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METRO GREEN LINE

OPERATIONS & MAINTENANCE PLAN

FOR MANUAL TRAIN OPERATIONS

JUNE 1993

Prepared for

THE METROPOLITAN TRANSPORTATION AUTHORITY

by

PB/DMJM - EMC TEAM

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1. INTRODUCTION

The purpose of this Operations and Maintenance (O&M) Plan is to provide the basic requirements for the initial manual operation and the maintenance of the Metro Green Line for the entire Norwalk to Marine service route.

The Metro Green Line will be a fully grade separated, double track rail transit line utilizing manual train operations (full automation may be implemented later). Traction power distribution will be by overhead contact wire. Passenger vehicles will be articulated and will be similar to the LB-LA Blue Line light rail vehicle. The clearance envelope and other basic dimensions will be the same for both Green Line and Blue Line vehicles. The Green Line is approximately 19.6 route miles in length with 14 stations.

Approximately 16.3 miles of the route is located in the median of the I-105 Freeway. All of the stations will have park-and-ride lots. The Wilmington/Willowbrook Avenue Station will be a transfer point between the Green Line and the Blue Line. A nonrevenue track will connect the Green and Blue lines via special trackwork east of the Wilmington/Willowbrook Avenue Station. The Central Control Facility (CCF) for both rail lines will be located in a two-story structure adjacent to the Wilmington/Willowbrook Avenue Station.

The Hawthorne Yard and Shop will be located near the southern end of the El Segundo Segment near 146th Street and Compton Boulevard.

All 14 stations on the Green Line segment will have high-level platforms. All of the initials stations will have center platforms. Passenger waiting facilities will not be fully enclosed or temperature controlled. A canopy will be provided over a portion of the platform.

Revenue service under manual operation is scheduled to begin on the Metro Green Line in December, 1994.

2. OPERATIONS

The operations plan for the initial service (December 1994) is presented in this section.

2.1 General Operations

The operations plan is based upon the following estimates and assumptions:

Service Frequency: 16 hours per day (4:30am - 8:30pm) in order to accomodate system testing.

7 days per week

Maximum Speed: 55 mph (automated operations will operate at 65 mph)

Average Station Dwell Time: 20 seconds

Peak Period Headway: 6 minutes initially

The Mainline Route Schematic for the Metro Green Line is shown in Figure 2-1.

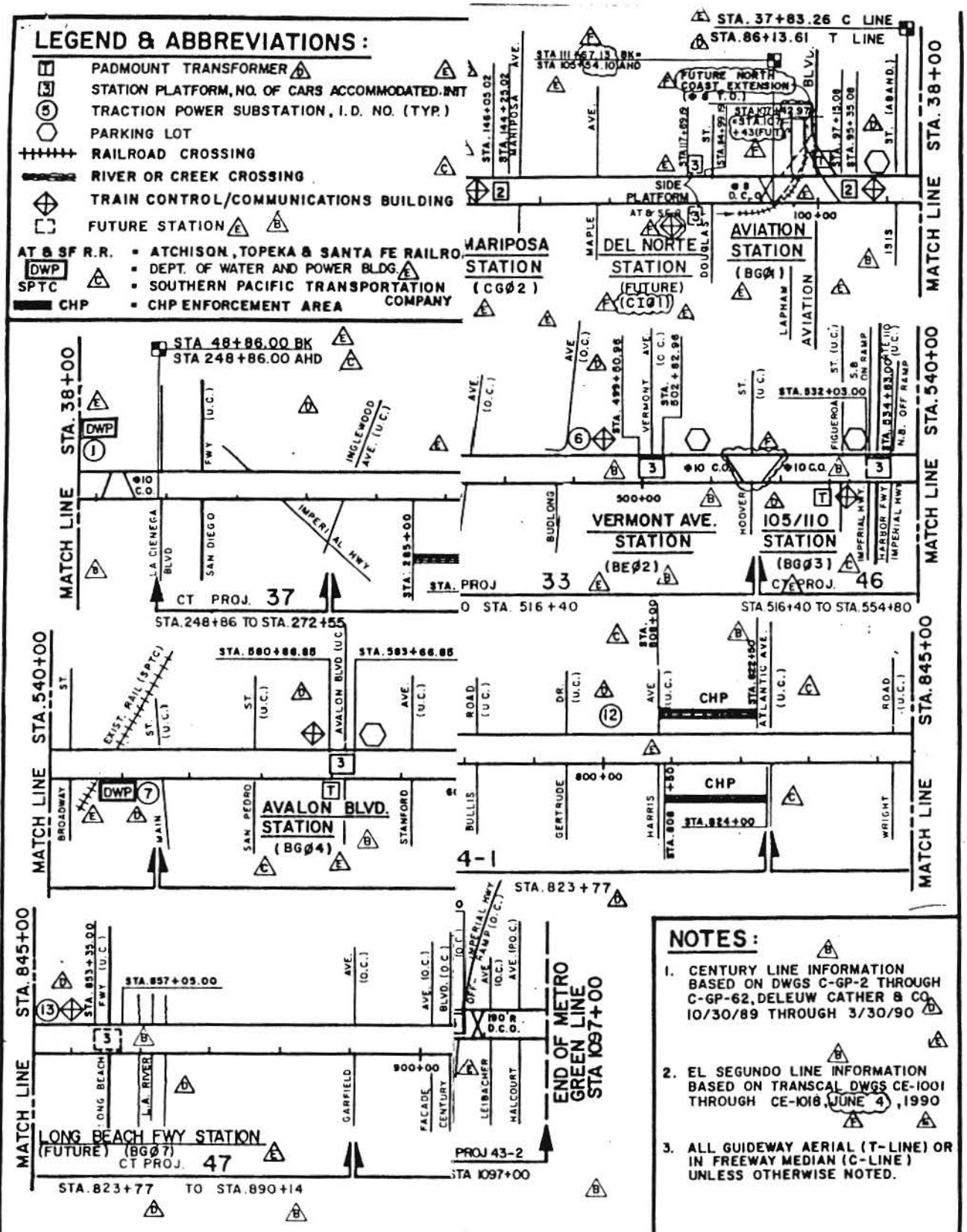
2.2 MAINLINE OPERATIONS

2.2.1 Preliminary Operating Schedules

The Green Line preliminary operating schedule for the initial service in December, 1994 is shown in Table 2-1.

The initial year operating schedule consists of 5 service periods on weekdays (early, AM peak, off-peak, PM peak, and evening) and 3 service periods on weekends and holidays (morning, mid-day, and evening). On weekdays, 6-minute headways are operated during peak periods and 9-minute headways are operated during all other service periods. On weekends and holidays, 9 and 15-minute headways are operated.

Future growth can be accommodated with the automatic operation of 2-car trains and/or operating on 4-minute headways.



NOTES:

1. CENTURY LINE INFORMATION BASED ON DWGS C-GP-2 THROUGH C-GP-62, DELEUW CATHER & CO. 10/30/89 THROUGH 3/30/90
2. EL SEGUNDO LINE INFORMATION BASED ON TRANSCAL DWGS CE-1001 THROUGH CE-1018, JUNE 4, 1990
3. ALL GUIDEWAY AERIAL (T-LINE) OR IN FREEWAY MEDIAN (C-LINE) UNLESS OTHERWISE NOTED.

FIGURE 2-1

REV.	DATE	DESCRIPTION
F	7/6/90	INCORP. COIOI FINAL, CENTURY TRACKWORK AT NRC, MIS
E	5/4/90	INCORPORATE COIOO PRE-FINAL, CENTURY REALIGN, MISC
D	4/19/89	INCORPORATE EL SEGUNDO FINAL ALIGN, CENTURY REALIGN, MI
C	10/7/88	INCORPORATE EL SEGUNDO FINAL P.E., CHP, TCC BLDGS.
B	5/9/88	REVISE CT LIMITS, 3 CAR PLATF., DELETE AVIATION DCO, OTHE MISC.
A	4/01/88	INITIAL ISSUE

Work Element | Physical Entity | Contract Number | Cost Element | Project Number

ROUTE SCHEMATIC

RO GREEN LINE

CONTRACT NO.

DRAWING NO. SY-H-002

REV. F | SHEET NO. 1 OF 1

SCALE 1" = 1000'

TABLE 2-1

GREEN LINE OPERATING SCHEDULE - INITIAL YEAR

		MON	TUE	WED	THUR	FRI	SAT	SUN
AM	4:00							
	5:00		1-CAR TRAINS AT 9-MINUTE HEADWAY					
	6:00						1-CAR TRAINS AT 9-MINUTE HEADWAY	
	7:00		1-CAR TRAINS AT 6-MINUTE HEADWAY					
	8:00							
	9:00							
	10:00							
	11:00							
PM	12:00		1-CAR TRAINS AT 9-MINUTE HEADWAY					
	1:00						1-CAR TRAINS AT 9-MINUTE HEADWAY	
	2:00							
	3:00							
	4:00		1-CAR TRAINS AT 6-MINUTE HEADWAY					
	5:00							
	6:00							
	7:00		1-CAR TRAINS AT 9-MINUTE HEADWAY				1-CAR TRAINS AT 9-MINUTE HEADWAY	
	8:00							
	9:00							
	10:00							
	11:00							
AM	12:00							
	1:00							

SCHDIY

The operating schedule represents 1.724 million annual revenue car miles for the initial year. The operating statistics are shown in Table 2-2 for the initial year.

2.2.2 Station to Station Triptime

The estimated one-way triptime for the initial Green Line is estimated to be 34 minutes. Allowing for a total time of 6 minutes for turnback/terminal station time, the roundtrip time for the line is estimated to be 77 minutes initially. The station to station triptime is shown in Table 2-3 for manual operations with a maximum speed of 55 mph.

