Jersey City Redevelopment Agency
Canal Crossing Redevelopment Project

TASK 4

Feasibility Study
for
Proposed Caven Point Avenue Light Rail Station

Draft

July 31, 2012

Prepared by
URS Corporation
for
T & M Associates

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CANAL CROSSING REDEVELOPMENT PROJECT

NEW HUDSON-BERGEN LIGHT RAIL STATION

FEASIBILITY STUDY

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1.0 EXECUTIVE SUMMARY

In accordance with the requirements of Task 4 of the Canal Crossing Redevelopment Project Scope of Services, an assessment of the technical feasibility of constructing a new light rail station in the vicinity of the southern portion of the redevelopment area was performed. This assessment included an analysis of projected ridership resulting from the site development in two target years, 2020 and 2035. It also included development of proposed station configuration alternatives, an analysis of advantages and disadvantages of each alternative and a discussion of associated engineering, construction, rail operations and capital cost impacts.

This study has concluded that it is technically feasible to construct a new station to serve the Canal Crossing Redevelopment Project. However, extensive modifications to existing rail infrastructure in the vicinity of the proposed new station site would result in significant construction and operational impacts and costs.

Projected ridership modeling and analysis has concluded that the need for a new station in the early stages of development (target year 2020) is marginal. However, as development progresses toward target year 2035, ridership potential increases significantly..

2.0 INTRODUCTION

2.1 Project Background

Canal Crossing is a 111-acre Redevelopment Area in the southeastern section of the City of Jersey City characterized by industrial and vacant land use surrounded by a residential population of predominantly minority households with relatively high unemployment and poverty rates. Redevelopment of the area is hampered by outdated infrastructure, contaminated brownfields and insufficient pedestrian access to mass transit.

The Canal Crossing Redevelopment Plan was adopted in 2009 following a collaboration of government agencies and local stakeholders incorporating the best principals of sustainable development including Smart Growth, New Urbanism and Green Building. To advance this plan, the Jersey City Redevelopment Agency (JCRA) was awarded a HUD Sustainable Communities Challenge Grant and a DOT TIGER II Infrastructure Planning Grant for the Canal Crossing Redevelopment Area. The grants obtained for the Canal Crossing Redevelopment Project require the implementation of sustainable concepts including the Six Livability Principles. The first of these principles is to provide more transportation choices.

2.2 Purpose of Study

The Hudson-Bergen Light Rail (HBLR) system runs along both the northern and the eastern borders of the redevelopment area. The West Side Avenue branch forms the northern border of the redevelopment area and the Garfield Avenue station is located at the northwest corner of the area. The Bayonne branch forms the eastern border of the redevelopment area. The HBLR Operations and Maintenance (O & M) Facility is located where these branches diverge at the northeastern portion of the site. Since the Canal Crossing Redevelopment Plan is transit-oriented, the plan suggests the addition of a new station on the Bayonne branch within the redevelopment site near the eastern terminus of Caven Point Avenue to provide an additional option for future residents to access the HBLR system and its connectivity to other regional transit modes. Included among the stated objectives of the redevelopment plan is to encourage pedestrian interconnection to the light rail stations. A map of the HBLR System is included as Figure 2-1.

The purpose of this study is to evaluate the technical feasibility of constructing a new station at the selected location on the Bayonne branch including siting considerations, environmental impacts, effects on existing HBLR infrastructure and operations, construction impacts and cost considerations. The study will also model and analyze future HBLR ridership generated by the incremental development of the Canal Crossing site.

2.3 Study Basis and Assumptions

2.3.1 Station Site Study Area

The site selected by JCRA for the proposed new station is at the southeastern portion of the redevelopment site along the HBLR's Bayonne Branch near the eastern terminus of Caven Point Avenue (See Figure 2-2). The southern limit of the redevelopment site is just north of Bayview Avenue, therefore, the proposed station site will be considered to be northeast of the Bayview Avenue overpass. The HBLR O & M Facility, which also includes a light rail vehicle storage yard, is located along the entire length of the northeastern portion of the redevelopment site. Therefore, the proposed station study area will be considered to be southwest of the rail yard lead track turnout. These boundaries, as well as existing track geometric constraints, limit the study area to a linear track segment of approximately 600 feet.

2.3.2 Station Design Basis

The HBLR System has been designed in accordance with the criteria and requirements outlined in the New Jersey Transit Light Rail Manual of Design Criteria (MODC). The current edition is dated May, 2004. This document applies to all aspects of light rail infrastructure, systems and equipment. Chapter 9 establishes specific guidelines and standards for the design of stations including general design parameters, platform geometry and configuration, weather protection, amenities, lighting, pedestrian access, vehicular access and parking. The current edition of the MODC will be used as the principal reference document for new station design criteria unless otherwise noted.

The new station must be configured and designed to handle patrons efficiently, economically, safely, conveniently and comfortably. Two means of station platform access/egress will be considered in concept development. The feasibility assessment considers anticipated growth and long-term life of the system. It is assumed that the new station would be standardized functionally for HBLR system consistency but coordinated with and reflective of the adjacent community.

The MODC will guide the evaluation of station platform geometry and configuration options. Dimensional requirements are normally established by the more stringent of fire/life safety requirements or the day-to-day patron loading criteria. Platform configurations under consideration include at-grade track side or center locations. Normal platform lengths currently in service are typically 185 feet long to accommodate two-car consists. Exceptions are at Tonnelle Avenue, Bergenline , Port Imperial and Hoboken Terminal where three-car consists can be accommodated. For planning purposes, this site will be evaluated considering a 270 foot platform to accommodate three-car consists.

It is assumed that station amenities will be consistent with system standards including weather protection, fare vending equipment, communication systems, lighting and other furnishings. It should be noted that no restroom facilities will be considered since it is assumed that the new station will not meet the definition of a terminal station.

In evaluating the proposed station site, circulation elements will consider pedestrian access by regular commuters, infrequent users and persons with disabilities. Access by pedestrians and bicyclist will be encouraged. Vertical circulation elements will be considered in conjunction with grade separated structures where required for pedestrian safety. No park-and-ride facility will be considered at this site but accommodations for kiss-and-ride patrons will be evaluated. Vehicular access will be assessed and impacts to adjacent streets included in the development plan will be minimized.

3.0 NEEDS ASSESSMENT

3.1 Ridership Modeling and Analysis

Ridership modeling and analysis for the Canal Crossing Redevelopment Project was a collaborative effort between NJ Transit and URS. NJ Transit planning staff conducted mode-share analysis using the North Jersey Transit Demand Forecasting Model and provided URS with this information. URS developed station level ridership numbers for existing HBLR stations and the proposed new station near Caven Point on the Bayonne Branch.

Ridership forecasts were developed for the following four scenarios:

1. 2020 without new station
2. 2020 with new station
3. 2035 without new station
4. 2035 with new station

The development of ridership forecasts followed typical travel demand modeling steps including:

A. Trip generation – determined number of person trips generated by new development
B. Trip distribution – allocation of trips to/from Canal Crossings to other destinations (i.e., Manhattan, other parts of Jersey City, etc.)
C. Allocation of trips to travel modes (i.e., auto, bus, LRT, etc.)

3.1.1 Canal Crossing Development

The project team (T&M and JCRA) provided a worksheet with projected development for each block.. The number of residential units and square feet of retail and office development was projected for years 2020 and 2035. For the purpose of ridership analysis, the Canal Crossing development was partitioned into north and south parts as shown in Figure 3-1. These partitions were created based on the proximity of each block to the existing Garfield Avenue Station to the proposed Caven Point Station. In the modeling analysis, trips from both parts (north and south) were allowed to access either station, but with a longer walk time. The north part of the development, near the existing HBLR station at Garfield Avenue, is expected to be under construction first. Table 3-1 lists the projected development by north and south parts for 2020 and 2035. A total of 1,484 residential units and 93,000 square feet of retail development were assumed to be developed by 2020, almost all of them in the north part of the Canal Crossing. By 2035, a total of 6,040 residential units, 93,000 square feet of retail and 767,000 square feet office space are projected.

Table 3-1 Canal Crossing Development Summary

Development		2020			2035		
		CC South	CC North	Total	CC South	CC North	Total
Residential	Units	250	1,234	**1,484**	3,110	2,930	**6,040**
Retail	SF	0	93,000	**93,000**	0	93,000	**93,000**
Office	SF	0	0	**0**	498,000	268,900	**766,900**

3.1.2 Modeling Process

NJT Staff estimated the trips produced by the residential development and trips attracted to the non-residential portion of the Canal Crossing development based on ITE Trip Generation procedures, other national reports and based on knowledge of Jersey City. These trips were converted to person trips and were further divided into work and non-work trips and were incorporated into the North Jersey Transit Demand Forecasting Model (NJTDFM). The model distributed work and non-work trips to all potential destinations in the New York Metropolitan region. Based on the location of destinations and the competitiveness of available travel modes between Canal Crossing and that destination, the model allocated trips to various travel models (i.e., auto, bus, LRT, etc.). For example, trips between Canal Crossing and Lower Manhattan have a very high (85%) LRT mode-share while trips between Canal Crossing and parts of Jersey City other than Downtown have a LRT mode-share of just 5%.

The results of modeling analysis, in terms of trip allocation to different geography and associated LRT mode share, were summarized using a 10 district system. These districts include: four in Manhattan, one for outer boroughs of New York City, New York other, Jersey City Downtown, Jersey City Other, other Hudson County, and other New Jersey/Pennsylvania. Figure 3-2 provides a graphical depiction of these districts.

Table 3-2 provides a summary of trips produced (i.e., from residential units) from Canal Crossing for all four scenarios that were analyzed. This table includes both amount of trips distributed to each district and trips made by LRT mode. As shown in the table, in year 2020, of the total 9,100 trips produced at Canal Crossing, Jersey City Other (3,600), Jersey City Downtown (1,100), and other Hudson County (1,900) represent the top three destinations. Similarly, trips made by LRT can also be derived from this table. For 2035, of the approximately 34,000 trips produced at the development, approximately 5,900 trips will use LRT in the scenario without the new station. The LRT usage for trips produced at Canal Crossing is expected to jump to 9,500 with the construction of the new station.

Table 3-3 provides a similar summary for trips that are attracted to non-residential development at Canal Crossing. In 2020, the 93,000 square feet of retail space is expected to attract 9,200 person-trips of which only approximately 300 will use LRT. Since the majority of trips are expected to come from Jersey City Other (5,000) for shopping purposes, low LRT usage is expected.

