LAU	22:54	3:19	40	23:34	--	--	22:54	--		446.6	446.6	0	
161	Reg	NB	72			N160803	16	Central Vly. Ltd	LAU	8:03	SFT	11:21	3:18	30	11:51	0:39	9	11:21	12:00		446.6	446.6	0	
62	Reg	SB	72	X4	400	S011200	1	Bay Area Ltd	SFT	12:00	ANA	15:25	3:25	40	16:05	0:54	14	15:25	16:19		476.9	953.8	476.9	
232	Reg	NB	72			N141619	14	LA-Merced	ANA	16:19	MCD	19:06	2:47	30	19:36	0:31	1	19:06	19:37		354.3	354.3	354.3	
243	Reg	NB	72			N151937	15	SF-Merced	MCD	19:37	SFT	21:11	1:34	40	21:51	--	--	21:11	--		161.2	161.2	161.2	
162	Reg	NB	73			N170810	17	S.Fernando Vly. Ltd	LAU	8:10	SFT	11:26	3:16	30	11:56	0:37	7	11:26	12:03		446.6	446.6	446.6	
63	Peak O/T	SB	73			S171203	17	S.Fernando Vly. Ltd	SFT	12:03	LAU	15:19	3:16	40	15:59	0:44	4	15:19	16:03		446.6	446.6	446.6	
226	Peak O/T	NB	73			N191603	19	S.Fernando Vly. Ltd	LAU	16:03	SFT	19:15	3:12	30	19:45	0:32	2	19:15	19:47		446.6	446.6	446.6	
125	Reg	SB	73			S151947	15	SF-Merced	SFT	19:47	MCD	21:21	1:34	40	22:01	--	--	21:21	--		161.2	161.2	161.2	
164	Reg	NB	74			N160833	16	Central Vly. Ltd	LAU	8:33	SFT	11:51	3:18	30	12:21	0:17	(13)	11:51	12:08	*	446.6	446.6	0	
64	Reg	SB	74			S161208	16	Central Vly. Ltd	SFT	12:08	LAU	15:27	3:19	40	16:07	0:40	0	15:27	16:07		446.6	446.6	0	
227	Peak O/T	NB	74			N181607	18	Central Vly. Ltd	LAU	16:07	SFT	19:27	3:20	30	19:57	0:33	3	19:27	20:00		446.6	446.6	446.6	
126	Reg	SB	74	X3	400	S012000	1	Bay Area Ltd	SFT	20:00	ANA	23:25	3:25	40	0:05	--	--	23:25	--		476.9	953.8	476.9	
165	Reg	NB	75			N170840	17	S.Fernando Vly. Ltd	LAU	8:40	SFT	11:56	3:16	30	12:26	0:37	7	11:56	12:33		446.6	446.6	446.6	
66	Reg	SB	75			S171233	17	S.Fernando Vly. Ltd	SFT	12:33	LAU	15:49	3:16	40	16:29	0:44	4	15:49	16:33		446.6	446.6	446.6	
230	Peak O/T	NB	75			N201633	20	Central Vly. Ltd	LAU	16:33	SFT	19:51	3:18	30	20:21	--	--	19:51	--		446.6	446.6	446.6	
1	Night	SB	M1			S140519	14	LA-Merced	MCD	5:19	ANA	8:01	2:42	40	8:41	0:51	11	8:01	8:52		354.3	354.3	354.3	
171	Reg	NB	M1			N040852	4	All-Stop	ANA	8:52	SFT	12:54	4:02	30	13:24	0:20	(10)	12:54	13:14	*	476.9	476.9	476.9	
73	Reg	SB	M1			S041314	4	All-Stop	SFT	13:14	ANA	17:17	4:03	40	17:57	0:35	(5)	17:17	17:52		476.9	476.9	476.9	
01190	Reg	NB	M1			N041752	4	All-Stop	ANA	17:52	SFT	21:54	4:02	30	22:24	--	--	21:54	--		476.9	476.9	476.9	
4	Peak O/T	SB	M2		400	S140619	14	LA-Merced	MCD	6:19	ANA	9:07	2:48	40	9:47	0:45	5	9:07	9:52		354.3	708.6	354.3	
179	Reg	NB	M2			N040952	4	All-Stop	ANA	9:52	SFT	13:54	4:02	30	14:24	0:20	(10)	13:54	14:14	*	476.9	476.9	476.9	
81	Reg	SB	M2			S041414	4	All-Stop	SFT	14:14	ANA	18:17	4:03	40	18:57	0:35	(5)	18:17	18:52		476.9	476.9	476.9	
253	Night	NB	M2			N041852	4	All-Stop	ANA	18:52	SFT	22:51	3:59	30	23:21	--	--	22:51	--		476.9	476.9	476.9	
131	Reg	NB	M3			N150537	15	SF-Merced	MCD	5:37	SFT	7:11	1:34	40	7:51	0:52	12	7:11	8:03		161.2	161.2	161.2	
31	Reg	SB	M3			S170803	17	S.Fernando Vly. Ltd	SFT	8:03	LAU	11:19	3:16	40	11:59	0:44	4	11:19	12:03		446.6	446.6	446.6	
193	Reg	NB	M3			N161203	16	Central Vly. Ltd	LAU	12:03	SFT	15:21	3:18	30	15:51	0:39	9	15:21	16:00		446.6	446.6	0	
94	Reg	SB	M3	X13	400	S011600	1	Bay Area Ltd	SFT	16:00	ANA	19:25	3:25	40	20:05	0:55	15	19:25	20:20		476.9	953.8	476.9	
258	Reg	NB	M3			N142020	14	LA-Merced	ANA	20:20	MCD	23:07	2:47	30	23:37	--	--	23:07	--		354.3	354.3	354.3	
133	Reg	NB	M4			N150637	15	SF-Merced	MCD	6:37	SFT	8:11	1:34	40	8:51	0:27	(13)	8:11	8:38	*	161.2	161.2	161.2	
35	Reg	SB	M4			S160838	16	Central Vly. Ltd	SFT	8:38	LAU	11:57	3:19	40	12:37	0:43	3	11:57	12:40		446.6	446.6	0	
197	Reg	NB	M4			N171240	17	S.Fernando Vly. Ltd	LAU	12:40	SFT	15:56	3:16	30	16:26	0:37	7	15:56	16:33		446.6	446.6	446.6	
100	Peak O/T	SB	M4		400	S211633	21	S.Fernando Vly. Ltd	SFT	16:33	LAU	19:51	3:18	40	20:31	--	--	19:51	--		446.6	893.2	446.6	
13	Peak O/T	SB	M5			S140719	14	LA-Merced	MCD	7:19	ANA	10:07	2:48	40	10:47	0:45	5	10:07	10:52		354.3	354.3	354.3	
187	Reg	NB	M5			N041052	4	All-Stop	ANA	10:52	SFT	14:54	4:02	30	15:24	0:20	(10)	14:54	15:14	*	476.9	476.9	476.9	
89	Peak O/T	SB	M5		400	S041514	4	All-Stop	SFT	15:14	ANA	19:19	4:05	40	19:59	--	--	19:19	--		476.9	953.8	476.9	
142	Reg	NB	M6			N150737	15	SF-Merced	MCD	7:37	SFT	9:11	1:34	40	9:51	0:27	(13)	9:11	9:38	*	161.2	161.2	161.2	
43	Reg	SB	M6			S160938	16	Central Vly. Ltd	SFT	9:38	LAU	12:57	3:19	40	13:37	0:43	3	12:57	13:40		446.6	446.6	0	

**CALIFORNIA HIGH SPEED RAIL**  
**APPENDIX A3 -- EQUIPMENT CYCLES -- PHASE 1 BASE SERVICE PLAN (Version 10)**

ID	OvertkScheme	Dir	Set	Set2	Consist	Train No.	Pattern	Train Type	Orig	OrigTime	Dest	DestTime	RunTime	MinLay	Avail	Layover	Excess	DestArr	DestDep	T	TrnMi	200m SetMi	Wkend	Yd
205	Reg	NB	M6			N171340	17	S.Fernando Vly. Ltd	LAU	13:40	SFT	16:56	3:16	30	17:26	0:37	7	16:56	17:33		446.6	446.6	446.6	
109	Peak O/T	SB	M6			S211733	21	S.Fernando Vly. Ltd	SFT	17:33	LAU	20:51	3:18	40	21:31	--	--	20:51	--		446.6	446.6	446.6	
																	*Additional 200m trainsets available for these equipment turns ←							
Totals																	2,037	106211	140405	83760				

	<u>Weekday</u>	<u>Weekend</u>
Days/yr	250	115
Ann miles	35101	9632
Ann miles	<b>44,734</b>	

## [B] – VARIATION, WITH 1.0-3.5% RECOVERY TIME ALLOWANCE

Appendix B presents the characteristics of a variation of the California High-Speed Train (HST) Phase 1 Service Plan, which assumes a lower and more aggressive allowance for schedule pad or recovery time, consistent with the intent of the HST system to operate at a very high level of precision. In this variation of the service plan, the express services operating between San Francisco and Los Angeles with one intermediate stop at San Jose would have a scheduled run time of 2 hours and 40 minutes, with a recovery time allowance of one percent. All other trains in this variation of the plan would have a recovery time allowance of three and one half percent.

In this version of the service plan, the train stopping patterns, hours of service, and service frequencies were kept essentially the same as that of the base service plan described in Appendix A. Certain changes were made to the assumptions and general principles to allow for the marginally faster travel times estimated for the “express” trains:

- Recovery time incorporated in the end-to-end train running times was reduced from 7 percent to 1 percent for “express” trains and to 3.5 percent for all other train types
- The minimum headway between trains following each other past a given point was kept at 3 minutes except for sections north of San Jose and near each terminal location, which includes San Francisco-Transbay, Los Angeles Union Station, Anaheim, and Merced stations, because it was assumed that the rate in which trains would arrive and depart these locations could support a minimum headway of no less than 2 minutes.
- In addition to the standard 1 to 3.5 percent recovery time applied to all trains, additional recovery was added to certain trains to adjust the running time so as to avoid the overtakes and to maintain the minimum spacing between trains. This is described in more detail in the *New Service Sequence* section of this memorandum.
- To further reduce the estimated travel time, station dwell times at intermediate stops were reduced from two minutes to 90 seconds at San Jose and Los Angeles Union Station, and from 90 seconds to 75 seconds at all other intermediate stops.
- While the original baseline timetable presented clock face scheduling, the reduction of the amount of recovery time in this iteration resulted in departure times that do not allow for maintaining the clock face structure as long as the stopping patterns of each service type are kept the same as in the baseline timetable.

This variation of the Phase 1 service plan for the initial operating segment between Anaheim, Los Angeles and San Francisco was composed of the following train types and service patterns:

1. San Francisco-Los Angeles-Anaheim “Express” service (Pattern #1)
  - Clockface departure on the hour southbound from San Francisco between 5:00 AM and 9:00 PM
  - Clockface hourly departures northbound from Anaheim at 35 minutes past the hour, and departures from Los Angeles at the “top of the hour”.
  - During the peak period, northbound departures at Los Angeles were changed to 59 minutes past the hour to create time slots for local and limited-stop trains in order to minimize the overtakes.

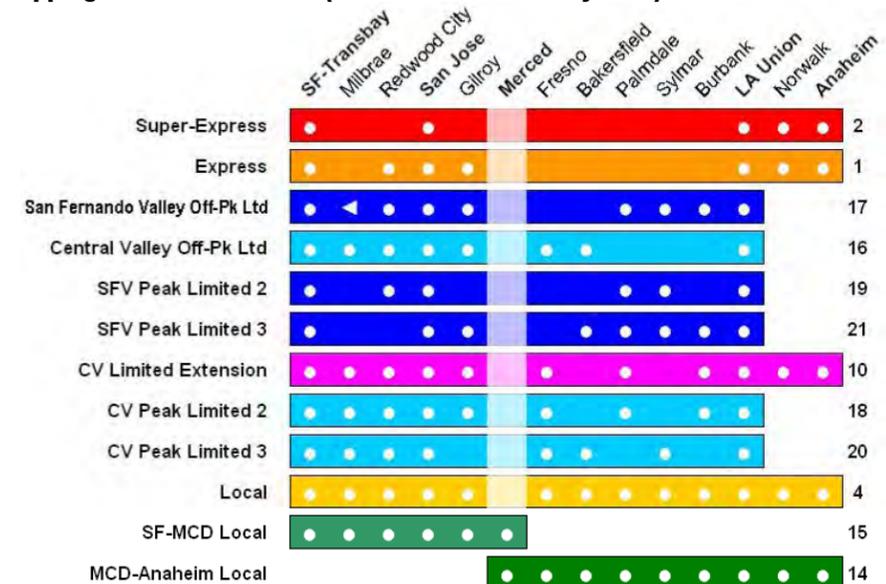
2. San Francisco-Los Angeles-Anaheim “Express” service (Pattern #2)
  - Southbound trains depart San Francisco at 5:30 AM, 6:30 AM, 7:30 AM, 3:30 PM, 4:30 PM, and 5:30 PM.
  - Northbound trains depart Anaheim at 5:05 AM, 6:05 AM, 7:05 AM, 3:05 PM, 4:05 PM, and 6:05 PM so that the trains can depart Los Angeles at the “bottom” (:30) of the hour.
3. San Fernando Valley Off-peak Limited – Limited stop service between San Francisco and Los Angeles stopping at stations in the San Fernando Valley and the Santa Clara/Silicon Valley area, while generally bypassing Central Valley stations (Pattern #17)
  - 30-minute headways in both direction for travel between 8:00 AM and 3:00 PM, and again between 6:00 PM and 9:00 PM.
  - Southbound departure from San Francisco at :03 and :33 of the hour; northbound departure from Los Angeles at :10 and :40 of the hour.
  - No overtakes occur en route
  - Two northbound trips, departing Los Angeles at 8:10 AM and 9:10 AM, provide service to the Milbrae station.
  - Northbound trains departing Los Angeles at :40 of the hour reduce speed between Palmdale and Bakersfield to increase travel time by 2 minutes in order to minimize the dwell time of local trains overtaken at Bakersfield.
  - Reduced service to 60-minute headways after 7:00 PM
4. San Fernando Valley Peak Limited – Peak-only Limited stop service between San Francisco and Los Angeles stopping at stations in the San Fernando Valley and the Santa Clara/Silicon Valley area, while generally bypassing Central Valley stations (Patterns #19 and 21).
  - Two trains per hour per direction with combined 28 to 32 minute headways during the peak period.
  - Southbound departures from San Francisco at :03 of the hour (Pattern #19) and :33 of the hour (Pattern #21); Northbound departures from Los Angeles at :03 of the hour (Pattern #19) and :35 of the hour (Pattern #21)
  - No overtakes occur en route
5. Central Valley Off-peak Limited – Limited stop service between San Francisco and Los Angeles stopping at all stations north of Bakersfield while skipping all San Fernando Valley stations (Pattern #16).
  - 30-minute headways in both directions for travel between 8:00 AM and 3:00 PM, and again between 6:00 PM and 9:00 PM.
  - Southbound departure from San Francisco at :08 and :38 of the hour; northbound departure from Los Angeles at :03 and :33 of the hours
  - No overtakes occur en route

- Southbound trains departing San Francisco at :08 of the hour reduce speed between Bakersfield and Los Angeles to increase travel time by 5 to 10 minutes in order to avoid an overtake.
  - Reduced service to 60-minute headways after 7:00 PM
6. Central Valley Peak Limited – Limited stop service between San Francisco and Los Angeles stopping at all stations in the Central Valley and the north while making limited stops in the San Fernando Valley (Patterns #10, 18, and 20)
- Two trains per hour per direction with 28 to 32 minute headways during peak period
  - Southbound departure from San Francisco at :08 of the hour (Pattern #10/18) and :39 of the hour (Pattern #20); Northbound departure from Los Angeles at :06 of the hour (Pattern #10) or :07 of the hour (Pattern #19) and :33 of the hour (Pattern #21)
  - Two roundtrips in each direction are extended to Anaheim
  - Southbound trains departing San Francisco at :08 of the hour are overtaken by Express trains (Pattern #2) at Fresno
  - Northbound trains departing Los Angeles at :06 or :07 of the hour are overtaken by Express trains (Pattern #2) at Fresno
  - Some southbound trains reduce speed between Bakersfield and Los Angeles in order to avoid an overtake.
7. Local service, making all stops between San Francisco and Anaheim (Pattern #4)
- All day, hourly service with semi-clockface schedule.
  - Southbound departure from San Francisco at :14 of the hour during peak period, :15 of the hour during off-peak period; northbound departure from Anaheim at :46 of the hour during peak period, :40 of the hour during off-peak period (departure at Los Angeles at :10 and :06 of the hour, respectively)
  - During the peak period, southbound trains are overtaken twice by Express trains (Pattern #2) at Gilroy and by San Fernando Valley Limited trains at Fresno; while northbound trains are overtaken once by Express trains (Pattern #2) at Bakersfield
  - During off-peak period, both southbound and northbound trains are overtaken once by San Fernando Valley Limited trains at Bakersfield
  - All trains during mid-day period are overtaken once by San Fernando Valley Limited trains at Bakersfield
8. Merced-Los Angeles Local (Pattern #14)
- All day, hourly service with semi-clockface schedule
  - Southbound departure from Merced at :05 of the hour throughout the day; northbound departure from Anaheim at :17 of the hour during peak period, :12 of the hour during off-peak period (departure at Los Angeles at :41 and :36 of the hour, respectively)

- During peak period, southbound trains have overtakes by Express (Pattern #1) and San Fernando Valley Limited trains at Fresno and Express trains (Pattern #2) at Bakersfield while northbound trains are overtaken once by Express trains (Pattern #1) at Bakersfield
  - During off-peak periods, all trains have overtakes: (by San Fernando Valley Limited and Express trains (Pattern #1); northbound at Bakersfield and southbound at Fresno)
  - Southbound trains arrive at Los Angeles Union Station before the following Central Valley Limited trains
9. San Francisco-Merced local service (Pattern #15)
- All-day, hourly service with semi-clockface schedule
  - Southbound departure from San Francisco at :47 of the hour throughout the day; northbound departure from Merced at :34 of the hour during peak period and :37 of the hour during off-peak period
  - No overtakes occur en route

Stations served by each stopping pattern are illustrated in the chart provided below:

**Stopping Pattern in Revised (with reduced recovery time) Phase 1 Service Plan**



Note: Trains make a stop at station with white circle; ◀: Special stop (northbound only).

This schedule variation provides a total of 260 revenue trips, the same number of trips assumed in the base plan. Since both service plans follow the same planning principles, the breakdown of the levels of service in each time period of the day is identical between them. This is illustrated in the revised timetable and time-distance chart presented in the Appendices B1 and B2.

As a result of reducing the recovery and station dwell times, it is estimated that Express trains (Pattern #2) can complete the travel between San Francisco and Los Angeles within 2 hours and 40 minutes. This reduction in the recovery and dwell times also improves the travel time of most of the projected 260 revenue trips in this service plan.

A hypothetical daily timetable for this service plan is presented in Appendix B1. This same schedule is presented in stringline (time-distance) diagram format in Appendix B2. Equipment cycles and the number of required trainsets will be the same in this scenario as in the base plan documented in Appendix A3, so a separate analysis of equipment cycles is not shown for the service plan variation.

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B1. Hypothetical Timetable

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CALIFORNIA HIGH-SPEED RAIL  
PHASE 1 TIMETABLE

VARIATION SERVICE PLAN

Turns from →

APPENDIX B1

Direction →	Reg	Mid 1	Reg	Reg	Mid 2	Reg	Night O/T	Reg	Reg	Night	Mid 1	Reg	Reg	Night	Reg	Reg	Night
Trainset	42	68	44	61	62	50	66	11	52	46	71	73	74	51	3	20	55
Train No. →	S171803	S161808	S041815	S171833	S161838	S151847	S142005	S011900	S171910	S041914	S161935	S151947	S012000	S042014	S152047	S012100	S042114
Pattern →	17	16	4	17	16	15	14	1	17	4	16	15	1	4	15	1	4
Service Type →	S.Fern'do Valley Limited	Central Valley Limited	All-Stop Local	S.Fern'do Valley Limited	Central Valley Limited	S.F. - Merced Local	L.A. - Merced Local	Bay Area Limited	S.Fern'do Valley Limited	All-Stop Local	Central Valley Limited	S.F. - Merced Local	Bay Area Limited	All-Stop Local	S.F. - Merced Local	Bay Area Limited	All-Stop Local
Mile	0.0	14.7	26.4	48.0	77.7	187.5	191.5	302.8	387.4	425.7	436.3	446.6	461.8	476.9			
Station	S.F.-Transbay	Millbrae	Redwood City	San Jose	Gilroy	Merced	Fresno	Bakersfield	Palmdale	Sylmar	Burbank	L.A. Union Sta.	Norwalk	Anaheim			
Dep	18:03	18:08	18:15	18:33	18:38	18:47		19:00	19:10	19:14	19:35	19:47	20:00	20:14	20:47	21:00	21:14
Arr																	
Dep		18:23	18:30	18:53	19:02			19:20	19:30	19:39	20:00	20:12	20:20	20:39	21:12	21:20	21:39
Arr																	
Dep	18:38	18:48	18:55	19:08	19:18	19:27		19:34	19:45	19:54	20:15	20:27	20:34	20:54	21:27	21:34	21:54
Arr																	
Dep	18:53	19:04	19:11	19:23	19:34	19:43		19:50	20:00	20:10	20:31	20:43	20:50	21:10	21:43	21:50	22:10
Arr																	
Dep						20:17						21:17			22:17		
Arr							20:05										
Dep		19:45	19:52	20:15			20:25			20:51	21:12			21:51			22:51
Arr							20:30			21:08	21:30			22:30			23:30
Dep		20:24	20:30	20:54			21:08			21:13	21:51			22:30			23:30
Arr							21:13			21:30	21:51			22:30			23:30
Dep	20:33		21:09	21:03			21:45		21:40	22:03				23:03			0:03
Arr							22:06		22:01	22:24				23:24			0:24
Dep	20:54		21:30	21:24			22:06		22:01	22:24				23:24			0:24
Arr							22:14		22:10	22:32				23:32			0:32
Dep	21:03		21:38	21:33			22:14		22:10	22:32				23:32			0:32
Arr	21:11	21:25	21:46	21:41	21:49		22:23	21:53	22:18	22:40	22:52		22:53	23:40		23:53	0:40
Dep			21:48				22:25	21:55		22:42			22:55	23:42		23:55	0:42
Arr			22:00				22:37	22:07		22:55			23:07	23:55		0:07	0:55
Dep			22:10				22:46	22:17		23:04			23:17	0:04		0:17	1:04
Arr																	
Available →	21:51	22:05	22:50	22:21	22:29	20:57	23:26	22:57	22:58	23:44	23:32	21:57	23:57	0:44	22:57	0:57	1:44
Turns for →																	

Turns from →

APPENDIX B1

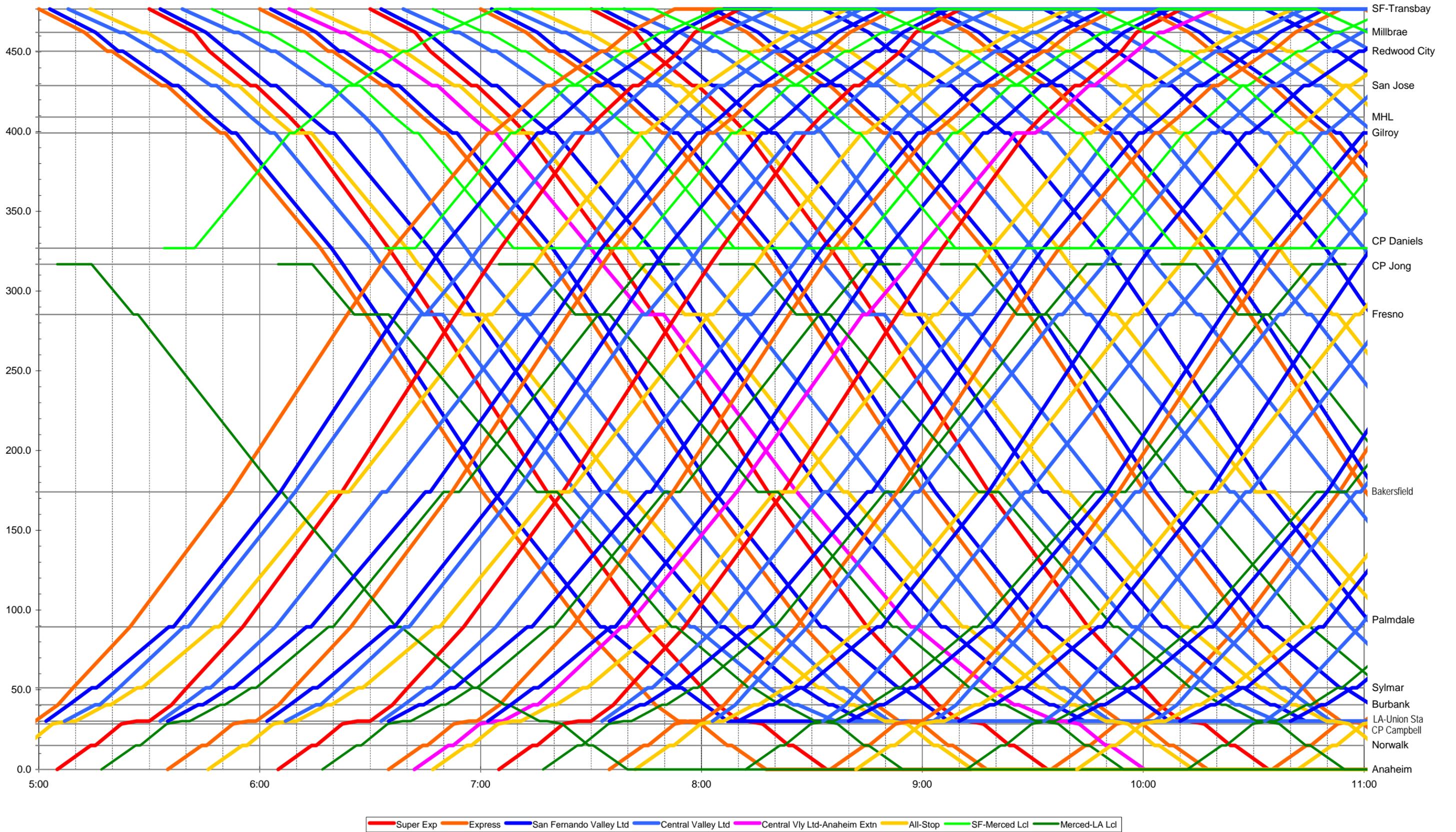
Direction →	Reg	Reg	Reg	Reg	Reg	Reg	Reg	Reg	Reg	Night	Reg	Reg	Night	Night O/T	Reg	Night	
Trainset	4	14	M1	15	10	1	2	57	19	M2	18	23	67	5	M3	70	13
Train No. →	N161803	N171810	N041746	N161833	N141812	N171840	N152034	N011835	N161913	N041855	N141912	N171940	N011935	N041955	N142020	N012035	N042055
Pattern →	16	17	4	16	14	17	15	1	16	4	14	17	1	4	14	1	4
Service Type →	Central Valley Limited	S.Fern'do Valley Limited	All-Stop Local	Central Valley Limited	L.A. - Merced Local	S.Fern'do Valley Limited	S.F. - Merced Local	Bay Area Limited	Central Valley Limited	All-Stop Local	L.A. - Merced Local	S.Fern'do Valley Limited	Bay Area Limited	All-Stop Local	L.A. - Merced Local	Bay Area Limited	All-Stop Local
Mile	0.0	15.0	30.3	40.6	51.1	89.4	174.1	285.4	354.4	399.2	428.8	450.5	462.2	476.9			
Station	ANA Anaheim	NSF Norwalk	LAU L.A. Union Sta.	BUR Burbank	SYL Sylmar	PMD Palmdale	BFD Bakersfield	FNO Fresno	MCD Merced	GLY Gilroy	SJC San Jose	RWC Redwood City	SFO Millbrae	SFT S.F.-Transbay			
Dep			17:46		18:12			18:35		18:55	19:12		19:35	19:55	20:20	20:35	20:55
Arr																	
Dep		17:56	18:08	18:22	18:34			18:45		19:05	19:22		19:45	20:05	20:30	20:45	21:05
Arr																	
Dep	18:03	18:10	18:10	18:33	18:36	18:40		19:00	19:13	19:19	19:36	19:40	20:00	20:19	20:44	21:00	21:19
Arr																	
Dep		18:19	18:18		18:45	18:49				19:29	19:45	19:49		20:29	20:53		21:29
Arr										19:37	19:54	19:58		20:37	21:02		21:37
Dep		18:28	18:19		18:54	18:58				19:37	19:54	19:58		20:37	21:02		21:37
Arr																	
Dep		18:48	18:28		19:14	19:18				19:58	20:14	20:18		20:58	21:27		21:58
Arr																	
Dep	18:58		19:19	19:24	19:28	19:55				20:08	20:29	20:55		21:29	21:58		22:29
Arr																	
Dep	19:37		20:03	20:07	20:34					20:47	21:08	21:34		22:08	22:37		23:08
Arr																	
Dep					20:58						21:58				22:57		
Arr							20:34										
Dep	20:18	20:31	20:44	20:48		20:59	21:09	21:04	21:28	21:50		21:59	22:04	22:50		23:04	23:50
Arr																	
Dep	20:34	20:47	21:00	21:04		21:15	21:25	21:20	21:44	22:05		22:15	22:20	23:05		23:20	0:05
Arr																	
Dep	20:48	21:00	21:14	21:18		21:28	21:40	21:34	21:58	22:19		22:28	22:34	23:19		23:34	0:19
Arr																	
Dep			21:24			21:50				22:29				23:29			0:29
Arr																	
Dep	21:12	21:20	21:39	21:42		21:48	22:04	21:53	22:22	22:44		22:48	22:53	23:44		23:53	0:44
Arr																	
Available →	21:42	21:50	22:09	22:12	21:38	22:18	22:34	22:23	22:52	23:14	22:38	23:18	23:23	0:14	23:37	0:23	1:14
Turns for →																	