2.2.3 Fleet Size

Fleet size is based upon the round trip time, peak-hour headway, 1 car per train, and operational and maintenance spares. A fleet 18 cars is required initially. The fleet sizing calculation is shown in Table 2-4.

TABLE 2-2

GREEN LINE ANNUAL REVENUE VEHICLE HOURS/MILES - INITIAL YEAR

SERVICE PERIOD	SERVICE HOURS	HEADWAY (minutes)	TRAINS ON LINE	CARS PER TRAIN	DAILY CAR MILES	DAILY CAR HOURS	ANNUAL CAR MILES	ANNUAL CAR HOURS
WEEKDAYS:								
AM Peak	3.0	6	13	1	1175	36	305500	9232
Off-Peak	6.0	9	9	1	1566	47	407160	12304
PM Peak	3.0	6	13	1	1175	36	305500	9232
Early/Evening	4.0	9	9	1	1044	32	271440	8202
Late	0.0	0	0	0	0	0	0	0
Weekday Subtotal	16.0				4960	150	1289600	38969
WEEKENDS:								
Morining	4.5	9	9	1	1175	36	122200	3693
Base	9.0	9	9	1	2350	71	244400	7385
Evening	2.5	9	9	1	653	20	67912	2052
Late	0.0	0	0	0	0	0	0	0
Weekend Subtotal	16.0				4178	126	434512	13130
TOTAL							1,724,112	52,099

Route Distance	=	19.58	Miles (NORWALK TO MARINE)
One-Way Run Time	=	0.59	Hours (35.5 Minutes)
Round Trip Time	=	77	Minutes
Average System Speed	=	33.1	Mph
Total Fleet Size	=	18	Cars
Annual Miles per Car	=	95,784	Average

TABLE 2-3

GREEN LINE STATION TO STATION TRIPTIME

STATIONS	DISTANCE (MILES)	CUM DIST (MILES)	TRIP (MIN)	DWELL (MIN)	TOTAL (MIN)	CUM TOT (MIN)
MARINE	0.00	0.00	0.00	0.00	0.00	0.00
Double cross-over	0.11		0.00	0.00	0.00	
Hawthorne Yard	0.26		0.00	0.00	0.00	
DOUGLAS	0.72	1.09	2.62	0.33	2.95	2.95
EL SEGUNDO	0.81	1.90	2.43	0.33	2.76	5.71
MARIPOSA	0.50	2.40	1.50	0.33	1.83	7.54
Double cross-over	0.71		0.00	0.00	0.00	
Marina Jct.	0.00		0.00	0.00	0.00	
AVIATION	0.22	3.33	2.23	0.33	2.56	10.10
Single cross-overs	0.31		0.00	0.00	0.00	
HAWTHORNE	1.23	4.87	2.31	0.33	2.64	12.74
Single cross-overs	1.36		0.00	0.00	0.00	
CRENSHAW	0.26	6.50	2.17	0.33	2.50	15.24
VERMONT	2.03	8.53	2.71	0.33	3.04	18.27
Single cross-overs	0.15		0.00	0.00	0.00	
105/110	0.46	9.14	1.46	0.33	1.79	20.07
AVALON	0.90	10.03	1.79	0.33	2.12	22.19
Pocket track	1.30		0.00	0.00	0.00	
WILMINGTON/WILLOWBRK	0.27	11.60	2.09	0.33	2.42	24.61
Pocket/Non-Rev	0.25		0.00	0.00	0.00	
LONG BEACH	1.47	13.32	2.29	0.33	2.62	27.24
Single cross-overs	0.23		0.00	0.00	0.00	
Future	1.67		0.00	0.00	0.00	
Single cross-overs	1.33		0.00	0.00	0.00	
LAKEWOOD	0.97	17.52	5.04	0.33	5.37	32.61
Single cross-overs	1.80		0.00	0.00	0.00	
NORWALK	0.26	19.58	2.75	0.00	2.75	35.35
Double cross-over	0.00		0.00	0.00	0.00	
TOTALS	19.58		31.39	3.96	35.35	
AVERAGE SPEED	30.55	(Based upon round trip including terminal station turnback time).				

NOTE: TRIPTIME BASED UPON MANUAL OPERATION WITH 55 MPH MAXIMUM SPEED.

TABLE 2-4

GREEN LINE FLEET SIZE - NORWALK TO MARINE
(DECEMBER, 1994)

35.5	MINUTE ONE-WAY TRIP TIME
71	MINUTE ROUND TRIP TIME
6	MINUTE TOTAL TURNBACK TIME
77	MINUTE TOTAL ROUND TRIP TIME
6.0	MINUTE PEAK-HOUR HEADWAY
1	CARS PER TRAIN (Peak-hour)
20%	MAINTENANCE SPARE RATIO

FLEET SIZE:

13	TRAINS PER HOUR
13	CARS ON LINE (Peak-hour)
2	OPERATIONAL SPARE CARS
15	REVENUE CARS (Peak-hour)
3	MAINTENANCE SPARE CARS
18	FLEET SIZE

2.2.4 Central Control

The central control function for the Green Line will be located in conjunction with the Blue Line in the Central Control Facility adjacent to the Wilmington/Willowbrook Station. Central Control personnel will be responsible for the supervision and coordination of the following main line and yard interface operations, maintenance, and security functions:

1. Train operations (main line)
2. Yard operations coordination (movements to/from main line)
3. Station operations
4. Security response and coordination
5. Emergency response and coordination
6. Maintenance activities (main line)

Central Control personnel will utilize various communications, controls, indications, alarms, displays, and rules and procedures (similar to those for the Blue Line) in the performance of their duties.

Communications capability provided at Central Control will include the following:

1. Radio communications will be required between:
   a. Central Control and authorized employees on-board trains and at stations.
   b. Central Control and maintenance vehicles and maintenance personnel along the right-of-way.
   c. Central Control and emergency response agencies (utilizing portable radios).
   d. Passengers on-board a specific car in a train and Central Control.
   e. Central Control and the yard.
2. Telephone communications will be required between:
   a. Central Control and the yard.

b. Central Control and emergency response agencies.

c. Passengers at a station and Central Control.

d. Central Control and personnel at blue light stations, ancillary rooms, and emergency management panels along the right-of-way.

3. Public address communications will be required between:

a. Central Control and passengers at a specific station or all stations.

b. Central Control and passengers on a specific train or all trains.

Central Control personnel will monitor and coordinate the status and operation of systems equipment and facilities including:

1. Traction and auxiliary power

2. Train control

3. Communications

4. Rail vehicles

5. Fare collection

6. Security and intrusion equipment

7. Elevators and escalators

8. Automatic fire detection and suppression equipment

9. Special trackwork

2.2.5 Normal Operations

A. General

During normal operations, trains will run with on-board train operators in accordance with predetermined schedules. All trains in revenue service will normally stop at all stations. Normally, all revenue trains will operate over the entire route between the Marine and Norwalk terminal stations.

For the initial service, train operations between Norwalk and Aviation will be governed by automatic train protection (ATP) with speed commands (similar to current operations in the mid-corridor of the Blue Line). Trains will be operated in the manual with cab signal mode with the operator observing cab signals and wayside signals. Train operations for the initial Aviation to Marine service will be governed by station to station manual control procedures (a train will not be allowed to depart a station until the preceeding train has departed the next station) with speed controlled manually by the train operator in accordance with wayside interlocking signals and posted speed limits. Trains will be operated at a maximum speed of 45 mph in the bypass mode. Routing at interlockings will be manual from central control, local control panel, or by automatic turnback at the Norwalk (and eventually Marine) station. Headway will be governed by the number of cars available (minimum headway is 2-1/2 minutes). Reverse running will be permitted. Three temporary signal aspects will be used to indicate 1) straight route aligned and locked (green), 2) diverging route aligned and locked (yellow), and 3) stop (red). The respective flashing aspects will be used for reverse running operations. During the initial service, train operations will not be restricted by Platform Intrusion Detection (PIDS), Wayside Intrusion Detection (WIDS), or other such interface subsystems.

Each day, the first train dispatched (from each end of the line, if appropriate) will be a "sweeper" train. The operator and/or other authorized personnel will perform a visual inspection of the line to ensure that the system is safe for revenue operations. A "sweeper" train will operate at a maximum speed of 45 mph until the line has been inspected.

For a typical weekday, trains will be dispatched from the Hawthorne Yard (and the Norwalk tail tracks, if appropriate) in accordance with the predetermined schedule for the early and the AM peak service periods. The transition from AM peak-period service to the off-peak service period is accomplished by removing trains from service and adjusting the operating headway as required by the schedule. Cars or trains removed from service will be stored at the yard or the Norwalk tail tracks. For the PM peak-period service, additional trains will be dispatched from the yard or tail tracks to adjust the headway to meet the schedule. The transition to the evening service period is performed in a manner similar to the AM peak- period to the off-peak period schedule change. At the end of the day, trains are removed from service after the last scheduled trip is completed.

B. Terminal Stations

The normal method of turnback at terminal stations will be as follows:

1. Trains crossover in front of the station to the outbound platform. After unloading/loading, trains depart via the outbound track.

2. Trains use alternate station platforms when close headways result in two trains being at a terminal station at (or near) the same time. This results in one train crossing over before the station to the outbound platform prior to unloading/loading and the following train arriving at the inbound platform and crossing over to the outbound track after unloading/loading.

The Norwalk Station will be equipped with two tail tracks for overnight storage or temporary storage of failed rail cars. Each tail track will accommodate 5 cars for a total storage capacity of 10 cars.

Capability for changing consists will be provided at terminal stations in order to minimize the fleet size and the time required for schedule changes involving close headways.