Table 3-2 Total Trips Generated by Residential Development

TO	2020						2035					
	without Station			with Station			without Station			with Station		
	Total Trips [1]	LRT Trips [1]	LRT Mode Share	Total Trips [1]	LRT Trips [1]	LRT Mode Share	Total Trips [1]	LRT Trips [1]	LRT Mode Share	Total Trips [1]	LRT Trips [1]	LRT Mode Share
All Destinations	9,147	1,933	21%	9,147	2,290	25%	34,181	5,920	17%	34,182	9,470	28%
Lower Manhattan	304	255	84%	304	275	90%	1,236	948	77%	1,236	1,061	86%
Manhattan Valley	150	84	56%	150	98	65%	612	316	52%	612	424	69%
Midtown Manhattan	612	370	60%	612	436	71%	2,407	1,432	59%	2,407	1,955	81%
Upper Manhattan	63	41	65%	63	44	70%	258	130	50%	258	190	74%
Brooklyn/Queens/SI	504	75	15%	504	85	17%	2,033	306	15%	2,034	354	17%
Other New York	28	7	25%	28	9	32%	76	17	22%	76	36	47%
JC - Downtown	1,122	809	72%	1,122	861	77%	4,298	2,784	65%	4,298	3,503	82%
JC - Other	3,570	158	4%	3,570	191	5%	13,385	487	4%	13,385	765	6%
Other Hudson County	1,908	213	11%	1,908	341	18%	6,906	699	10%	6,906	1,292	19%
Other New Jersey/PA	886	4	0%	886	20	2%	2,970	13	0%	2,970	97	3%

[1] Trips ***PRODUCED AT*** Canal Crossing Development

Table 3-3 Total Trips Generated by Non-Residential Development

FROM	2020						2035					
	without Station			with Station			without Station			with Station		
	Total Trips [2]	LRT Trips [2]	LRT Mode Share	Total Trips [2]	LRT Trips [2]	LRT Mode Share	Total Trips [2]	LRT Trips [2]	LRT Mode Share	Total Trips [2]	LRT Trips [2]	LRT Mode Share
All Destinations	9,251	296	3%	9,250	354	4%	13,804	653	5%	13,803	836	6%
Lower Manhattan	3	0	0%	3	0	0%	6	0	0%	6	0	0%
Manhattan Valley	8	0	0%	8	0	0%	19	0	0%	19	0	0%
Midtown Manhattan	4	0	0%	4	0	0%	31	1	3%	31	3	10%
Upper Manhattan	4	0	0%	4	0	0%	73	1	1%	73	3	4%
Brooklyn/Queens/SI	11	0	0%	11	0	0%	207	2	1%	207	5	2%
Other New York	20	0	0%	20	0	0%	63	0	0%	63	0	0%
JC - Downtown	403	52	13%	403	52	13%	571	91	16%	571	121	21%
JC - Other	4,985	191	4%	4,985	209	4%	7,293	420	6%	7,293	511	7%
Other Hudson County	1,019	52	5%	1,019	92	9%	1,790	135	8%	1,790	189	11%
Other New Jersey/PA	2,794	2	0%	2,793	2	0%	3,751	4	0%	3,750	5	0%

[2] Trips ***ATTRACTED TO*** Canal Crossing Development

3.1.3 LRT Station Ridership

URS analyzed model results to develop an estimate of the potential increase in LRT usage at the existing and proposed new station. Total trips and LRT mode-share for trips from the north and south portions of the Canal Crossing development were summarized. Assumptions related to how trips from the development will access the three existing stations near the development site as well as the proposed new station were made to distribute the projected LRT ridership. These assumptions were based on the proximity of the station relative to development, pattern of existing LRT usage, and professional judgment of URS and NJT staff. For example, it was assumed that approximately 5% of trips will prefer to drive to the Liberty State Park Park-n-Ride lot and take LRT rather than walking to nearby station.

Table 3-4 lists the summary of trips, station access allocation, and calculated station usage. This information is summarized for “with” and “without” new station scenarios in 2020 and 2035.

The major observations from this table are listed below:

LRT Trips:

1. In 2020, out of a total of 18,400 daily trips, approximately 2,200 trips will be made using the existing LRT stations, if a new station is not constructed. In the scenario with new station, LRT trips will increase to 2,600.
2. In 2035, out of a total of 48,000 daily trips related to Canal Crossing, approximately 6,600 trips will be made via LRT without the new station. If a new station at Caven Point is constructed, trips made by LRT will increase to 10,300, a significant increase.

Station Allocation:

1. For scenarios without a new station (both 2020 and 2035), for LRT trips from the north part of the development, it is assumed that 90% will use the existing Garfield Avenue Station, 5% will use Richard Street Station and 5% will use the Liberty State Park Station (LSP).
2. For trips made from south part of the development, without a new station, it is assumed that 85% will use the Garfield Avenue Station, 10% will use Richard Street Station and 5% will use LSP.
3. In scenarios with a new LRT Station at Caven Point, for trips from the south part of the development, it was assumed that 90% will use the new station, 5% will use Garfield Avenue Station and 5% will use LSP. With the new station, there is no need to use Richard Street Station.

Incremental Station Use:

1. It is projected that approximately 600 trips will be made using the new station in 2020 on an average weekday. This number is expected to increase to 5,300 trips by 2035.
2. The existing Garfield Avenue Station usage will increase by 1,900 and 4,500 trips in 2020 and 2035, respectively with new station scenarios.
3. In 2035 without new station scenario, the Garfield Avenue Station will see an increase of 5,800 trips.

It should be noted that all numbers are listed in production/attraction (P/A) trip format so one-half of these trips will be station boarding (Ons) and one-half will be alighting (Offs). Also it should be noted that the station usage listed for the existing LRT station in the table is an incremental value associated with the Canal Crossing Development. These numbers should be added to projected station usage without the Canal Crossing Development (no development scenario).

TABLE 3-4 INCREMENTAL LRT TRIPS FROM CANAL CROSSING DEVELOPMENT

		2020						2035					
		Without New Station			With New Station			Without New Station			With New Station		
		CC South	CC North	Total	CC South	CC North	Total	CC South	CC North	Total	CC South	CC North	Total
		Trips											
Trips	Total	1,409	16,989	18,398	1,409	16,988	18,397	20,559	27,426	47,985	20,560	27,425	47,985
	LRT	140	2,089	2,229	408	2,238	2,646	1,961	4,614	6,575	5,381	4,926	10,306
		Allocation (Percent) of Trips to LRT Stations											
Station Allocation	Garfield Ave.	85	90		5	85		85	90		5	85	
	LSP	5	5		5	5		5	5		5	5	
	Richard St.	10	5		0	0		10	5		0	0	
	CC Station	0	0		90	10		0	0		90	10	
	Total	100	100		100	100		100	100		100	100	
		Daily Station Use for Trips from Canal Crossing											
Incremental Trips	Garfield Ave.	119	1,880	1,999	20	1,902	1,923	1,667	4,153	5,820	269	4,187	4,456
	LSP	7	104	111	20	112	132	98	231	329	269	246	515
	Richard St.	14	104	118	0	0	0	196	231	427	0	0	0
	CC Station	0	0	0	367	224	591	0	0	0	4,843	493	5,335
	Total	140	2,089	2,229	408	2,238	2,646	1,961	4,614	6,575	5,381	4,926	10,306
	Net New Trips				268	149	417				3,419	312	3,731

3.1.4 RIDERSHIP ANALYSIS SUMMARY

Ridership forecasts associated with the redevelopment at Canal Crossing were conducted using the transit demand forecasting model maintained by New Jersey Transit. Ridership estimates for future years 2020 and 2035 for three existing LRT stations around the development site and the proposed new station at Caven Point on the Bayonne Branch were developed for scenarios with and without new station. It is projected that the new development at Canal Crossing will generate approximately 2,200 LRT trips in year 2020 without new station scenario. If the new station at Caven Point is constructed, the number of development trips using LRT would increase to 2,600, a net increase of 400 trips. However, by 2035, the number of trips made via LRT from Canal Crossing would increase significantly to 6,600 in the scenario without the new station and to over 10,000 trips with new station, a net increase of 3,700 trips. For a comparison, the existing HBLR serves approximately 45,000 trips. Table 3-5 lists Ons and Offs at existing stations on HBLR.

In summary, the Canal Crossing redevelopment will generate a significant amount of trips that would be made by LRT. However, the majority of the demand for the proposed Caven point station would be generated beyond 2020, once the residential units are constructed in the southern portion of the development. The forecasting analysis also estimated a significant increase in LRT trips at the Garfield Avenue Station. Hence, NJT will further study, as a separate effort from the current scope, the improvement needs at this station focusing on pedestrian access and shuttle bus service for trips from Canal Crossing.

TABLE 3-5 EXISTING STATION USAGE ON HBLR

Station	July-Aug 2011		Sept-Oct 2011		Nov-Dec 2011		Jan-Feb 2012		Mar-April 2012		Average Jul 11-Apr 12	
	On	Offs	On	Offs	On	Offs	On	Offs	On	Offs	On	Offs
8th St.	1,162	1,133	1,147	1,201	1,138	1,102	1,186	1,307	1,249	1,227	1,176	1,194
22nd St.	1,779	1,566	1,836	1,673	1,817	1,723	1,795	1,815	1,872	1,717	1,820	1,699
34th St.	1,794	1,544	1,749	1,618	1,677	1,565	1,620	1,490	1,646	1,586	1,697	1,561
45th St.	1,014	771	972	927	836	822	857	881	912	935	918	867
Danforth Ave.	970	691	911	774	848	743	787	767	929	751	889	745
Richard St.	633	525	643	579	593	525	645	476	688	563	640	534
West Side	1,575	1,519	1,846	1,811	1,914	1,867	1,693	1,606	1,734	1,659	1,752	1,692
MLK Drive	1,184	1,295	1,305	1,401	1,426	1,518	1,179	1,227	1,206	1,307	1,260	1,350
Garfield	737	701	744	765	813	729	731	656	731	734	751	717
Liberty P/R	2,767	2,781	2,985	2,713	2,711	2,404	2,684	2,253	2,800	2,401	2,789	2,510
Jersey Ave.	1,114	918	1,163	1,153	1,125	1,076	940	1,072	1,020	1,001	1,072	1,044
Marin Blvd.	473	512	532	543	560	605	524	564	573	510	532	547
Essex St.	1,299	1,400	1,319	1,415	1,124	1,424	1,267	1,406	1,174	1,300	1,237	1,389
Exch Pl.	4,866	5,673	4,972	5,668	5,210	5,980	4,979	5,841	4,683	5,606	4,942	5,754
Harborside	1,822	1,957	1,764	2,037	1,743	1,890	1,714	1,895	1,704	1,645	1,749	1,885
Harsimus	1,097	961	991	821	1,052	851	995	781	1,031	822	1,033	847
Newport	6,044	6,954	5,757	6,343	6,370	6,663	5,799	6,462	6,068	6,325	6,008	6,549
Hoboken	5,417	5,316	5,148	5,323	5,149	5,357	5,340	5,567	4,803	5,323	5,171	5,377
2nd St.	1,056	892	1,115	976	1,075	882	943	733	1,054	803	1,049	857
9th St.	2,411	2,094	2,659	2,114	2,447	1,969	2,555	1,814	2,424	2,044	2,499	2,007
Lincoln Harbor	737	730	757	795	703	682	686	753	760	708	729	734
Port Imperial	996	800	1,105	819	1,092	705	1,021	810	1,055	831	1,054	793
Bergenline Ave.	3,078	3,394	3,243	3,239	3,208	3,494	3,088	2,975	3,142	3,457	3,152	3,312
Tonnelle Ave.	1,148	1,046	1,122	1,077	1,056	1,111	1,111	988	1,072	1,075	1,102	1,059
Total	**45,173**	**45,173**	**45,785**	**45,785**	**45,687**	**45,687**	**44,139**	**44,139**	**44,330**	**44,330**	**45,023**	**45,023**

4.0 DEVELOPMENT OF STATION FEASIBILITY ALTERNATIVES

4.1 Existing Site Conditions

The northern portion of the proposed station study site is east of the terminus of Caven Point Avenue. The HBLR O & M Facility is served by an access road beginning at the terminus of Caven Point Avenue and extending in a northeasterly direction parallel to and northwest of the HBLR right-of-way. The balance of the land use adjacent to the proposed station site northwest of the right-of-way and southwest of Caven Point Avenue is currently industrial. The proposed Canal Crossing Development street system will retain Caven Point Avenue as currently aligned but will create a new street (Pine Street) parallel to the HBLR and the proposed station site. The area south and east of the HBLR right-of-way in the proposed station site study area currently functions as a regional storm water detention pond maintained by New Jersey Transit.

The topography west of the HBLR right-of-way is generally flat and only 7-10 feet above mean sea level. A 5-10 foot wide drainage ditch, constructed in conjunction with the light rail project, extends the full length of the study area west of the right-of-way and conveys storm drainage runoff through one of five box culverts (within the study area) under the track bed into the detention pond east of the right-of-way. The bottom of the detention pond is only approximately five feet above sea level. The track profile in the study area is level and the top of rail elevation was constructed approximately one foot above the statistical 100-year flood elevation.