## B2. Stringline Diagrams

- Morning Peak Period
- Mid-Day Period
- Afternoon Peak Period
- Evening and Late Night Period

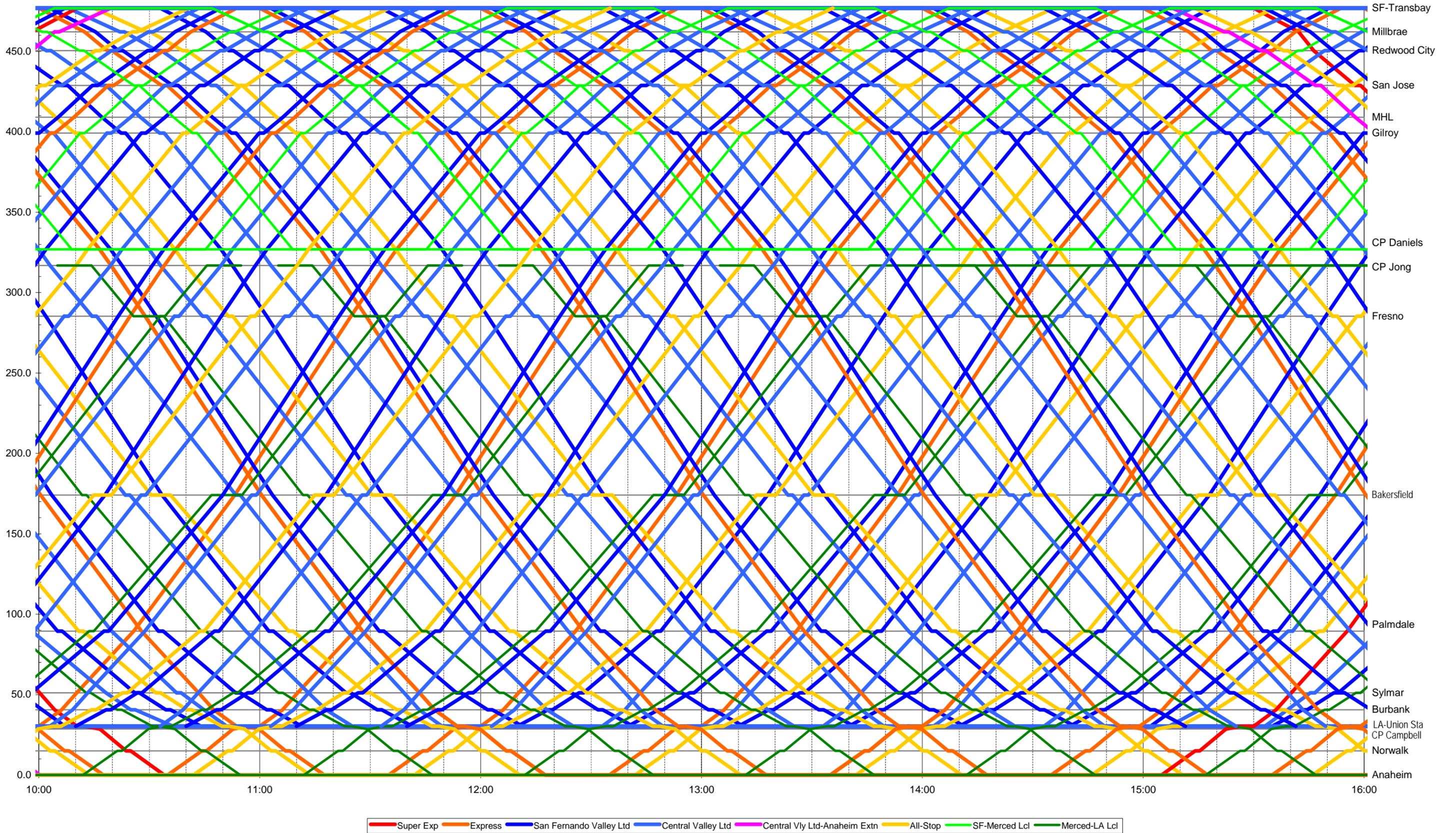
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Appendix B2 - HSR PHASE 1 SERVICE PLAN - VARIATION (Version 10B) - MORNING PEAK

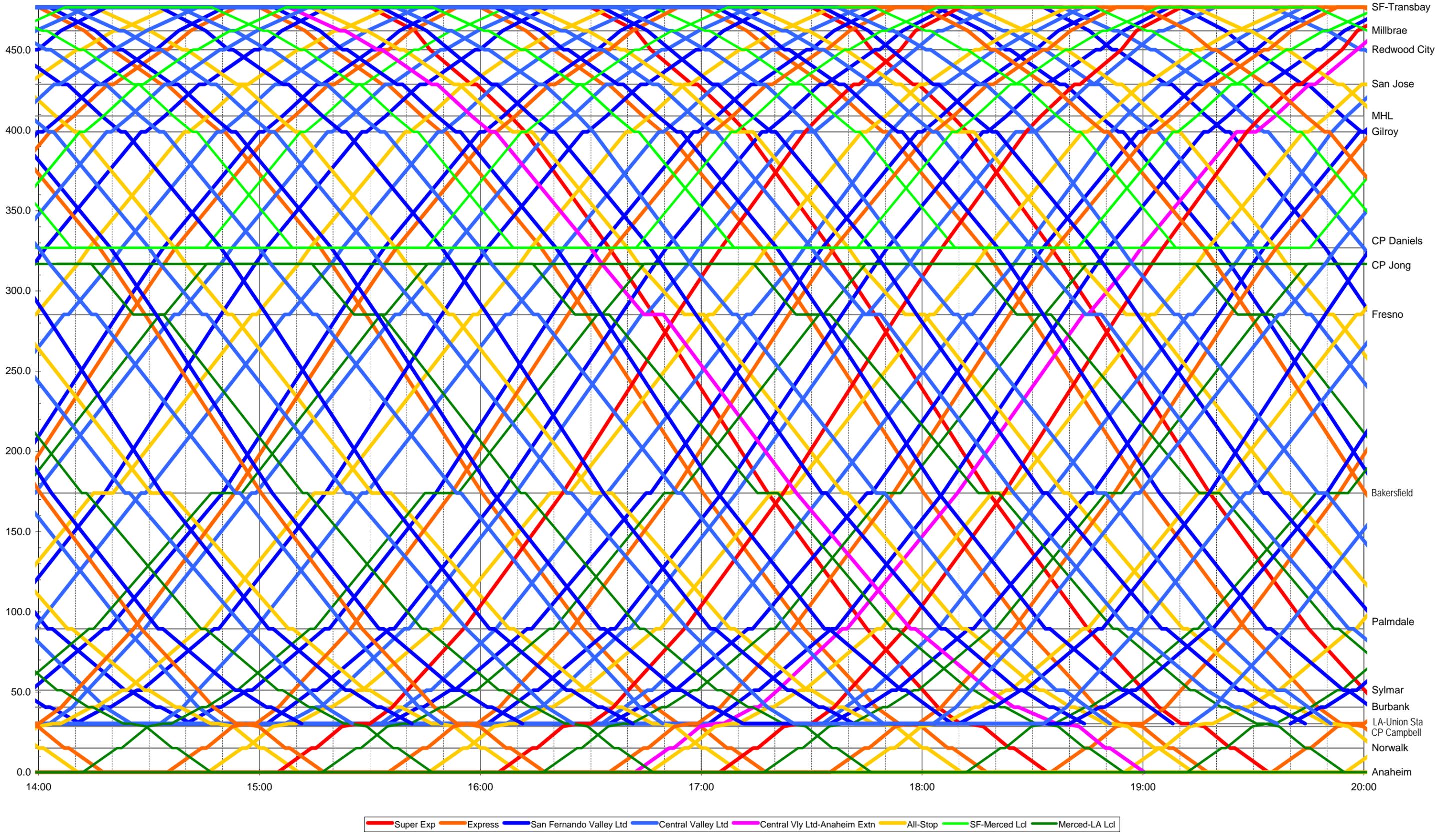


Legend: Super Exp (red), Express (orange), San Fernando Valley Ltd (dark blue), Central Valley Ltd (light blue), Central Vly Ltd-Anaheim Extn (magenta), All-Stop (yellow), SF-Merced Lcl (green), Merced-LA Lcl (dark green)

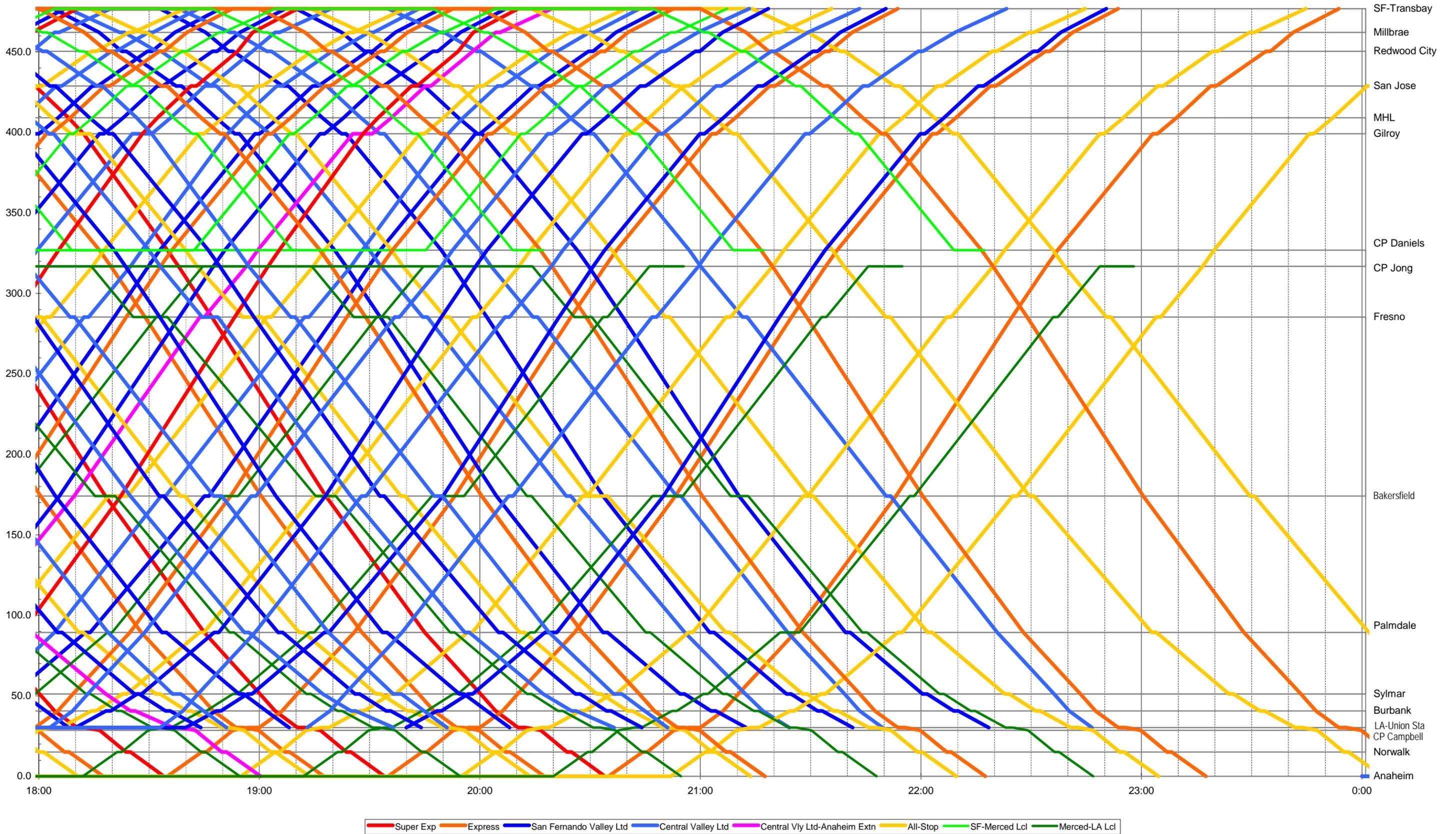
Appendix B2 - HSR PHASE 1 SERVICE PLAN - VARIATION (Version 10B) - MID-DAY



Appendix B2 - HSR PHASE 1 SERVICE PLAN - VARIATION (Version 10B) - AFTERNOON PEAK



Appendix B2 - HSR PHASE 1 SERVICE PLAN - VARIATION (Version 10B) - LATE EVENING





BOARD OF DIRECTORS 2010

SEAN ELSBERND, CHAIR  
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KEN YEAGER

MICHAEL J. SCANLON  
EXECUTIVE DIRECTOR

February 4, 2010

PRP-1802-LTO-PB-001

Mr. Dominic Spaethling  
Parsons Brinkerhoff  
303 Second Street, Suite 700 N  
San Francisco, CA 94107

Subject: Caltrain Operations Schedule  
CHSR Planning

Dominic,

At your request, Caltrain is transmitting for your use the 2025 Caltrain 10 train per peak hour Timetable. A few words concerning this timetable. The timetable assumes existing Caltrain operating speeds and station to station run times have not been vetted. The schedule is intended as a planning tool to assist PB in developing the CHSR Operations Plan and Schedule within the shared corridor. Caltrain is providing this information with the understanding that it is subject to changes in future Caltrain operational requirements or planning strategies. If such changes to the planned schedule occur, then Caltrain expects that CHSR will consequently adjust its Operations Plan as required to coordinate with Caltrain.

Sincerely,

  
Michelle Bouchard *for*  
Director  
Caltrain Rail Transportation

CC: R. Doty, PRP; Doc. Control

Enc: Caltrain 2025 Operations Schedule

**PENINSULA CORRIDOR JOINT POWERS BOARD**  
1250 San Carlos Avenue – P.O. Box 3006  
San Carlos, CA 94070-1306 (650)508-6269

**10 Train Per Hour Schedule - With Transbay**

**EMU: Limited/Locals**

**Northbound**

Tamien	5:02a	5:57a	6:15a	6:27a	6:45a	6:57a	7:15a	7:27a	7:45a	7:57a	8:15a	8:27a	8:45a																				
San Jose Diridon	4:30a	5:05a	6:00a	6:06a	6:12a	6:18a	6:24a	6:30a	6:36a	6:42a	6:48a	6:54a	7:00a	7:06a	7:12a	7:18a	7:24a	7:30a	7:36a	7:42a	7:48a	7:54a	8:00a	8:06a	8:12a	8:18a	8:24a	8:30a	8:36a	8:42a	8:48a	8:54a	
College Park																																	
Santa Clara	4:35a	5:10a	6:05a	6:17a	6:29a	6:35a	6:47a	6:59a	7:05a	7:17a	7:29a	7:35a	7:47a	7:57a	8:05a	8:17a	8:29a	8:35a	8:47a	8:59a													
Lawrence	4:39a	5:14a	6:11a	6:17a	6:26a	6:33a	6:44a	6:56a	7:03a	7:14a	7:26a	7:33a	7:44a	7:56a	8:04a	8:14a	8:26a	8:33a	8:44a	8:56a	9:03a												
Sunnyvale	4:42a	5:17a	6:11a	6:17a	6:29a	6:41a	6:47a	6:59a	7:11a	7:17a	7:29a	7:41a	7:47a	7:59a	8:11a	8:17a	8:29a	8:41a	8:47a	8:59a													
Mountain View	4:47a	5:22a	6:16a	6:24a	6:29a	6:34a	6:40a	6:46a	6:56a	7:04a	7:10a	7:16a	7:26a	7:34a	7:40a	7:46a	7:56a	8:04a	8:11a	8:16a	8:26a	8:34a	8:40a	8:46a	8:56a	9:04a	9:10a						
San Antonio	4:50a	5:25a	6:24a	6:29a	6:54a	6:59a	7:24a	7:29a	7:54a	7:59a	8:24a	8:29a	8:54a	8:59a	9:24a	9:29a	9:54a	9:59a															
California Avenue	4:53a	5:28a	6:27a	6:32a	6:57a	7:02a	7:27a	7:32a	8:02a	8:07a	8:32a	8:37a	9:02a	9:07a	9:32a	9:37a	10:02a	10:07a															
Palo Alto	4:57a	5:32a	6:23a	6:31a	6:36a	6:41a	6:47a	6:53a	7:01a	7:06a	7:11a	7:17a	7:23a	7:31a	7:36a	7:41a	7:47a	7:53a	8:01a	8:06a	8:11a	8:18a	8:23a	8:31a	8:36a	8:41a	8:47a	8:53a	9:01a	9:06a	9:11a	9:17a	
Menlo Park	4:59a	5:34a	6:33a	6:43a	6:49a	7:03a	7:13a	7:19a	7:33a	7:43a	7:49a	8:03a	8:13a	8:20a	8:33a	8:43a	8:49a	9:03a	9:13a	9:19a													
Atherton	5:01a	5:36a	6:26a	6:41a	6:49a	6:54a	7:00a	7:11a	7:19a	7:24a	7:30a	7:41a	7:49a	7:54a	8:00a	8:11a	8:19a	8:25a	8:30a	8:41a	8:49a	8:54a	9:00a	9:11a	9:19a	9:24a	9:31a	9:42a	9:52a				
Redwood City	5:05a	5:40a	6:30a	6:44a	6:57a	7:03a	7:14a	7:27a	7:33a	7:44a	7:57a	8:03a	8:14a	8:28a	8:33a	8:44a	8:57a	9:03a	9:14a	9:27a													
San Carlos	5:08a	5:43a	6:33a	6:40a	6:46a	7:10a	7:16a	7:40a	7:46a	8:10a	8:16a	8:40a	8:46a	9:10a	9:16a	9:40a	9:46a																
Belmont	5:10a	5:45a	6:37a	6:43a	6:49a	6:54a	7:01a	7:07a	7:13a	7:19a	7:24a	7:31a	7:37a	7:43a	7:49a	7:54a	8:01a	8:07a	8:13a	8:19a	8:24a	8:32a	8:37a	8:43a	8:49a	8:54a	9:01a	9:07a	9:13a	9:19a	9:24a	9:31a	
Hillsdale	5:13a	5:48a	6:37a	6:43a	6:49a	6:56a	7:04a	7:16a	7:28a	7:34a	7:40a	7:47a	7:52a	7:58a	8:04a	8:10a	8:17a	8:22a	8:28a	8:34a	8:41a	8:47a	8:52a	8:58a	9:04a	9:10a	9:17a	9:22a	9:28a	9:34a	9:40a	9:44a	
Hayward Park	5:15a	5:50a	6:47a	6:52a	6:58a	7:04a	7:10a	7:17a	7:22a	7:28a	7:34a	7:40a	7:47a	7:52a	7:58a	8:04a	8:10a	8:17a	8:22a	8:28a	8:34a	8:41a	8:47a	8:52a	8:58a	9:04a	9:10a	9:17a	9:22a	9:28a	9:34a	9:40a	
San Mateo	5:17a	5:52a	6:41a	6:53a	7:11a	7:23a	7:41a	7:53a	8:11a	8:23a	8:41a	8:53a	9:11a	9:23a																			
Burlingame	5:20a	5:55a	6:43a	6:57a	7:13a	7:31a	7:43a	8:13a	8:31a	8:43a	9:13a	9:31a	9:43a																				
Broadway	5:22a	5:57a	6:43a	6:57a	7:13a	7:31a	7:43a	8:13a	8:31a	8:43a	9:13a	9:31a	9:43a																				
Millbrae	5:26a	6:01a	6:47a	6:52a	6:58a	7:04a	7:10a	7:17a	7:22a	7:28a	7:34a	7:40a	7:47a	7:52a	7:58a	8:04a	8:10a	8:17a	8:22a	8:28a	8:34a	8:41a	8:47a	8:52a	8:58a	9:04a	9:10a	9:17a	9:22a	9:28a	9:34a	9:40a	
San Bruno	5:30a	6:05a	6:54a	7:08a	7:16a	7:38a	7:46a	8:08a	8:16a	8:38a	8:46a	9:08a	9:16a																				
So. San Francisco	5:34a	6:09a	6:54a	7:11a	7:18a	7:24a	7:41a	7:48a	7:54a	8:11a	8:18a	8:24a	8:41a	8:49a	8:54a	9:11a	9:18a	9:24a	9:41a	9:48a													
Bayshore	5:39a	6:14a	7:06a	7:13a	7:36a	7:43a	8:06a	8:13a	8:36a	8:43a	9:06a	9:13a	9:36a	9:43a																			
22nd Street	5:44a	6:19a	7:05a	7:10a	7:17a	7:24a	7:29a	7:35a	7:40a	7:47a	7:54a	7:59a	8:05a	8:10a	8:17a	8:24a	8:29a	8:35a	8:40a	8:47a	8:54a	9:00a	9:05a	9:10a	9:17a	9:24a	9:29a	9:35a	9:40a	9:47a	9:54a	9:59a	
4th & King	5:48a	6:23a	7:10a	7:22a	7:40a	7:52a	8:10a	8:22a	8:40a	8:52a	9:10a	9:22a	9:40a	9:52a																			
Transbay			7:10a	7:22a	7:40a	7:52a	8:10a	8:22a	8:40a	8:52a	9:10a	9:22a	9:40a	9:52a																			

**Southbound**

Transbay			6:01a	6:13a	6:31a	6:43a	7:01a	7:13a	7:31a	7:43a	8:01a	8:13a	8:31a	8:43a																			
4th & King	4:55a	5:25a	6:00a	6:06a	6:12a	6:18a	6:24a	6:30a	6:36a	6:42a	6:48a	6:54a	7:00a	7:06a	7:12a	7:18a	7:24a	7:30a	7:36a	7:42a	7:48a	7:54a	8:00a	8:06a	8:12a	8:18a	8:24a	8:30a	8:36a	8:42a	8:48a	8:54a	
22nd Street	5:00a	5:30a	6:05a	6:17a	6:23a	6:29a	6:35a	6:47a	6:53a	7:05a	7:17a	7:23a	7:29a	7:35a	7:47a	7:53a	7:59a	8:05a	8:17a	8:23a	8:29a	8:35a	8:47a	8:53a	8:59a								
Bayshore	5:04a	5:34a	6:09a	6:17a	6:25a	6:39a	6:47a	6:55a	7:09a	7:17a	7:25a	7:47a	7:55a	8:09a	8:17a	8:25a	8:39a	8:47a	8:55a														
South SF	5:09a	5:39a	6:21a	6:33a	6:51a	7:03a	7:21a	7:33a	7:51a	8:03a	8:21a	8:33a	8:51a	9:03a																			
San Bruno	5:13a	5:43a	6:18a	6:24a	6:31a	6:41a	6:48a	6:54a	7:01a	7:11a	7:18a	7:24a	7:31a	7:41a	7:48a	7:54a	8:01a	8:11a	8:18a	8:24a	8:31a	8:41a	8:48a	8:54a	9:01a	9:11a							
Millbrae	5:16a	5:46a	6:18a	6:24a	6:31a	6:41a	6:48a	6:54a	7:01a	7:11a	7:18a	7:24a	7:31a	7:41a	7:48a	7:54a	8:01a	8:11a	8:18a	8:24a	8:31a	8:41a	8:48a	8:54a	9:01a	9:11a							
Broadway	5:19a	5:49a	6:18a	6:24a	6:31a	6:44a	6:58a	7:08a	7:14a	7:28a	7:38a	7:44a	7:58a	8:08a	8:14a	8:28a	8:38a	8:44a	8:58a	9:08a													
Burlingame	5:21a	5:51a	6:28a	6:38a	6:58a	7:08a	7:28a	7:38a	7:58a	8:08a	8:28a	8:38a	8:58a	9:08a																			
San Mateo	5:24a	5:54a	6:23a	6:31a	6:41a	6:48a	6:53a	7:01a	7:11a	7:18a	7:23a	7:31a	7:41a	7:48a	7:53a	8:01a	8:11a	8:18a	8:23a	8:31a	8:41a	8:48a	8:53a	9:01a	9:11a	9:18a							
Hayward Park	5:26a	5:56a	6:27a	6:35a	6:45a	6:52a	6:57a	7:05a	7:15a	7:22a	7:27a	7:35a	7:45a	7:52a	7:57a	8:05a	8:15a	8:22a	8:27a	8:35a	8:45a	8:52a	8:57a	9:05a	9:15a	9:22a							
Hillsdale	5:29a	5:59a	6:27a	6:35a	6:45a	6:52a	6:57a	7:05a	7:15a	7:22a	7:27a	7:35a	7:45a	7:52a	7:57a	8:05a	8:15a	8:22a	8:27a	8:35a	8:45a	8:52a	8:57a	9:05a	9:15a	9:22a							
Belmont	5:31a	6:01a	6:41a	6:47a	6:55a	7:00a	7:13a	7:25a	7:30a	7:41a	7:47a	7:55a	8:00a	8:13a	8:17a	8:25a	8:30a	8:43a	8:47a	8:55a	9:00a	9:13a	9:17a	9:25a	9:31a								
San Carlos	5:33a	6:03a	6:30a	6:43a	6:55a	7:00a																											



**10 Train Per Hour Schedule - With Transbay**  
**EMU: Limited/Locals**

**Northbound**

Tamien	5:57p		6:15p		6:27p		6:45p				8:27p		9:27p																	
San Jose Diridon	6:00p	6:06p	6:12p	6:18p	6:24p	6:30p	6:36p	6:42p	6:48p	6:54p	7:00p	7:30p	8:30p	9:30p	10:30p	81														
College Park																														
Santa Clara	6:05p		6:17p		6:35p		6:47p				7:05p		7:35p		8:35p		9:35p		10:35p											
Lawrence	6:14p		6:26p		6:32p		6:44p		6:56p		7:02p		7:09p		7:39p		8:39p		9:39p		10:39p									
Sunnyvale	6:11p		6:17p		6:35p		6:41p		6:47p		7:05p		7:12p		7:42p		8:42p		9:42p		10:42p									
Mountain View	6:16p		6:26p		6:33p		6:40p		6:46p		6:56p		7:03p		7:10p		7:17p		7:47p		8:47p		9:47p		10:47p					
San Antonio	6:24p		6:29p				6:54p		6:59p				7:20p		7:50p		8:50p		9:50p		10:50p									
California Avenue	6:32p		6:38p						7:02p		7:08p		7:23p		7:53p		8:53p		9:53p		10:53p									
Palo Alto	6:23p		6:30p		6:36p		6:42p		6:47p		6:53p		7:00p		7:06p		7:12p		7:17p		7:27p		7:57p		8:57p		9:57p		10:57p	
Menlo Park	6:25p		6:32p		6:38p		6:44p		6:55p		7:02p		7:08p		7:14p		7:29p		7:59p		8:59p		9:59p		10:59p					
Atherton																														
Redwood City	6:30p		6:37p		6:43p		6:49p		6:54p		7:00p		7:07p		7:13p		7:19p		7:24p		7:35p		8:05p		9:05p		10:05p		11:05p	
San Carlos	6:33p		6:46p		6:57p		7:03p		7:16p		7:18p		7:38p		8:08p		9:08p		10:08p		11:08p									
Belmont	6:41p		6:48p				7:11p		7:18p				7:40p		8:10p		9:10p		10:10p		11:10p									
Hillsdale	6:37p		6:44p		6:54p		7:01p		7:07p		7:14p		7:24p		7:31p		7:43p		8:13p		9:13p		10:13p		11:13p					
Hayward Park																														
San Mateo	6:40p		6:47p		6:57p		7:04p		7:10p		7:17p		7:27p		7:34p		7:47p		8:17p		9:17p		10:17p		11:17p					
Burlingame	6:50p		7:00p				7:20p		7:30p				7:50p		8:20p		9:20p		10:20p		11:20p									
Broadway	6:44p				7:14p				7:29p		7:35p		7:40p		7:56p		8:26p		9:26p		10:26p		11:26p							
Millbrae	6:48p		6:59p		7:05p		7:10p		7:18p		7:29p		7:35p		7:40p		7:56p		8:26p		9:26p		10:26p		11:26p					
San Bruno	6:57p		7:09p				7:27p		7:39p		8:00p		8:30p		9:30p		10:30p		11:30p											
So. San Francisco	7:06p		7:13p				7:36p		7:43p		8:04p		8:34p		9:34p		10:34p		11:34p											
Baysshore	8:09p		8:39p		9:39p		10:39p		11:39p																					
22nd Street	7:02p		7:08p		7:15p		7:25p		7:32p		7:38p		7:45p		7:55p		8:14p		8:44p		9:44p		10:44p		11:44p					
4th & King	7:06p		7:12p		7:19p		7:24p		7:29p		7:36p		7:42p		7:49p		7:54p		7:59p		8:18p		8:48p		9:48p		10:48p		11:48p	
Transbay	7:11p		7:24p		7:41p		7:54p																							