2.2.6 Abnormal Operations

A. General

Abnormal operations result when train or wayside failures or incidents disrupt service. Depending upon the nature of the failure or incident, various operating strategies will be implemented. Some abnormal operations strategies will be pre-programmed into the train control system. while others will be implemented based upon existing conditions. All abnormal operations will be implemented with safety as the primary concern. Abnormal operation strategies will include, but are not limited to, the following:

- o Troubleshooting/temporary solution
- o Single-track operation (also occurs in conjunction with routine maintenance activities)
- o Pushing/pulling disabled train
- o Local control operation
- o Mid-line turnback

- o Emergency bus operation
- o Temporary stoppage of operations

B. Abnormal Operation Strategies

When a failure or incident occurs, the appropriate system personnel (Train Operator, Transit Police, Equipment or Facilities Maintenance) are dispatched by Central Control to investigate or troubleshoot the problem. If possible, a temporary solution (cutout of vehicle subsystem such as doors, brakes, or propulsion; initiating reduced vehicle performance; blocking of switch points; or removal of an offender from a train) is implemented. Problem vehicles will be removed from service or wayside equipment will be repaired as soon as possible. In some cases, a train may have to be pushed or pulled by another train. When this occurs, passengers will be off-loaded at the next station (or preceding station for trains which are to push or pull another train) and the problem train will be operated at reduced speed to the nearest storage location where it will be removed from service. In order to minimize schedule delays, trains without passengers will not stop at stations when being removed from service. Station run-through speed will be limited to a maximum of 45 mph. In cases involving wayside problems at interlockings, operations may have to be controlled from a local control panel until repairs can be made.

Single-track operations will be implemented when the operational strategy requires trains to be routed around an obstruction (including routine maintenance activities) on a section of main line track. Single-track operation will be established based upon track sections between interlockings. Depending upon service period requirements, trains will operate in alternate directions or in fleets during single-track operations. Fleeting will be used when it is advantageous to move 2 or more trains in one direction for every train movement in the opposite direction.

Mid-line turnback and emergency bus operation strategies will be implemented when a segment of the system involving both main line tracks is obstructed or cannot be operated. In such cases, trains may be turned back at a station (or a station adjacent to an interlocking) which is near the obstructed section. Mid-line turnback operations may be either single ended (obstruction is at one end of the line) or double ended (obstruction is at a mid-point in the line). Emergency bus operations will be implemented to provide service around the obstructed section.

All train operations may be stopped temporarily as the safest strategy in extreme circumstances. This strategy would be used as a result of an earthquake. All trains would be stopped and instructions would be provided by Central Control.

C. System Access

Abnormal as well as normal operations require access to system facilities and equipment. System access to the right-of-way will be provided as follows:

- At stations
- Hi-rail maintenance vehicle access gates located in conjunction with the CHP enforcement areas along the freeway right-of-way west of the Vermont Station (westbound side of freeway) and west of the Lakewood Station (eastbound side of freeway).
- Stairways between stations on elevated structures
- Via trains
- Via hi-rail vehicles
- Non-revenue connection at Wilmington

Combinations of these access methods will often be necessary to reach a specific location on the system. For example, maintenance personnel responding to a signal failure may have to enter at a station and travel on foot or on another train to reach the desired location. A track maintenance crew may enter the line at the non- revenue connection and travel via hi-rail vehicle to a work site. Access to the right-of-way will be authorized by Central Control.

D. Special Trackwork

Special trackwork, single and double crossovers and pocket tracks, will be utilized for both normal and abnormal operations. In order to be effective, special trackwork must be properly located.

Normal terminal station operations will utilize crossovers located ahead of the station for the turnback movements. Normal movements between a terminal station and tail tracks will utilize a crossover located behind the station. Crossovers located ahead of a terminal station may be configured as either pairs of single crossovers or as a double crossover. A double crossover is usually preferred between a station and tail tracks in order to allow maximum length tail tracks.

Two pocket tracks, one on each side of the Wilmington Station, will be provided. The pocket track to the east will be stub-ended, but will have a direct connection to the non-revenue connector to the Blue Line. The pocket tracks will be utilized for the following:

- Staging of hi-rail maintenance vehicles to allow more timely access to work locations;
- Storage of rail cars being transferred to and from the Long Beach main yard and shop;
- Storage of failed trains; and
- Mid-line turnbacks.

Pocket tracks will have a capacity of at least three cars.

Single-track operations will utilize crossovers located at strategic intervals along the route. Crossovers for single-track operations will be located at intervals which provide a preferred sustainable single-tracking headway of 12 minutes. Pairs of single crossovers are preferred because the diamond crossing associated with double crossovers is eliminated. The mid-point between pairs of single crossovers will be used to establish the distance between crossovers. Table 2-5 shows the distance, trip time, and the estimated single-tracking headway between crossovers provided on the Green Line.

TABLE 2-5

GREEN LINE SPECIAL TRACKWORK TRIPTIME

STATIONS	DISTANCE (MILES)	TRIP (MIN)	SINGLE TRACKING HDWAY (MIN)*
Marine	0.00	0.00	
Double cross-over	0.00	0.00	
Hawthorne Yard	0.37	0.74	5.5
Douglas			
El Segundo			
Mariposa			
Double cross-over	2.74	6.58	17.2
Marina Jct.			
Aviation			
Single cross-overs	0.53	0.91	5.8
Hawthorne			
Single cross-overs	2.59	3.45	10.9
Crenshaw			
Vermont			
Single cross-overs	2.44	4.88	13.8
105/110			
Avalon			
Pocket track	2.66	3.99	12.0
Wilmington/Willowbrk			
Pocket/Non-Rev			(SEE BELOW)
Long Beach			
Single cross-overs	2.22	2.96	9.9
Future			
Single cross-overs	3.00	4.00	12.0
Lakewood			
Single cross-overs	2.77	3.69	11.4
Norwalk	0.26	0.62	
Double cross-over	0	0	

* Sustained single tracking headway = 2 times one-way trip time plus 4 minutes for signal/switch time and negotiating crossovers. Wilmington pocket track is not considered for single tracking operations due to use for storage of trains or maintenance equipment or movements between the Green and Blue Lines.

2.3 YARD OPERATIONS

2.3.1 General

The design of the Hawthorne Yard and Shop is based upon the following assumptions:

1. The Hawthorne Yard & Shop will support the Green Line and future Coast line operations.

2. The storage capacity of the Hawthorne Yard is 29 cars.

3. Satellite storage of rail vehicles will be provided at Norwalk and Torrance and/or Marina Del Rey (in the future) due to yard site constraints.

4. The yard & shop will accommodate train operations and rail vehicle light maintenance functions. Maintenance-of-way functions will be performed primarily out of the facility located at the Metro Red Line yard site.

5. The Green Line rail vehicle will utilize dimensions and equipment compatible with the Blue Line LRV.

6. Wheel truing, major rail vehicle overhauls and body repairs will be performed at the Long Beach shop. Major rail vehicle component overhauls and repairs will be performed by contract, at the Long Beach shop, or at other MTA facilities.

The basic functional operating and maintenance requirements for the Hawthorne Yard and Shop are as follows:

1. The configuration of the yard & shop will consist of manually operated yard and shop trackage. Initially, yard switches will be hand thrown. In mid 1995, ATP functions will be available in the yard to allow train routing from the yard control console.

2. Initially, yard operations and activities will be controlled and monitored by personnel located in the Yard Control Room. Close coordination will be maintained with personnel at the Central Control. In the future, the yard control function will be performed from a yard console located at the Central Control Facility.

3. The entire yard site will be fenced or otherwise secured in accordance with CPUC General Order 95. A guardhouse will be provided at the main entrance to the site.

4. A network of roadways will be provided for access to the shop, parking areas, and outdoor storage areas. At-grade road crossings of trackage will be protected by stop signs or warning devices for automotive traffic.

5. Parking for employees and visitors will be provided. At least 70 parking spaces will be provided in order to accommodate the two largest shifts.

6. Yard trackage, train control, and traction power will be designed, to the extent possible, to provide the most efficient and flexible operations for the following movements:

   a. Between the yard storage tracks and mainline

   b. From the mainline to the car wash, cleaning platform, and the future transfer zone

   c. Between yard storage tracks and the car wash, cleaning platform, and the future transfer zone