Soil conditions in the vicinity of the proposed station site are not specifically known but are generally understood to be poor with respect to their engineering properties and subject to seasonally high groundwater levels. There is also a local and regional history of soil contamination as evidenced by the remediation activities currently underway within the Canal Crossing Development site to the north and east.

With the exception of the existing HBLR infrastructure within the right-of-way, there are only two known subsurface utilities in the vicinity of the proposed station site. An existing water main and gas main within the Caven Point right-of-way extend under the HBLR track bed and detention pond to the southeast. Casing pipes were installed under the tracks during the light rail project construction to protect these utility pipes.

A site reconnaissance of the proposed station study area was conducted to review existing conditions. Photos of the site features within and adjacent to the HBLR right-of-way are included in Appendix B.

4.2 Existing HBLR Infrastructure

The most significant issues affecting the development of station feasibility alternatives are the impacts on the physical rail infrastructure in the station study area as well as the impacts on current and future operations. As previously noted, the HBLR O & M Facility is located at the northeastern corner of the Canal Crossing Development site, where the Bayonne and West Side Avenue Branches diverge. Light rail vehicles entering and exiting the rail storage yard and maintenance facility utilize the South Yard Lead Track located at the south end of the yard and the north end of the proposed station site to access the main line tracks of the Bayonne Branch. An interlocking, or series of crossover tracks on the main line directly southwest of the lead track turnout, allows rail vehicles to move between the northbound and southbound tracks. This interlocking occupies virtually the entire proposed station study site. Building a station in the vicinity of the interlocking would not only inhibit its intended function, but would have a significant impact on yard access and rail operations. Therefore, the only way a station could be accommodated at this site would be to relocate or reconfigure the interlocking and all of its associated track, signal, power and communication systems.

The HBLR system derives its traction power from an overhead catenary system (OCS). The electrified contact wire above the track is supported by a system of brackets hung from poles located either between tracks or adjacent to their sides. Depending on loading conditions and track geometry, some poles utilize guy wires attached to anchor foundations to complete the support system. There are fourteen (14) OCS poles and anchors within the proposed station study area. All but three (3) are located at trackside, primarily because the interlocking crossover tracks inhibit the use of center poles. Construction of a new station within the study area would also require a reconfiguration of the OCS system associated with the existing interlocking.

Another significant segment of HBLR infrastructure within the proposed new station study area is the system-wide cableway. This system includes an underground electrical duct bank consisting of a series of four to six conduits encased in concrete aligned parallel to and approximately ten feet east of the easterly or northbound HBLR track. These conduits carry signal, communications and power cables critical to rail operations. The system also includes several underground manholes and junction boxes as well as an above ground central instrument house (CIH) and transformer adjacent to the northern crossover of the existing interlocking.

Figure 4-1 depicts a current plan and profile of HBLR tracks and related infrastructure in the station study area.

4.3 Existing HBLR Operations

The HBLR operates in revenue service approximately twenty (20) hours per day, seven (7) days per week on both the Bayonne Branch, east of the redevelopment site, and on the West Side Avenue Branch north of the site. With respect to current operations, this discussion focuses on the Bayonne Branch in the vicinity of the proposed new station.

The service schedule in effect in early 2012 includes a mix of daily local and express trains both northbound and southbound. Local stations served north and south of the proposed new station site are at Liberty State Park and Richard Street respectively. These stations are separated by approximately three (3) minutes of running time. Express trains begin and end at 8th Street Bayonne to the south and skip all stations between 45th Street in Bayonne and Essex Street in Jersey City which represent the express stations closest to the proposed new station site.

Table 4-1 summarizes the number of northbound (NB) and southbound (SB) trains passing through the site of the proposed new station at Caven Point Avenue based on the schedule in effect in early 2012.

TABLE 4-1 CURRENT SERVICE PLAN – BAYONNE BRANCH

SERVICE	5:00 AM - 12:00 N	12:01 PM – 1:00 AM	TOTAL
NB Local	30	48	78
NB Express	10	4	14
Total NB Trains	**40**	**52**	**92**
SB Local	41	52	93
SB Express	4	8	12
Total SB Trains	**45**	**60**	**105**

In addition to revenue service, the proposed station site is also subject to non-revenue rail traffic from vehicles entering and exiting the storage yard and maintenance facility by virtue of its proximity to the South Yard Lead Track and adjacent interlocking as previously discussed.

The two most significant issues to be addressed with regard to current HBLR operations if a new station is constructed are as follows:

- How would new station construction activities affect current operations and what accommodations must be made to maintain the required level of service through this period
- How should the current operating plan be modified to permit the new station to function best in serving the future population of the Canal Crossing redevelopment

Construction impacts and operational alternatives are discussed in Sections 5.2 and 5.3.

4.4 Description of Station Alternatives

In order to assess the feasibility of constructing a new HBLR station at the selected site on the Bayonne Branch to serve the future Canal Crossing development ridership, several conceptual alternatives were developed. These alternatives include a "no build" alternative and three (3) new station alternatives. Each of the new station options have two variations on the basic concepts related to platform location and configuration. An assessment of the advantages and disadvantages of this alternative is included in Section 5.0. The following is a discussion of the alternatives evaluated.

4.4.1 No Build Alternative

Under this scenario, a new station would not be constructed at the selected site on the Bayonne Branch. As the Canal Crossing site is incrementally developed, passengers would predominantly utilize the existing Garfield Avenue Station in the northern portion of the site to access the HBLR. Figure 2-2 illustrates the location of the Garfield Avenue Station relative to the redevelopment site.

4.4.2 Alternative 1 (Option 1A & 1B)

This alternative would require a reconfiguration of the existing "universal" crossover interlocking to a "diamond" crossover interlocking using either the current southern crossover (Option 1A) or the northern crossover (Option 1B) as the location for the new diamond. In both variations of this option, two new side platforms would be constructed in the vicinity of the crossover that was removed as part of the interlocking reconfiguration. Option 1A would require relocation of the existing CIH and transformer. It may be possible to salvage the CIH and transformer in Option 1B. This alternative and options are illustrated on Figures 4-2 and 4-3.

4.4.3 Alternative 2 (Option 2A & 2B)

This alternative concept has two options that include construction of a third main line track east of the existing northbound track in the vicinity of the new station. The concept also requires that a crossover track, or perhaps the entire interlocking, be relocated to the tangent track south of the Bayview Avenue overpass. In Option 2A, the existing southern crossover would be relocated and two side platforms would be constructed,

one adjacent to the existing southbound track and one adjacent to (east of) the new track. The new third track segment would serve the new northbound platform. Option 2B is similar to Option 2A except that the new station would consist of a center platform configuration constructed between the existing northbound track and the new third track. This alternative and options are illustrated on Figures 4-4 and 4-5.

4.4.4 Alternative 3 (Option 3A & 3B)

This alternative concept has two options that include construction of a third track west of the existing southbound track in the vicinity of the new station. This new track would essentially extend the South Yard Lead Track south of the new station site. In Option 3A, the existing interlocking would be removed and a new interlocking constructed on the tangent track south of the Bayview Avenue overpass. The South Yard Lead Track would be realigned and extended such that its turnout would be approximately 600 feet south of its current location. This would permit the construction of a station consisting of two side platforms adjacent to the existing main line tracks. Option 3B would be similar to Option 3A except that the Yard Lead Track would be extended further south, beyond the Bayview Avenue overpass, to a point just north of the new interlocking. This would provide more room for the station platforms and track realignment. This alternative and options are illustrated on Figures 4-6 and 4-7.

5.0 ASSESSMENT OF ALTERNATIVES

All of the alternatives considered were evaluated in terms of a number of factors including engineering, construction, HBLR operations and capital costs. Table 5-1 summarizes comparative advantages and disadvantages of each of the alternatives considered. The following is a discussion of the factors considered.

5.1 Engineering Considerations

Each one of the alternatives that involve new station construction would require a wide range of engineering considerations to be addressed during design development. These considerations include siting and environmental issues as well as significant redesign and reconfiguration of the existing HBLR infrastructure in the vicinity.

All options associated with each of the alternatives involve modifications to the existing drainage ditch and at least two culverts that convey runoff from the west side of the HBLR tracks to the detention pond to the east. This is required as a result of the addition of earth fill and re-grading that would be necessary to permit access to the new station platforms. The extent of the required grading and drainage modifications are even more significant in Alternatives 2 and 3 because they each consider a third track either east or west of the existing right-of-way. In addition, the third track suggested in Alternative 2 would result in a slight loss in detention pond storage capacity.

Foundation design for the proposed station platforms in this area would require special attention for each of the alternatives. As previously indicated, based on prior construction in the vicinity, subsurface soil conditions are expected to be structurally poor, possibly contaminated and subject to seasonally high groundwater. A site-specific subsurface investigation program would be required to determine and analyze engineering properties of soils and develop foundation design criteria and site mitigations needed. Foundations would also be required to span the existing drainage culverts and any utilities that traverse the site opposite Caven Point Avenue.

By far the most significant engineering considerations affecting all of the alternatives reviewed are those associated with required modifications to the HBLR infrastructure. As previously stated, the existing interlocking, including crossover tracks, overhead catenary supports, signal and communication infrastructure would have to be relocated while still maintaining service on the branch and access to the rail yard. In Alternative 1, the existing crossover tracks would be modified to a “diamond” configuration. This would be costly and disruptive to install and more expensive to maintain than a standard crossover through its service life. Alternatives 2 and 3 would require the entire interlocking to essentially be relocated approximately 1000 feet southward based on current track geometry and station siting requirements. Catenary system support structures would require redesign and reconfiguration at both the current and proposed interlocking sites under this scenario. Additionally, Alternative 3 would require relocation of the underground system-wide cableway ductbank, manholes and Central Instrument House (CIH).

TABLE 5-1 COMPARISON OF STATION ALTERNATIVES (Part 1)

FACTOR	NO BUILD	ALTERNATIVE 1	
		OPTION 1A	OPTION 1B
Engineering / Environmental	**ADVANTAGES** • No impacts to Caven Point site **DISADVANTAGES** • Poor HBLR accessibility for southern portion of development site (>1/4 mile distance to Garfield Ave. Station)	**ADVANTAGES** • Preferred station location per development plan **DISADVANTAGES** • High maintenance diamond crossover required • OCS, signal modifications, CIH relocation • Some grading & drainage modifications east & west of HBLR ROW; utility conflicts at north end	**ADVANTAGES** • Possibly no CIH relocation required **DISADVANTAGES** • High maintenance diamond crossover required • OCS, signal modifications required
Construction	**ADVANTAGES** • No impacts to Caven Point site **DISADVANTAGES** • Accessibility improvements to Garfield Ave. Station may be required	**ADVANTAGES** • Trackwork modifications limited to crossover & DF track at new platforms **DISADVANTAGES** • Construction staging issues related to interlocking relocation and platform construction will extend schedule	**ADVANTAGES** • Trackwork modifications limited to crossover & DF track at new platforms **DISADVANTAGES** • Construction staging issues related to interlocking relocation and platform construction will extend schedule
HBLR Operations	**ADVANTAGES** • No impacts to Bayonne Branch operations **DISADVANTAGES** • Access to system for entire development limited to Garfield Ave. Station	**ADVANTAGES** • None **DISADVANTAGES** • New station location will adversely impact O&M Facility access/egress from South Yard Lead Track • Construction will impact operations	**ADVANTAGES** • Reconfigured interlocking close to yard lead track **DISADVANTAGES** • New station location will adversely impact O&M Facility access/egress from South Yard Lead Track • Construction will impact operations
Capital Cost	**ADVANTAGES** • No capital cost expenditure for new station **DISADVANTAGES** • None	**ADVANTAGES** • Less expensive than Alternatives 2 & 3 **DISADVANTAGES** • Cost several times more expensive than average station as a result of HBLR infrastructure impacts	**ADVANTAGES** • Less expensive than Alternatives 2 & 3 **DISADVANTAGES** • Cost several times more expensive than average station as a result of HBLR infrastructure impacts