**Southbound**

Transbay	5:01p		5:13p		5:31p		5:43p				7:30p		8:30p		9:30p		10:30p		12:01a											
4th & King	5:00p		5:06p		5:12p		5:18p		5:24p		5:30p		5:36p		5:42p		5:48p		5:54p		7:35p		8:35p		9:35p		10:35p		12:06a	
22nd Street																														
Bayshore	5:14p		5:21p				5:44p		5:51p		7:39p		8:39p		9:39p		10:39p		12:10a											
South SF	5:11p		5:19p		5:35p		5:41p		5:49p		7:44p		8:44p		9:44p		10:44p		12:15a											
San Bruno	5:15p		5:33p		5:45p		6:03p		7:48p		8:48p		9:48p		10:48p		12:19a													
Millbrae	5:18p		5:25p		5:30p		5:36p		5:41p		5:48p		5:55p		6:00p		6:06p		6:11p		7:51p		8:51p		9:51p		10:51p		12:22a	
Broadway																														
Burlingame	5:35p		5:46p				6:05p		6:16p		7:56p		8:56p		9:56p		10:56p		12:27a											
San Mateo	5:23p		5:30p		5:41p		5:53p		6:00p		6:11p		7:59p		8:59p		9:59p		10:59p		12:30a									
Hayward Park	5:32p				6:02p				6:11p		8:01p		9:01p		10:01p		11:01p		12:32a											
Hillsdale	5:27p		5:35p		5:40p		5:45p		5:51p		5:57p		6:05p		6:10p		6:15p		6:21p		8:04p		9:04p		10:04p		11:04p		12:35a	
Belmont																														
San Carlos	5:30p		5:44p		5:54p		6:00p		6:14p		6:24p		8:08p		9:08p		10:08p		11:08p		12:37a									
Redwood City	5:36p		5:42p		5:50p		6:00p		6:06p		6:12p		6:20p		6:30p		8:14p		9:14p		10:14p		11:14p		12:45a					
Atherton																														
Menlo Park	5:40p		5:46p		5:57p		6:10p		6:16p		6:27p		8:19p		9:19p		10:19p		11:19p		12:48a									
Palo Alto	5:43p		5:49p		5:55p		6:00p		6:07p		6:13p		6:19p		6:25p		6:30p		6:37p		8:25p		9:25p		10:25p		11:25p		12:56a	
California Ave.																														
San Antonio	6:01p		6:06p				6:31p		6:36p		8:28p		9:28p		10:28p		11:28p		12:59a											
Mountain View	5:50p		5:56p		6:05p		6:14p		6:20p		6:26p		6:35p		6:44p		8:32p		9:32p		10:32p		11:32p		1:03a					
Sunnyvale	6:00p		6:13p		6:18p		6:30p		6:43p		6:48p		8:36p		9:36p		10:36p		11:36p		1:07a									
Lawrence	5:56p		6:03p		6:16p		6:26p		6:33p		6:46p		8:39p		9:39p		10:39p		11:39p		1:10a									
Santa Clara	6:01p		6:14p		6:25p		6:31p		6:44p		6:55p		8:44p		9:44p		10:44p		11:44p		1:15a									
College Park																														
San Jose Diridon	6:05p		6:11p		6:18p		6:24p		6:29p		6:35p		6:41p		6:48p		6:54p		6:59p		8:46p		9:46p		10:46p		11:46p		1:17a	
Tamien	6:16p		6:34p		6:46p		7:04p																							



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APPENDIX A: NETWORK SCHEMATICS

APPENDIX B: NETWORK STRINGLINES

APPENDIX C: TERMINAL TRACK OCCUPANCY CHARTS

# CONCEPT LEVEL OPERATIONS ANALYSIS FOR SAN FRANCISCO TERMINALS

## 1.0 EXECUTIVE SUMMARY

A concept level analysis was undertaken to describe whether the capacity of six alternative Downtown San Francisco Terminal configurations could feasibly support the draft conceptual 2035 service levels for both the California High Speed Train Project (HST) and Caltrain (2025). This study examined the operational feasibility of six different downtown terminal track configurations and operating scenarios using future service forecasts depicting both HST and Caltrain passenger train volumes. These scenarios focused on the Downtown San Francisco Terminal and the alternatives are described as follows:

1. **Transbay Transit Center (HST Only)** - A total of six platform tracks for the HST at the Transbay Transit Center. Three approach interlocking “throat” tracks to provide universal access to all station platform tracks. Caltrain operations assumed to originate and terminate at Fourth and King Terminal and therefore were not part of the analysis of this alternative.
2. **Fourth and King Street (HST Only)** - A total of eight platform tracks for the HST at the Fourth and King Terminal. Four approach interlocking “throat” tracks to provide universal access to all station platform tracks. Caltrain operations assumed to originate and terminate at the TTC and therefore were not part of the analysis of this alternative.
3. **Transbay Transit Center and Fourth and King Street** - A “shared use” (HST and Caltrain) joint terminal option including both the Transbay Transit Center (TTC) and the Fourth and King Terminal providing a total of eight platform tracks for the HST (4 at the TTC and 4 at Fourth and King) and a total of seven platform tracks for Caltrain (2 at the TTC and 5 at Fourth and King).
4. **Fourth and King Street (Stacked Station)** - A “shared use” terminal option located at Fourth and King Street assuming an additional “level” of tracks and platforms to increase terminal capacity if sufficient capacity to accommodate the HST service plan could not be accomplished with the preceding options. The results of the Alternative 3 analysis indicated that the capacity provided (in Alternative 3) could feasibly support the HST service assumptions. Consequently, this option was removed from further consideration
5. **Beale Street (All HST service and Caltrain)**- A joint terminal option (for Caltrain) between Beale Street and Fourth and King Street providing a total of 8 platform tracks for the HST and 2 platform tracks for Caltrain. In this option there was no change to the Terminal at Fourth and King Street since no HST were assigned there.
6. **Beale Street and Fourth and King Street**- A joint terminal option between a proposed Beale Street Terminal and the Fourth and King Terminal providing a total of ten platform tracks for the HST (6 at Beale Street and 4 at Fourth and King) and a total of seven platform tracks for Caltrain (2 at Beale Street and 5 at Fourth and King).

The future daily service levels assumed for the HST were initially based on the California High Speed Rail Authority (Authority) Phase 1 Service Plan. Following this step and using this (Phase 1) service plan, additional ridership forecast data was developed and a draft conceptual service plan was crafted to reflect a preliminary level of service for the full build out year of 2035. While this preliminary full build service plan is conceptual in nature, and therefore subject to refinement, it was utilized to approximate an operating timetable that identifies 10 to 12 HST per hour operating in to and out of the San Francisco Terminal during the peak periods.

Future Caltrain service, for this analysis, was based on the JPB draft conceptual 2025 Service Plan developed by Caltrain and provided to the Authority. This (Caltrain) service plan assumes a total of 10 trains per hour during the peak periods.

Each of the terminal/station track configuration concepts was modeled using the Berkeley Simulation Software Rail Traffic Controller (RTC) to estimate the feasibility of the various track alternatives to support the assumed train volumes. In summary, the results of the study and associated analysis were as follows:

- **Alternative 1** (See Figure 1) - This alternative, with a total of six platform tracks for the HST does not provide ample capacity for the forecast HST train service levels.
- **Alternative 2** (See Figure 2) - The analysis determined that the approach interlocking “throat” track configuration for Alternative 2 did not provide the throughput capacity necessary to support the forecast HST service levels. The design configuration presented a potential “single point of failure” where one switch is the single access point to five platform tracks, thus impeding efficient operations by seriously limiting parallel movements into and out of the terminal.
- **Alternative 3** (See Figure 3) - The alignment configuration developed for the Alternative 3 two terminal/station option provides for sufficient parallel train movement capability thereby minimizing conflicts between arriving and departing trains. In addition, the number of platform tracks or “edges” provided by the combination of both terminals (8 for the HST and 7 for Caltrain) is sufficient to accommodate the assumed scheduled turnaround times (including the 30 minute exception for TTC) for both the HST and Caltrain.
- **Alternative 4** - This alternative was not subject to this study process. It was developed as a “fall back” or contingency to Alternative 3 should this (Alternative 3) concept configuration prove incapable of supporting the proposed service levels of both Caltrain and the HST. The results of the Alternative 3 analysis confirmed the ability of this (Alternative 3) terminal configuration to support the proposed service levels; consequently, it was not necessary to conduct an analysis on Alternative 4.
- **Alternative 5** (See Figures 4 & 5) - This alternative was not included as part of this analysis. For the two alignment configuration options proposed for this alternative, the first Beale Street configuration was determined to be infeasible from a constructability standpoint. For the second Beale Street configuration, based on the capacity results for Alternative 2 and the inability of an interlocking design that presents a single switch access to the platforms to support the lower train service volumes applied in the Alternative 2 analysis, it was concluded that an operations review was unnecessary.
- **Alternative 6** (See Figure 6) - The alignment configuration concept developed for the Alternative 6, two terminal option provides for sufficient parallel train movements to minimize conflicts between arriving and departing trains. The number of platform tracks or “edges” provided in the combination of both terminals (10 for HST and 7 for Caltrain) is sufficient to accommodate the assumed scheduled turnaround times for the HST and Caltrain as defined in this report within acceptable parameters of the operating assumptions.

The schedules used in this analysis for both the HST and Caltrain are not yet fully developed to operate in conjunction with each other in a fully integrated “shared use”, “joint” operating plan. Merge points at the hypothetical Bayshore alignment interchange and the deadhead movements to and from the hypothetical Bayshore storage and maintenance facility and the Terminals are still under study. In addition, these concept level draft schedules do not currently include the running time differential for Caltrain trains that do not stop at Bayshore or 22nd Street on the alignment segment to the TTC or Beale Street. These issues are begin carried forward for further study and will be addressed with further refinement of the

schedules in the next steps of the operational analysis that will include the entire rail corridor between San Francisco and San Jose.

Further details associated with each concept, the analysis and results are presented in this report.

## 2.0 INTRODUCTION

An examination of the design configurations for the proposed downtown San Francisco Terminal alternatives for the California High Speed Train Project (HST) was performed as part of an overall alternatives analysis to describe the feasibility of the various options to provide the operational capacity required to support the forecast HST service. The terminal alternatives studied were as follows:

- Alternative 1 (Alternatives Analysis Subsection 0b) – Transbay Transit Center (TTC) using the California High Speed Rail Authority (Authority) Phase 1 Service Schedule. See Figure 1.
- Alternative 2 (Alternatives Analysis Subsection 0c) – Fourth and King Terminal using the conceptual HST Draft Full Build Service Schedule. See Figure 2.
- Alternative 3 (Alternatives Analysis Subsection 0a) – TTC and Fourth and King Terminal using the conceptual HST Draft Full Build Service Schedule and the Caltrain Draft 2025 Schedule (as provided by the JPB). See Figure 3.
- Alternative 4– Fourth and King Terminal – “Stacked” Station (If required capacity is not provided under Alternative 3).
- Alternative 5 – Beale Street using the conceptual HST Draft Full Build Service Schedule and the Caltrain Draft 2025 Schedule. See Figures 4 and 5.
- Alternative 6 (Alternatives Analysis Subsection 0d) – Beale Street and Fourth and King Terminal using the conceptual HST Draft Full Build Service Schedule and the Caltrain Draft 2025 Schedule. See Figure 6.

This report and analysis describes each of the alternative alignment configuration concepts and their ability to support the capacity requirements of the associated service assumptions for the HST. The conclusions of this analysis will be used (in conjunction with other considerations) to describe which alignment configurations present viable solutions for addressing the capacity requirements for a San Francisco Terminal(s). Service levels assumed for this analysis were initially based on those that have been previously defined in the Authority HST Phase 1 Service Plan. For service levels associated with the CHSTP 2035 full build out, a draft conceptual service plan was developed using ridership forecast data for 2035. For scenarios that include joint HST and Caltrain operations, the JPB Draft 2025 Service Plan for Caltrain was used.

The purpose of this study is to describe whether the terminal/station(s) capacity as defined in each of the alignment concept alternatives is sufficient to feasibly support the assumed HST and/or Caltrain Service Plans. Terminal capacity in this study is defined as the “network” that includes the total number of platform tracks or “edges” and station “throat” and approach “tracks” needed to feasibly operate the assumed HST and/or Caltrain Service Plans in to and out of San Francisco.

## 3.0 OBJECTIVE

The number of alignment configurations, locations and service combinations identified for San Francisco requires that a concept level operational review of each of the San Francisco Terminal alternatives be conducted. This analysis is intended to further the understanding of the station track requirements for the HST service under each alternative in order to identify an operationally feasible configuration. The objective of this analysis is to describe whether the terminal capacity of the proposed alignment configuration alternatives can feasibly support the demand of the proposed HST Service Plans with a peak schedule of up to 10 to 12 trains per hour (TPH) in each direction for all alternatives, and up to 10 TPH for Caltrain in those alternatives that propose joint terminal operations.

## 4.0 SIMULATION MODEL

The Berkeley Simulation Software Rail Traffic Controller (RTC) simulation software (the Model) was used to simulate operations for trains arriving and departing the San Francisco Terminals in each alignment configuration. The Model was selected because it accurately simulates passenger operations using the performance characteristics of specific train-set technologies and replicates the horizontal and vertical geometric attributes of the track infrastructure. It provides the range of information and analytical and reporting capabilities required for this analysis and was designed as a flexible tool that can be modified, refined and upgraded to examine a variety of operational and infrastructure alternatives. This dynamic train simulation instrument is also the Model selected as the primary tool for operations/capacity analysis and infrastructure validation for the CHSTP.

## 5.0 ASSUMPTIONS

There are three principal categories of assumptions that were applied universally to all scenarios simulated for the operational analyses of the San Francisco Terminal alignment alternatives:

- Train Performance Characteristics
- Operational Requirements and Service Design
- Infrastructure / Track Configuration

### 5.1 TRAIN PERFORMANCE CHARACTERISTICS

The train characteristics that are universally applicable to all of the simulation Model alternatives include:

- For HST: characteristics based upon the specifications for the French AGV train-sets. These train-sets are 400 meters long and capable of reaching speeds up to 220 mph.
- For Caltrain: characteristics based upon the specifications for an 8 car Siemens DD EMU capable of reaching speeds of up to 110 mph.

### 5.2 OPERATIONAL REQUIREMENTS

- HST service operates non-stop Millbrae to San Francisco
- HST maximum operating speed will be 125 miles per hour (mph)
- Caltrain maximum operating speed was assumed to be 110 mph, except where specific "civil" restrictions may apply
- HST and Caltrain non-revenue to revenue and revenue to non-revenue trains are assumed to have a turnaround time of 15 minutes
- Morning "start up" trains originate from a yard facility assumed to be in proximity to Bayshore
- Operations were simulated for the time period from 4:00 A.M. to 8:00 P.M.

## 5.3 SERVICE DESIGN ASSUMPTIONS

The service level assumptions applied in the Model are as follows:

- HST Service Plan: Train schedules as documented in this analysis are based on a conceptual draft full build service plan that was developed using the CHSTP ridership forecast data for 2035. The conceptual service plan identifies 10 to 12 trains per hour operating in to and out of the terminal during the peak periods.
- Caltrain Service Plan: Train schedules for Caltrain are based on the Draft conceptual 2025 Service Plan developed by Caltrain that assumes a total of 10 trains per hour, 4 to the TTC and 6 to Fourth and King Terminal.

The schedules used in this analysis for both the HST and Caltrain are not yet fully developed to operate in conjunction with each other in a fully integrated operating plan. They do not include the "merge points" at the hypothetical Bayshore Alignment interchange or for the deadhead movements to and from the hypothetical Bayshore storage and maintenance facility and the Terminals. In addition, these schedules do not currently include the running time differential for Caltrain trains that do not stop at Bayshore or 22nd Street when routed to the TTC or Beale Street. These issues are being carried forward for further study and will be addressed with the schedules further refined in the next steps of the operational analysis that will include the entire rail corridor between San Francisco and San Jose.

## 5.4 INFRASTRUCTURE / MAINLINE TRACK CONFIGURATION

The primary study area for the analysis was composed of the mainline segment of the peninsula corridor between Millbrae and downtown San Francisco. Note that north of Control Point (CP) Army; alignments are configured to conform to the specific terminal concepts developed for each alternative.

## 6.0 SIMULATION MODEL CASES – OPERATIONAL ANALYSIS

The Model was developed to represent the assumed service attributes and physical characteristics of the portion of the peninsula corridor between Millbrae and San Francisco, focusing on the capacity of the different terminal configuration alternatives. This section describes the terminal configuration concepts and assumptions applied to each specific simulation Model Case, and also summarizes the results of each scenario as follows:

### Model Case 1 – Alternative 1: Transbay Transit Center Only (See Figure 1)

The alignment configuration assumed for the Transbay Transit Center (TTC) followed the design developed for the Locally Preferred Alternative (LPA) and presented in the Project Specific Environmental Impact Report / Environmental Impact Statement (EIR/EIS). This includes:

- Total of six platform tracks; this alternative assumes all six tracks for HST.
- Three approach interlocking "throat" tracks to provide universal access to all station platform tracks.
- Two track mainline connection provided for the Caltrain mainline at Control Point (CP) Common.
  - Universal crossovers provided at CP Common.

Model Case 2 – Alternative 2: Fourth and King Terminal Only (See Figure 2)

- Total of eight platform tracks for the HST service at Fourth and King Terminal
- Beginning at CP Common, four approach interlocking “throat” tracks to provide access to all station platform tracks
- Two track mainline for the HST from Millbrae to CP Common
- Hypothetical HST layover and storage facility at Bayshore
  - Inbound yard lead from Bayshore connects to mainline at CP Common; outbound lead connects to mainline near CP Army.

Model Case 3 – Alternative 3: TTC and Fourth and King Terminals (See Figure 3)

The conceptual alignment for Alternative 3 assumes:

- Four tracks total between Millbrae and Bayshore.
  - Two tracks predominantly for Caltrain (during peak periods)
  - Two tracks predominantly for the HST (during peak periods)
- North and South of Bayshore,
  - Grade separated crossovers at Bayshore allow for universal access between the four mainline tracks and the Bayshore maintenance facility.
- Stops are provided to Bayshore and 22<sup>nd</sup> Street stations for Caltrain only.
- Four mainline tracks between Bayshore and CP Common.
  - Two tracks for “shared use” between the HST and Caltrain to the TTC
  - Two tracks for “shared use” between the HST and Caltrain to the Fourth and King Terminal
- Two yard lead tracks are necessary from the hypothetical Bayshore maintenance facility to the mainline.
- Subterranean station at Fourth and Townsend with outside platforms for exclusive use by Caltrain
- Three platforms and six tracks in the TTC
  - Four northern tracks are for the exclusive use of the HST
  - Two southern tracks are for the exclusive use of Caltrain
  - Three approach “shared use” interlocking “throat” tracks to provide universal access to/from all station platform tracks.
- Five platforms and nine tracks total in the Fourth and King Terminal
  - Four northern tracks are for the exclusive use of the HST
  - Five southern tracks are for the exclusive use of Caltrain
  - Three approach interlocking “throat” tracks that provide universal access to all Caltrain platform tracks and HST platform track one. HST platform tracks 2, 3 and 4 are accessed from the western two “throat” tracks only.

Model Case 4 – Alternative 6: Beale Street and Fourth and King Terminals (See Figure 5)

The conceptual alignment for Alternative 6 assumes:

- Four tracks total between Millbrae and Bayshore.
  - Two tracks predominantly for Caltrain (during peak periods)
  - Two tracks predominantly for the HST (during peak periods)
- North and South of Bayshore:
  - Grade separated crossovers at Bayshore allow for universal access between the four mainline tracks and the Bayshore maintenance facility.
- Stops are provided to Bayshore and 22<sup>nd</sup> Street stations for Caltrain only.
- Four mainline tracks between Bayshore and CP Common.
  - Two tracks for “shared use” between the HST and Caltrain to the TTC
  - Two tracks for “shared use” between the HST and Caltrain to the Fourth and King Terminal
- Two yard lead tracks are necessary from the hypothetical Bayshore maintenance facility to the mainline.
- Subterranean station at Fourth and Townsend with island platform for exclusive use by Caltrain
- Four platforms and eight tracks total in the Beale Street Terminal
  - Six western tracks are for the exclusive use of the HST
  - Two eastern tracks are for the exclusive use of Caltrain
  - Three approach interlocking “throat” tracks to provide universal access to all station platform tracks.
- Five platforms and nine tracks total in Fourth and King Terminal
  - Four northern tracks are for the exclusive use of the HST
  - Five southern tracks are for the exclusive use of Caltrain
  - Three approach interlocking “throat” tracks that provide universal access to all Caltrain platform tracks and the HST platform track one. HST platform tracks 2, 3 and 4 are accessed from the western two “throat” tracks only.

## 6.1 MODEL CASE 1 – ALTERNATIVE 1

### Assumptions

The San Francisco Terminal configuration Model Case 1 assumed:

- Service Level Assumptions: As described in Section 5.3 plus:
  - Only the HST operations were simulated using the CHSTP Phase 1 Service Plan.
  - Caltrain operations are assumed to operate to Fourth and King Terminal; no Caltrain operations were simulated in this Case.

- All revenue to revenue train turns for the HST were scheduled based on the assumption of a 30 minute turnaround time, which is an exception to the minimum scheduled CHSTP system turnaround time assumed to be 40 minutes.

### Approach

The San Francisco Terminal Model Case 1 (refer to Appendix A – Figure 1) examined the capacity of the TTC in its ability to accommodate the conceptual HST Phase 1 service plan with six platform tracks and three approach interlocking “throat” tracks to provide universal access to all station platform tracks. Caltrain operations were assumed to be located at the Fourth and King station.

### Objective

The purpose of the San Francisco Terminal Model Case 1 was to describe, at a conceptual level of analysis, the feasibility of the assumed terminal configuration of six platform tracks at the TTC to provide sufficient capacity to operate the forecast levels of HST service.

### Conclusions

The Alternative 1 San Francisco Terminal alignment configuration as currently presented is unable to meet the needs of the HST operation as assumed in the Phase 1 Service Plan, and consequently the Full Build Service Plan (which has higher service levels). Only during the start-up period in the early morning timeframe, when trains arrive from the storage yard and require a 15 minute turnaround time, is adequate terminal capacity available. For the majority of the service day, when all of the trains are operating in revenue service and performing revenue to revenue “turns”, the terminal capacity is constrained to 4 to 5 trains per hour. This is significantly less than the 8 to 9 trains per hour presented in the Phase 1 Service Plan or the 10 to 12 trains per hour assumed in the Full Build Service Plan.

In order to respond effectively to the CHSTP ridership demand forecast, the high speed rail “inter-city” service pattern developed in the Phase 1 Service Plan required scheduling “clusters” of trains operating throughout the day rather than “even” intervals or “headways” typical of conventional, short distance transit systems (such as heavy rail transit and LRT) . This results in trains arriving and departing the TTC in groups of two or three trains with time separations ranging from two to four minutes. This service pattern creates an imbalance in the arrivals and departures (i.e. uneven arriving and intervals) within a 60 minute period. Consequently, the elapsed turnaround time for an arriving train to the next departing train (that satisfies the assumed 30 minute scheduled turnaround time) can lead to turn times that are slightly shorter or longer than the 30 minute objective. Significant “gaps” begin to occur in the capacity of the TTC using the CHSTP Phase 1 Schedule demand in the 8:00 A.M. to 9:00 A.M. period where the turn-around time dynamics begin to deteriorate below the assumed minimum of 30 minutes. This deterioration increases through-out the remainder of the morning simulation period forcing the reduction of turn-around time to unacceptably shorter durations. In order to achieve even the “exceptional” minimum turn-around time adopted for the TTC analysis there would need to be an additional number of station tracks and platform “edges” provided. The simulation showed that there is insufficient capacity during the morning peak period at the TTC indicating that this alternative is not feasible and rendered the remaining step (testing the Full Buildout service plan) of the Alternative 1 simulation unnecessary. Noting that the TTC did not provide sufficient capacity to support the Phase 1 Schedule it was determined that the Full Build Service Plan, which has more trains (than Phase 1) would similarly prove infeasible.

## 6.2 MODEL CASE 2 – ALTERNATIVE 2

### Assumptions

The San Francisco Terminal configuration Model Case 2 assumed:

- Service Level Assumptions: As described in Section 5.3 plus:
  - Maximum of 12 HST per hour in each direction based on the conceptual draft Full Build service plan
  - Caltrain operations are assumed to operate to the TTC; no Caltrain operations were simulated in this Case.

### Approach

The San Francisco Terminal Model Case 2 (refer to Appendix A – Figure 2) examined the capacity of the Fourth and King Terminal in its ability to accommodate the conceptual HST service plan with eight platform tracks (“edges”) and four approach interlocking “throat” tracks to provide universal access to and from all station platform tracks.

### Objective

The purpose of the San Francisco Terminal Model Case 2 was to describe, at a conceptual level of analysis, the feasibility of the assumed terminal configuration of eight platform tracks at the Fourth and King Terminal to provide sufficient capacity to operate the forecast levels of HST.

### Conclusions

The Alternative 2 San Francisco Terminal alignment configuration as currently presented will not support the operation of the conceptual CHSTP Draft Full Build Service Plan assumed in this analysis. The configuration of the interlocking at CP Common creates a single point of failure for the approach to Fourth and King Terminal, consistently causing multiple delays of between 45 seconds and 8.5 minutes to both inbound and outbound trains. This single point of failure is considered a “fatal flaw” in the Alternative 2 design.

The results of the simulation analysis conducted on the Alternative 2 alignment configuration and the conceptual HST service patterns indicated that the interlocking proposed at CP Common is not sufficient to allow the necessary train movements required to support the maximum of 12 trains per hour assumed during the maximum peak periods of service as identified in the service plan. The alignment configuration proposed for this alternative creates a “single point of failure” for the approach to the terminal located at CP Common in which parallel train movements are severely limited. In practical terms this means that access to platforms five through nine can only be provided by passing through a single switch point at CP Common. With some trains scheduled as close as 3 minutes apart during peak periods for both inbound and outbound trains, providing only a “single point” for access to five platforms does not provide the through-put capacity required to reliably maintain schedule adherence and on-time performance.

The movement of trains within the terminal is further constrained as a result of the revenue to non-revenue and non-revenue to revenue movements to and from the yard. To minimize platform occupancy times, up to 5 trains per hour during the peak are required to deadhead to/from the yard rather than remain at the terminal platform to turn. This occurs when there are more trains arriving in a 60 minute period than there are platform tracks to accommodate these arriving trains assuming a standard 40 minute turnaround time. To further help in addressing this capacity issue, exceptions were made in some cases by “scheduling” turnaround times less than 40 minutes in order to minimize the number of trains traveling to and from the yard. However turnaround times of less than 36

minutes were not assumed. Throughout the course of the simulation, 10 train sets were scheduled with 36 to 39 minute turnaround times.

### 6.3 MODEL CASE 3 – ALTERNATIVE 3

#### Assumptions

The San Francisco Terminal configuration Model Case 3 assumed:

- Service Level Assumptions: As described in Section 5.3 plus:
  - Maximum of 12 HST per hour in each direction based on a conceptual draft Full Build service plan
  - Maximum of 10 Caltrain trains per hour in each direction based on the Draft Caltrain 2025 Service Plan, 4 trains to the TTC and 6 to Fourth and King.

#### Approach

The San Francisco Terminal Model Case 3 (refer to Appendix A – Figure 3) examined the capacity of a joint San Francisco Terminal between the Fourth and King Station and the TTC and their combined ability to support the conceptual HST and Caltrain draft service plans with a total of eight platform tracks for the HST (4 at TTC and 4 at Fourth and King) and a total of seven platform tracks for Caltrain (2 at TTC and 5 at Fourth and King). The approach interlocking “throat” tracks to the TTC provide universal access to and from all station platform tracks. For Fourth and King Terminal, the approach interlocking “throat” tracks provide universal access to all Caltrain platform tracks and HST platform track one. HST platform tracks 2, 3 and 4 are accessed from the western two “throat” tracks only.