   d. Between yard storage tracks

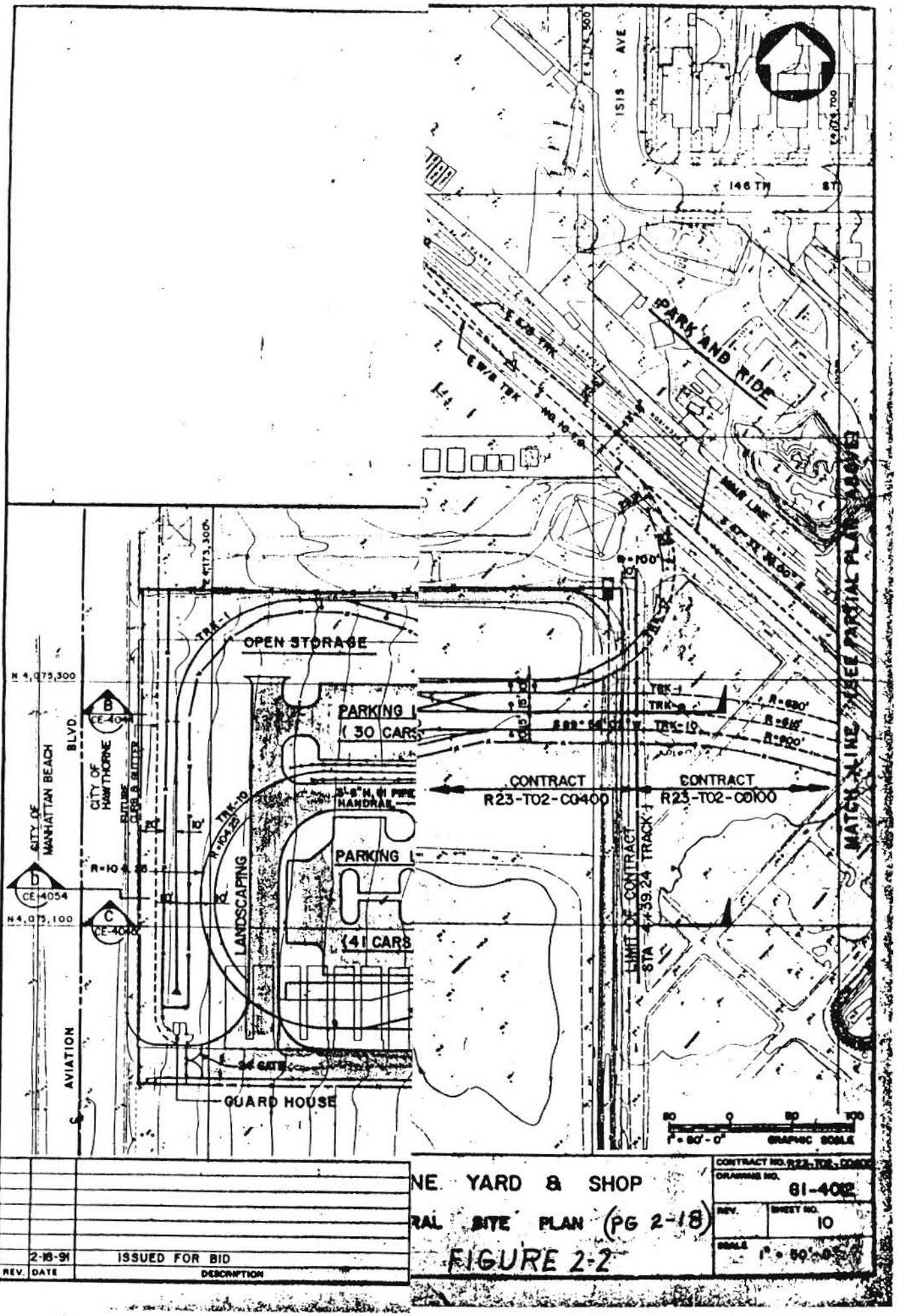
   e. Between the future transfer zone and vehicle shop

The general arrangement of the Hawthorne Yard and Shop is shown in Figure 2-2.

2.3.2 Yard Control

All rail vehicle movements and vehicle and facilities maintenance activities performed in the yard will be controlled and authorized by yard control personnel located in the yard control room initially and at the Central Control Facility after automatic train protection becomes available in the yard in 1995.

While initial yard operations will be coordinated from the yard control room, the room will also provide future operational flexibility. It will be located so as to afford visibility of the mainline lead tracks, yard storage tracks, car wash, cleaning platform, and the future transfer zone. The yard control room windows will be tinted and will be sloped to reduce glare. The control room windows will begin no more than 2 feet from the floor and will extend to within 1 foot of the ceiling.



REV.	DATE	DESCRIPTION
	2-18-91	ISSUED FOR BID

NE YARD & SHOP

RAL SITE PLAN (PG 2-18)

CONTRACT NO. R23-T02-C0400

DRAWING NO. 81-4012

REV. | SHEET NO. 10

SCALE 1" = 50'-0"

FIGURE 2-2

The following functions will be controlled and/or monitored by yard control personnel:

1. Dispatch/receipt of trains to/from the mainline

2. Trains movements over automated trackage (including coupling/uncoupling)

3. Train/car movements to/from yard storage tracks

4. Car movements to/from shop and servicing tracks

5. Traction power sectionalization for yard and shop tracks (excludes tracks within the shop)

6. Blue flag protection for yard and shops tracks when required

7. Operation of the car wash

8. Pedestrian and roadway access to yard trackage areas and the traction power substation

9. Alarms and other functions, as required

The communications requirements for the yard are as follows:

1. Radio communications between:

   a. Yard Control (at both the yard control room and the Central Control Facility locations) and authorized employees on-board cars in the yard and facilities maintenance personnel when working in the yard

   b. Yard Control and emergency response agencies (utilizing portable radios)

2. Telephone communications between:

   a. Yard Control at the CCF and the yard control room and operator reporting area

   b. Yard Control (at both CCF and yard locations) and emergency response agencies

   c. Yard Control and the vehicle shop

   d. Yard Control and the Blue Line main yard and shop

3. Public address communications between:

   a. Yard Control (at boath CCF and yard locations) and designated yard areas (e.g. cleaning platform, car washer, etc.)

   b. Areas within the shop

2.3.3 Yard Operations

Trains will be dispatched to and from the yard in accordance with the pre-established schedules. Yard control personnel will verify that sufficient trains are available to meet schedules and will coordinate routings for the storage tracks, shop, car washer, and car cleaning platform. Trains will be passed from main line control to yard control and vice versa. The actual passing of trains will be coordinated between yard and central control personnel. Trains which are to be routed into the yard (or other storage locations) will be checked by system personnel at the last station stop to verify that all passengers have disembarked.

When a train completes its final revenue run for the day, it will be routed to the yard where it will be routed to the proper track for storage until needed for revenue service or movement within the yard for cleaning, washing, maintenance or to other storage tracks.

When the rail vehicles are in the yard, they will be under control of yard control personnel located initially in the yard control room and ultimately at the Central Control Facility. Rail vehicles will be manually operated through all yard functions under the direction and coordination of yard control personnel.

The maximum speed limits within the yard will be as follows:

10 mph - absolute maximum
5 mph - for movements into/out of the shop
2 mph - during car wash and coupling/uncoupling movements

3. MAINTENANCE

The maintenance plans for rail vehicles and facilities for the manually operated Green Line are presented in this section.

3.1 Maintenance Philosophy

A. General

Functionally, the maintenance organization is a service organization responsible for making available to operations, on a timely basis, the facilities and equipment necessary to perform their intended functions safely, efficiently, and economically.

Controlled maintenance over the life of a system is economical, conducive to lower operating costs, and contributes to an increased availability of facilities and equipment. The primary objectives of controlled maintenance programs are:

1. To maximize the safety, comfort, satisfaction, and convenience of passengers and employees

2. To provide adequate protection of property and equipment

3. To minimize system downtime

4. To minimize operating costs.

B. Preventive Maintenance

Preventive maintenance programs consist of routine tasks which are scheduled and performed at specified intervals. Tasks such as inspection, cleaning, lubrication, and servicing are included in preventive maintenance programs. The objectives of preventive maintenance programs are to:

1. Maximize passenger comfort and satisfaction

2. Reduce service failures and resultant corrective maintenance

3. Prolong facility and equipment life

4. Provide for inspection to ensure operational safety and system dependability

5. Minimize system maintenance costs

6. Optimize workload schedules.

C. Corrective Maintenance

Corrective maintenance consists of troubleshooting, repairing failed equipment, and returning the equipment to service.

The goal of corrective maintenance is to return a failed piece of equipment to service as quickly as possible in order to minimize system downtime and to reduce the time required to restore operational service. To accomplish this goal, corrective maintenance includes two distinct methods for troubleshooting and repairing system elements and subsystems as follows:

1. The restoration to service of a failed system element will be accomplished, where possible, by a technique called unit exchange, which involves replacing the lowest-level replaceable unit. When a system element fails, diagnostic technicians will respond to the failure and correct the problem, if possible, by replacing the failed unit from a supply of like units previously tested and adjusted to perform the intended function. Unit exchange requires that equipment and facilities be designed and configured so that repairs can be accomplished in this fashion and that provisions are made in manufacturing to assist the diagnostic technician in quickly and effectively determining the problem. This may require the incorporation of special fault indicators, portable test equipment, and a supply of critical replacement units.

2. Corrective maintenance of assemblies or components will consist of troubleshooting and repairing failed assemblies or components and then testing and adjusting the assemblies or components to meet the intended function and to ensure the correctness of the repair. To accomplish the corrective maintenance of failed assemblies or components requires that equipment and facilities be provided so that repairs and overhaul activity will be accomplished in a component repair shop under conditions of efficient shop layout, cleanliness, competent supervision, adequate testing, and quality control.

D. Testing

Testing will be accomplished by the use of test apparatus configured to perform static and dynamic testing at the vehicle or wayside system and subsystem levels, and static bench testing at the assembly and component levels. The objectives of thorough testing are:

1. To ensure proper function of items under test

2. To provide for timely and accurate failure diagnosis

3. To reduce the time required to restore equipment to serviceable condition (and reduce the resultant costs) by identifying the lowest-level, failed, replaceable component.

E. Contract Maintenance

In certain instances, it may be more cost effective to have assembly or component repair and overhaul work performed by service contracts. The degree to which component or assembly repair and overhaul work is contracted out to local service shops or to the original equipment manufacturers is an important determinant of maintenance facility requirements, staffing, personnel skill levels, spare parts inventory, and component repair procedures. Factors to be evaluated in the decision include:

1. MTA policies and practices
2. Availability of suitable contractors
3. Logistics, inventory, and material-handling requirements
4. Labor agreements
5. Special equipment requirements and costs
6. Availability of special skills and workload of maintenance forces
7. Liability implications
8. Equipment warranty implications
9. Relative costs.

F. Maintenance Scheduling

Maintenance scheduling maintains all vehicle and wayside workload schedules (preventive maintenance, corrective repairs, overhauls, modifications, etc.). This function coordinates maintenance requirements with operations, engineering, and inventory control personnel to ensure availability of vehicles, wayside elements, parts and materials, and the resolution of problems. Maintenance scheduling also maintains all vehicle and wayside maintenance records and documentation and provides the backup for the preparation of reports, analyses, and annual maintenance budgets.