TABLE 5-1 COMPARISON OF STATION ALTERNATIVES (Part 2)

FACTOR	ALTERNATIVE 2		ALTERNATIVE 3	
	OPTION 2A	OPTION 2B	OPTION 3A	OPTION 3B
Engineering / Environmental	**ADVANTAGES** • Diamond crossover not required **DISADVANTAGES** • Significant grading & drainage modifications east & west of HBLR • New interlocking required; OCS, system wide cableway impacted	**ADVANTAGES** • Diamond crossover not required **DISADVANTAGES** • Significant grading & drainage modifications east of HBLR ROW at detention pond	**ADVANTAGES** • Preferred Station location **DISADVANTAGES** • Significant grading & drainage modifications west of HBLR ROW, and east at detention pond	**ADVANTAGES** • None **DISADVANTAGES** • More extensive grading & drainage modifications west of ROW compared to Option 3A
Construction	**ADVANTAGES** • None **DISADVANTAGES** • Construction staging issues related to interlocking relocation & platform construction will extend schedule	**ADVANTAGES** • Less impact to southbound track compared to Option 2A **DISADVANTAGES** • Construction staging issues will extend schedule	**ADVANTAGES** • None **DISADVANTAGES** • Construction staging issues will extend schedule • Re-alignment of South Yard Lead Track required	**ADVANTAGES** • None **DISADVANTAGES** • Construction staging issues will extend schedule • Re-alignment of South Yard Lead Track required
HBLR Operations	**ADVANTAGES** • Better access/egress to yard • Express trains able to bypass **DISADVANTAGES** • Requires additional switching operations & maintenance • Northbound passengers must cross three tracks to access platform	**ADVANTAGES** • Better access/egress to yard • Express trains able to bypass **DISADVANTAGES** • Requires additional switching operations & maintenance • All passengers must cross two tracks to access platform	**ADVANTAGES** • Fewer station impacts to yard access than Alternative 1 **DISADVANTAGES** • No express bypass track • Northbound passengers must cross three tracks to access platform	**ADVANTAGES** • Fewer station impacts to yard access than Alternative 1 **DISADVANTAGES** • No express bypass track Northbound passengers must cross three tracks to access platform
Capital Cost	**ADVANTAGES** • None **DISADVANTAGES** • Additional cost of new interlocking • Additional cost of third track	**ADVANTAGES** • None **DISADVANTAGES** • New track & interlocking costs • High site preparation costs	**ADVANTAGES** • None **DISADVANTAGES** • New track & interlocking costs • Additional cost of re-aligning & extending South Yard Lead Track	**ADVANTAGES** • None **DISADVANTAGES** • New track & interlocking costs • Greater cost of extending South Yard Lead Track than Option 3A

5.2 Construction Impacts

Each one of the proposed new station alternatives would result in significant construction impacts complicated by their proximity to the active HBLR right-of-way. Issues to be addressed in construction planning include sequence of work and staging; work zone safety; work shift utilization and productivity; and scheduling impacts resulting from coordination with HBLR operations.

As previously mentioned each alternative will require modifications to several culvert inlets and outlets to permit functional drainage during construction and following required re-grading at the proposed passenger platform sites. Access to both sides of the HBLR right-of-way would be required to facilitate the placement of earth embankment and drainage structures. Installation of temporary grade crossings with appropriate safety considerations would be required.

Foundations for the new platforms would, by definition, be within fouling distance of existing operating track. Construction would have to be carefully staged to minimize service impacts. The use of precast elements may be required to expedite installation.

Construction, relocation or re-configuration of HBLR infrastructure will result in the most significant construction impacts. Trackwork associated with new interlocking construction would have to be completed prior to removal of the existing turnouts and crossovers. The overhead catenary wire and support system would have to be reconstructed in a sequentially staged manner to permit rail operations to continue with minimal interruption. Similarly, the underground system-wide cableway ductbank and manholes would have to be relocated to support the new interlocking signals and power supply. This will likely require a separate system installation and a coordinated, sequential cutover to the new service.

5.3 HBLR Operations Impacts

Construction impacts previously described must be addressed in the context of HBLR operational impacts. Operationally coordinated construction planning would be essential to minimize service disruptions, particularly during rush hours, and maintain access to and from the HBLR O & M Facility via the south yard lead track.

As previously indicated in Section 4.3 (Reference Table 4-1), HBLR currently operates local and express service through the proposed station site. Both Alternatives 1A and 1B would adversely affect O & M Facility access and current operations. Access to and from the yard would be limited by rail vehicles serving the proposed station.

Alternatives 2 and 3 have been developed to address impacts the proposed station would impose on rail operations at this location for both revenue service and yard access. Alternatives 2A and 2B provide a new third track east of the current northbound track. This new track would permit northbound or southbound passenger service to stop at the new station platforms without blocking rail traffic entering or exiting the yard. It

would also provide an express track to bypass the new station platforms. Alternatives 3A and 3B essentially extend the south yard lead track further southward to avoid conflicts between non-revenue trains and passenger trains stopped at the new station platforms. For either Alternative 2 or 3, it may be advantageous to construct the new track in the early stages of construction and place it in service to provide operational flexibility in staging the balance of construction.

From a planning perspective, it would be anticipated that construction activities outside the fouling limits of the HBLR would be performed during normal weekday shifts or if necessary overnight. Cut-ins would be performed during weekend outages. Watchman protection and a carefully crafted work plan would be necessary to insure the safety of construction crews and railroad employees. Further assessment would be required to determine if more extensive outages would be necessary.

If a new station is constructed at Caven Point Avenue, a wide range of service options could be considered. In addition to local service, the new station could include some form of skip-stop or express service to and from Bayonne or could serve as a terminal station for select service.

5.4 Cost Considerations

The construction cost of a "typical" low platform light rail station varies depending on site conditions, platform configuration and amenities provided. For the purposes of relative comparisons made in this study, we have assumed that a station constructed in accordance with the design basis described in this report could be constructed for approximately $6-$7 million if built on an unencumbered site in 2012. With the addition of engineering, construction management and other associated project "soft" costs, the total project cost could be in the range of $12-$15 million.

We have added to this base assumption order of magnitude costs to address site conditions, required HBLR infrastructure modifications and impacts associated with staged construction in an operating environment for each of the alternatives considered. It should be noted that all of these factors are highly variable depending on site specific conditions, construction staging plans, operating constraints and market conditions. Therefore, it should be cautioned that the relative costs represent an order of magnitude comparison and not a precise construction cost estimate.

All of the proposed station alternatives involve significant impacts to current HBLR infrastructure and the cost of these modifications, performed adjacent to an operating railroad, drive the total project costs. Limited work windows and lower productivity would increase unit costs. Therefore, thoughtful construction planning would be necessary to mitigate operational impacts and total project costs.

Among the new station options considered, Alternatives 1A and 1B are the least expensive. Although trackwork modifications would be comparatively less extensive

than the other alternatives, related catenary system re-configuration, signal and communication system modifications would be significant. Operational disadvantages associated with these two alternatives may outweigh the relative cost advantages.

Alternatives 2 and 3 are in the range of 30% to 50% more expensive than Alternative 1 but provide some operational advantages. These two alternatives would also be much more disruptive to ongoing rail operations as their construction sites are much larger and their implementation schedules much longer than Alternative 1.

Table 5-2 presents a relative comparison of order of magnitude construction costs assuming the station would be constructed within the next several years. These costs would obviously require additional escalation to the midpoint year of construction if the new station is not justified until a future development ridership level is reached in subsequent years.

TABLE 5-2 COMPARISON OF STATION ROUGH ORDER OF MAGNITUDE (ROM) COSTS ($Million)

DESCRIPTION	ALTERNATIVE					
	1A	1B	2A	2B	3A	3B
Station Construction (1)	7.2	7.2	7.6	6.1	7.6	7.6
Associated Project Costs (2)	3.4	3.4	3.6	2.9	3.6	3.6
Estimated ROM Costs	10.6	10.6	11.2	9.0	11.2	11.2
Inflation (10%) & Contingency (20%)	3.2	3.2	3.4	2.7	3.4	3.4
Total Estimated ROM Station Costs	**13.8**	**13.8**	**14.6**	**11.7**	**14.6**	**14.6**
HBLR Infrastructure Allowance (3)	6.0	6.0	10.0	10.0	9.0	10.0
Associated Project Costs (2)	3.0	3.0	5.0	5.0	4.5	5.0
Estimated ROM Costs	9.0	9.0	15.0	15.0	13.5	15.0
Inflation (10%) & Contingency (40%)	4.5	4.5	7.5	7.5	6.7	7.5
Total Estimated ROM HBLR Costs	**13.5**	**13.5**	**22.5**	**22.5**	**20.2**	**22.5**
GRAND TOTAL ROM COST (Station & Rail infrastructure)	**27.3**	**27.3**	**37.1**	**34.2**	**34.9**	**37.1**

(1) Includes station construction and related site development completed by 2015
(2) Includes engineering, construction mgmt., permitting
(3) Includes allowance for trackwork, OCS re-configuration, traction power, signals & communications

6.0 CONCLUSIONS

Although it is technically feasible to construct a new light rail station at the Caven Point Avenue site suggested by the Canal Crossing Redevelopment Project, the site-specific construction costs, particularly related to HBLR infrastructure modifications make it significantly more expensive than a "typical" LRT station. Relocation of the existing rail interlocking with its associated construction and operating impacts would require complex technical considerations and an extraordinary funding source.

Additionally, based on the projected ridership generated by the proposed development, at least in the initial years, the need for a new station at this location is marginal. Most of the first phase of development is planned for the northern portion of the site, within one-quarter mile of the existing HBLR Garfield Avenue Station on the West Side Avenue Branch. As this branch currently has more available capacity than the Bayonne Branch, it appears logical to encourage use of this station in the near term.

However, as the proposed development progresses in subsequent years, the location and magnitude of projected ridership, based on the assumptions evaluated in this study, suggest a second station on the Bayonne Branch in the vicinity of Caven Point Avenue is justified. Projected LRT ridership (over 10,000 trips) with a new station in place in 2035 more than justifies a new station as this level of usage at the new station alone (over 5,300 trips) would most probably rank the new station among the busiest in the system at that time. Projected ridership levels in 2035 also suggest that the Garfield Avenue Station usage would increase by about 5,800 trips over current levels with a new station at Caven Point also serving the community.