#### Objective

The purpose of the San Francisco Terminal Model Case 3 was to describe, at a conceptual level of analysis, the feasibility of the assumed terminal configuration, consisting of a total of eight platform tracks for the HST and a total of seven platform tracks for Caltrain between the TTC and the Fourth and King Terminal, to provide sufficient capacity to operate the forecast levels for HST and Caltrain trains.

#### Conclusions

The Alternative 3 San Francisco Terminal alignment configuration as currently presented can feasibly support the operation of the conceptual HST and Caltrain draft service plans as assumed in this analysis. The alignment configurations developed for the two terminals provide sufficient parallel train movement capability to minimize conflicts between arriving and departing trains. The number of platform “edges” provided between both terminals (8 for the CHSTP and 7 for Caltrain) is sufficient to accommodate the assumed turnaround times (including the 30” HST exception for TTC) for the HST and Caltrain as defined in this report with limited exceptions.

At Fourth and King Street Terminal, revenue to revenue train turns for the HST were scheduled based on the assumption of a 40 minute turnaround time. Due to the turnaround time exception previously assumed for the TTC, the HST turnaround times at the TTC used in the analysis were 30 minutes. Turn-around times for Caltrain were assumed to be 20 minutes for standard revenue to revenue service and 15 minutes for revenue to non-revenue trains. The interlocking “throat” in this alternative for Fourth and King allows for multiple parallel train movements in and out of the facility, which is an improvement over Alternative 2 due to the shorter Caltrain platform length requirements. This allows the interlocking to “process” a higher number of trains per hour. When compared to the observations in Alternative 2, where the “fatal flaw” was identified in the interlocking configuration at CP Common and its failure to provide parallel train movement capability causing a “single point of

failure”, the Alternative 3 CP Common interlocking configuration is more robust. This is because, with the introduction of Caltrain service, two of the 400 meter platforms designated in Alternative 2 for HST service could be shortened in length to accommodate the 8 car Caltrain consists. The platform reductions provided more “space”, allowing the interlocking configurations to be improved to thereby increasing through-put at CP Common and mitigating the “single point of failure”.

The results of the simulation analysis conducted on the Alternative 3 alignment configuration indicated that while there are some exceptions to the assumed minimum turnaround times for the HST, (5 trains have turnaround times between 27 and 29 minutes at the TTC and 7 trains have turnaround times between 34 and 39 minutes at Fourth and King) all trains for both services were able to be run in accordance with their schedules.

It should be noted here that the schedules used in this analysis for both the HST and Caltrain are conceptual and not, as yet designed to operate in conjunction with each other in a fully integrated operating plan. They do not include merge points at the hypothetical Bayshore Alignment interchange and they do not account for the running time differential for Caltrain trains that do not stop at Bayshore or 22<sup>nd</sup> Street when routed to the TTC. These issues will be addressed and the schedules further refined in the next steps of the operational analysis that will include the entire rail corridor between San Francisco and San Jose.

### 6.4 MODEL CASE 4 – ALTERNATIVE 6

#### Assumptions

The San Francisco Terminal configuration Model Case 4 assumed:

- Service Level Assumptions: As described in Section 5.3 plus:
  - Maximum of 12 HST per hour in each direction based on the conceptual draft Full Build service plan that was developed using ridership forecast data for 2035
  - Maximum of 10 Caltrain trains per hour in each direction based on the Caltrain Draft 2025 Service Plan, 4 trains to Beale Street and 6 trains to Fourth and King.

#### Approach

The San Francisco Terminal Model Case 4 (refer to Appendix A – Figure 6) examined the capacity of a joint San Francisco Terminal between the Fourth and King Terminal and Beale Street and their combined ability to support the conceptual HST and Caltrain draft service plans with a total of ten platform tracks for the HST (6 at Beale Street and 4 at Fourth and King) and a total of seven platform tracks for Caltrain (2 at Beale Street and 5 at Fourth and King). The approach interlocking “throat” tracks to the Beale Street Terminal provide universal access to and from all station platform tracks. For Fourth and King Terminal, the approach interlocking “throat” tracks provide universal access to all Caltrain platform tracks and HST platform track one. HST platform tracks 2, 3 and 4 are accessed from the western two “throat” tracks only.

#### Objective

The purpose of the San Francisco Terminal Model Case 4 was to describe, at a conceptual level of analysis, the feasibility of the assumed terminal configuration, consisting of a total of ten platform tracks for the HST and a total of seven platform tracks for Caltrain between the combined Beale Street and Fourth and King Terminals, to provide sufficient capacity to operate the assumed forecast service levels for the HST and Caltrain trains.

#### Conclusions

The Alternative 6 San Francisco Terminal alignment configuration as currently presented can feasibly support the operation of the conceptual HST and Caltrain service plans as assumed in this analysis. The alignment configurations developed for the two terminals provide sufficient parallel train movement capability to minimize conflicts between arriving and departing trains. The total number of platform tracks or “edges” provided in both terminals combined (10 for HST and 7 for Caltrain) is sufficient to accommodate the assumed turnaround times for the HST and Caltrain as defined in this report within acceptable parameters of the operating assumptions.

At both Fourth and King Street Terminal and Beale Street all revenue to revenue train turns for the HST were scheduled based on the assumption of a 40 minute turnaround time. The interlocking “throat” throughput for Fourth and King used the same configuration as in Alternative 3 and allows for multiple parallel train movements in to and out of the facility, which is an improvement over Alternative 2 due to the shorter Caltrain platform length requirements. This allows the interlocking to process a higher number of trains per hour. The three track “throat” to Beale Street provides an interlocking with multiple routing options allowing for parallel train movements to and from multiple platforms, increasing the overall train processing capability of the terminal compared to Alternative 3. This three track throat arrangement is successful in this alternative (as compared to a similar configuration assumed for Alternative 5) because the set of “universal” crossover switches are located closer to the terminal, thus reducing the time that trains would occupy any given arriving or departing routes.

The results of the simulation analysis conducted for the Alternative 6 alignment configuration indicated that while there are some exceptions to the assumed minimum turnaround times for both the HST and Caltrain, all trains for both services were able to be run in accordance with their schedules.

It should be noted here that the schedules used in this analysis for both the HST and Caltrain are conceptual and not, as yet designed to operate in conjunction with each other in a fully integrated operating plan. They do not include the merge points at the hypothetical Bayshore Alignment interchange and they do not account for the running time differential for Caltrain trains that do not stop at Bayshore or 22<sup>nd</sup> Street when routed to the TTC. These issues will be addressed and the schedules further refined in the next steps of the operational analysis that will include the entire rail corridor between San Francisco and San Jose.

## 7.0 CONCLUSIONS

Based on the analyses conducted of the four Alternatives selected for simulation modeling, it was determined that Alternatives 3 and 6 are the two alignment configurations that offer a feasible configuration for achieving the necessary capacity and assumed service and operational objectives. Alternatives 1 and 2 did not provide sufficient capacity to feasibly support the conceptual HST service level requirements of up to 12 trains per hour in each direction as assumed in the Full Build Out Draft Conceptual Service Plan.

It should be noted that Alternatives 4 and 5 were “dropped” from consideration prior to conducting the operational simulation, modeling analysis. Alternative 4 was developed exclusively as a “fall back” contingency to Alternative 3 should the alignment configuration simulated proved to be unable to support the proposed service levels of both Caltrain and the HST. With the results of the modeling and analysis confirming the ability of the terminal configuration proposed in Alternative 3 to provide sufficient capacity to support the assumed service levels, there was no longer the necessity for further study of Alternative 4.

For Alternative 5, two conceptual variations for proposed configurations were reviewed. The first option (Beale Street Alt. 5A – Figure 4) depicted a “universal access” interlocking achieved through the use of switching “ladders” that enabled both parallel train movements and multiple routing options for trains. In particular, any track in the terminal could be reached by arriving and departing trains and the “throat” of this interlocking arrangement was located at the immediate entrance of the terminal. .

The second option (Beale Street Alt. 5B – Figure 5) described the same 10 track terminal arrangement as Alt.5A, but described a completely different interlocking arrangement. In this interlocking arrangement the “throat” was designed to be much farther away from the terminal. It was also significantly smaller and provided access to the terminal via three “branch routes”. The “branch routes” provided some ability for parallel routing to 4 tracks located in the middle of the station but manifested “single point of failure” access to the 6 outside station tracks. This configuration would “force” arriving and departing trains located on the outside of the terminal to be routed in a manner that precluded other trains from moving until they were entirely clear of the interlocking throat, a throat which in this alternative, is farther away from the station. Additionally, trains would be forced to “queue” up on the approach tracks waiting for conflicting routes and/or preceding trains to clear coming into or moving out of the terminal. The results of the analysis indicated that this terminal configuration does not support the assumed HST or Caltrain train operations previously described for this alternative.

The Beale Street Alt.5A configuration as depicted was determined to be infeasible for constructability reasons. Based on the previous analysis describing the inability of “single point of failure” interlocking designs to support the lower train service volumes used in Alternative 2, it was neither prudent nor practicable to conduct an operations simulation using the configuration design proposed in Beale Street Alt. 5B.



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**CALIFORNIA HIGH-SPEED TRAIN PROJECT**  
**SAN FRANCISCO**  
 ALTERNATIVE 1: TRANSBAY  
 TRANSIT CENTER (HST) ONLY  
 AA ALTERNATIVE OB  
 FIGURE 1

CONTRACT NO.	XXX
DRAWING NO.	
SCALE	1"=300'
SHEET NO.	OF



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DATE	03-24-10



**CALIFORNIA HIGH-SPEED TRAIN PROJECT**  
**SAN FRANCISCO**  
 ALTERNATIVE 2:  
 4TH STREET AND KING STREET (HST ONLY)  
 AA ALTERNATIVE OC  
 FIGURE 2

CONTRACT NO.	XXX
DRAWING NO.	
SCALE	1"=300'
SHEET NO.	OF



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IN CHARGE	
DATE	03-24-10



**CALIFORNIA HIGH-SPEED TRAIN PROJECT**  
**SAN FRANCISCO**  
 ALTERNATIVE 3: TRANSBAY  
 TRANSIT CENTER  
 AA ALTERNATIVE 0A  
 FIGURE 3

CONTRACT NO.	XXX
DRAWING NO.	
SCALE	1"=300'
SHEET NO.	OF



NOT  
 1. TURNOUTS NORTH OF 4TH AND KING ARE ON DIRECT FIXATION TRACK AND HAVE POINT OF SWITCH AT HEEL OF FROG OF PRECEDING TURNOUT.

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DRAWN BY	
CHECKED BY	
IN CHARGE	
DATE	03-25-10



**CALIFORNIA HIGH-SPEED TRAIN PROJECT**  
**SAN FRANCISCO**  
 ALTERNATIVE 5A: BEALE STREET  
 (ALL HST AND CALTRAIN)  
 AA ALTERNATIVE OD  
 FIGURE 4

CONTRACT NO.	XXX
DRAWING NO.	
SCALE	1"=300'
SHEET NO.	OF



NO. 11  
 1. TURNOUTS NORTH OF 4TH AND KING ARE ON DIRECT FIXATION TRACK AND HAVE POINT OF SWITCH AT HEEL OF FROG OF PRECEDING TURNOUT.

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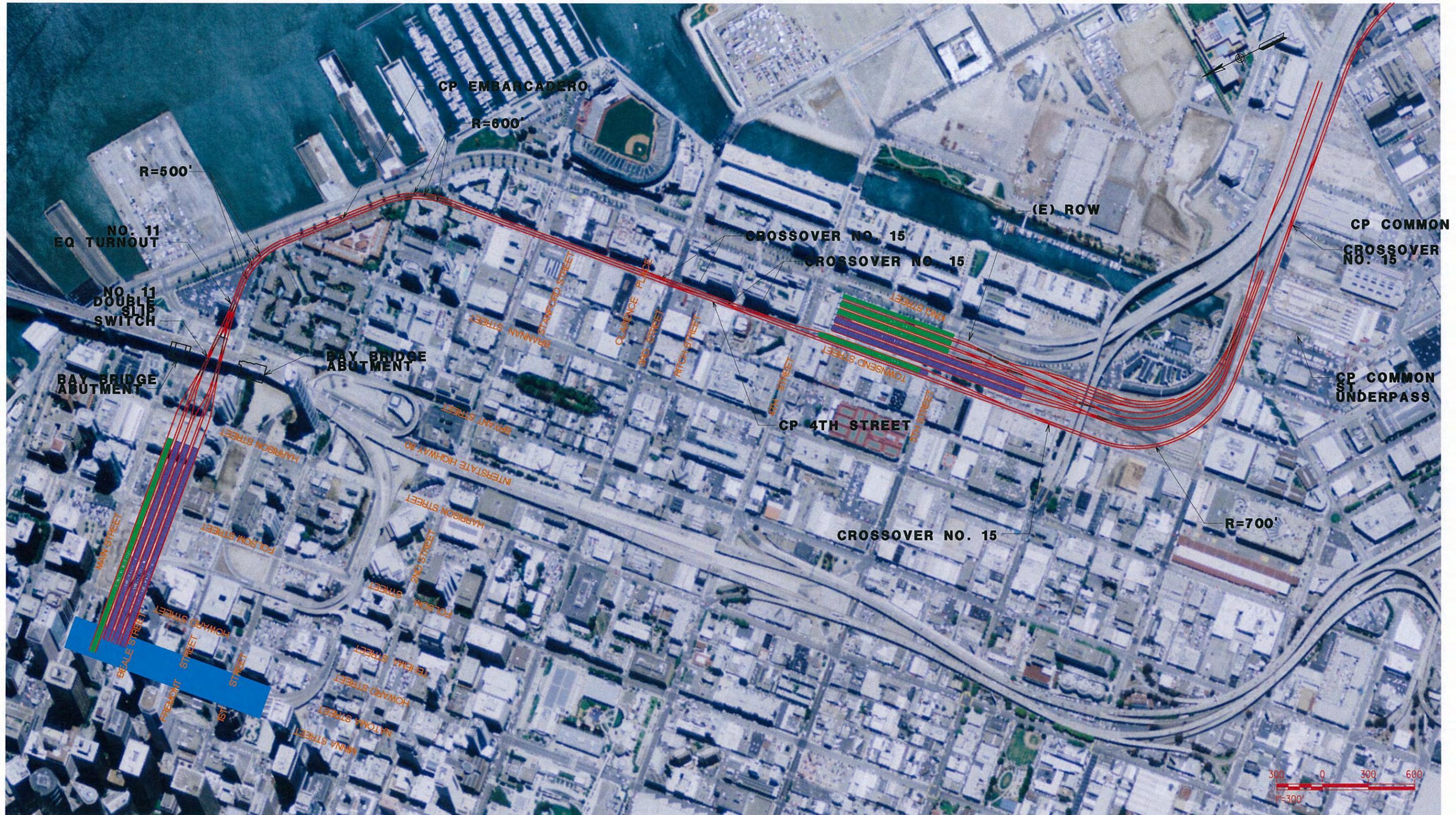
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DATE	03-25-10



**CALIFORNIA HIGH-SPEED TRAIN PROJECT**  
**SAN FRANCISCO**  
 ALTERNATIVE 5B: BEALE STREET  
 (ALL HST AND CALTRAIN)  
 AA ALTERNATIVE OD  
 FIGURE 5

CONTRACT NO.	XXX
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SHEET NO.	OF



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DATE	03-25-10



**CALIFORNIA HIGH-SPEED TRAIN PROJECT**  
**SAN FRANCISCO**  
 ALTERNATIVE 6: BEALE STREET  
 AND 4TH STREET AND KING STREET  
 AA ALTERNATIVE OD  
 FIGURE 6

CONTRACT NO.	XXX
DRAWING NO.	
SCALE	1"=300'
SHEET NO.	OF

FOR STUDY PURPOSES ONLY



**ALTERNATIVE 7  
BEALE STREET (ALL HST AND CALTRAIN)  
AA ALTERNATIVE 0D  
FIGURE 7**

CONCEPTUAL ENGINEERING REVIEW OF BEALE STREET  
SAN FRANCISCO TERMINAL PROPOSAL  
11/25/2009  
PARSONS

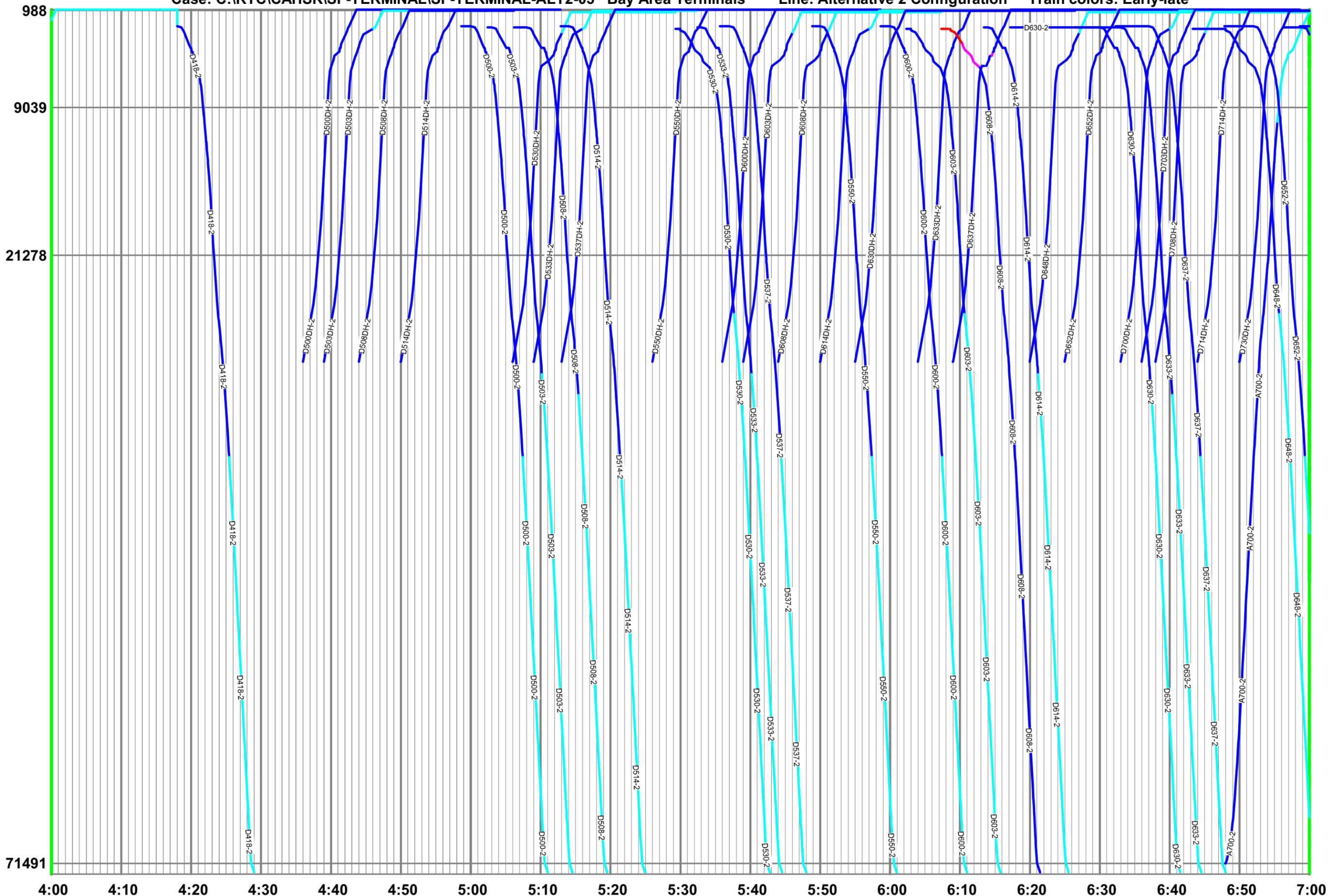




22nd StrN

Paul AveN

Milbrea



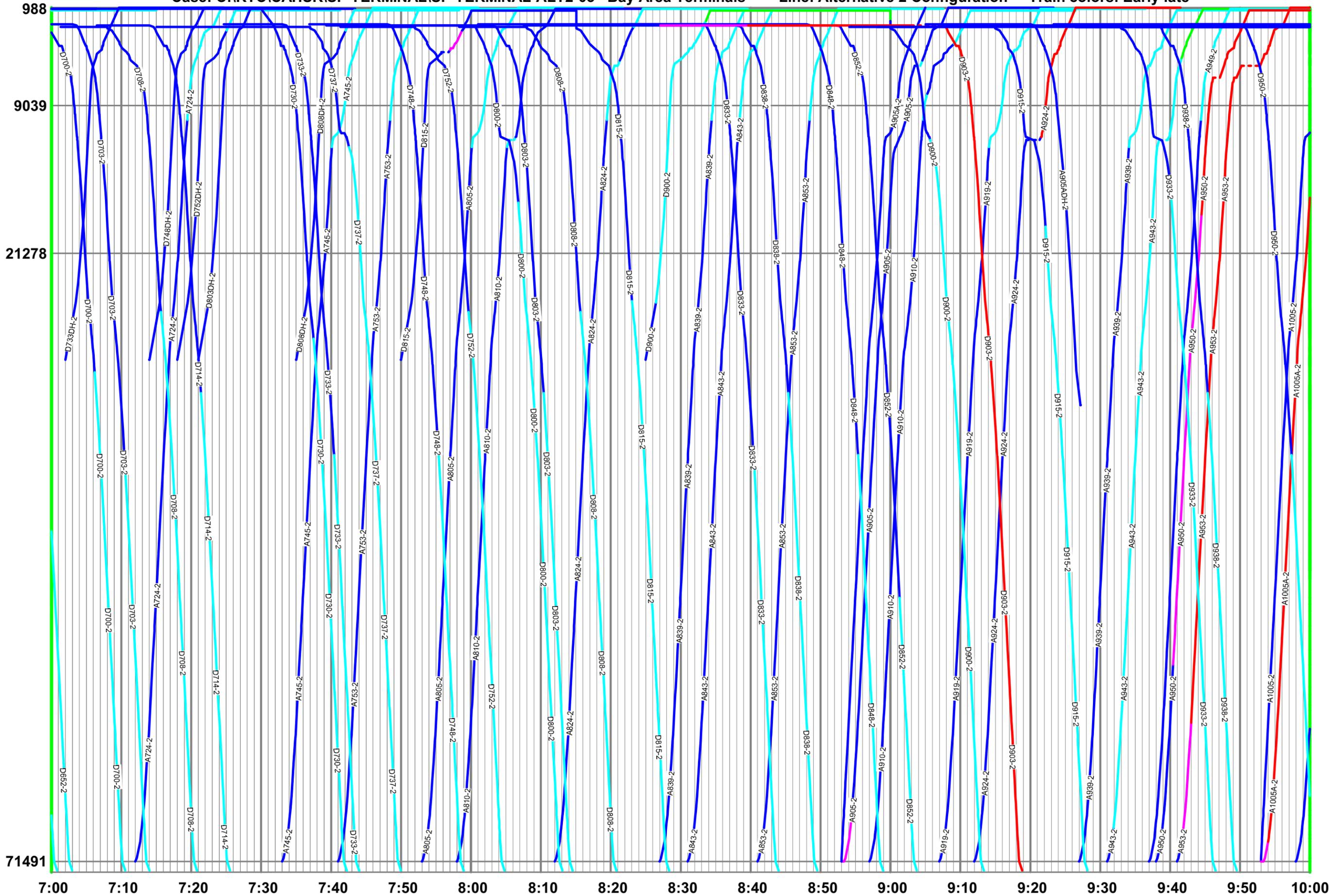
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MONDAY

22nd StrN

Paul AveN

Milbrea



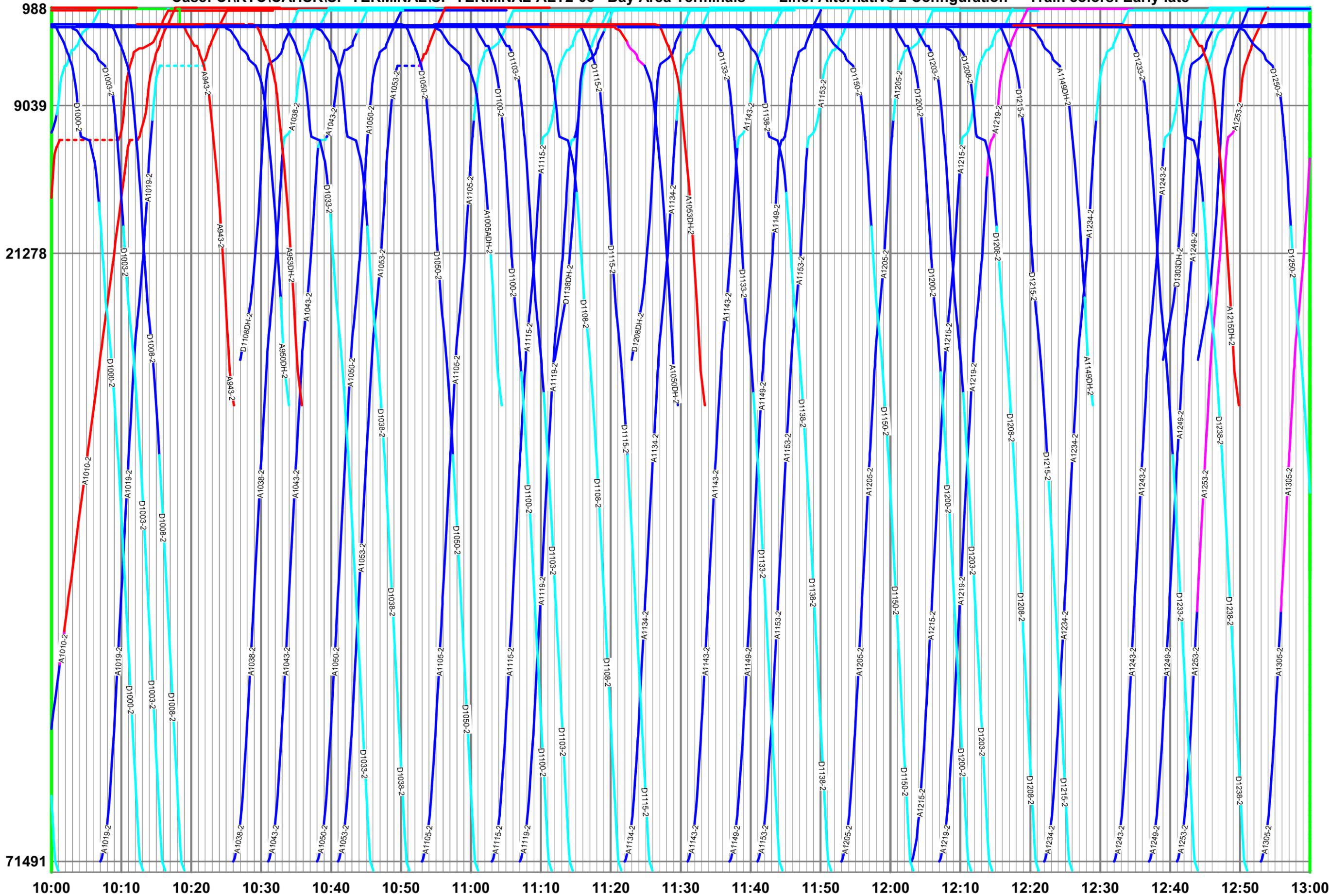
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MONDAY