3.2 Rail Vehicle Maintenance

3.2.1 General

The following vehicle maintenance activities will be performed at the Hawthorne Yard and Shop:

- o Preventive maintenance
- o Corrective repairs
- o Major component changeout
- o Wheel truing (future)
- o Interior cleaning

- o Exterior washing

- o Limited component repair and overhaul

Preventive maintenance for rail vehicles will be performed on the basis of hours or miles of mainline operation in accordance with the manufacturers' recommendations. Changeout of major components will involve the replacement of failed components or scheduled changeouts. Components removed from vehicles will be shipped to the appropriate component repair location (e.g. Long Beach main yard, other MTA facility, contract vendor, or the manufacturer). Limited component repair capability will be provided for vehicle truck assemblies, train control system electronic components, batteries, and various electrical and mechanical components which can be repaired quickly and easily after removal from a vehicle.

Interior cleaning of rail vehicles will be performed daily at a cleaning platform. Power outlets, hose bibs, lighting, and storage cabinets will be provided on the cleaning platform. Exterior cleaning will be performed in the car washer. The car washer will include storage and mixing tanks for water and cleaning chemicals, recycling equipment, brushes, water and chemical application arches with splash shields, manual cleaning platforms, local control panel, power outlets, hose bibs, and lighting. Initially, each rail vehicle will be washed once every two days.

3.2.2 Vehicle Maintenance Shop Requirements

The vehicle maintenance shop will include the space, facilities, and equipment needed to accomplish the required activities in an efficient and orderly manner. The vehicle shop will be capable of maintaining all of the rail vehicles for the Green Line and the Coast Lines. The overall facility layout will have an orderly arrangement of maintenance functions by activity, and in such a manner that each work activity can be performed with a minimum of interference from the other work activities. The vehicle work positions will be designed for quick and easy access to vehicle equipment.

The requirements for the Hawthorne Shop are as follows:

A. The shop will be designed to provide at least 8 rail vehicle work positions as follows:

1	in-floor hoist position
1	floor level position (for portable vehicle jacks)
4	pit positions
2	wheel truing positions
===	
8	shop positions

B. Shop tracks will accommodate not more than 2 cars each and will be spaced 25 feet apart, insofar as possible.

C. An overhead contact wire system will be provided for the movement of cars into/out of the shop. Sectionalization of the OCS will be provided for each rail vehicle shop position (the future wheel truing track will be considered as one vehicle position).

D. The future wheel truing track will be separated from other shop tracks due to noise considerations. The future wheel truing machine will be located near the center of the track to allow a car to remain within the shop during wheel truing and to allow other maintenance activities when the machine is not in use. The wheel truing machine shall be interlocked with the OCS in order to prevent simultaneous operation.

E. The in-floor hoist position will be located adjacent to a floor- level position with reinforced floor areas for accommodating portable LRV jacks. The in-floor vehicle hoists will be shallow- pit type. The body supports will also be capable of lifting the vehicle, when selected. Two manually operated truck turntables will provide access to a truck/component track located adjacent to the in-floor hoist position. The truck/component track will be equipped with one truck hoist and two 7 1/2-ton capacity jib cranes.

F. Vehicle pit work positions will be equipped with stairs, ramps, lighting, water, and power similar to the configuration of the service and inspection pits at the Long Beach vehicle shop.

G. A two-ton capacity jib bridge crane will be provided for two of the shop tracks equipped with pits. The two-ton capacity jib crane located over the pit positions will be interlocked with the OCS to preclude simultaneous operation.

H. An inspection/maintenance platform will be provided in conjunction with the two-ton capacity jib crane for access to rail vehicle roof-mounted equipment at the two pit work positions.

I. Capability for plug-in diagnostic testing of car subsystems/equipment will be provided at each vehicle work position except for the future wheel truing area. A test equipment control/monitoring room will be provided. The test control room will be located within viewing distance of the vehicle work positions.

J. Use of natural light will be maximized in the design of the shop.

K. Floor space for the following operations and vehicle maintenance facilities will be provided in the vehicle shop:

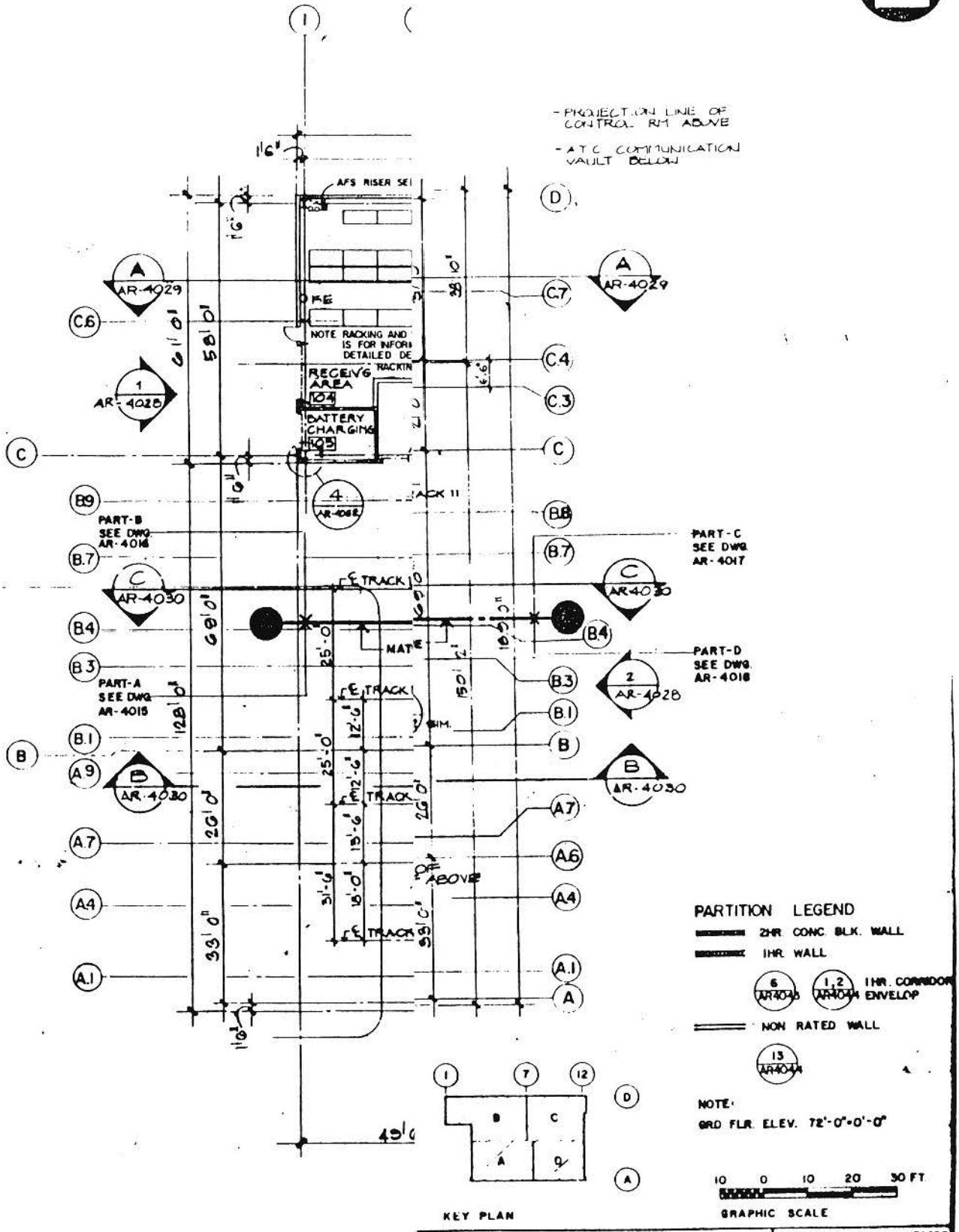
ROOM/SPACE	MINIMUM SQ. FT.	REMARKS
Yard control room	350	Mezzanine with view of yard.
Transportation offices	700	Mezzanine.
Train operator reporting/lunch	500	Adjacent to offices on mezzanine.
Transportation restrooms/lockers	700	Mezzanine, with 50: 50 men-to- women ratio.
Training/conference room	500	Quiet area on mezzanine.
Maintenance offices	1800	1000 sq. ft. on 1st floor.
Car cleaning supplies	300	Accessible to yard pedestrian overpass.
Maintenance lunch room	300	1st floor.
Maintenance restrooms/lockers	700	1st floor. 90:10 men to women ratio.
Electronic test & repair	400	1st floor.
Small component repair	350	1st floor.
Major component area	3000	Adjacent to truck/component track.
Parts storeroom	6500	1st floor.
Parts office & records	250	Adjacent to storeroom.
Secured parts storage	250	Adjacent to storeroom.
Toolroom	300	Adjacent to storeroom.
Tool car storage	150	1st floor.

ROOM/SPACE	MINIMUM SQ. FT.	REMARKS
Test equipment control room	120	1st floor with view of car test position.
Battery room	200	1st floor on outside wall.
Forklift/electric cart storage	As req'd.	For 4-5 vehicles. Near battery room.
Air compressor room	600	Isolate due to noise.
ATC/communication equipment	1100	1st floor. Includes Communications battery room.
Mechanical/electrical equipment	As req'd. rooms	

The floor plan for the Hawthorne Shop is shown in Figure 3-1.

3.2.3 Hawthorne Shop Maintenance Equipment

The preliminary maintenance equipment list for the Hawthorne Shop is shown in Table 3-1.