APPENDIX A

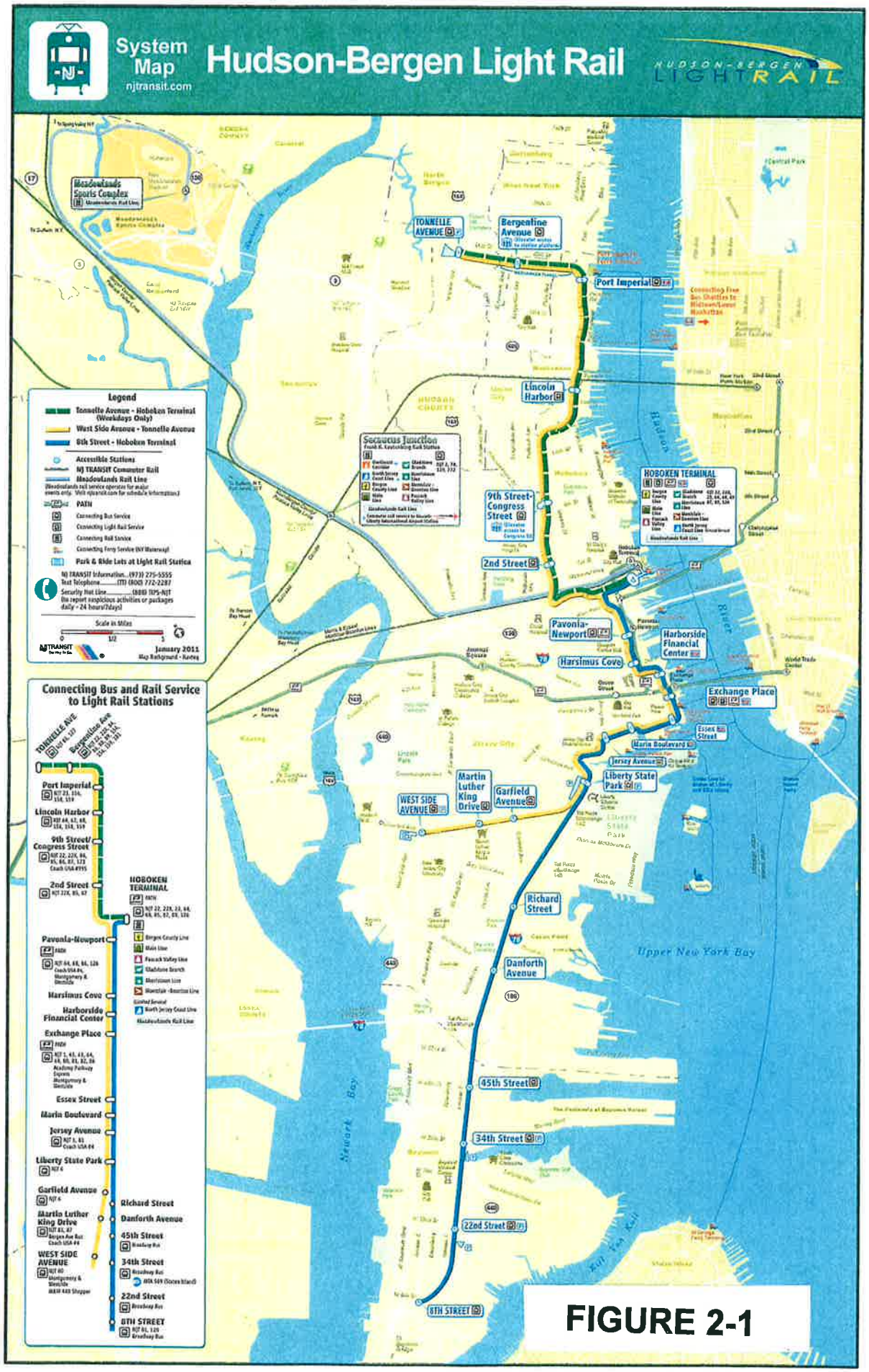
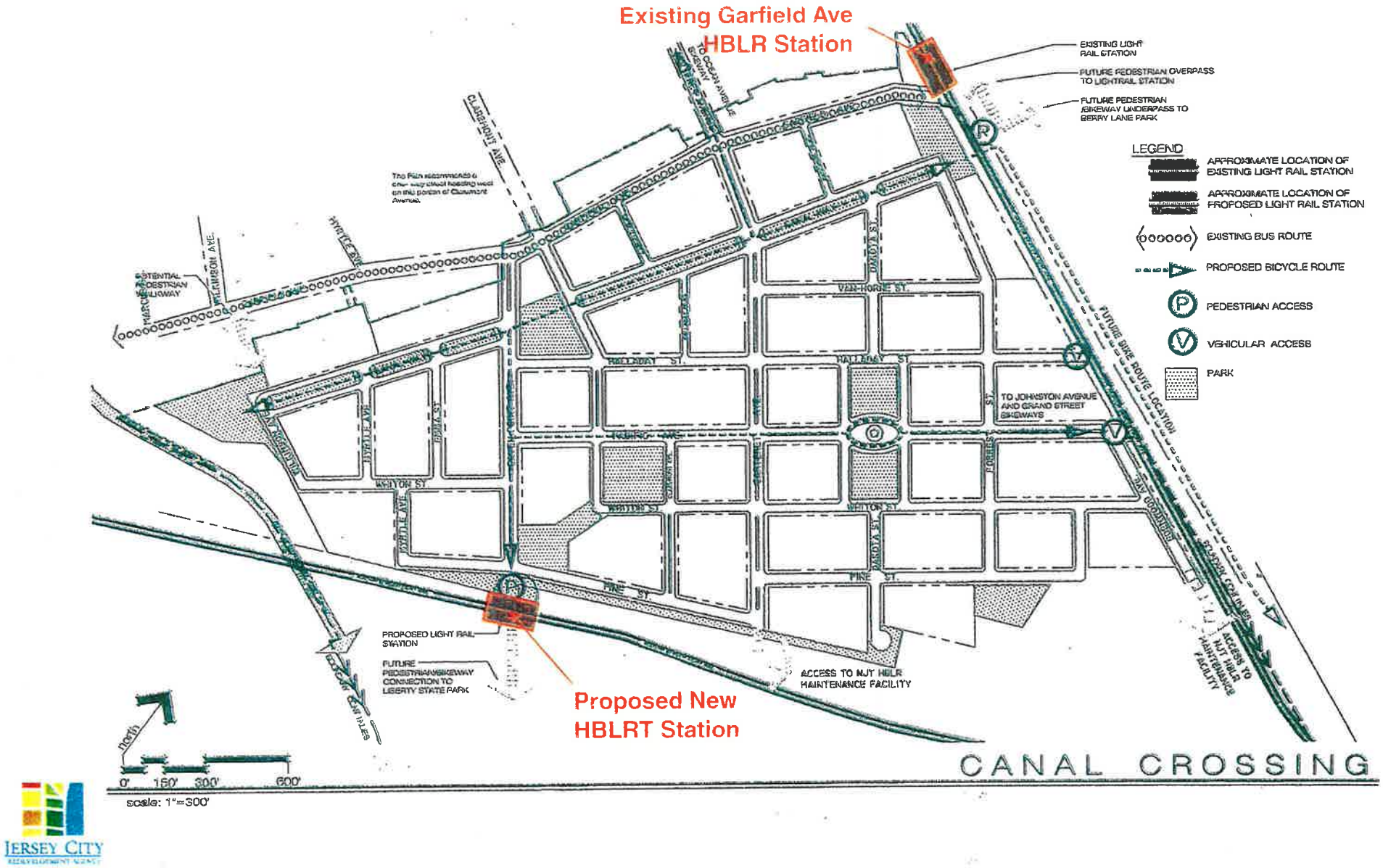

System Map
njtransit.com
Hudson-Bergen Light Rail
HUDSON-BERGEN LIGHT RAIL
Meadowlands Sports Complex
TONNELLE AVENUE
Bergenline Avenue
Port Imperial
Lincoln Harbor
Secaucus Junction
9th Street-Congress Street
2nd Street
HOBOKEN TERMINAL
Pavonia-Newport
Harsimus Cove
Harborside Financial Center
Exchange Place
Essex Street
Marin Boulevard
Jersey Avenue
Liberty State Park
WEST SIDE AVENUE
Martin Luther King Drive
Garfield Avenue
Richard Street
Danforth Avenue
45th Street
34th Street
22nd Street
8TH STREET
Upper New York Bay
Newark Bay
Legend
Tonnelle Avenue - Hoboken Terminal (Weekdays Only)
West Side Avenue - Tonnelle Avenue
8th Street - Hoboken Terminal
Accessible Stations
NJ TRANSIT Commuter Rail
Meadowlands Rail Line
PATH
Connecting Bus Service
Connecting Light Rail Service
Connecting Rail Service
Connecting Ferry Service (NY Waterway)
Park & Ride Lots at Light Rail Station
NJ TRANSIT Information...(973) 275-5555
Text Telephone.....(TT) (800) 772-2287
Security Hot Line.....(888) TIPS-NJT
(to report suspicious activities or packages daily - 24 hours/7days)
Scale in Miles
0
1/2
1
January 2011
Map Background - Navteq
Connecting Bus and Rail Service to Light Rail Stations
TONNELLE AVE
Bergenline Ave
Port Imperial
Lincoln Harbor
9th Street/ Congress Street
2nd Street
Pavonia-Newport
Harsimus Cove
Harborside Financial Center
Exchange Place
Essex Street
Marin Boulevard
Jersey Avenue
Liberty State Park
Garfield Avenue
Martin Luther King Drive
WEST SIDE AVENUE
HOBOKEN TERMINAL
Richard Street
Danforth Avenue
45th Street
34th Street
22nd Street
8TH STREET

FIGURE 2-1

Redevelopment Transit Plan



JERSEY CITY
REDEVELOPMENT AGENCY

FIGURE 2-2

Figure 3-1 Canal Crossing Blocks and North/South Partition for Ridership Analysis