22nd StrN

Paul AveN

Milbrea



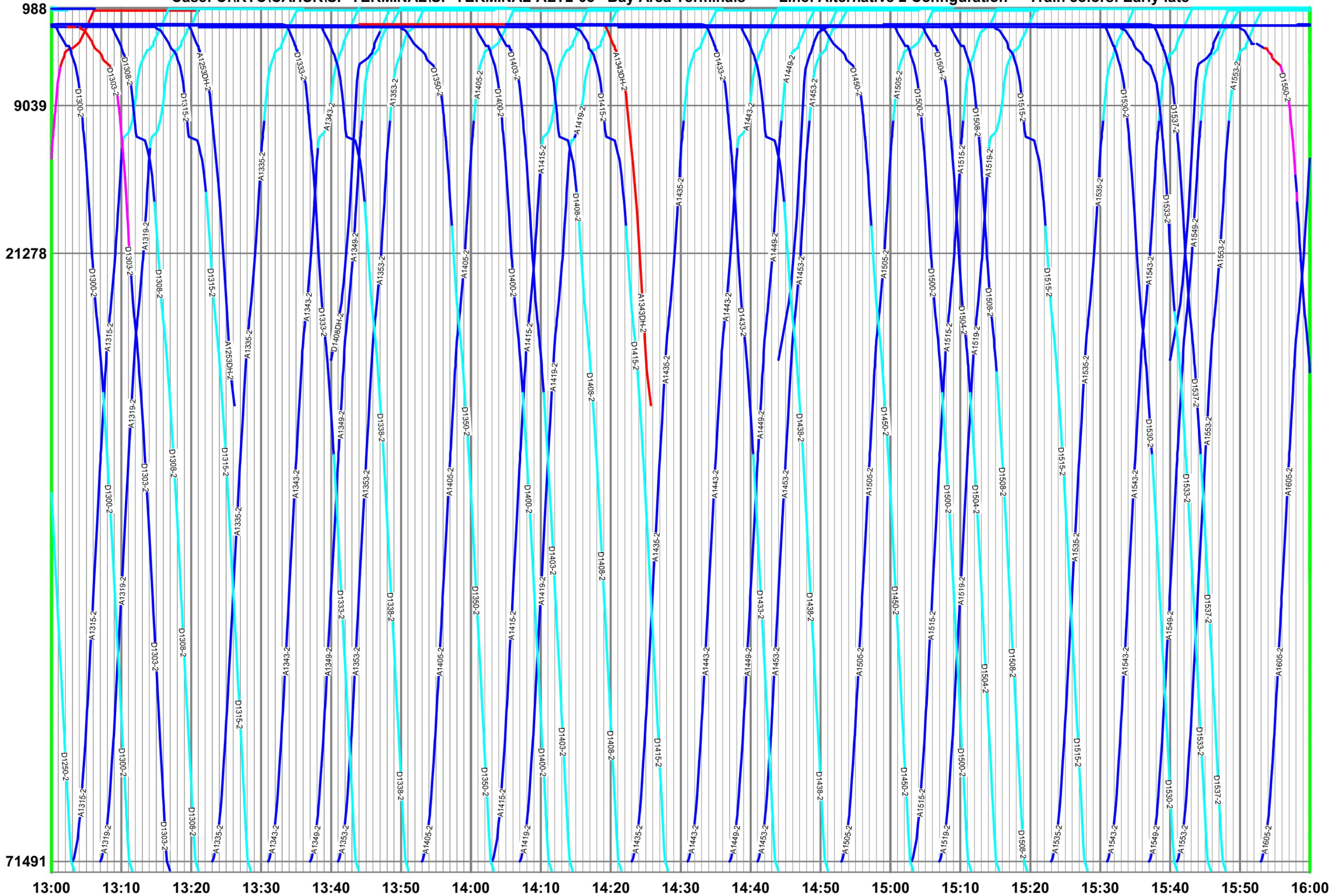
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MONDAY

22nd StrN

Paul AveN

Milbrea



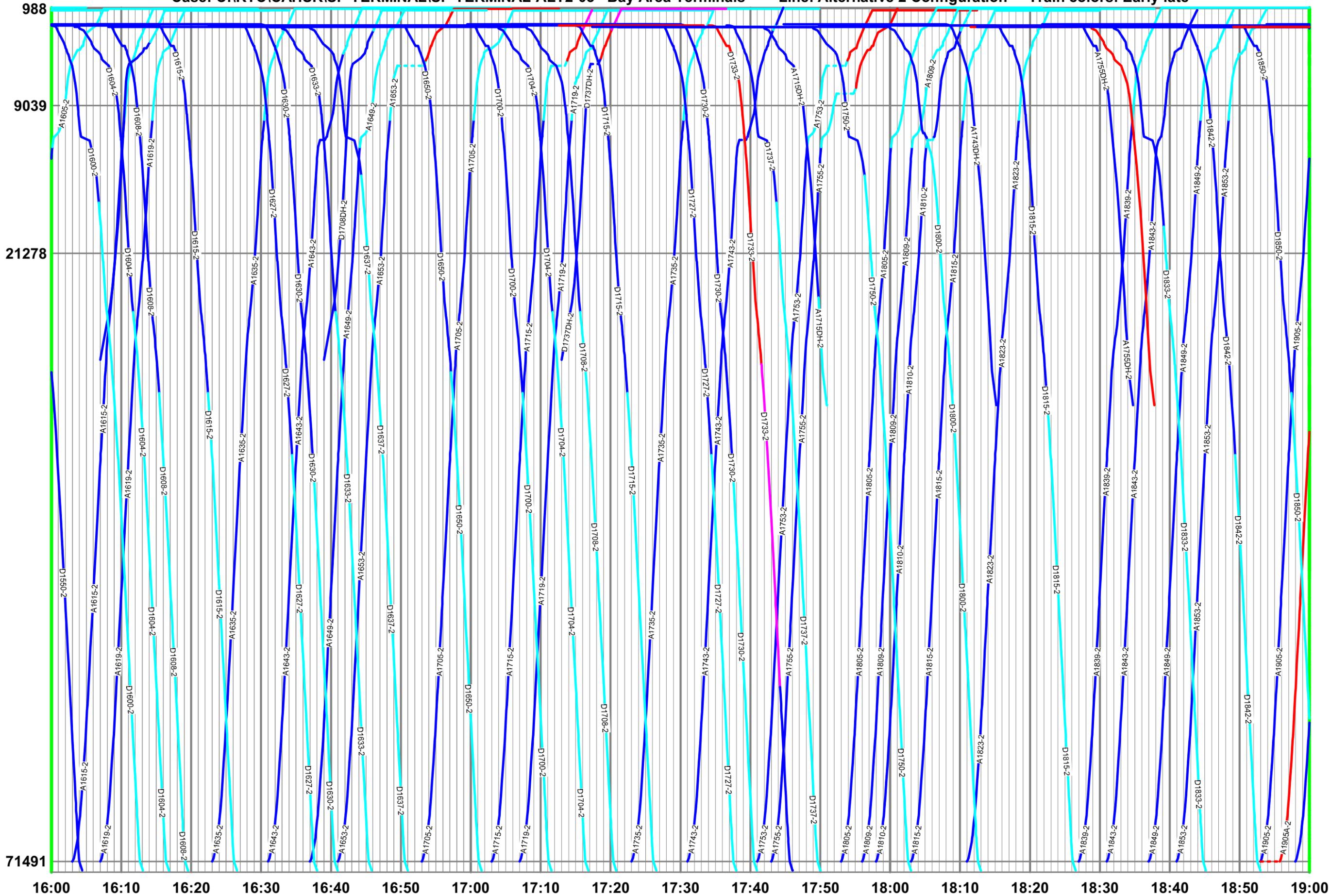
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MONDAY

22nd StrN

Paul AveN

Milbrea



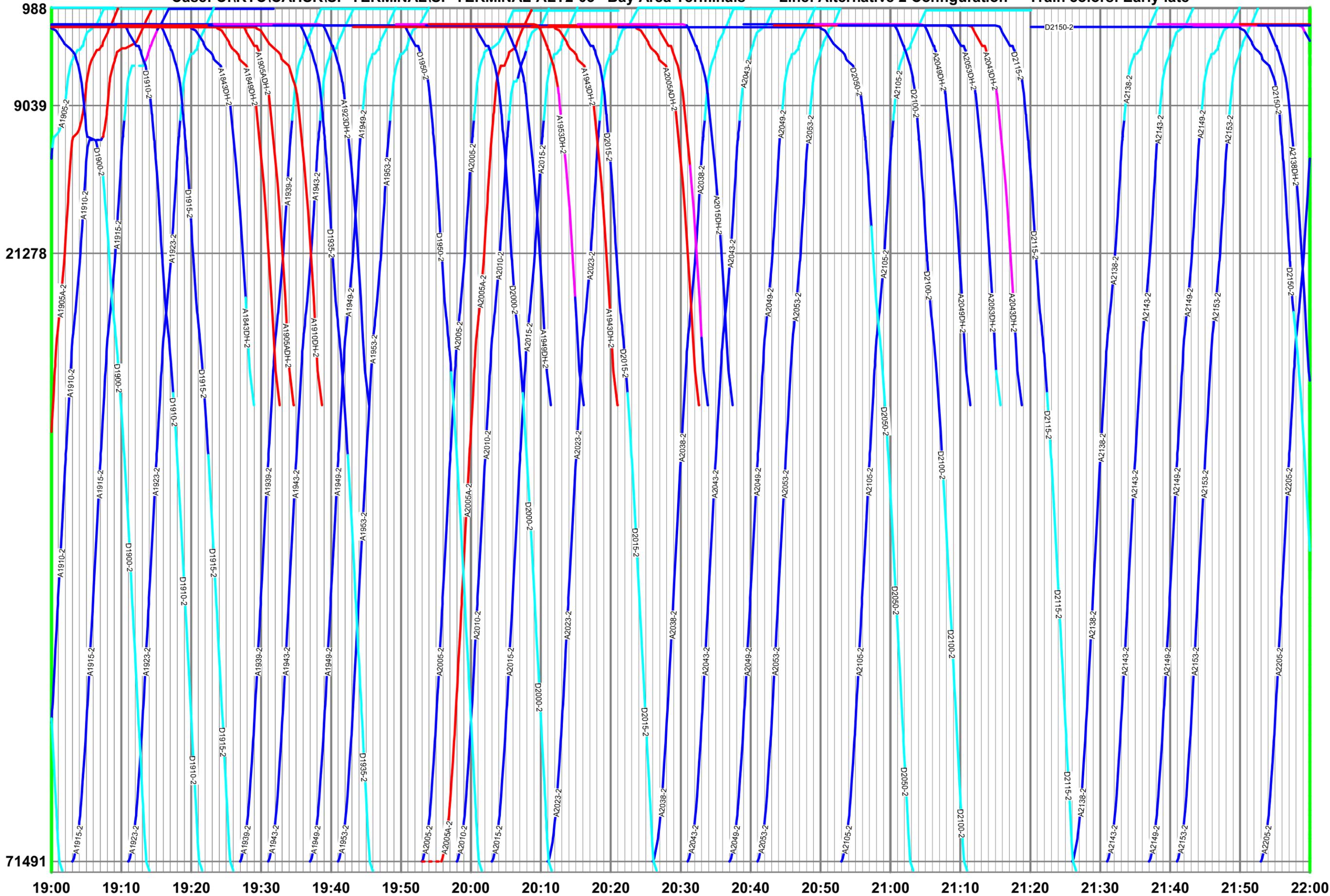
16:00 16:10 16:20 16:30 16:40 16:50 17:00 17:10 17:20 17:30 17:40 17:50 18:00 18:10 18:20 18:30 18:40 18:50 19:00

MONDAY

22nd StrN

Paul AveN

Milbrea



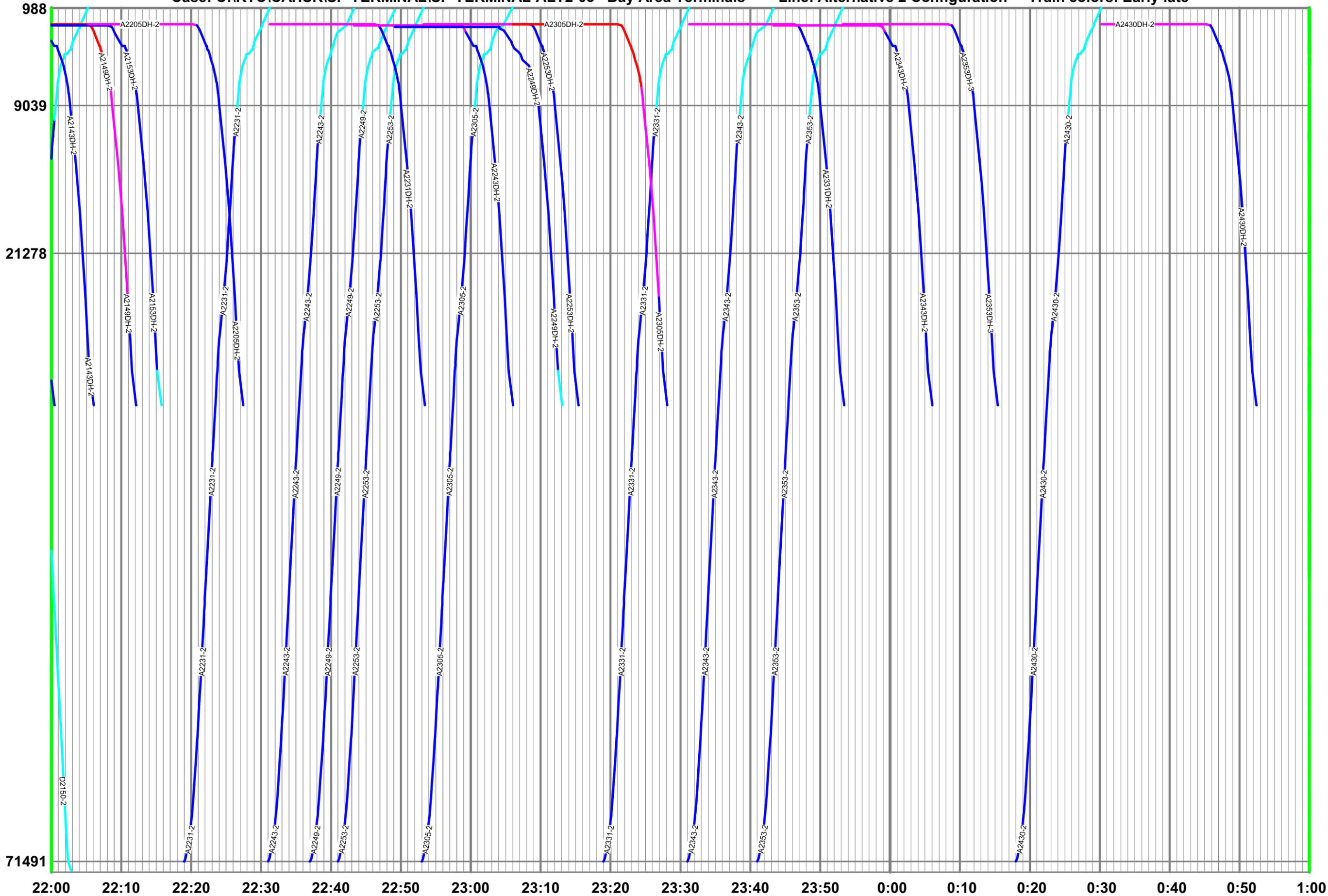
19:00 19:10 19:20 19:30 19:40 19:50 20:00 20:10 20:20 20:30 20:40 20:50 21:00 21:10 21:20 21:30 21:40 21:50 22:00

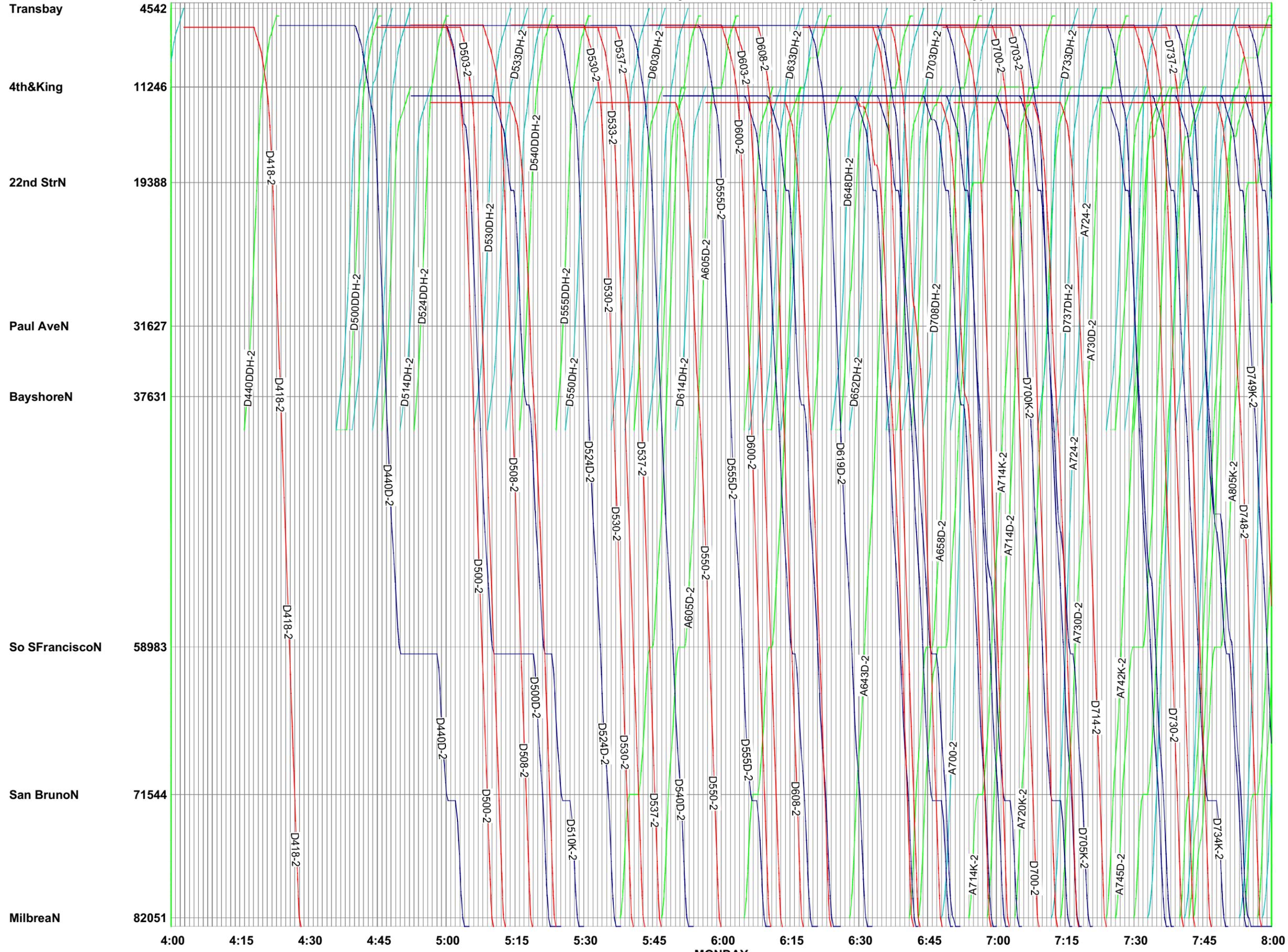
MONDAY

22nd StrN

Paul AveN

Milbrea

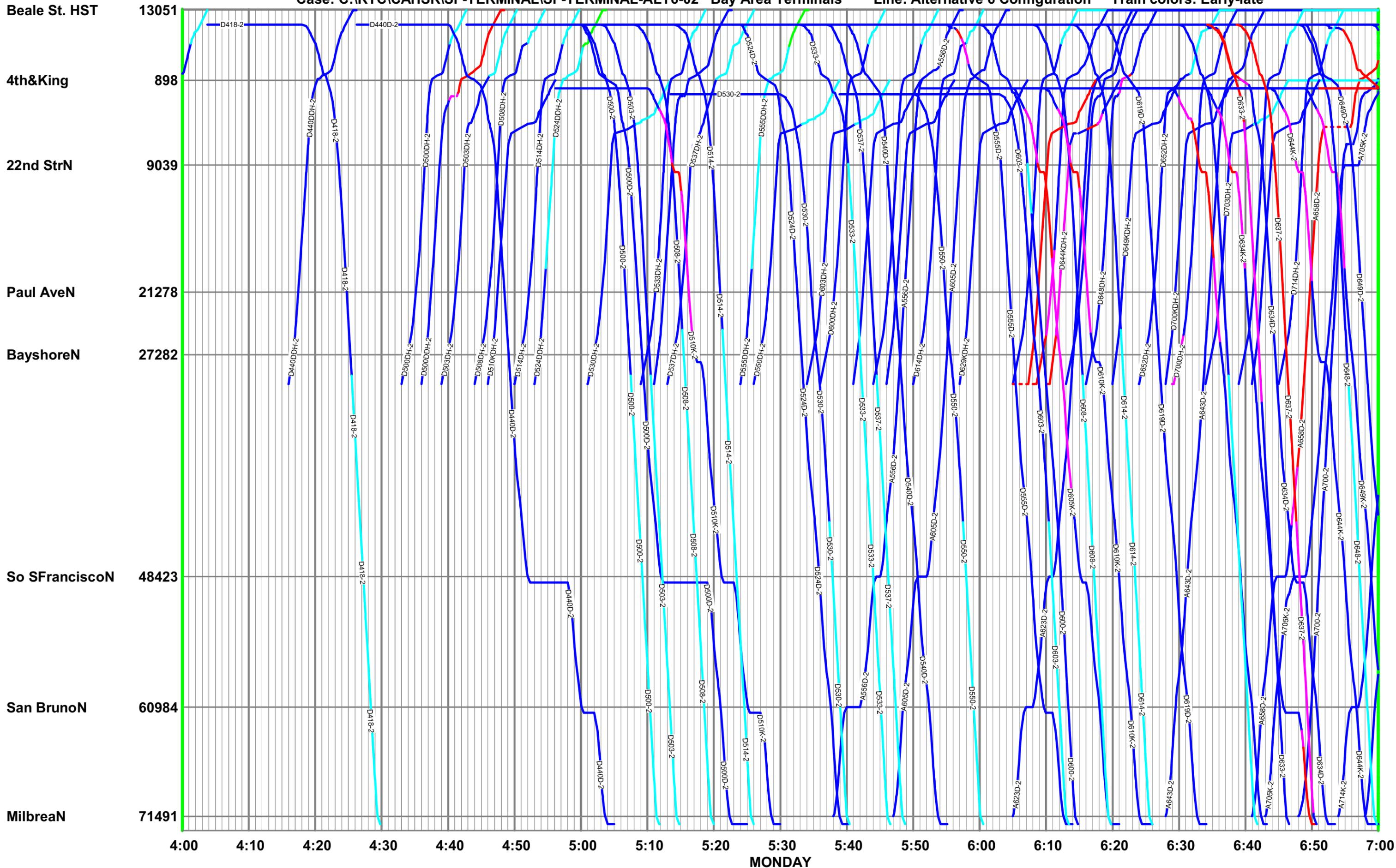


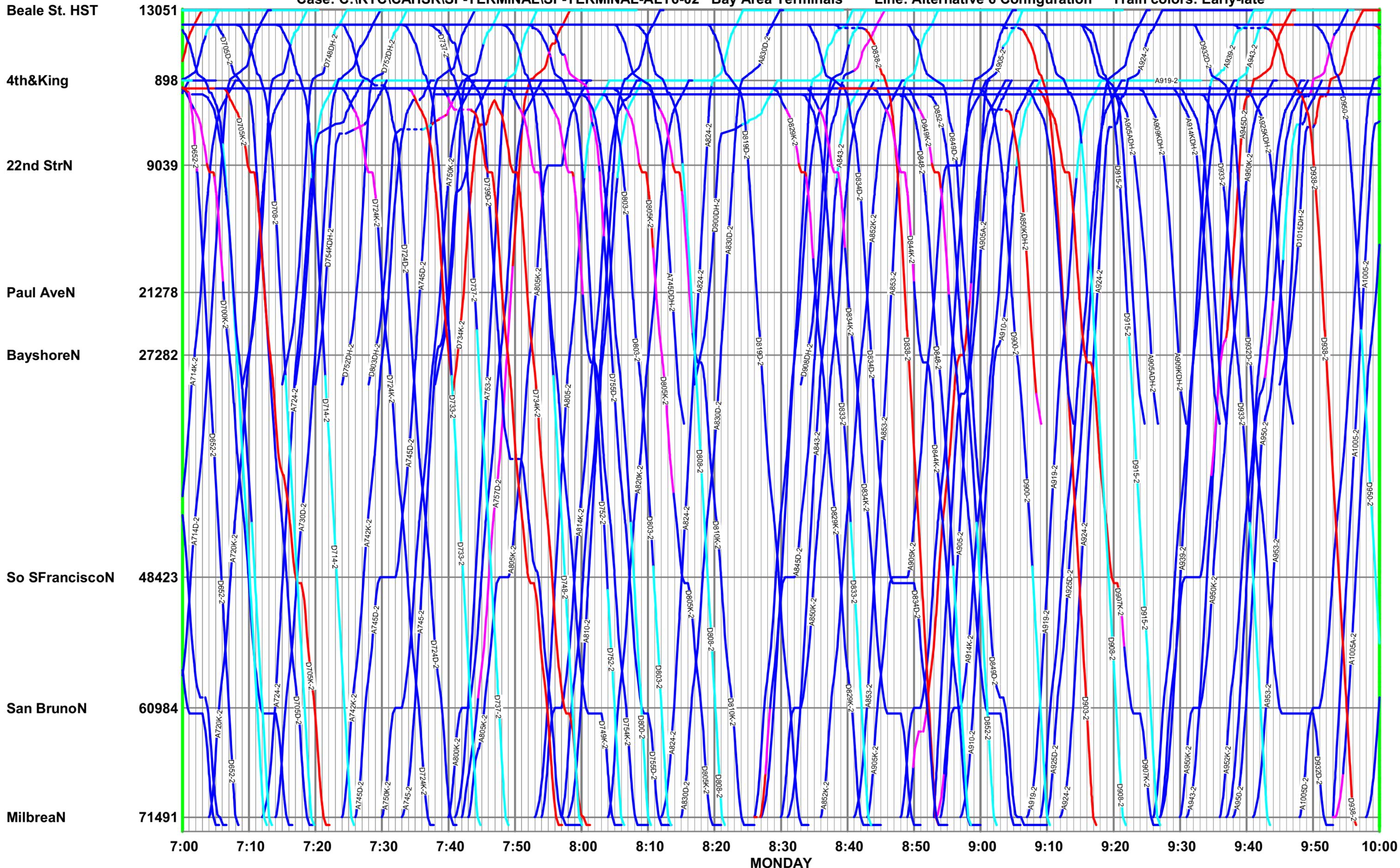










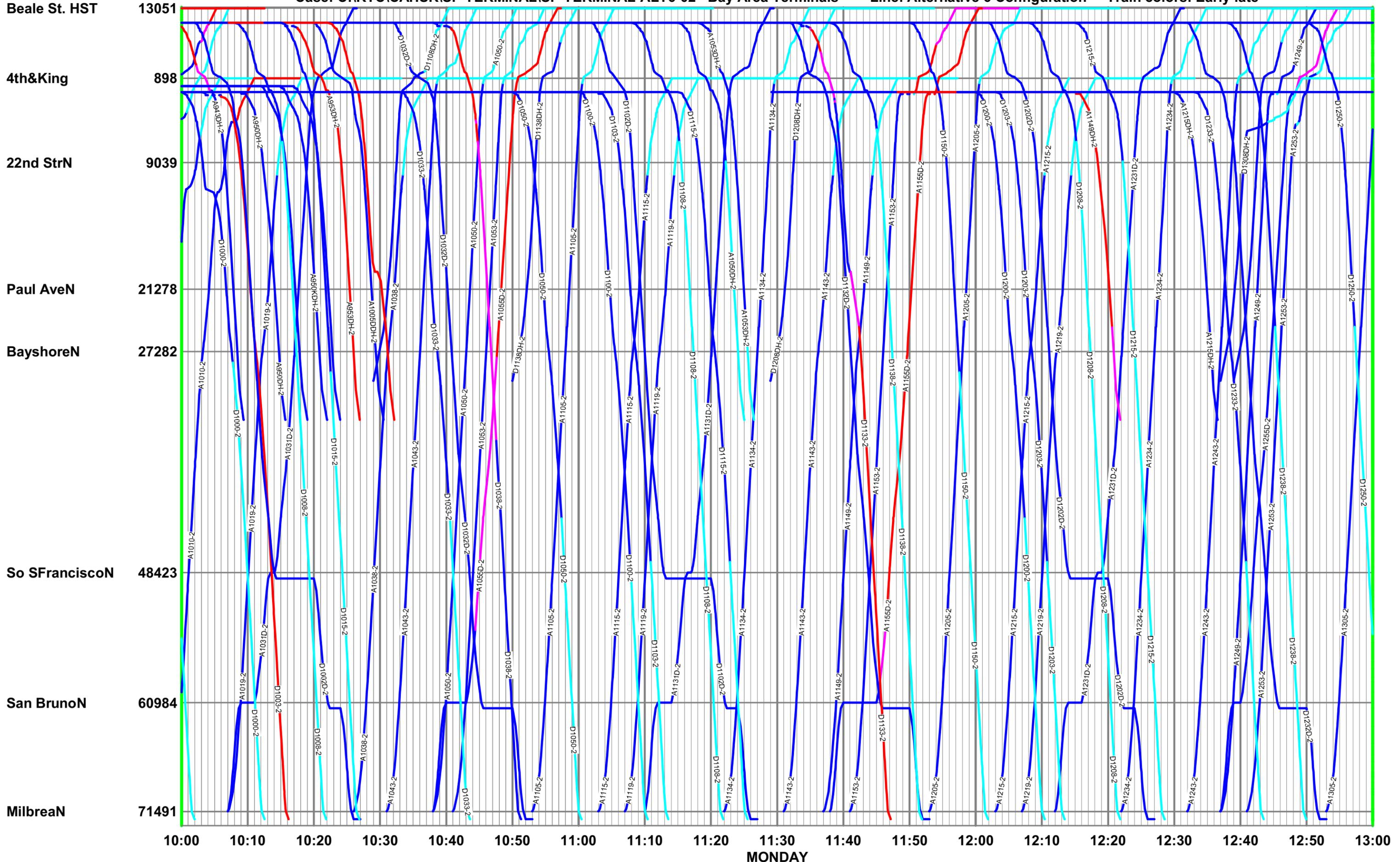


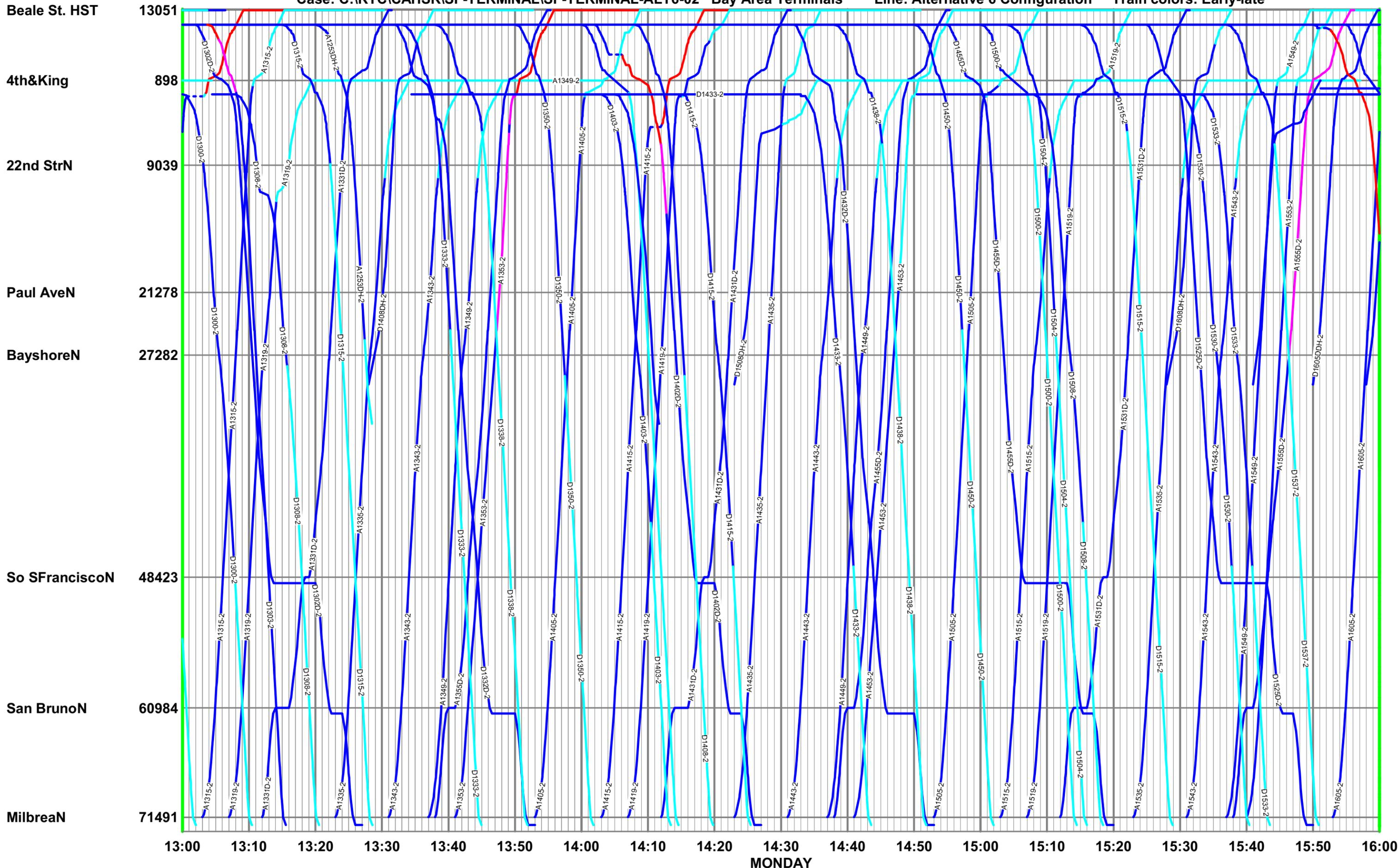
Beale St. HST  
4th&King  
22nd StrN  
Paul AveN  
BayshoreN  
So SFraniscoN  
San BrunoN  
MilbreaN