REV.	DATE	DESCRIPTION
	2-18-91	ISSUED FOR BID

RNE YARD & SHOP

MAINTENANCE SHOP

E GROUND FLOOR PLAN

FIGURE 3-1

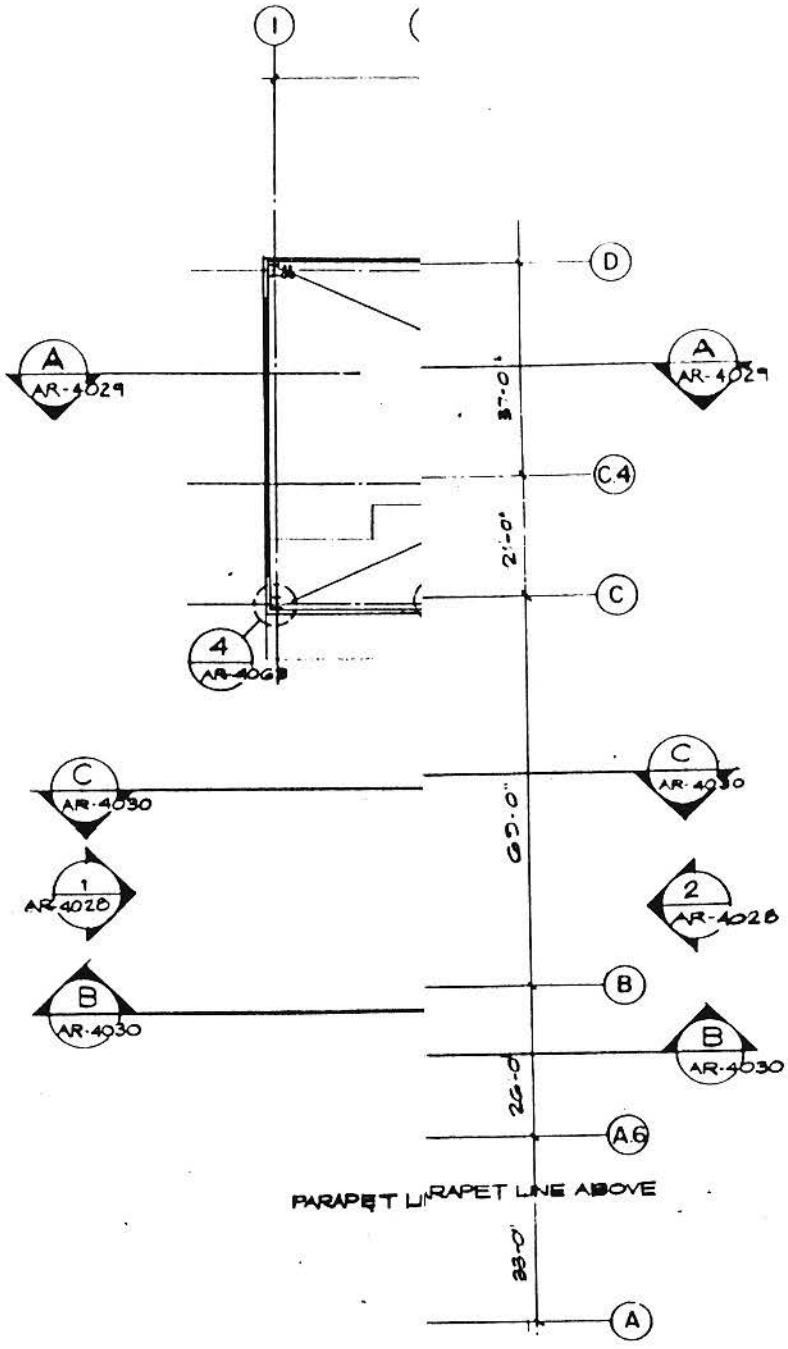
3-8

CONTRACT NO. RED-TOE-00490

DRAWING NO. AR - 4012

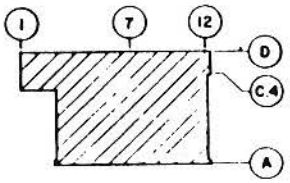
REV. | SHEET NO. 151

SCALE 1/16" = 1'-0"



PARTITION LEGEND

- 2HR. CONC. BLK. WALL
- 1HR WALL
- 6 AR4043 / 1,2 AR4044 1HR. CORRIDOR ENVELOP
- NON RATED WALL
- 13 AR4044



KEY PLAN

10 0 10 20 30 FT.

GRAPHIC SCALE

REV.	DATE	DESCRIPTION
	2-18-91	ISSUED FOR BID

Work Element | Physical Entity | Contract Designation | Cost Element | Project Number

RNE YARD & SHOP

MAINTENANCE SHOP

MEZZANINE FLOOR PLAN

FIGURE 3-1

3-8A

CONTRACT NO. R23-T02-C0400

DRAWING NO. AR - 4013

REV.

SHEET NO. 152

SCALE 1/16" = 1'-0"

HAWTHORNE SHOP MAINTENANCE EQUIPMENT LIST - TABLE 3-1

LINE ITEM	EQUIPMENT	DESCRIPTION	USE/LOCATION	QUANTITY INITIAL	QUANTITY FUTURE	QUANTITY TOTA
1	Portable LRV jacks	Electric, 10-ton capy.	Shop track #12	8	0	8
2	Portable carbody stands	10-ton capy.	Shop track #12	8	0	8
3	Forklift	Electric, 2-ton	General shop	1	0	1
4	Shop lift truck	Electric, walk behind	General shop	1	0	1
5	Lift table	1-ton, air operated	General shop	2	0	2
6	Lift truck hopper	2-cu.yd.	General shop	4	0	4
7	Pedestal grinder	12",2hp, 208v	Truck/component area	1	0	1
8	Drill press	15", 208v	Truck/component area	1	0	1
9	Magnetic particle tester	Portable, 120v	Truck/component area	1	0	1
10	Workstand	LRV air cond. unit	Truck/component area	1	0	1
11	Pipe bending table	120v	Truck/component area	1	0	1
12	Ultrasonic parts cleaner	6 qt. capy, 120v	Electronic repair	1	0	1
13	Battery rack	2 tier, 24 battery capy.	Battery room	2	0	2
14	Battery charger	LRV & shop vehicles, as required	Battery rm/storerm	3	0	3
15	Storage cabinet	Metal, lockable	General shop	8	0	8
16	Storage rack	Metal, adjustable shelf	General shop	6	0	6
17	Shop workbench	Steel top	General shop	10	0	10
18	Electronic workbench	Metal bench, wood top, with 120v	Electronic repair	2	0	2
19	Ladder, LRV access	Portable, insulated	General shop	4	0	4
20	Scaffold	Portable, insulated	General shop	2	0	2
21	Vacuum cleaner	Wet/dry, 10 gal. capy, 120v	Shop/cleaning platfm	4	0	4
22	Lubrication cart	Portable,4 ten gal.drums	General shop	4	0	4
23	Bench grinder	7", 120v	Component repr areas	2	0	2
24	ARC welder/generator	Portable, 300amp, 208v	General shop	1	0	1
25	MIG Welder	Portable, 400amp, 208v	General shop	1	0	1
26	Welding curtain	4 panel	General shop	2	0	2
27	Electrode oven	Bench mounted, 120v, 1200w	General shop	1	0	1
28	Welding/cutting outfit	Portable, 2 wheel, gas	General shop	1	0	1
29	Shop Floor Scrubber	Electric, with charger	General shop	1	0	1
30	Scissor Lift Dock	Electric, 10-ton capacity	Material Dept.	1	1	2
31	Truck/Wheel Dolly	Handle 28" thru 34" wheels	Equipment Maint.	2	0	2
			Total	87	1	88

NOTE: Track tools and rail vehicle portable test equipment lists are to be developed.

3.3 Facilities Maintenance

3.3.1 General

Facilities maintenance functions for the Green Line will be performed primarily out of the maintenance-of-way facility located at MTA's Metro Red Line yard site. The facilities maintenance functions associated with the Green line include inspection, maintenance, and repair of the following elements:

- o Trackwork
- o Train control
- o Communications
- o Traction Power
- o Fare Collection Equipment
- o Stations and other structures
- o Landscaping, fencing and other right-of-way elements

Facilities maintenance will be accomplished utilizing a combination of system personnel and service contracts. Generally, the approach to facilities maintenance will parallel that utilized for the Blue Line. To the extent practical, personnel and equipment for the Blue Line will also be utilized for the Green Line.

3.4 Automotive Vehicles and Equipment

The preliminary list of automotive vehicles and equipment required for the Green Line is shown in Table 3-2.

GREEN LINE AUTOMOTIVE VEHICLES AND EQUIPMENT LIST - TABLE 3-2

LINE ITEM	EQUIPMENT	DESCRIPTION	USE/LOCATION	QUANTITY INITIAL	QUANTITY FUTURE	QUANTITY TOTAL
1	Emergency response truck	Hi-rail, 1-ton hoist	Vehicle/Facilities	1	0	1
2	LRV car mover	Hi-rail, w/couplers	Yard & Shop	1	0	1
3	Scissors platform truck	Hi-rail, stake sides	Track, OCS	1	0	1
4	Aerial work truck	Hi-rail, 45' work ht.	Traction Power, OCS	1	0	1
5	Pickup, 1-ton	Hi-rail, with lift gate	Facilities Maint.	1	0	1
6	Portable generator	2 wheel, 30 kw minimum	Emergency power	1	1	2
7	Stake truck	5-ton, lift gate	Material Dept	1	0	1
8	Utility van	1-ton, side & rear doors	ATC, Tctn Pwr, Comm, FC	4	1	5
9	Pickup	1/2-ton	Vehicle/Facilities	1	1	2
10	Passenger Van	11-Passenger capacity	Transportation	1	0	1
11	Sport wagon	Small size Blazer/Bronco	Transportation	2	0	2
12	Sedan	Standard size	Transportation	1	0	1
13	Sedan	Standard size	Security	4	1	5
			Total	20	4	24

4. STAFFING AND COST ESTIMATES

4.1 General

The staffing plan and cost estimates for the Green Line for the initial year and the system startup period are presented in this section for the following organizations:

- o Transportation
- o Vehicle Maintenance
- o Facilities Maintenance
- o Material Department

The staffing plan and cost estimates are subject to refinement as system design progresses and are based upon the following assumptions:

A. Existing staff for the Blue Line will be utilized to the extent practical.

B. Costs are expressed in 1993 dollars and are based upon MTA rates and other costs utilized for the Blue Line O&M cost estimates. Cost estimates include the following:

1. Fringe benefit rate of 47.5%.
2. General and Administration rate of 7.0%.
3. Average productive hours per year per employee of 1810 for salaried positions and 1750 for hourly positions.
4. Contingency rate of 8.0% and escalation rate of 6.0%.