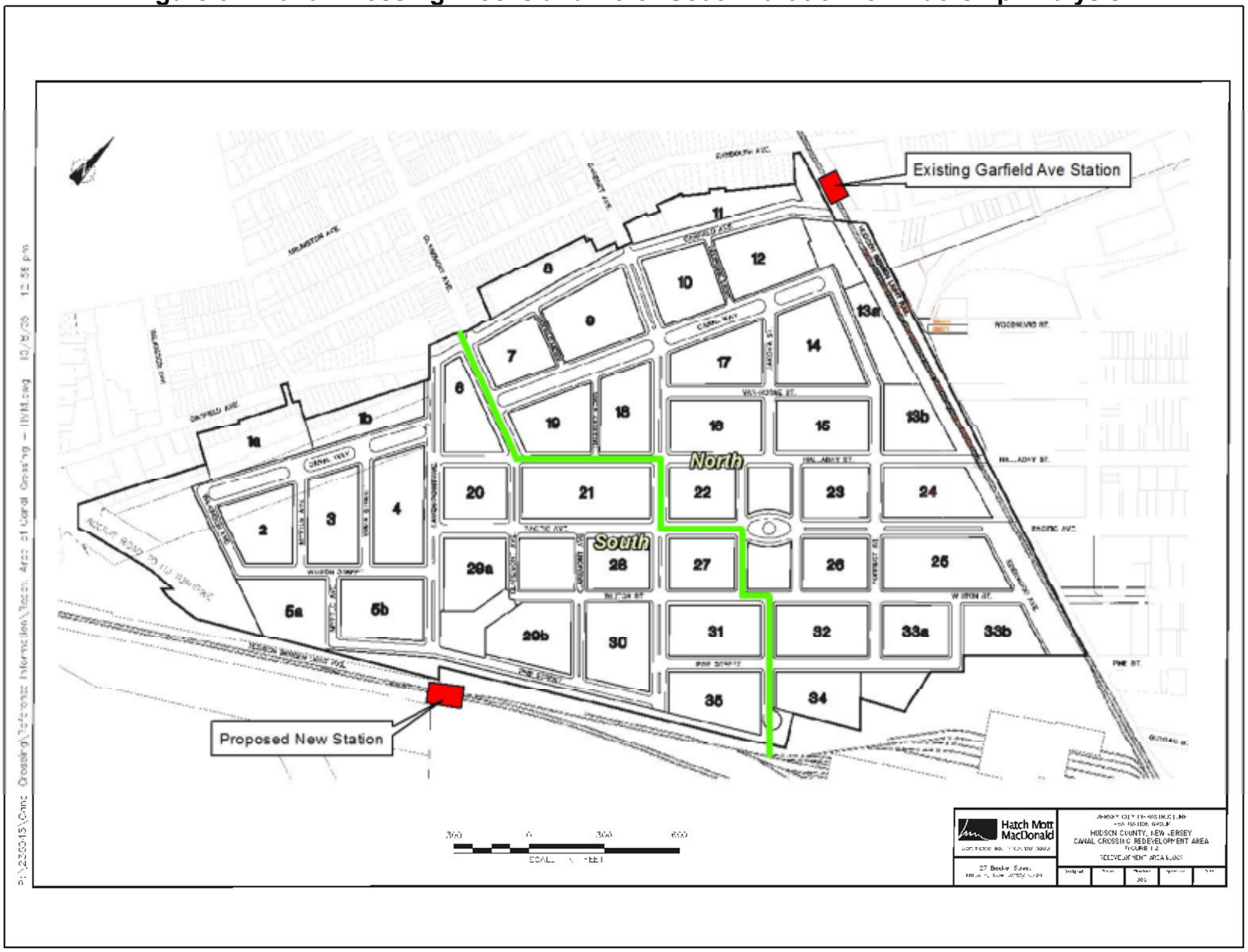


FIGURE 3-1

Figure 3-2 Districts for Trip Table Summary

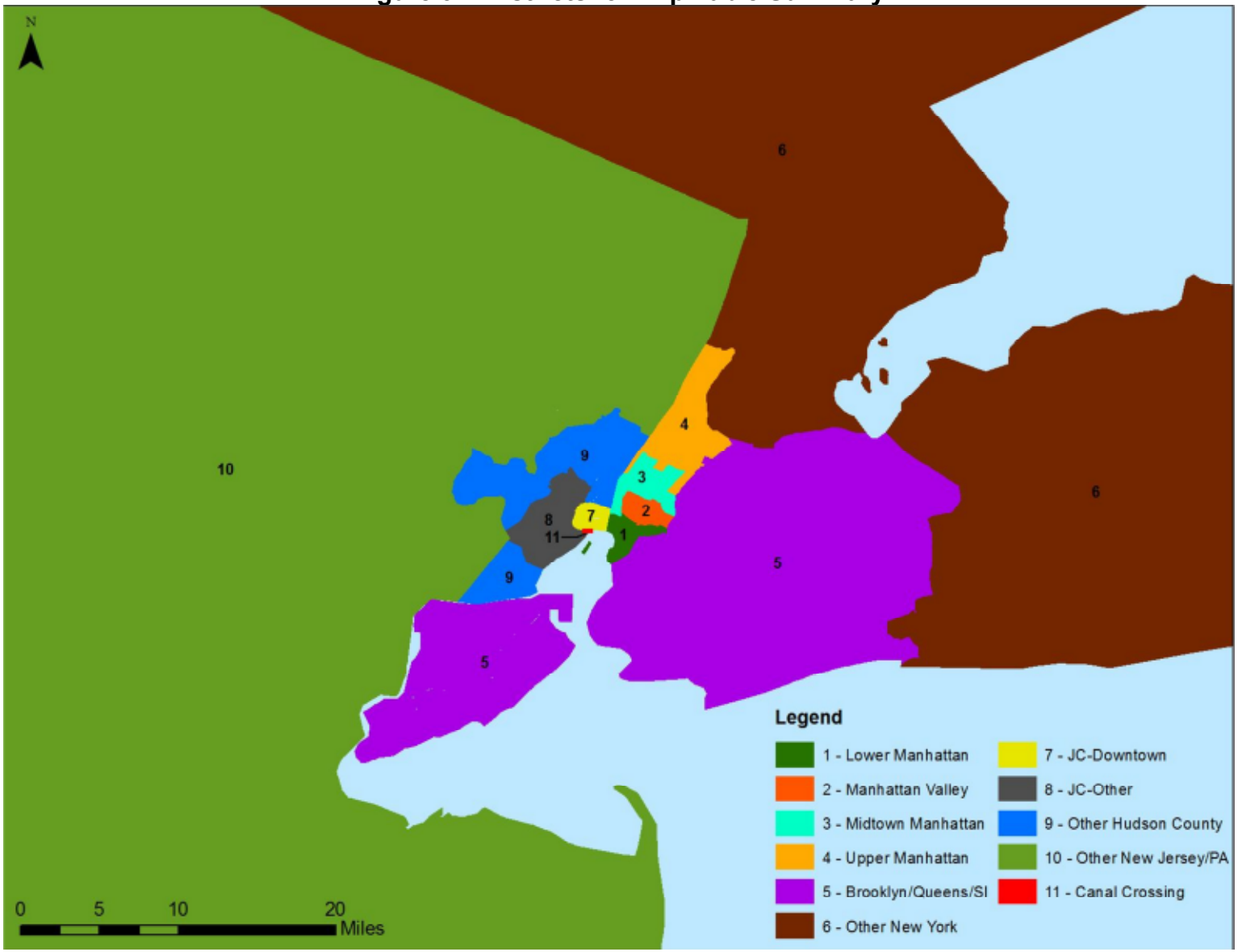
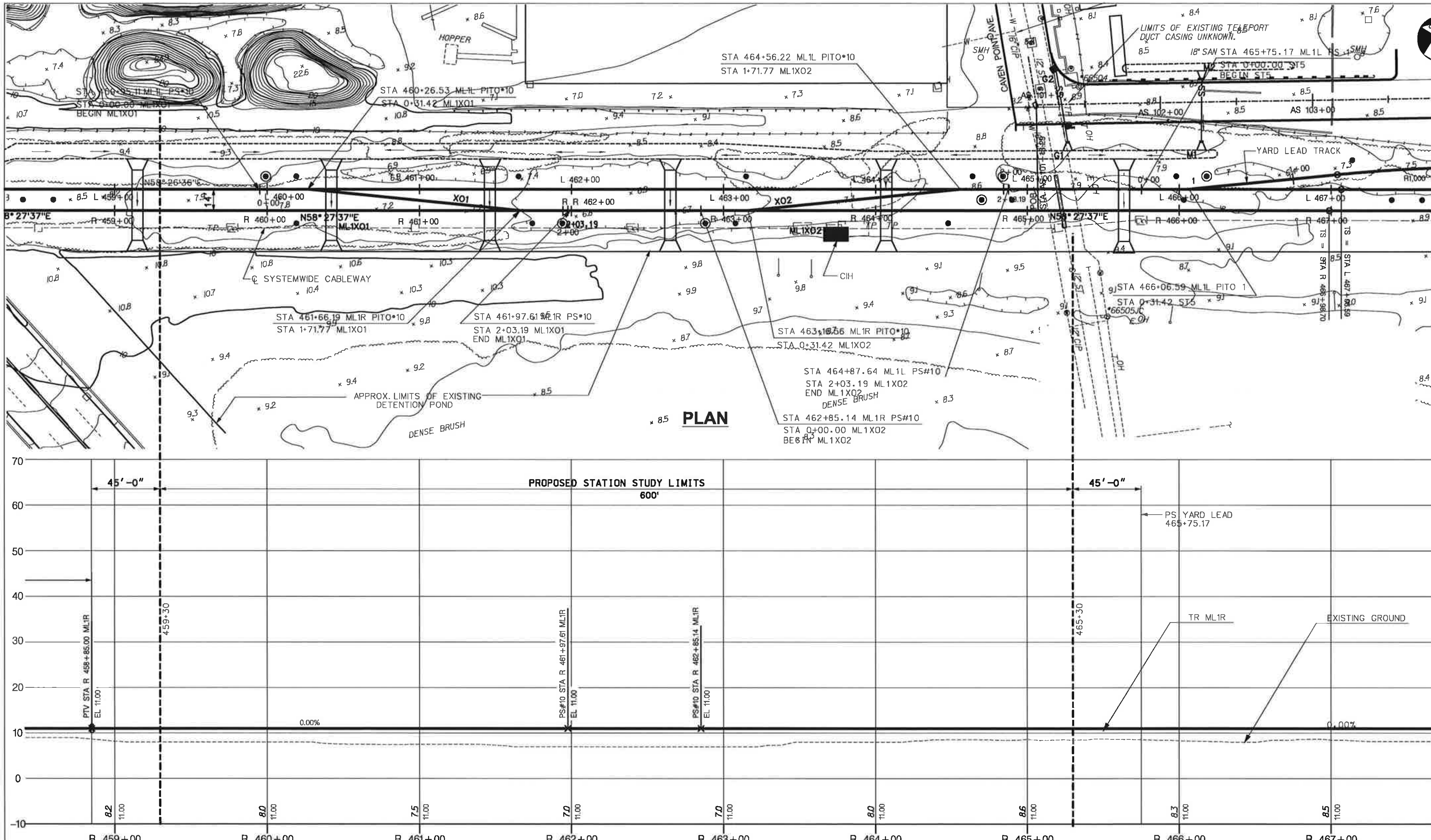


FIGURE 3-2



LEGEND:

- ℄ TRACK
- SWITCH
- CATENARY POLE
- CATENARY POLE ANCHOR
- DRAINAGE SWALE
- DRAINAGE CULVERT

SCALE IN FEET — 10' 5' 0 10' 20' VERT

SCALE IN FEET — 30' 20' 10' 0 30' 60' HORIZ

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Canal Crossing Redevelopment Area

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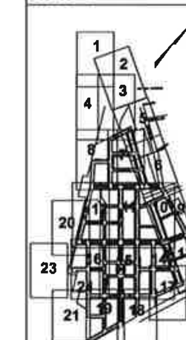

KEY PLAN

P.E. SEAL

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PROFESSIONAL ENGINEER, URS

DATE

LICENSED PROFESSIONAL ENGINEER
STATE OF NEW JERSEY
LICENSE No.

DRAWING TITLE: EXISTING HBLR PLAN & PROFILE PROPOSED STATION SITE

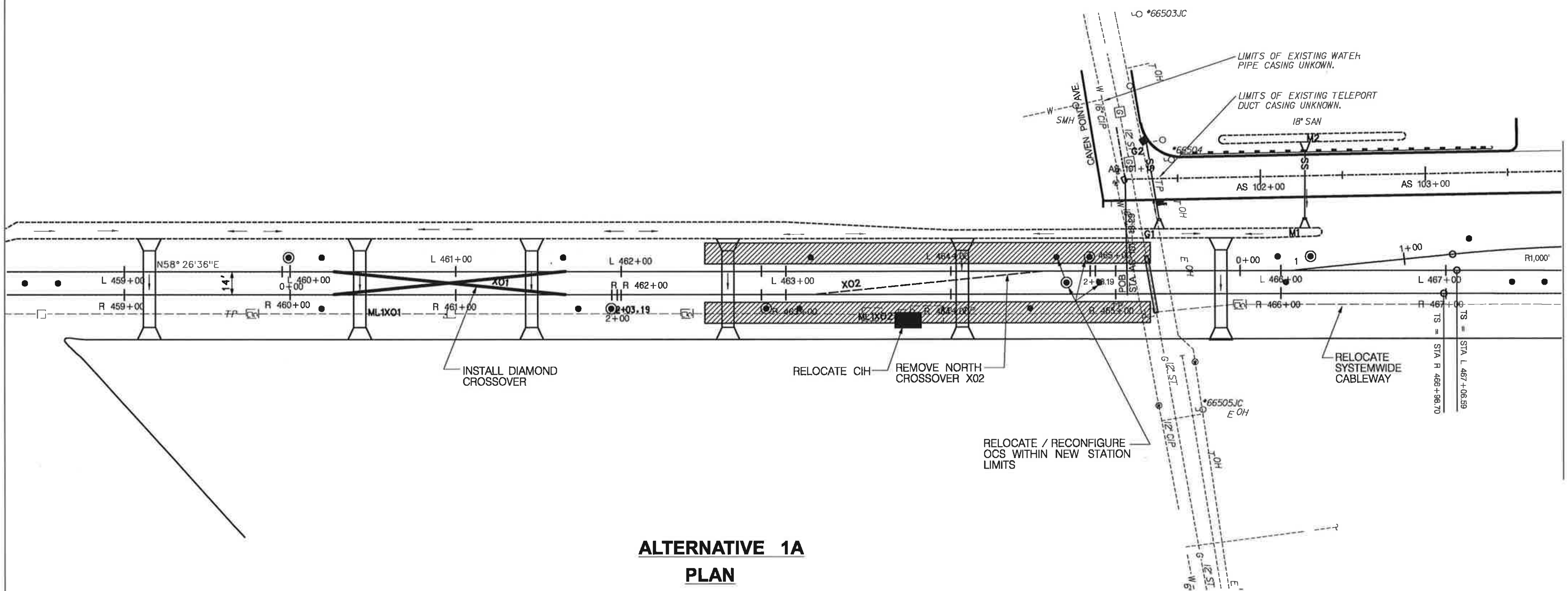
SCALE:

DATE: 06/15/12

Designed by | Drawn by | Checked by

Drawing Number: FIG 4-1

Sheet of



ALTERNATIVE 1A
PLAN

LEGEND:

- ℄ TRACK
- SWITCH
- CATENARY POLE
- CATENARY POLE ANCHOR
- DRAINAGE SWALE
- DRAINAGE CULVERT
- PROPOSED NEW STATION PLATFORM

SCALE IN FEET
30' 20' 10' 0 30' 60'

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KEY PLAN

P.E. SEAL

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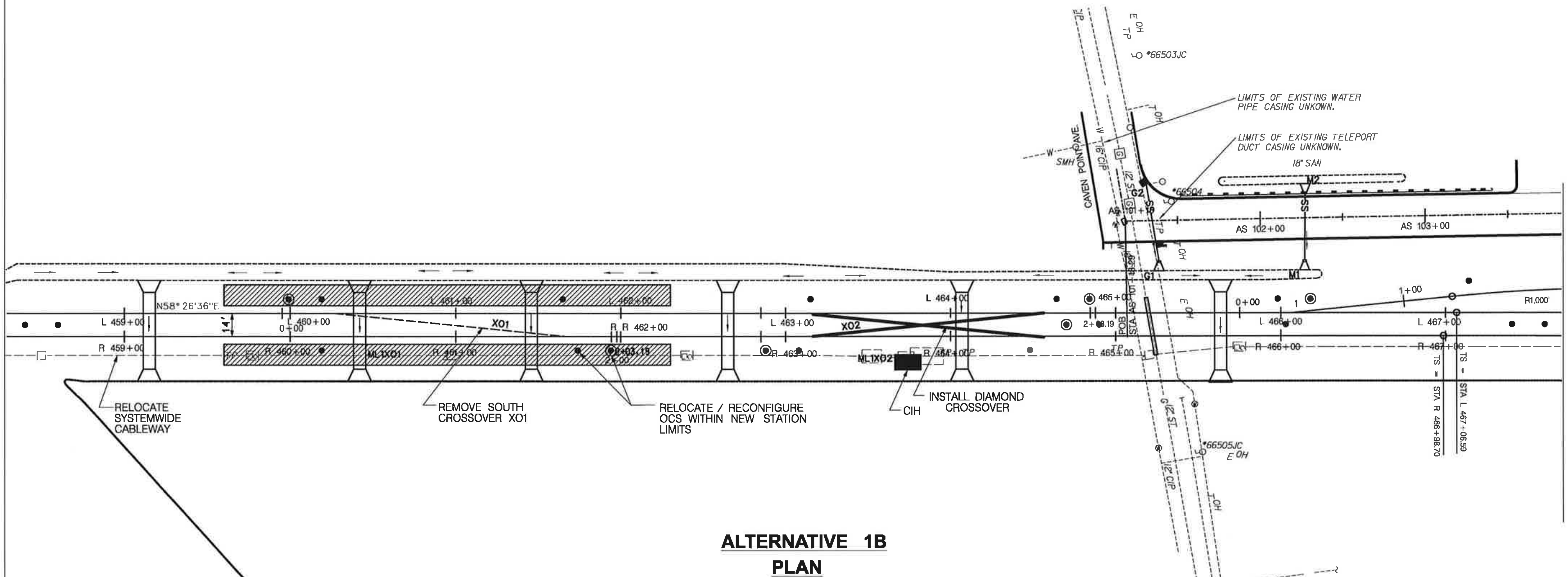
PROFESSIONAL ENGINEER, URS

LICENSED PROFESSIONAL ENGINEER
STATE OF NEW JERSEY
LICENSE No.

DRAWING TITLE
PROPOSED CAVEN POINT STATION ALTERNATIVE 1A

DATE: 06/15/12

Drawing Number: **FIG 4-2**



ALTERNATIVE 1B PLAN

LEGEND:

- ℄ TRACK
- SWITCH
- CATENARY POLE
- CATENARY POLE ANCHOR
- DRAINAGE SWALE
- DRAINAGE CULVERT
- PROPOSED NEW STATION PLATFORM

SCALE IN FEET: 30' 20' 10' 0 30' 60'

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KEY PLAN

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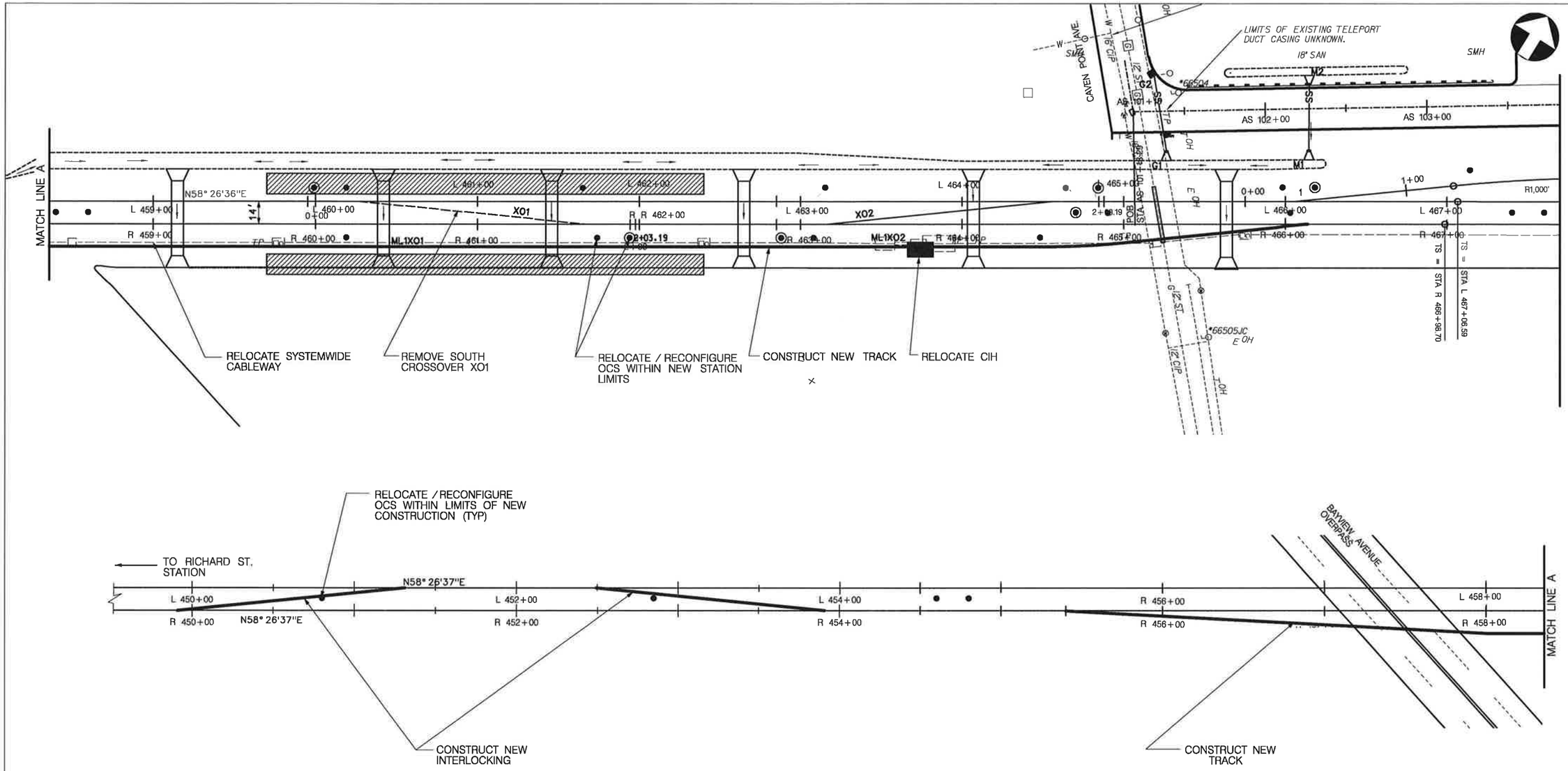

ALTERNATIVE 2A
PLAN

LEGEND:

- ℄ TRACK
- SWITCH
- CATENARY POLE
- CATENARY POLE ANCHOR
- DRAINAGE SWALE
- DRAINAGE CULVERT
- PROPOSED NEW STATION PLATFORM

SCALE IN FEET
30' 20' 10' 0 30' 60'
HORIZ

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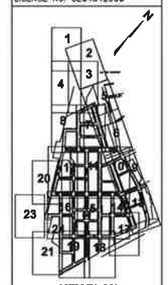

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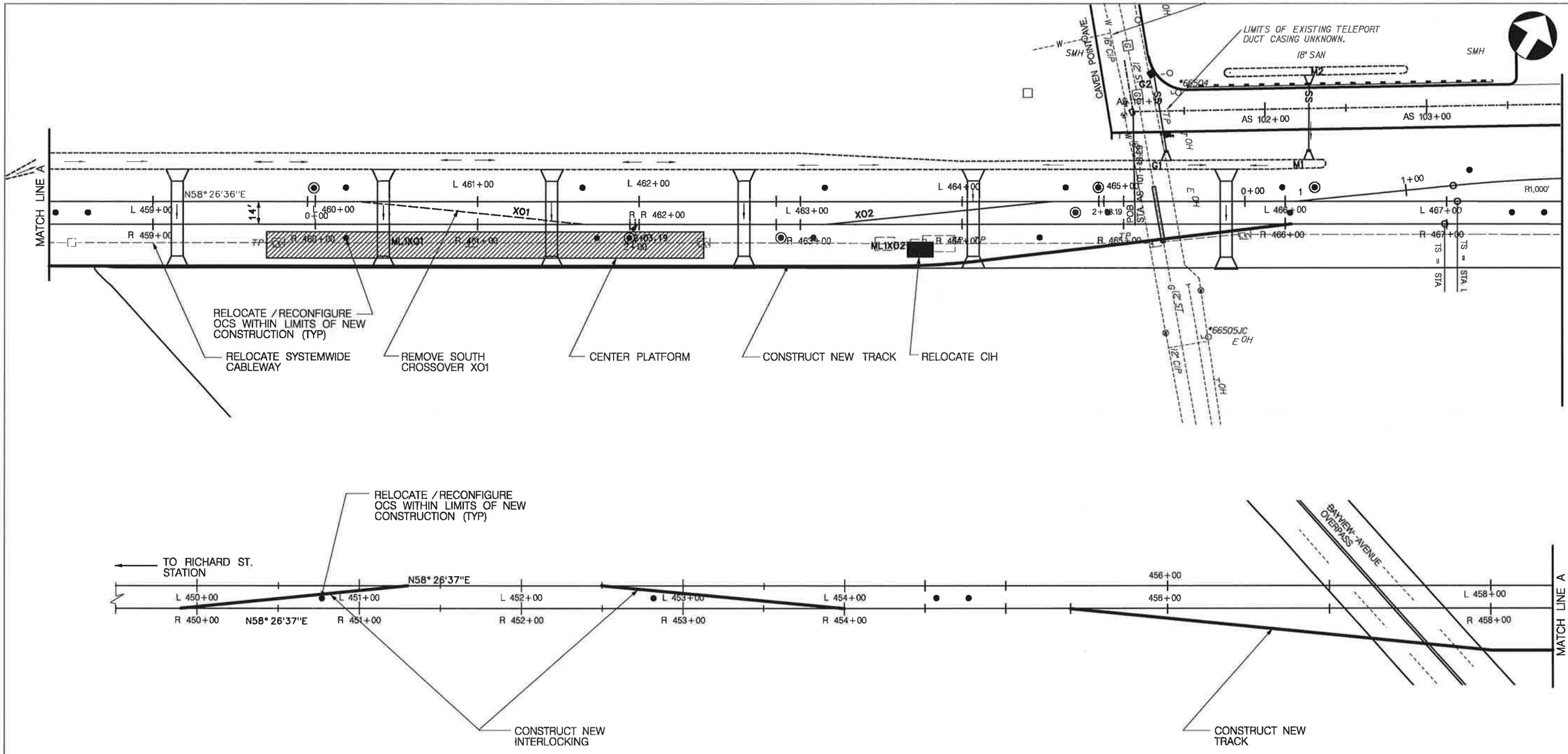