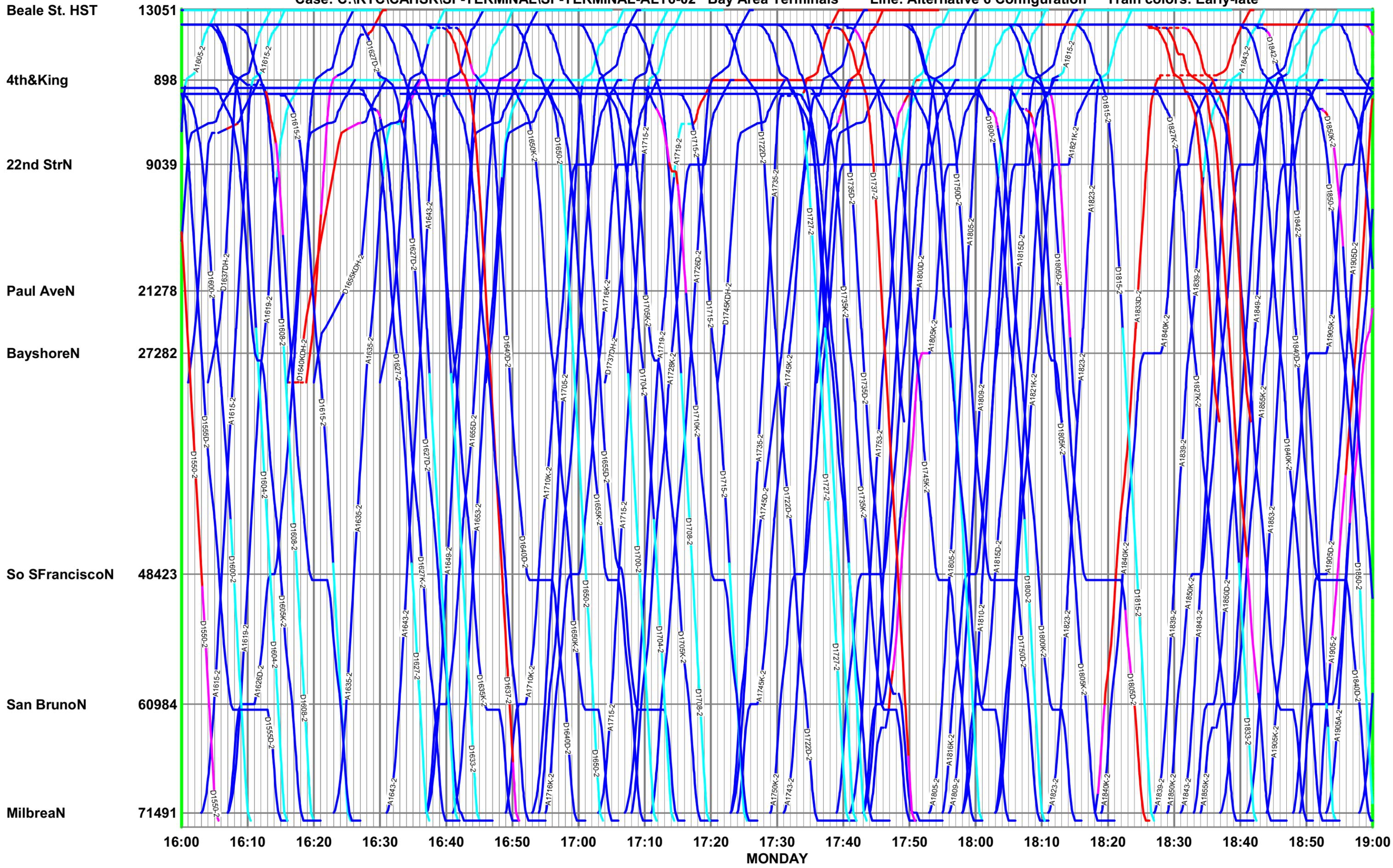
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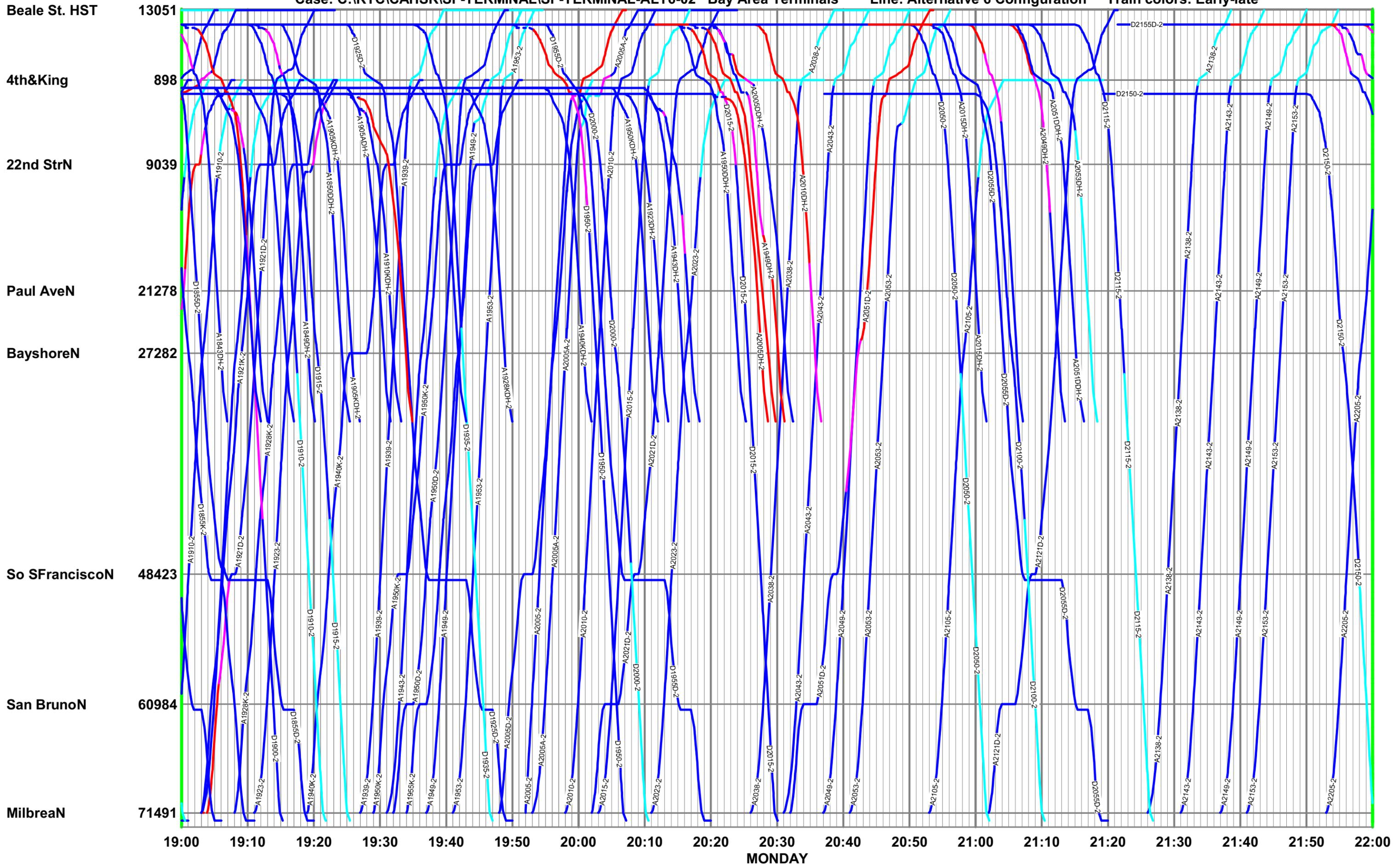
7:00 7:10 7:20 7:30 7:40 7:50 8:00 8:10 8:20 8:30 8:40 8:50 9:00 9:10 9:20 9:30 9:40 9:50 10:00

MONDAY



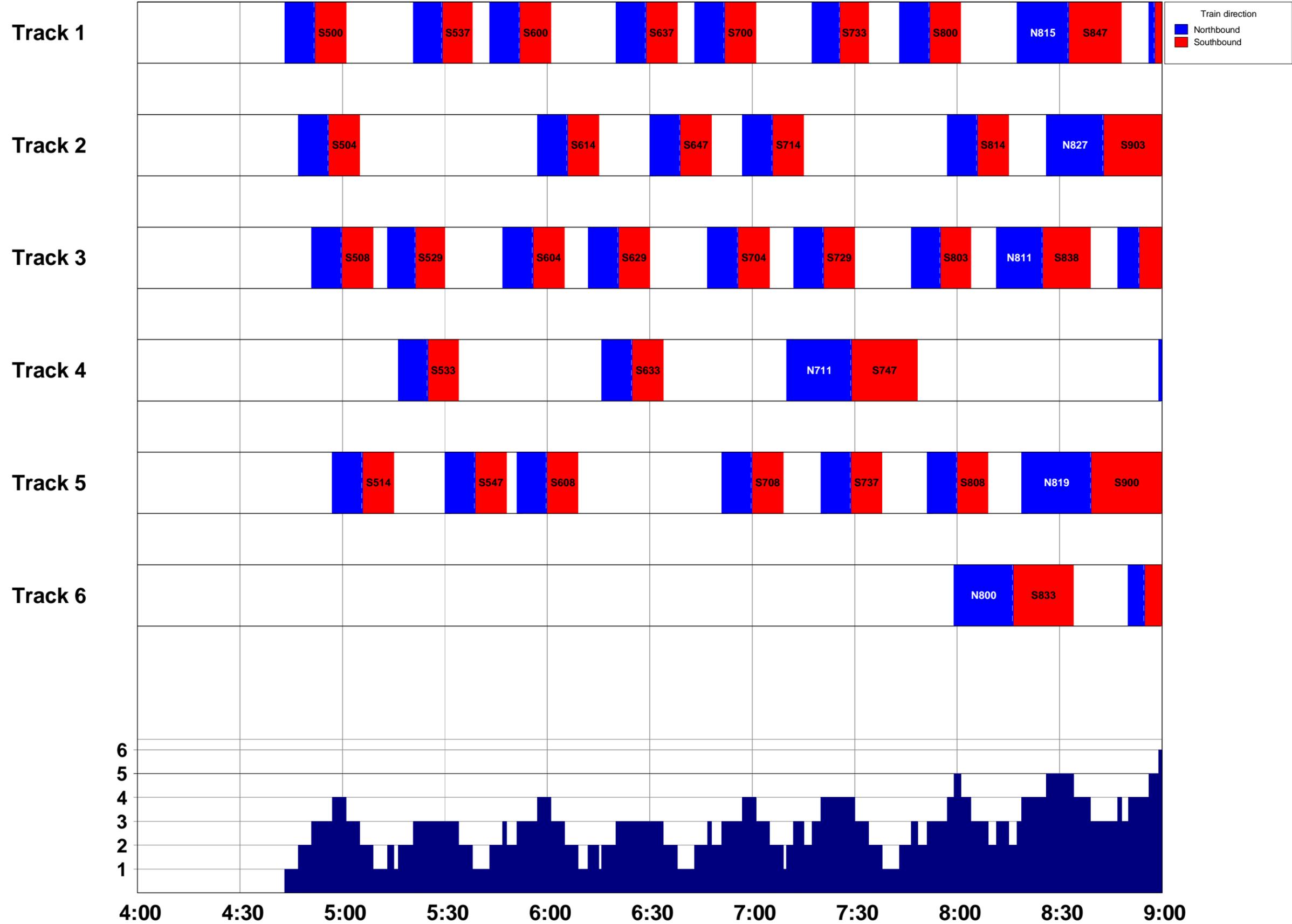




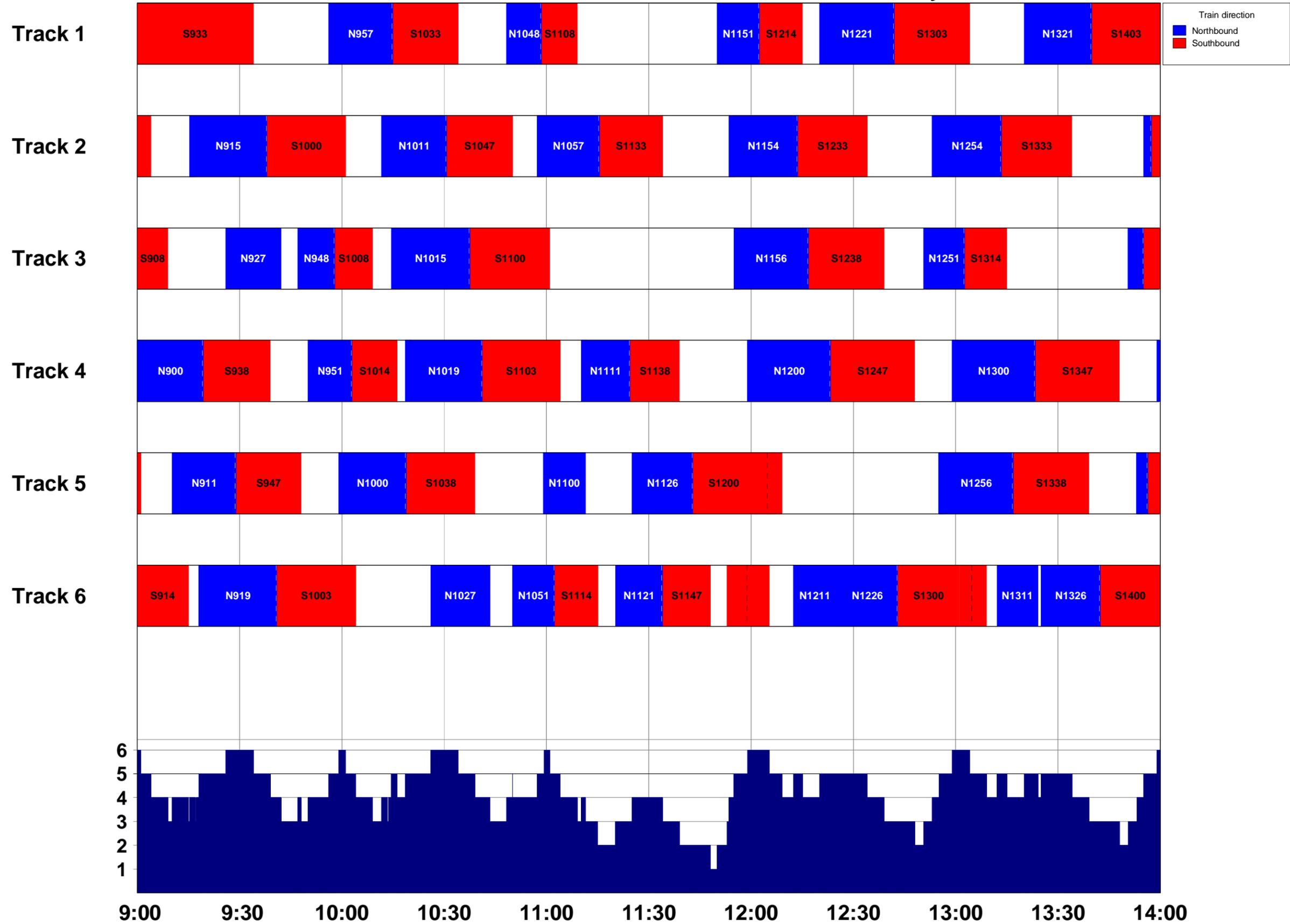




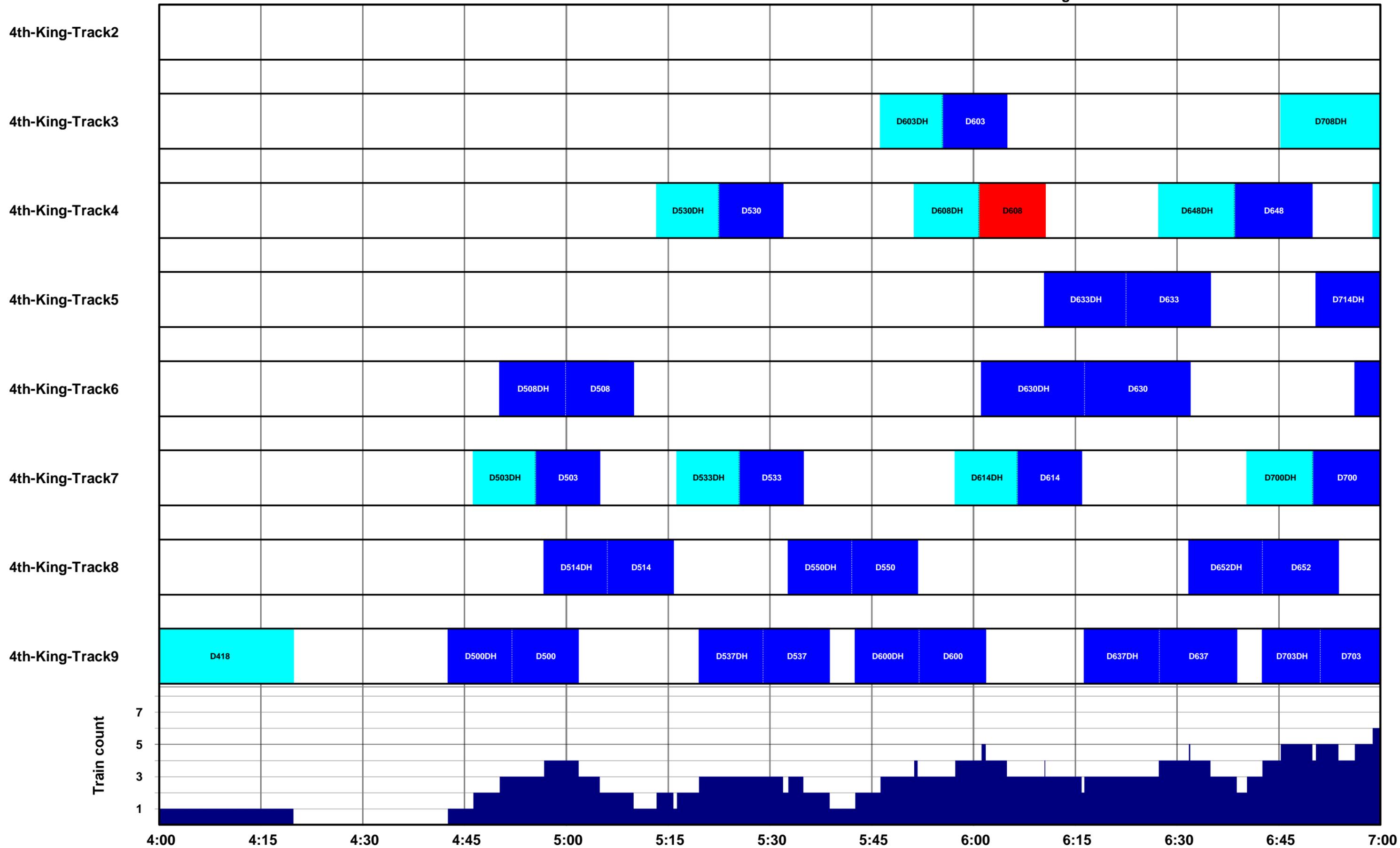
Case: C:\RTC\TRANSBAY09\T04a Track set: Transbay