4.2 Initial Year Staffing and Cost Estimates

The staffing estimates for the initial year are based upon shift coverage and annual productive hours per employee. Shift coverage for the Green Line is established with consideration for the following staffing characteristics:

- o Positions which must be continually available on-line in order to accomplish operations. Such positions include train operators, line supervisors, central control dispatchers, CCTV operators, fare collection equipment technicians, etc..
- o Positions which are necessary in order to accommodate yard and shop operations. Such positions include rail vehicle supervisors and mechanics, car cleaners, storekeepers, etc.

- Positions which are required, but not necessarily on a continuous on-line basis. Such positions include track workers, TPSS electricians, communications technicians, etc.. These positions, when combined with those of the Blue Line, provide mobile, full coverage capability for routine activities as well as immediate response needs for both lines.

The cost estimate for the initial year includes direct labor, indirect labor, general and administrative, non-labor, and traction power costs. Labor costs are based upon the equivalent staff calculated from the shift coverage and the appropriate hourly and fringe benefit rates. Non-labor costs are based upon the quantities of equipment and facilities and other factors appropriate for the Green Line.

A summary of the cost estimate for the initial year is shown in Table 4-1. Staffing and labor cost estimates for Transportation, Vehicle Maintenance, Facilities Maintenance, and the Material Department are shown in Tables 4-2 through 4-5. The cost estimates for the non-labor categories are shown in Table 4-6.

TABLE 4 - 1

OPERATIONS AND MAINTENANCE COST ESTIMATE

GREEN LINE O & M COST ESTIMATE SUMMARY (1993 $)

MANUAL OPERATION - INITIAL SERVICE (DEC 1994)

		STAFF	ANNUAL COST (INCL FRINGE)	PER CENT DISTRIB	LABOR% DIST
DIRECT LABOR					
TRANSPORTATION		79	5,036,797	36.31	48.89
VEHICLE MAINTENANCE		24	1,808,709	13.04	17.56
FACILITY MAINTENANCE		39	2,569,266	18.52	24.94
O&M SUPPORT		10	684,716	4.94	6.65
SUB TOTAL		152	$10,099,488	72.80	
OVERTIME ALLOWANCE	% =	0.02	201,990	1.46	1.96
GENERAL & ADMIN	% =	0.07	907,550	6.54	
NON LABOR			$1,215,271	8.76	
TRACTION POWER			$1,448,254	10.44	
SUBTOTAL			$13,872,553	100.00	100.00
CONTINGENCY	% =	0.08	$1,109,804		
SUBTOTAL			$14,982,357		
ESCALATION	% =	0.06	$898,941		
GRAND TOTAL			$15,881,299		

OPERATIONS AND MAINTENANCE COST ESTIMATE

GREEN LINE TRANSPORTATION STAFFING

MANUAL OPERATION - INITIAL SERVICE (DEC 1994)

JOB CLASS	PROD. HRS/YR	DAYS WEEK	SHIFT: DAY	P.M.	GRAVE	TOT. LAB HRS	TOTAL STAFF	EQUIV STAFF	HOUR RATE	ANNUAL COST
MANAGER, TRANSP.	1810	5	1	0	0	2080	1.1	1	32.53	67,662
SR SUPERVISOR	1810	5	0	0	0	0	0.0	0	29.43	0
SECRETARY	1810	5	1	0	0	2080	1.1	1	17.03	35,422
ANALYST	1810	5	0	0	0	0	0.0	0	26.66	0
INSTRUCTOR	1810	5	2	0	0	4160	2.3	2	28.01	116,522
SUPERVISOR - LINE	1810	5	3	3	0	12480	6.9	7	26.66	388,170
SUPERVISOR - LINE	1810	2	2	2	0	3328	1.8	2	26.66	110,906
YARD CONTROLLER	1810	7	1	1	1	8736	4.8	5	26.66	277,264
CENTRAL CONTROLLER	1810	5	3	2	1	12480	6.9	7	26.66	388,170
CENTRAL CONTROLLER	1810	2	2	2	1	4160	2.3	2	26.66	110,906
CCTV OPERATOR	1750	7	3	2	0	14560	8.3	8	17.03	283,379
TRAIN OPERATOR	1750	5	14	13	2	60320	34.5	34	17.88	1,264,474
TRAIN OPERATOR	1750	2	10	10	2	18304	10.5	10	17.88	371,904
SUBTOTAL										3,414,778
FRINGE: (47.5%)										1,622,019
TOTAL: (1993 $)								79		5,036,797

OPERATIONS AND MAINTENANCE COST ESTIMATE

GREEN LINE VEHICLE MAINTENANCE STAFFING

MANUAL OPERATION - INITIAL SERVICE (DEC 1994)

JOB CLASS	PROD. HRS/YR	DAYS WEEK	SHIFT: DAY	P.M.	GRAVE	TOT. LAB HRS	TOTAL STAFF	EQUIV. STAFF	HOUR RATE	ANNUAL COST
MANAGER	1810	5	1	0	0	2080	1.1	1	34.44	71,635
SECRETARY/CLERK	1810	5	1	0	0	2080	1.1	1	17.03	35,422
ENGINEER	1810	5	1	0	0	2080	1.1	1	33.01	68,661
INSTRUCTOR	1810	5	0	0	0	0	0.0	0	33.01	0
WARRANTY ANALYST	1810	5	0	0	0	0	0.0	0	30.15	0
SR SUPERVISOR	1810	5	1	0	0	2080	1.1	1	33.01	68,661
SUPERVISOR	1810	7	1	1	1	8736	4.8	5	30.15	313,560
SPECIALIST	1750	7	2	2	2	17472	10.0	10	21.42	445,536
SPECIALIST	1750	2	0	0	0	0	0.0	0	21.42	0
ASSISTANT	1750	7	1	1	1	8736	5.0	5	15.01	222,768
ASSISTANT	1750	2	0	0	0	0	0.0	0	15.01	0

SUBTOTAL:			1,226,243
FRINGE: (47.5%)			582,466
TOTAL: (1993 $)		24	1,808,709

OPERATIONS AND MAINTENANCE COST ESTIMATE

GREEN LINE FACILITIES MAINTENANCE STAFFING

MANUAL OPERATION - INITIAL SERVICE (DEC 1994)

JOB CLASS	PROD. HRS/YR	DAYS WEEK	SHIFT: DAY	P.M.	GRAVE	TOT. LAB HRS	TOTAL STAFF	EQUIV STAFF	HOUR RATE	ANNUAL COST
MANAGER	1810	5	1	0	0	2080	1.1	1	32.48	67,558
ENGINEER	1810	5	0	0	0	0	0.0	0	32.48	0
ENGINEER ASSOC/ANLST	1810	5	2	0	0	4160	2.3	2	31.94	132,870
SECRETARY/CLERK	1810	5	1	0	0	2080	1.1	1	17.01	35,381
WARRANTY ANALYST	1810	5	0	0	0	0	0.0	0	31.94	0
SUPV TPSS	1810	5	1	0	0	2080	1.1	1	32.05	66,664
SUPV SIGNALS	1810	5	1	0	0	2080	1.1	1	32.05	66,664
SUPV TRACK	1810	5	1	0	0	2080	1.1	1	32.05	66,664
SUPV FAC MAINT	1810	5	0	0	0	0	0.0	0	32.05	0
SUPV ELEC	1810	5	0	0	0	0	0.0	0	32.05	0
INSPECTOR TPSS	1750	5	2	2	3	14560	8.3	8	19.93	331,635
INSPECTOR SIGNALS	1750	5	2	2	3	14560	8.3	8	19.93	331,635
INSPECTOR TRACK	1750	5	2	2	3	14560	8.3	8	19.93	331,635
INSPECTOR FAC MAINT	1750	5	1	1	0	4160	2.4	2	19.93	82,909
INSPECTOR COMM	1750	5	1	1	0	4160	2.4	2	19.93	82,909
INSPECTOR ELEC	1750	5	1	1	0	4160	2.4	2	19.93	82,909
ELECTRICIAN	1750	5	0	0	0	0	0.0	0	19.93	0
PROP MAINTAINER	1750	5	1	1	0	4160	2.4	2	15.01	62,442
SUBTOTAL										1,741,875
FRINGE: (47.5%)										827,391
TOTAL: (1993 $)								39		2,569,266

OPERATIONS AND MAINTAINENCE COST ESTIMATE

GREEN LINE O&M SUPPORT STAFFING

MANUAL OPERATION - INITIAL SERVICE (DEC 1994)

JOB CLASS	PROD. HRS/YR	DAYS WEEK	SHIFT: DAY	P.M.	GRAVE	TOT. LAB HRS	TOTAL STAFF	EQUIV STAFF	HOUR RATE	ANNUAL COST
SUPV MATERIAL DEPT	1810	5	1	0	0	2080	1.1	1	32.05	66,664
STOREKEEPER	1810	5	1	0	0	2080	1.1	1	19.93	41,454
STOCK CLERK	1750	7	1	1	1	8736	5.0	5	15.01	156,104
SUPPRT TEAM SUPV TPS	1810	5	1	0	0	2080	1.1	1	32.05	66,664
SUPPRT TEAM SUPV SIG	1810	5	1	0	0	2080	1.1	1	32.05	66,664
SUPPRT TEAM SUPV TRK	1810	5	1	0	0	2080	1.1	1	32.05	66,664
SUBTOTAL										464,214
FRINGE: (47.5%)										220,502
TOTAL: (1993 $)								10		684,716