ALTERNATIVE 2B
PLAN

LEGEND:

- ℄ TRACK
- SWITCH
- CATENARY POLE
- CATENARY POLE ANCHOR
- DRAINAGE SWALE
- DRAINAGE CULVERT
- PROPOSED NEW STATION PLATFORM

SCALE IN FEET
30' 20' 10' 0 30' 60'

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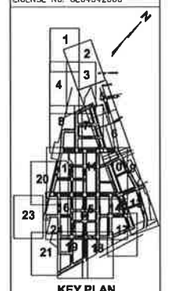

KEY PLAN

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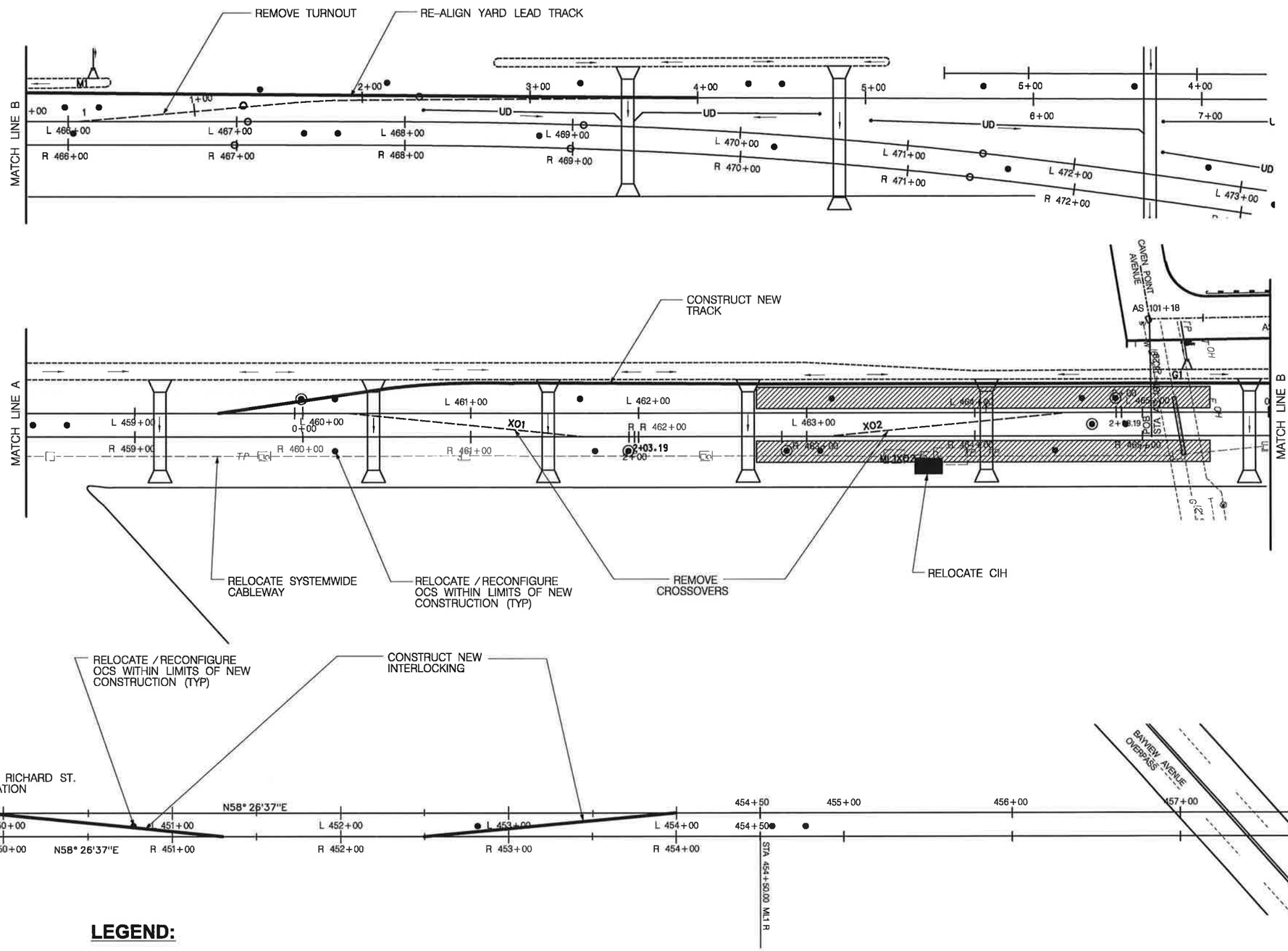

LEGEND:

- ℄ TRACK
- SWITCH
- CATENARY POLE
- CATENARY POLE ANCHOR
- DRAINAGE SWALE
- DRAINAGE CULVERT
- PROPOSED NEW STATION PLATFORM

ALTERNATIVE 3A PLAN

SCALE IN FEET
30' 20' 10' 0 30' 60'

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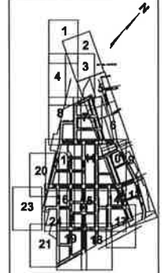

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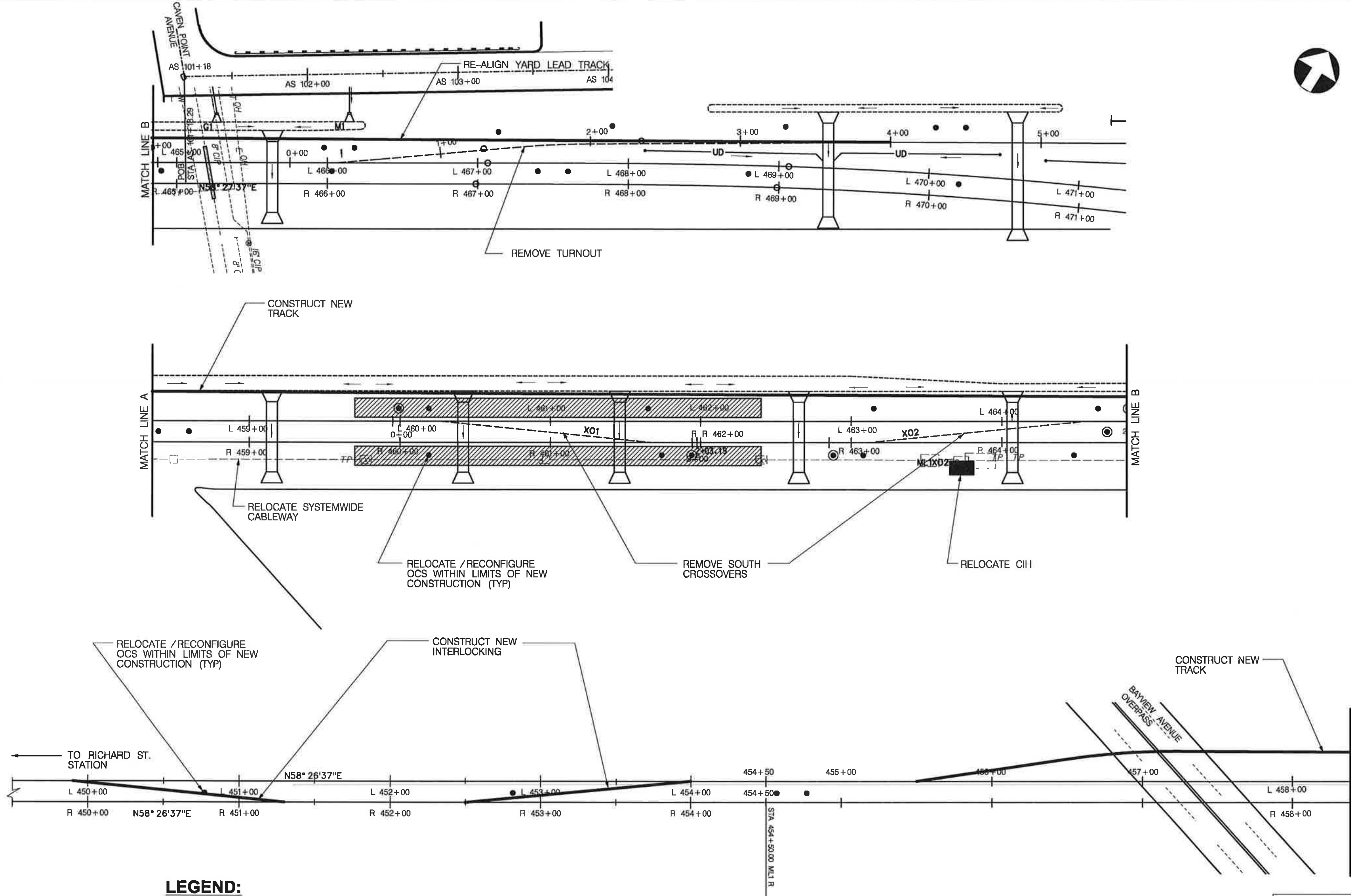

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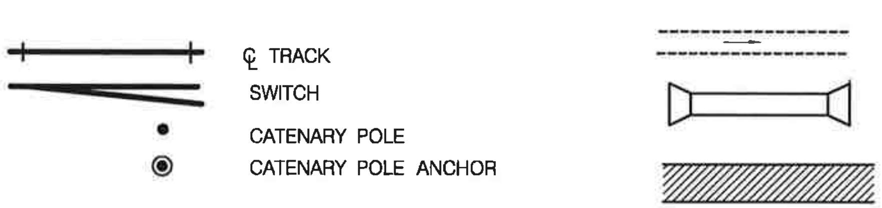

ALTERNATIVE 3B PLAN

SCALE IN FEET

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DRAWING TITLE: PROPOSED CAVEN POINT STATION ALTERNATIVE 3B

DATE: 06/15/12

FIG 4-7

APPENDIX B

Photo B-1
(West Side of HBLR ROW Looking North)

Photo B-2
(West Side of HBLR ROW Looking North)

Photo B-3
(West Side of HBLR ROW Looking South)

Photo B-4
(West Side of HBLR ROW Looking South)

Photo B-5
(West Side of HBLR ROW Looking South at Bayview Ave.)

Photo B-6
(East Side of HBLR ROW Looking South)

Photo B-7
(East Side of HBLR ROW Looking South)

Photo B-8
(East Side of HBLR ROW Looking South at CIH)

Photo B-9
(East Side of HBLR ROW Looking North)

Photo B-10
(East Side of HBLR ROW Looking South at Crossover)

Photo B-11
(Typical Catenary Pole Foundation in ROW)

Photo B-12
(Typical System-wide Manhole in ROW)