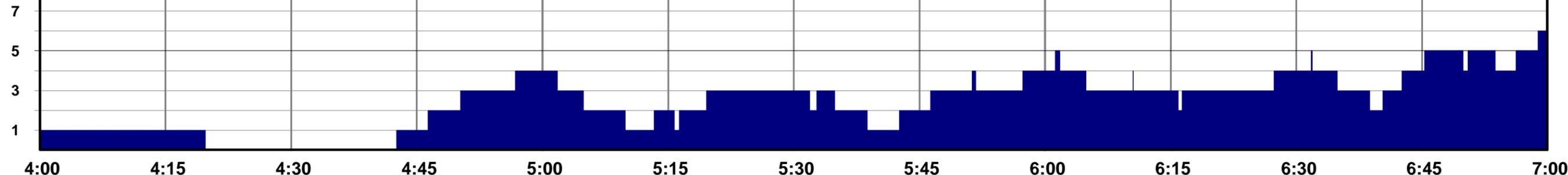
6 Track Transbay Terminal Configuration



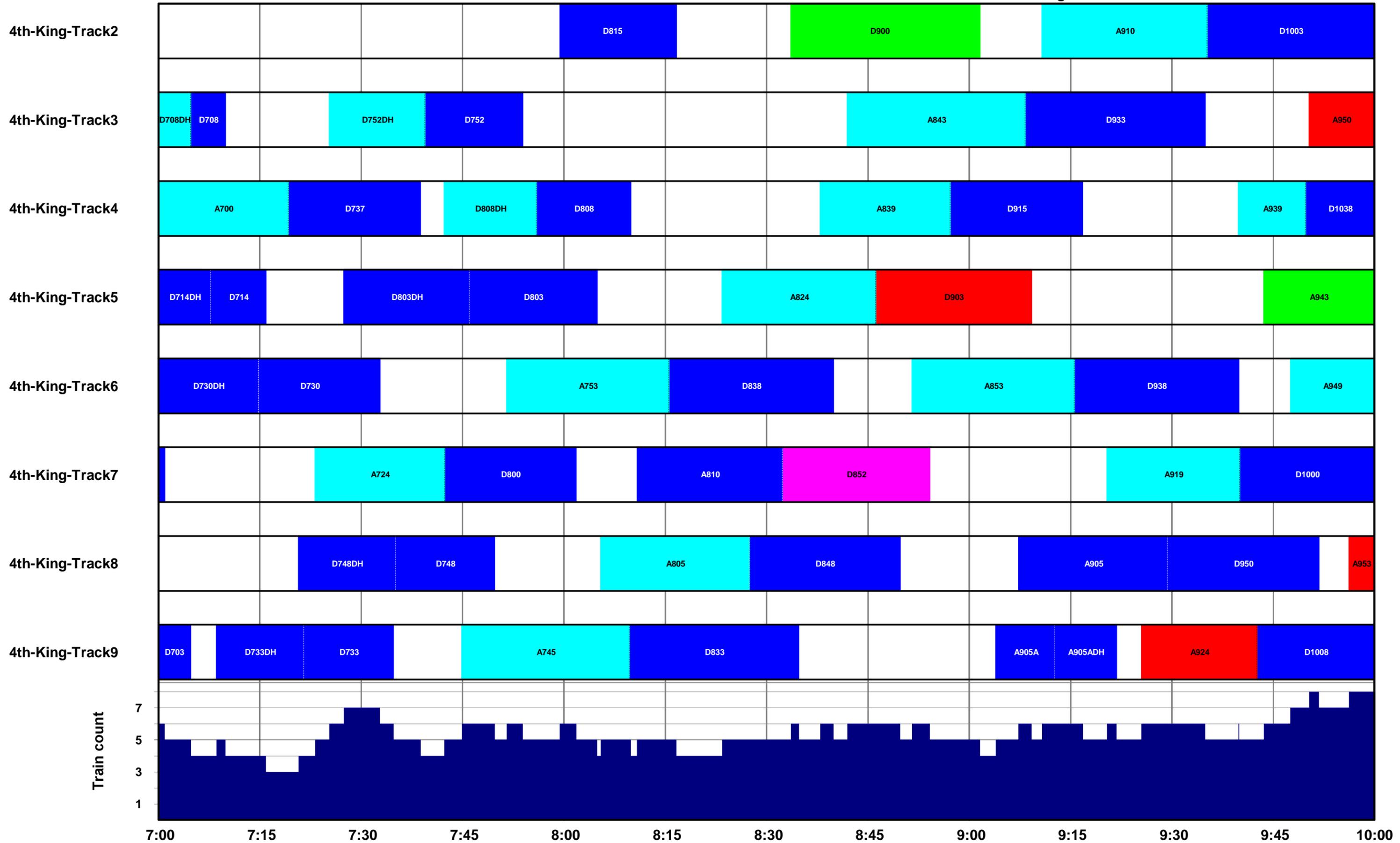
6 Track Transbay Terminal Configuration

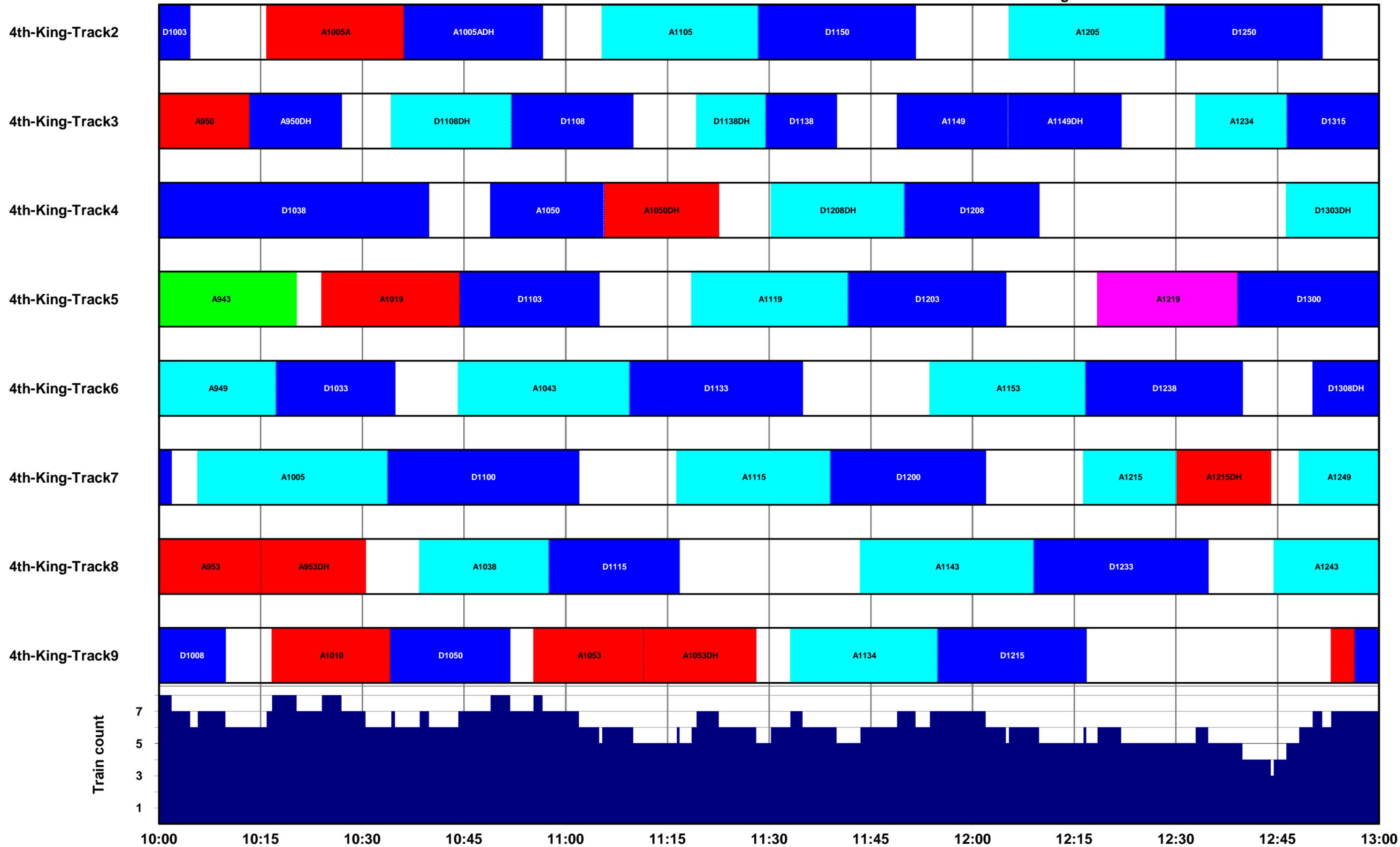


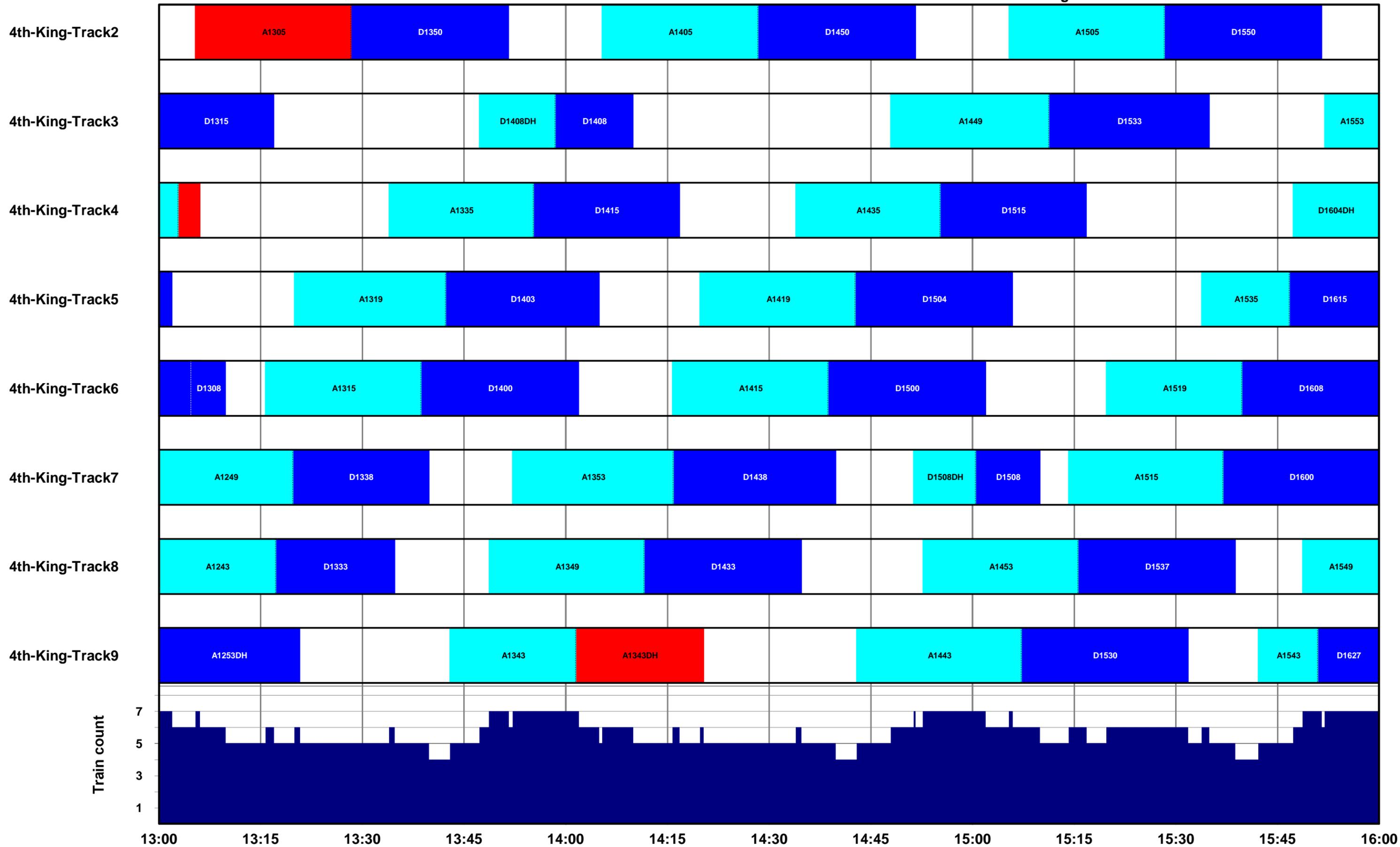
Train count



MONDAY



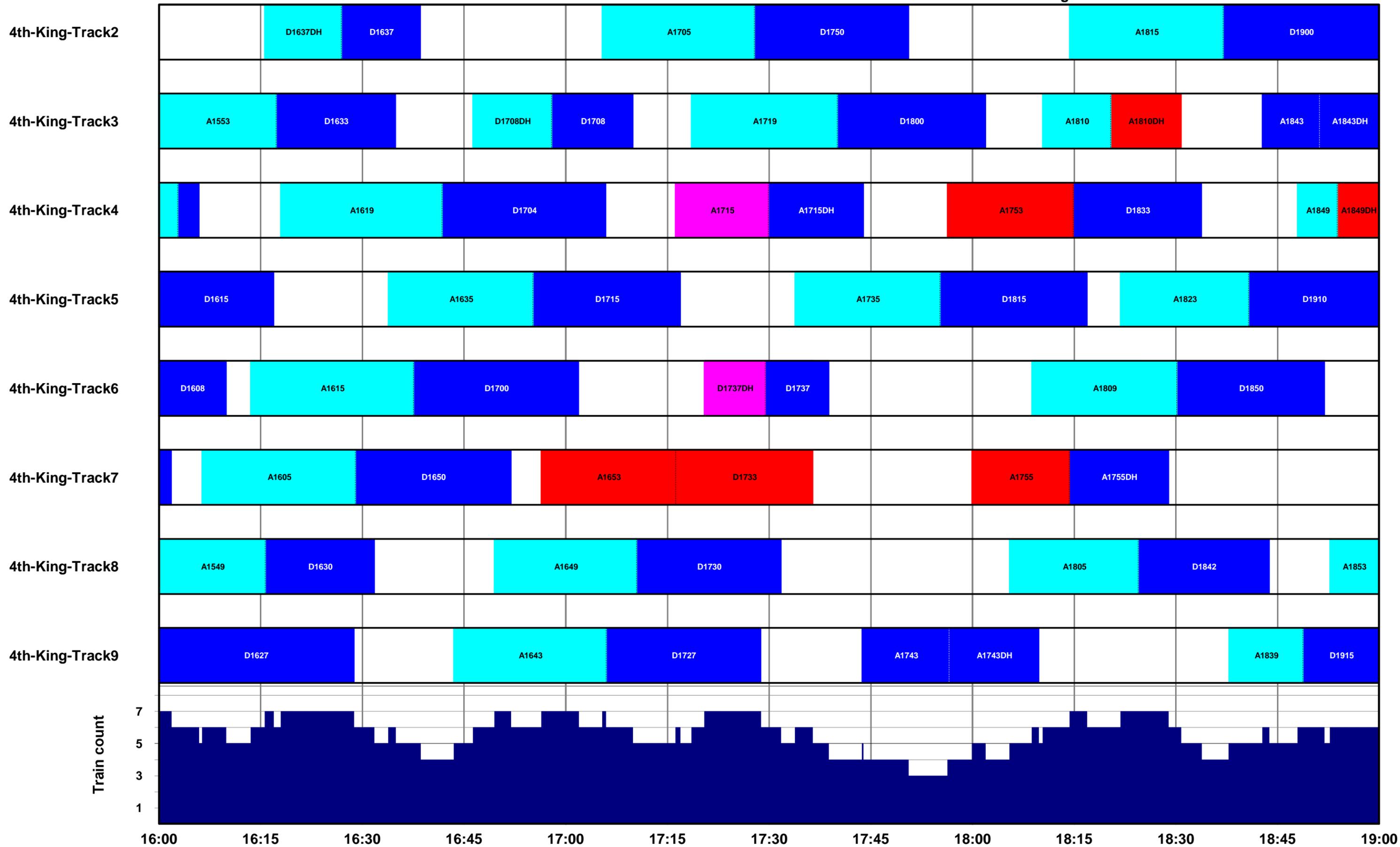


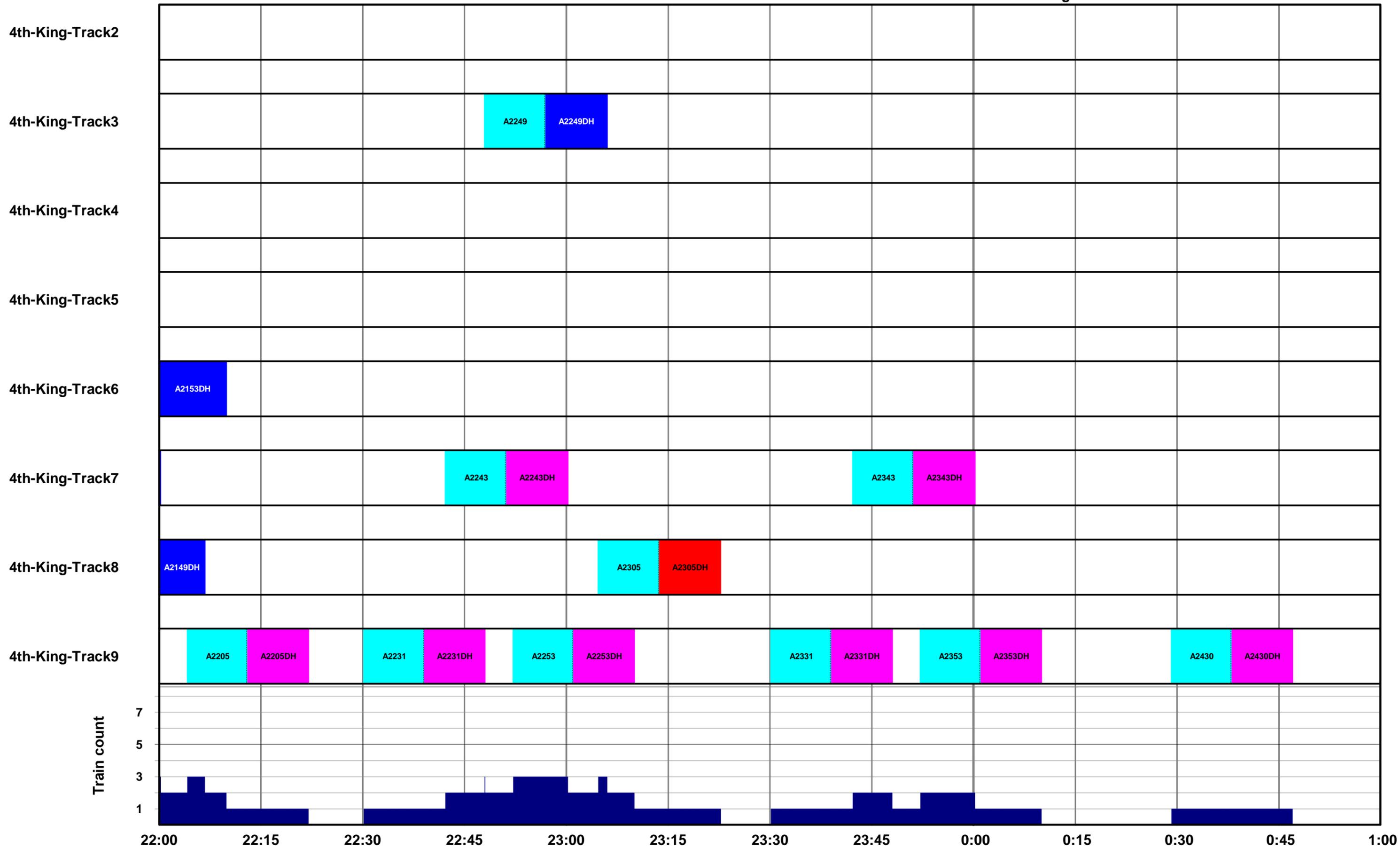


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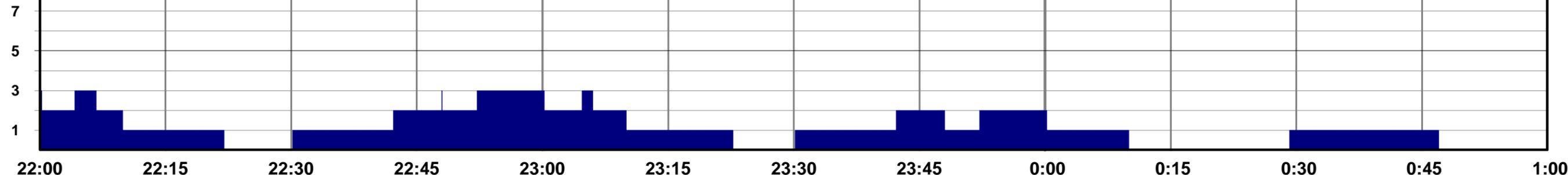
7  
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MONDAY



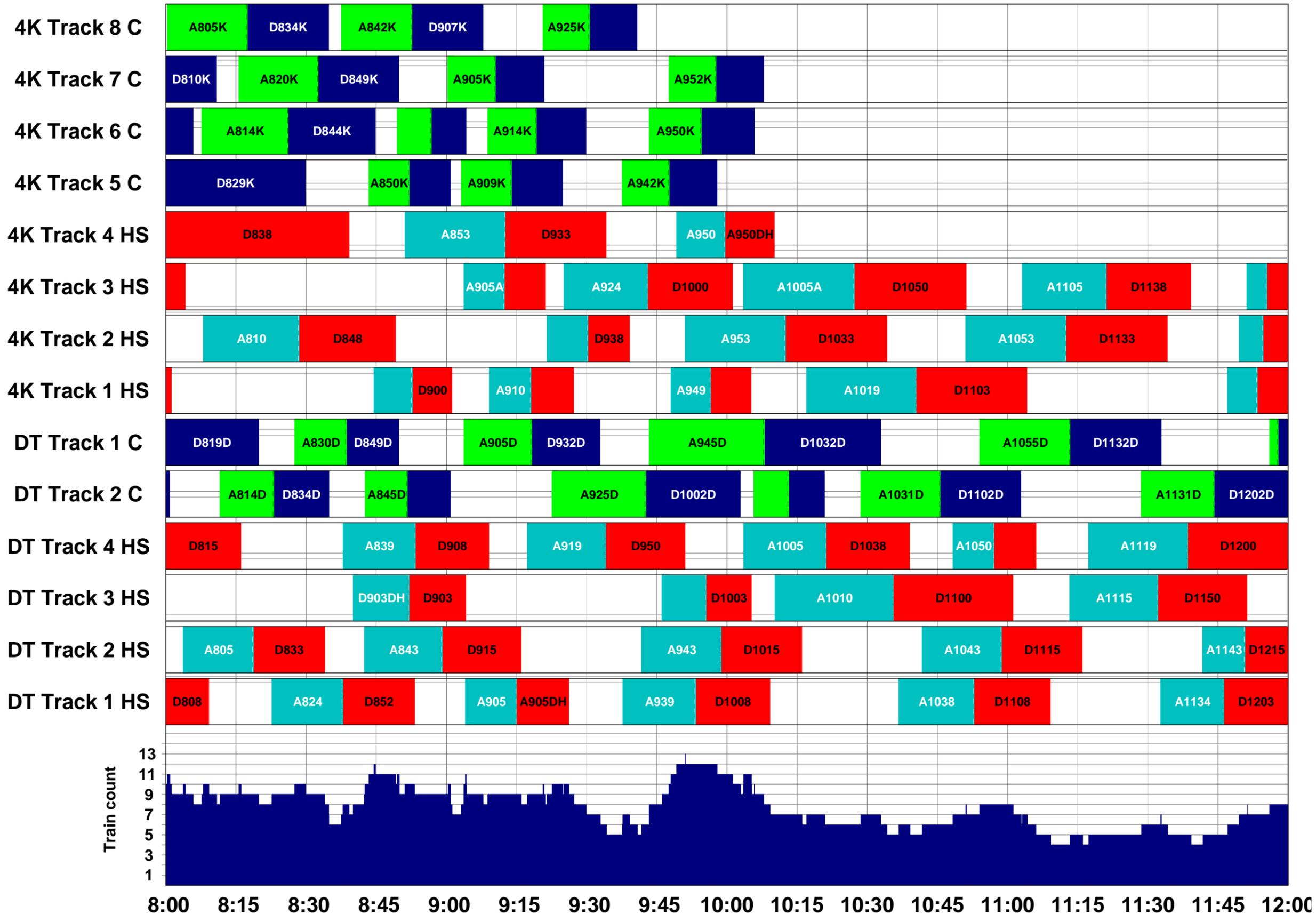


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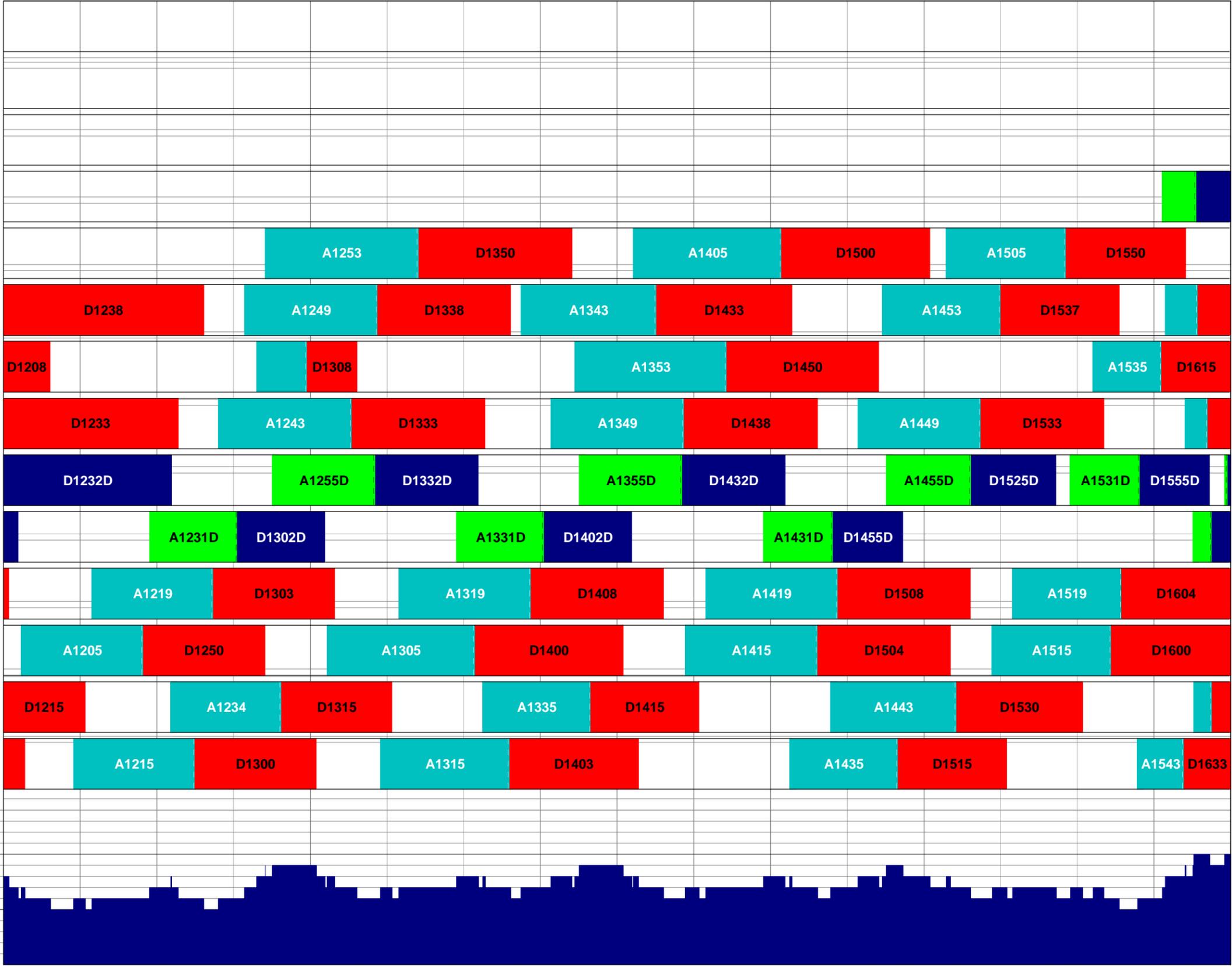
MONDAY

TUESDAY



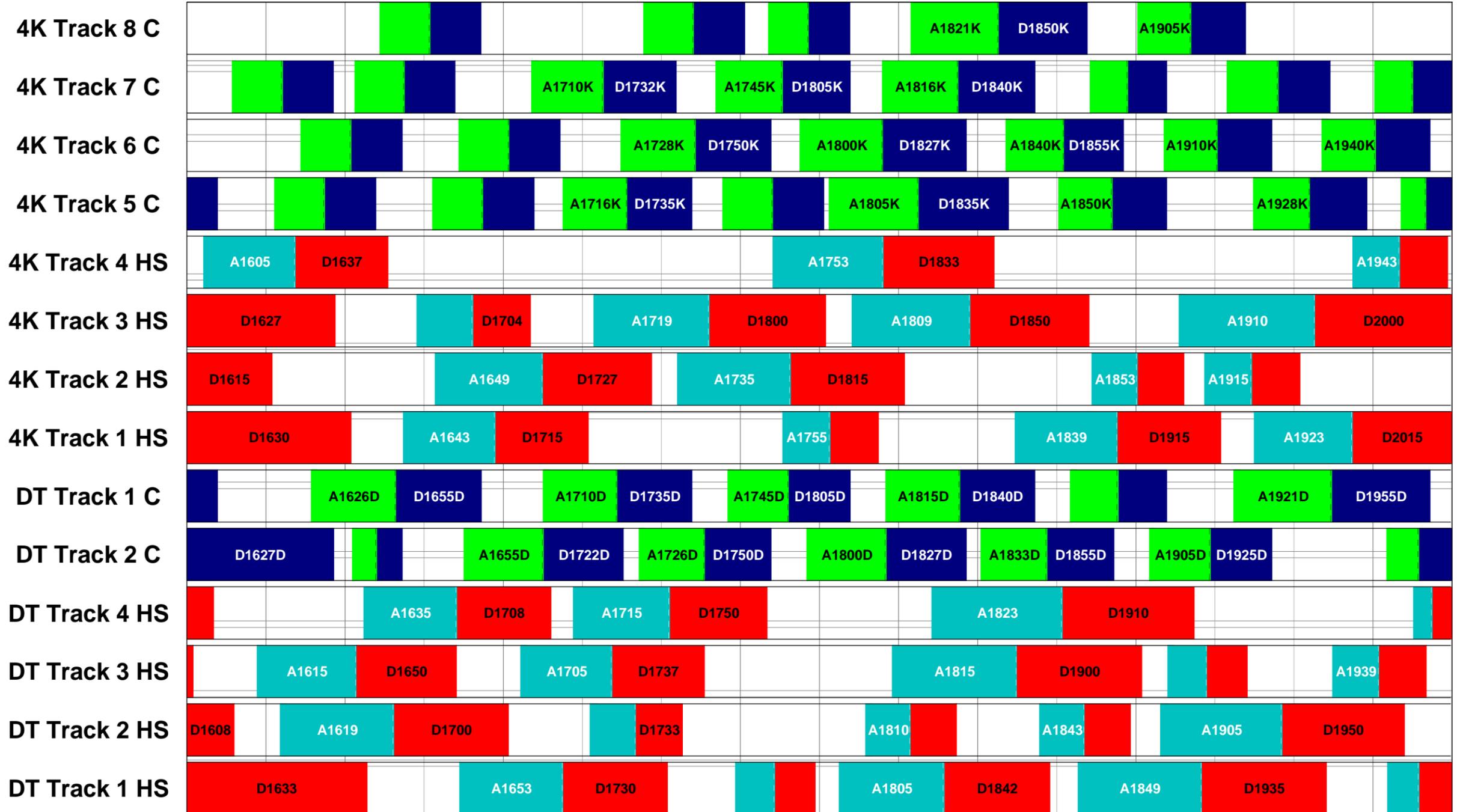
MONDAY

4K Track 8 C  
 4K Track 7 C  
 4K Track 6 C  
 4K Track 5 C  
 4K Track 4 HS  
 4K Track 3 HS  
 4K Track 2 HS  
 4K Track 1 HS  
 DT Track 1 C  
 DT Track 2 C  
 DT Track 4 HS  
 DT Track 3 HS  
 DT Track 2 HS  
 DT Track 1 HS



12:00 12:15 12:30 12:45 13:00 13:15 13:30 13:45 14:00 14:15 14:30 14:45 15:00 15:15 15:30 15:45 16:00

MONDAY



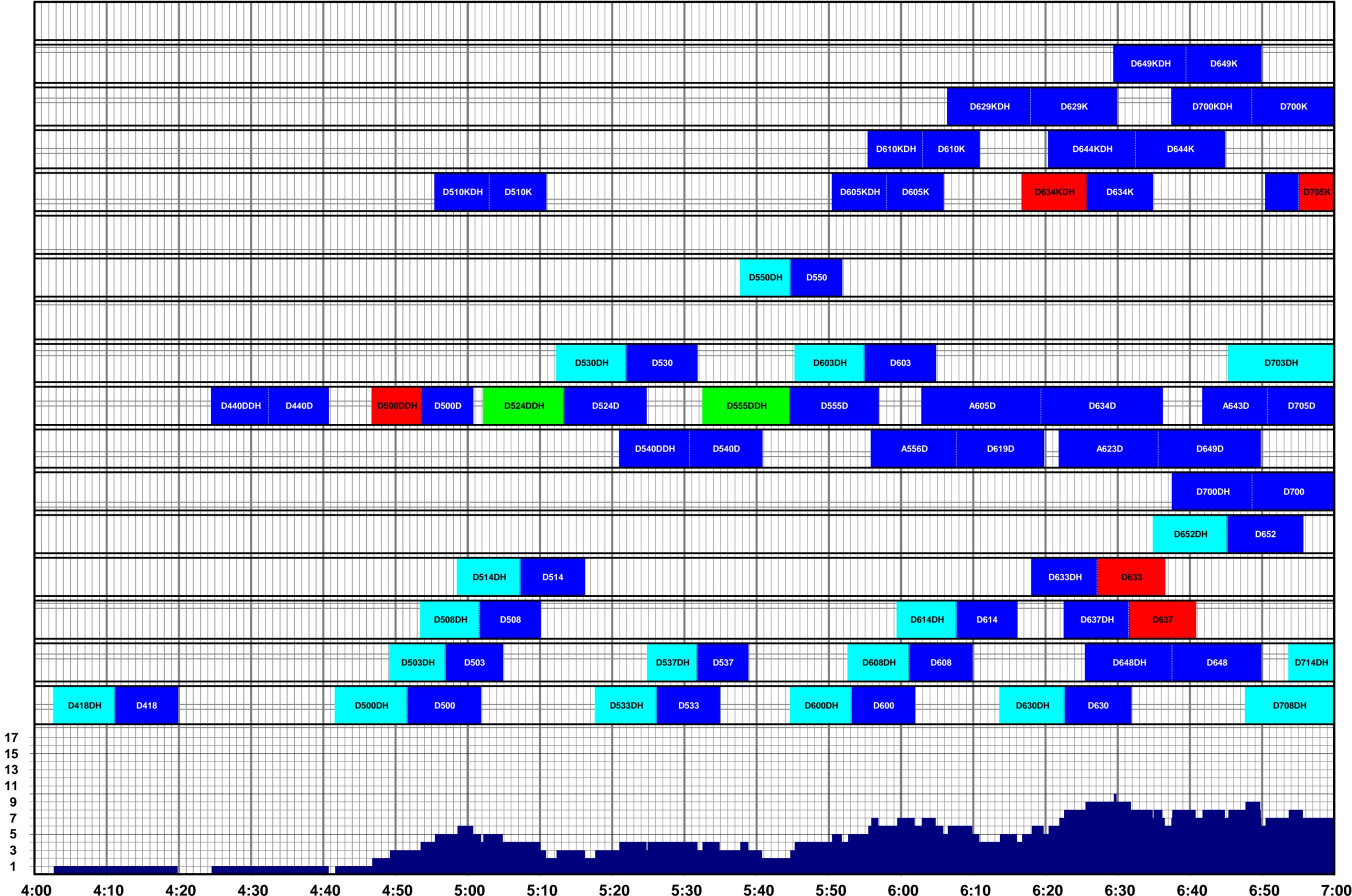
Train count



16:00 16:15 16:30 16:45 17:00 17:15 17:30 17:45 18:00 18:15 18:30 18:45 19:00 19:15 19:30 19:45 20:00