TABLE 4 - 6

OPERATIONS AND MAINTENANCE COST ESTIMATE

GREEN LINE NON LABOR COSTS

MANUAL OPERATION - INITIAL SERVICE (DEC 1994)

REF.	DIVISION	COST	
	TRANSPORTATION		
TR1	MISC. SUPPLIES & SERVICES	25,184	
	SUBTOTAL:		$25,184
	VEHICLE MAINTENANCE		
VM1	VEHICLE PARTS & MATERIAL	66,600	
VM2	COMPONENT REPAIR CONTRACT	16,650	
VM3	MISC. SUPPLIES & SERVICES	9,044	
	SUBTOTAL:		$92,294
	FACILITIES MAINTENANCE		
MW1	TRACK MATERIAL	21,525	
MW2	RAIL GRINDING CONTRACT	23,575	
MW3	RAIL INSPECTION CONTRACT	9,225	
MW4	OTHER TRACK CONTRACT	38,950	
MW5	TRAIN CONTROL MATERIAL	21,000	
MW6	TRAIN CONTROL CONTRACT	29,400	
MW7	COMMUNICATIONS MATERIAL	32,000	
MW8	COMPUTER MAINT. CONTRACT	75,000	
MW9	FARE EQUIP. MATERIAL/CONTRACT	25,000	
MW10	TRACTION POWER MATERIAL	9,000	
MW11	OCS MATERIAL	18,450	
MW12	TRACTION POWER/OCS CONTRACT	18,450	
MW13	BLDG/FACILITY MATERIAL	6,000	
MW14	ELEVATOR CONTRACT	93,500	
MW14	ESCALATOR CONTRACT	96,250	
MW15	STA/BLDG JANITORIAL CONTRACT	60,000	
MW16	LANDSCAPING/GROUNDS CONTRACT	120,000	
MW17	BUILDING MAINTENANCE CONTRACT	15,000	
MW18	MAINT VEHICLE MATERIAL	9,900	
MW19	MAINT VEHICLE CONTRACT	18,000	
MW20	SHOP EQUIPMENT MATERIAL	15,500	
MW21	SHOP EQUIPMENT CONTRACT	12,400	
MW22	CORROSION CONTROL CONTRACT	19,425	
MW23	MISC. SUPPLIES/SERVICES	12,846	
	SUBTOTAL:		$800,396

	O&M SUPPORT		
SP1	MISC. SUPPLIES & SERVICES	6,847	
	SUBTOTAL:		$6,847
	UTILITIES		
UT1	LIGHT, HEAT & POWER	150,000	
UT2	WATER	18,000	
UT3	TRASH REMOVAL	6,000	
UT4	TELEPHONE	30,000	
UT5	WASTE DISPOSAL	9,900	
	SUBTOTAL:		$213,900
	OTHER		
OT1	FARE MEDIA	18,750	
OT2	FUEL & LUBRICANTS	21,900	
OT3	MISC. SUPPLIES & SERVICES	36,000	
OT4	CLAIMS/LEGAL EXPENSE	0	
	SUBTOTAL:		$76,650
	TOTAL	$1,215,271	$1,215,271
TP1	TRACTION POWER	1,448,254	
	TOTAL		$1,448,254

4.3 System Startup Staffing and Cost Estimates

Staffing and cost estimates for the startup of the Green Line are based upon the staffing requirements for the initial year of operation, key milestone events, and lead times for personnel hiring and training. The startup period begins prior to the start of revenue service in December, 1994.

Startup cost includes estimates for labor, non-labor, travel and per diem (for system operator's personnel), traction power, and general and administrative costs. Labor costs are based upon the number of transportation, Vehicle Maintenance, Facilities Maintenance, and Material Department personnel required for each job classification on a monthly basis. Labor and non-labor costs are then summarized on a quarterly basis.

The startup cost summary, by quarter, is shown in Table 4-7. The startup staffing summary, by quarter, is shown in Table 4-8. Table 4-9 contains the monthly staffing schedule for the startup of the Green Line.

GREEN LINE STARTUP STAFFING AND COST ESTIMATE

QUARTERLY COST (1993 $) TABLE 4-7

	30-Jun-93	30-Sep-93	31-Dec-93	31-Mar-94	30-Jun-94	30-Sep-94	31-Dec-94	31-Mar-95	30-Jun-95	TOTALS
LABOR COSTS	193,147	437,865	561,170	970,328	1,571,710	2,172,221	2,441,872	0	0	8,348,313
OVERTIME: 5%	0	0	0	0	78,586	108,611	122,094	0	0	309,290
NON LABOR	112,025	253,962	325,478	562,790	911,592	1,259,888	1,416,286	0	0	4,842,022
TRAVEL & PER DIEM	0	0	0	25,000	50,000	0	0	0	0	75,000
TRACTION POWER	61,035	138,365	177,330	306,624	512,378	708,144	796,050	0	0	2,699,925
GEN & ADMIN: 7%	21,362	48,428	62,065	109,068	182,832	247,850	278,618	0	0	950,224
SUBTOTAL	387,569	878,621	1,126,043	1,973,809	3,307,098	4,496,715	5,054,919	0	0	17,224,774
CONTINGENCY: 8%	31,006	70,290	90,083	157,905	264,568	359,737	404,393	0	0	1,377,982
SUBTOTAL	418,575	948,910	1,216,126	2,131,714	3,571,666	4,856,452	5,459,312	0	0	18,602,756
ESCALATION: 6%	25,114	56,935	72,968	127,903	214,300	291,387	327,559	0	0	1,116,165
TOTAL BUDGET	443,689	1,005,845	1,289,094	2,259,617	3,785,966	5,147,840	5,786,871	0	0	19,718,921

NOTES:

1. REVENUE SERVICE (NORWALK TO MARINE) BEGINS IN DECEMBER, 1994.

GREEN LINE STARTUP STAFFING AND COST ESTIMATE

QUARTERLY STAFFING TABLE 4-8

CATEGORY	30-Jun-93	30-Sep-93	31-Dec-93	31-Mar-94	30-Jun-94	30-Sep-94	31-Dec-94	31-Mar-95	30-Jun-95	TOTALS
TRANSPORTATION	5	5	0	15	18	28	8	0	0	79
EQUIPMENT	1	0	2	20	1	0	0	0	0	24
FACILITIES	9	8	0	0	20	0	2	0	0	39
O&M SUPPORT	0	0	5	2	3	0	0	0	0	10
TOTAL	15	13	7	37	42	28	10	0	0	152
CUM. TOTAL	15	28	35	72	114	142	152	152	152	

			1993					1995
JOB CLASS	STAFF	SAL/MO	4	5	6	11	12	1
MANAGER, TRANSP.	1	8176	1	1	1	1	1	0
SR SUPERVISOR	0	7397	0	0	0	0	0	0
SECRETARY	1	4280	0	0	0	1	1	0
INSTRUCTOR	2	7040	0	2	2	2	2	0
ANALYST	0	6701	0	0	0	0	0	0
SUPERVISOR-LINE	9	6701	0	0	0	9	9	0
YARD CONTROLLER	5	6701	0	0	0	5	5	0
CENTRAL CONTROLLER	9	6701	0	2	2	9	9	0
CCTV OPERATOR	8	4280	0	0	0	8	8	0
TRAIN OPERATOR	44	4494	0	0	0	44	44	0
MANAGER, EQUIPMENT	1	8656	1	1	1	1	1	0
ENGINEER	1	8297	0	0	0	1	1	0
SECRETARY/CLERK	1	4280	0	0	0	1	1	0
INSTRUCTOR	0	8297	0	0	0	0	0	0
WARRANTY ANALYST	0	7578	0	0	0	0	0	0
SR SUPERVISOR	1	8297	0	0	0	1	1	0
SUPERVISOR	5	7578	0	0	0	5	5	0
SPECIALIST	10	5384	0	0	0	10	10	0
ASSISTANT	5	3773	0	0	0	5	5	0
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
MANAGER,FACILITIES	1	8163	0	0	0	1	1	0
ENGINEER ASSOC/ANL	2	8028	0	0	0	2	2	0
SECRETARY/CLERK	1	4280	0	0	0	1	1	0
SUPV TPSS	1	8055	0	0	0	1	1	0
SUPV SIGNALS	1	8055	0	0	0	1	1	0
SUPV TRACK	1	8055	0	0	0	1	1	0
SUPV FAC MAINT	0	8055	0	0	0	0	0	0
INSPECTOR TPSS	8	5009	0	3	3	8	8	0
INSPECTOR SIGNALS	8	5009	0	2	2	8	8	0
INSPECTOR TRACK	8	5009	0	2	2	8	8	0
INSP FAC MAINT	2	5009	0	0	0	2	2	0
INSP COMM/ELEC	4	5009	0	1	1	4	4	0
PROPERTY MAINT	2	3773	0	1	1	2	2	0
SUPV, MATERIAL	1	8055	0	0	0	1	1	0
STOREKEEPER	1	5009	0	0	0	1	1	0
STOCK CLERK	5	3773	0	0	0	5	5	0
SUPP TEAM SUPV TPS	1	8055	0	0	0	1	1	0
SUPP TEAM SUPV SIG	1	8055	0	0	0	1	1	0
SUPP TEAM SUPV TRK	1	8055	0	0	0	1	1	0
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
TOTAL STAFF	152.0		2.0	15.0	15.0	152.0	152.0	0.0

STARTA