MONDAY

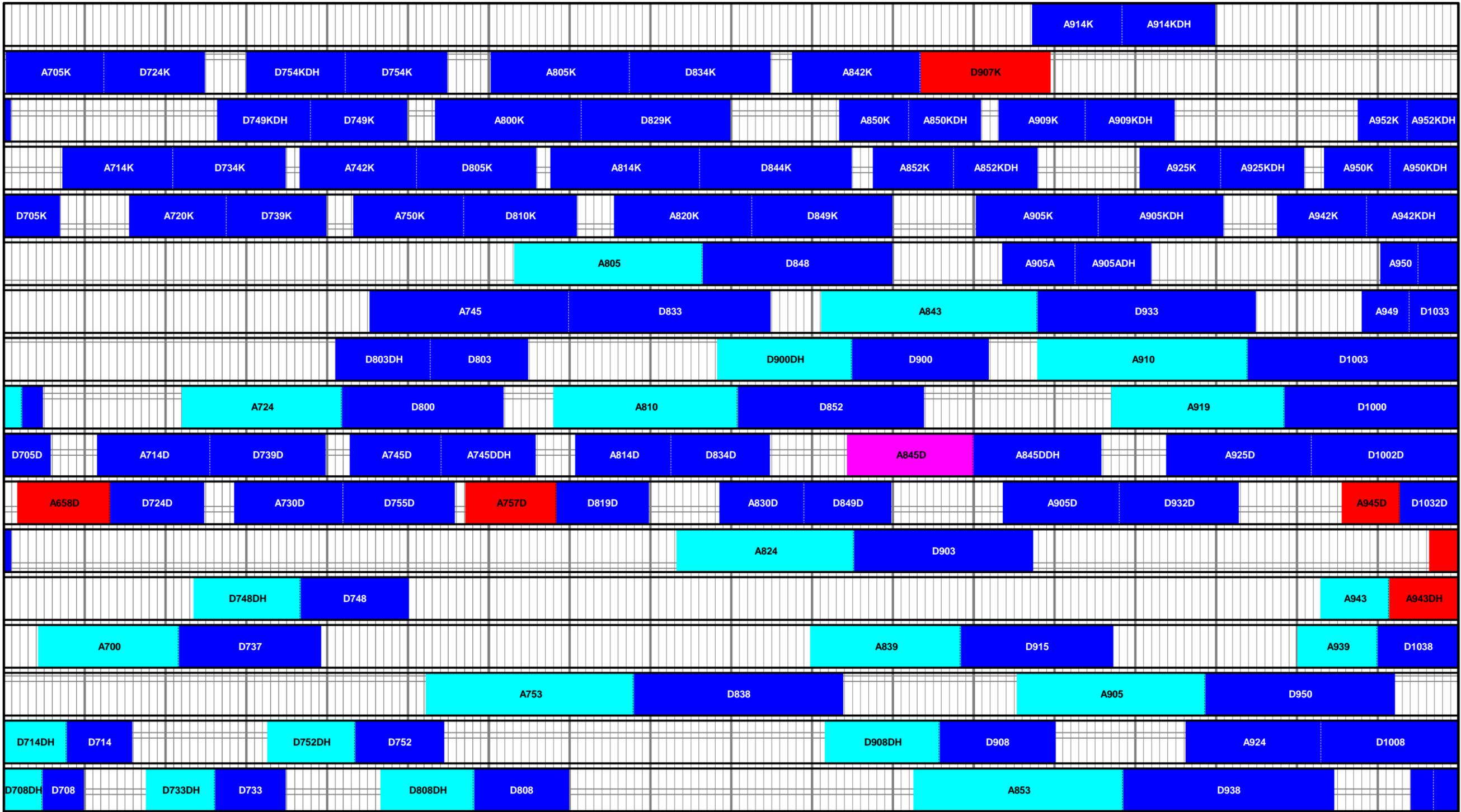
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4-King-Caltrain2  
4-King-Caltrain3  
4-King-Caltrain4  
4-King-Caltrain5  
4-King-CHST1  
4-King-CHST2  
4-King-CHST3  
4-King-CHST4  
Beale-Caltrain1  
Beale-Caltrain2  
Beale-CHST1  
Beale-CHST2  
Beale-CHST3  
Beale-CHST4  
Beale-CHST5  
Beale-CHST6



4:00 4:10 4:20 4:30 4:40 4:50 5:00 5:10 5:20 5:30 5:40 5:50 6:00 6:10 6:20 6:30 6:40 6:50 7:00

MONDAY

4-King-Caltrain1  
 4-King-Caltrain2  
 4-King-Caltrain3  
 4-King-Caltrain4  
 4-King-Caltrain5  
 4-King-CHST1  
 4-King-CHST2  
 4-King-CHST3  
 4-King-CHST4  
 Beale-Caltrain1  
 Beale-Caltrain2  
 Beale-CHST1  
 Beale-CHST2  
 Beale-CHST3  
 Beale-CHST4  
 Beale-CHST5  
 Beale-CHST6



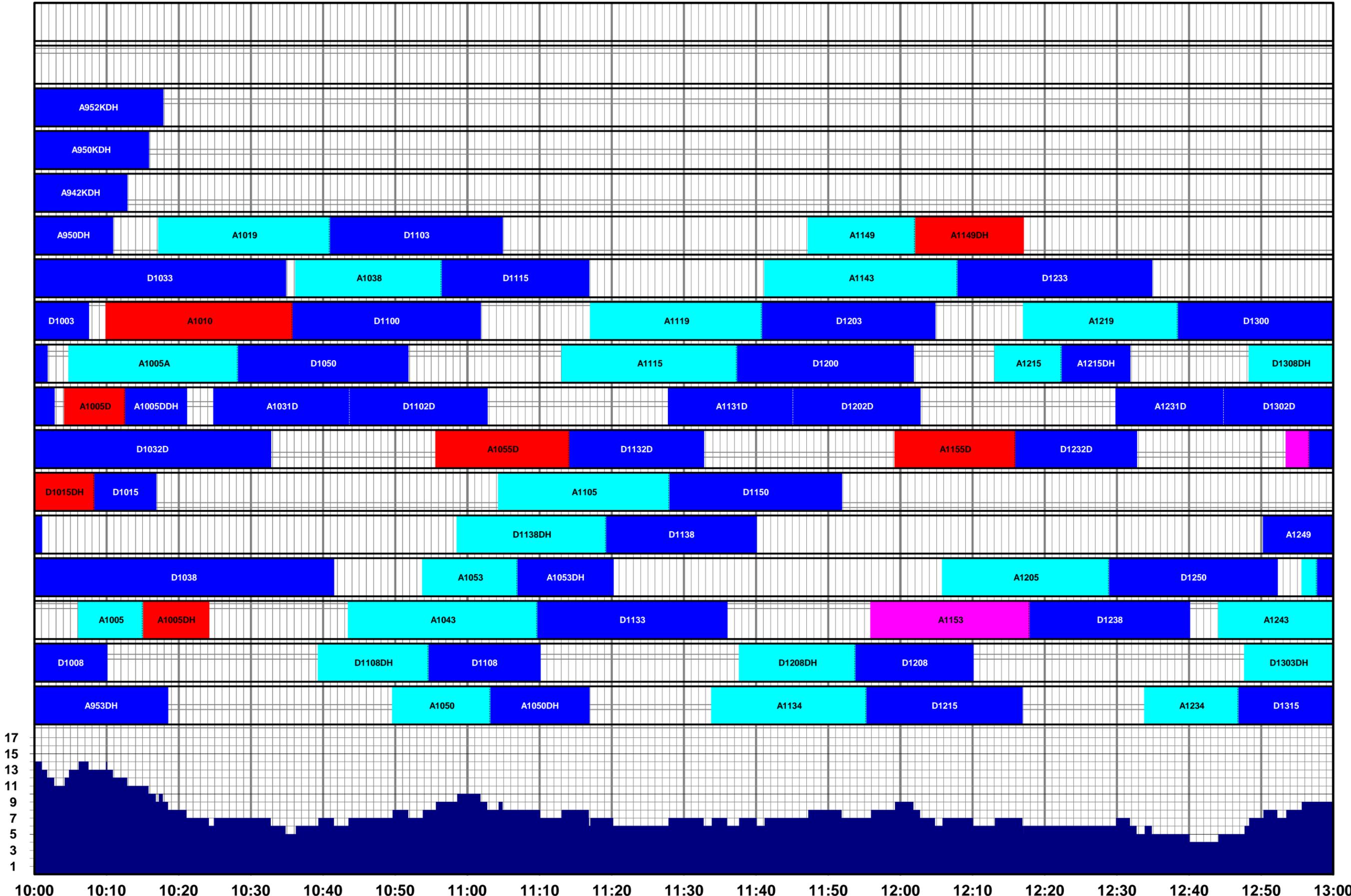
Train count

17  
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13  
11  
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1

7:00 7:10 7:20 7:30 7:40 7:50 8:00 8:10 8:20 8:30 8:40 8:50 9:00 9:10 9:20 9:30 9:40 9:50 10:00

MONDAY

4-King-Caltrain1  
 4-King-Caltrain2  
 4-King-Caltrain3  
 4-King-Caltrain4  
 4-King-Caltrain5  
 4-King-CHST1  
 4-King-CHST2  
 4-King-CHST3  
 4-King-CHST4  
 Beale-Caltrain1  
 Beale-Caltrain2  
 Beale-CHST1  
 Beale-CHST2  
 Beale-CHST3  
 Beale-CHST4  
 Beale-CHST5  
 Beale-CHST6



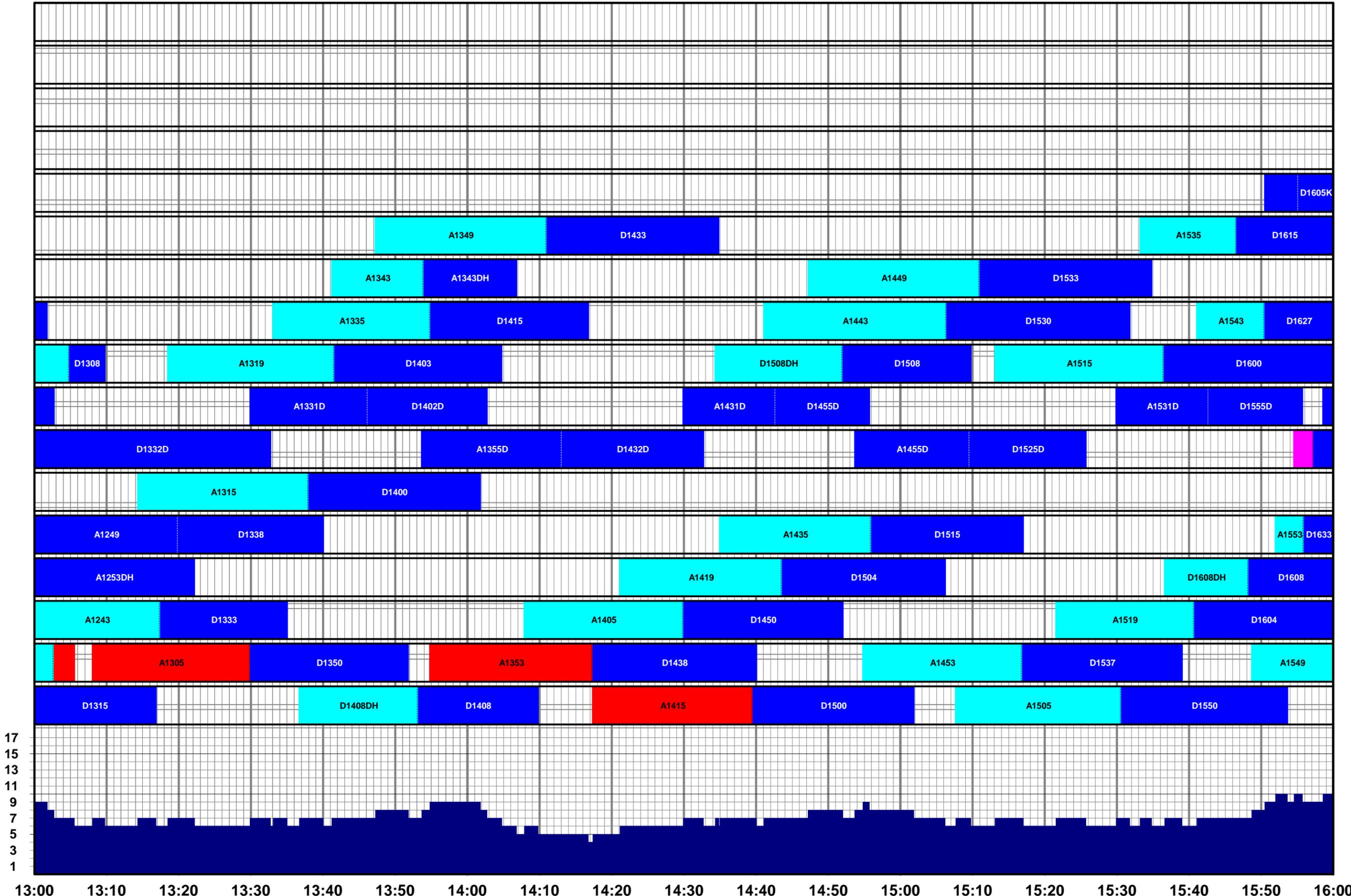
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10:00 10:10 10:20 10:30 10:40 10:50 11:00 11:10 11:20 11:30 11:40 11:50 12:00 12:10 12:20 12:30 12:40 12:50 13:00

MONDAY

4-King-Caltrain1  
4-King-Caltrain2  
4-King-Caltrain3  
4-King-Caltrain4  
4-King-Caltrain5  
4-King-CHST1  
4-King-CHST2  
4-King-CHST3  
4-King-CHST4  
Beale-Caltrain1  
Beale-Caltrain2  
Beale-CHST1  
Beale-CHST2  
Beale-CHST3  
Beale-CHST4  
Beale-CHST5  
Beale-CHST6

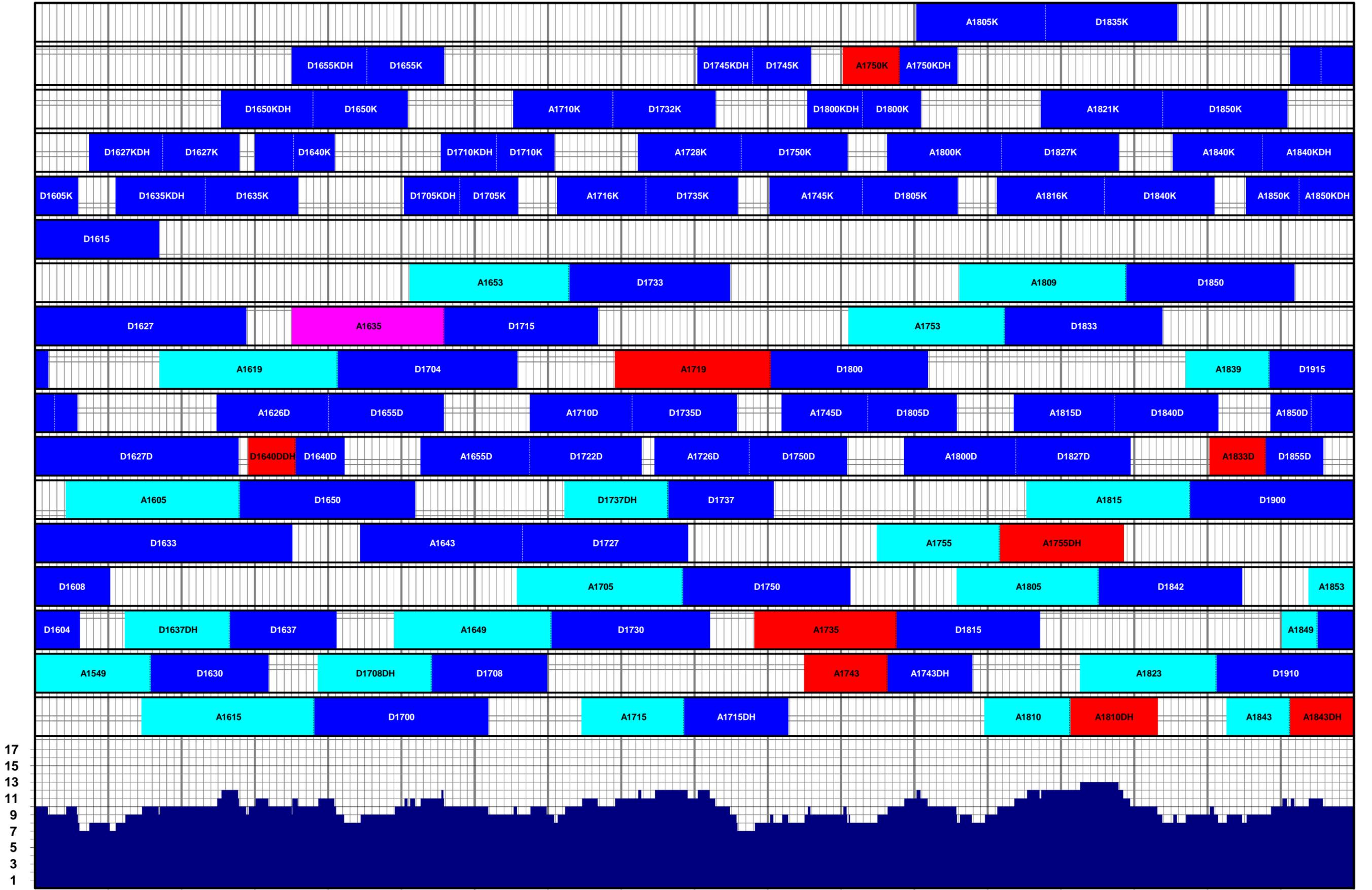


Train count

13:00 13:10 13:20 13:30 13:40 13:50 14:00 14:10 14:20 14:30 14:40 14:50 15:00 15:10 15:20 15:30 15:40 15:50 16:00

MONDAY

4-King-Caltrain1  
4-King-Caltrain2  
4-King-Caltrain3  
4-King-Caltrain4  
4-King-Caltrain5  
4-King-CHST1  
4-King-CHST2  
4-King-CHST3  
4-King-CHST4  
Beale-Caltrain1  
Beale-Caltrain2  
Beale-CHST1  
Beale-CHST2  
Beale-CHST3  
Beale-CHST4  
Beale-CHST5  
Beale-CHST6



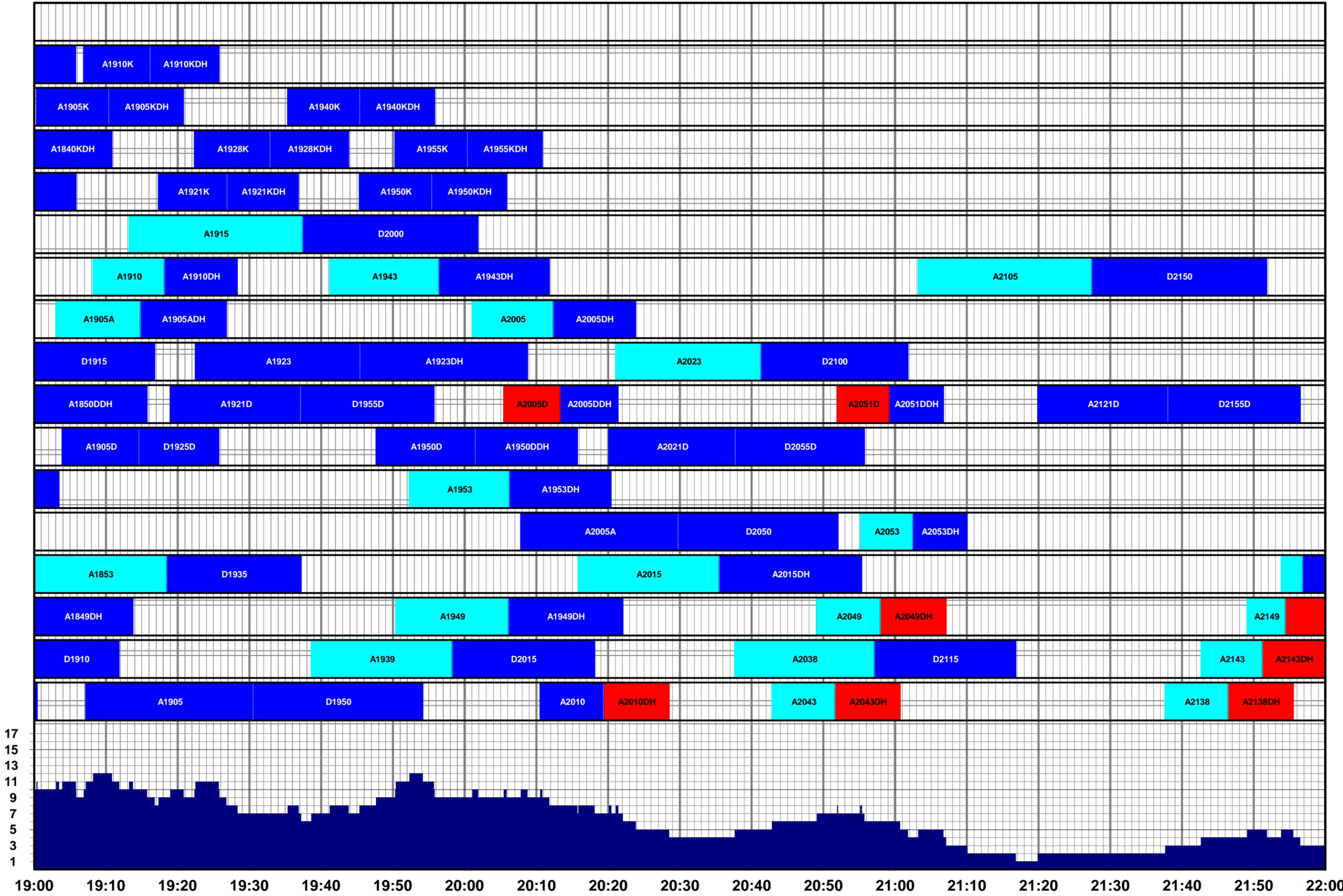
Train count

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16:00 16:10 16:20 16:30 16:40 16:50 17:00 17:10 17:20 17:30 17:40 17:50 18:00 18:10 18:20 18:30 18:40 18:50 19:00

MONDAY

4-King-Caltrain1  
4-King-Caltrain2  
4-King-Caltrain3  
4-King-Caltrain4  
4-King-Caltrain5  
4-King-CHST1  
4-King-CHST2  
4-King-CHST3  
4-King-CHST4  
Beale-Caltrain1  
Beale-Caltrain2  
Beale-CHST1  
Beale-CHST2  
Beale-CHST3  
Beale-CHST4  
Beale-CHST5  
Beale-CHST6



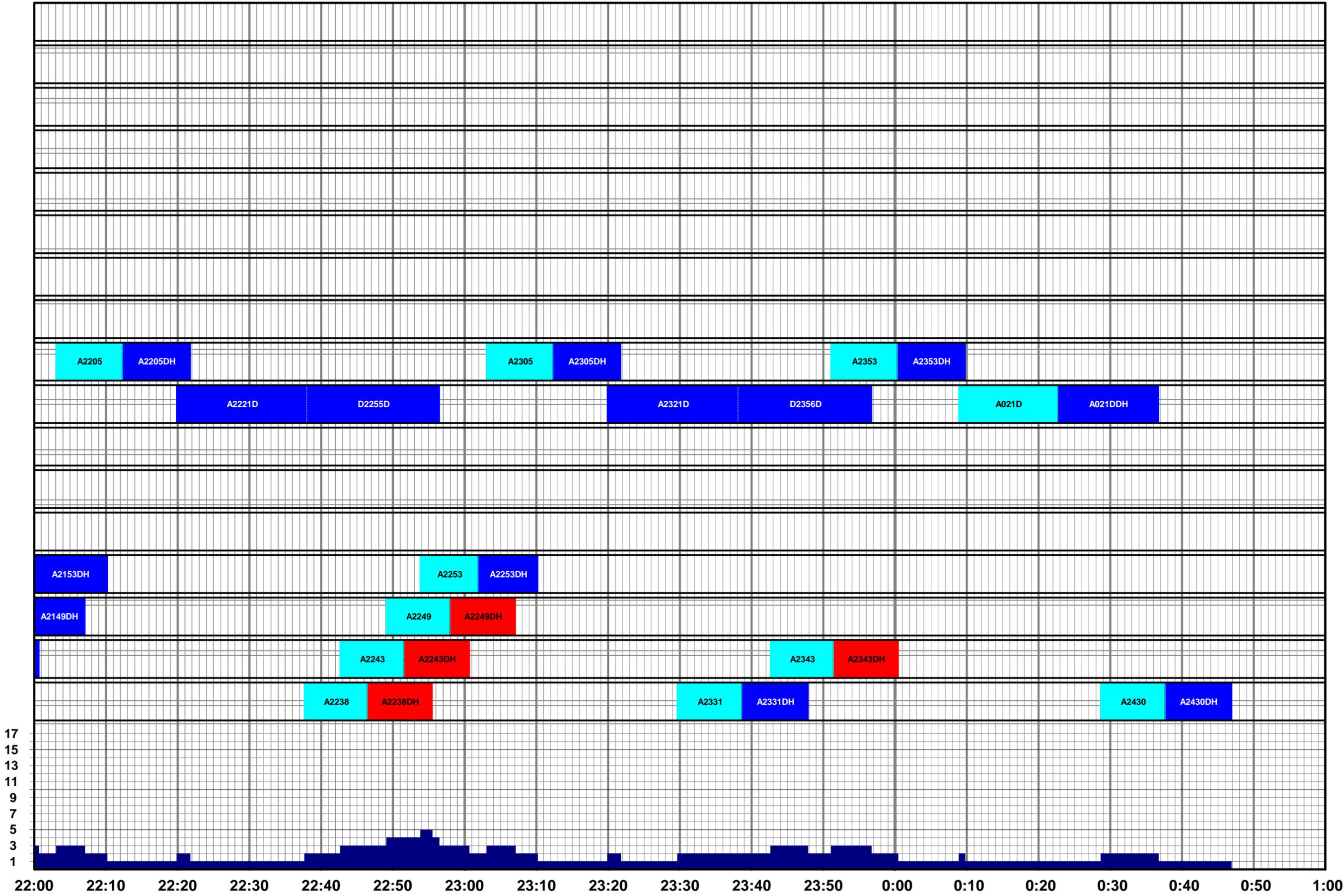
Train count

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13  
11  
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3  
1

19:00 19:10 19:20 19:30 19:40 19:50 20:00 20:10 20:20 20:30 20:40 20:50 21:00 21:10 21:20 21:30 21:40 21:50 22:00

MONDAY

4-King-Caltrain1  
4-King-Caltrain2  
4-King-Caltrain3  
4-King-Caltrain4  
4-King-Caltrain5  
4-King-CHST1  
4-King-CHST2  
4-King-CHST3  
4-King-CHST4  
Beale-Caltrain1  
Beale-Caltrain2  
Beale-CHST1  
Beale-CHST2  
Beale-CHST3  
Beale-CHST4  
Beale-CHST5  
Beale-CHST6



Train count  
17  
15  
13  
11  
9  
7  
5  
3  
1

22:00 22:10 22:20 22:30 22:40 22:50 23:00 23:10 23:20 23:30 23:40 23:50 0:00 0:10 0:20 0:30 0:40 0:50 1:00

MONDAY

TUESDAY